

Scott's version

KnotTheoryPath = "~/projects/KnotTheory/trunk/";

AppendTo[\$Path, KnotTheoryPath];

<< KnotTheory`

Loading KnotTheory` version of November 19, 2008, 11:39:57.9761.

Read more at <http://katlas.org/wiki/KnotTheory>.

KnotTheoryDirectory []

/Users/scott/projects/KnotTheory/trunk/KnotTheory

Kh[Knot [3, 1], Program → "FastKh"] [q, t]

LinkOpen::linke : Error 19

JLink`InstallJava::launch : The Java runtime could not be launched.

JLink`Java::init : Java is not running. You must call InstallJava[] to start the Java runtime.

JLink`Java::init : Java is not running. You must call InstallJava[] to start the Java runtime.

JLink`KeepJavaObject::obj : At least one argument to KeepJavaObject was not a valid Java object.

KnotTheory::loading : Loading precomputed data in PD4Knots`.

LinkOpen::linke : Error 19

JLink`InstallJava::launch : The Java runtime could not be launched.

JLink`Java::init : Java is not running. You must call InstallJava[] to start the Java runtime.

General::stop : Further output of JLink`Java::init will be suppressed during this calculation.

JLink`KeepJavaObject::obj : At least one argument to KeepJavaObject was not a valid Java object.

KnotTheory::credits : The Khovanov homology program FastKh was written by Dror Bar-Natan.

$$\frac{1}{q^3} + \frac{1}{q} + \frac{1}{q^9 t^3} + \frac{1}{q^5 t^2}$$

Kh[Knot [3, 1], Program → "JavaKh-v1"] [q, t]

KnotTheory::credits : The Khovanov homology program JavaKh-v1 was written by Jeremy Green in the summer of 2005 at the University of Toronto.

$$\frac{1}{q^3} + \frac{1}{q} + \frac{1}{q^9 t^3} + \frac{1}{q^5 t^2}$$

Kh[Knot [3, 1], Program → "JavaKh-v2"] [q, t]

KnotTheory::credits : The Khovanov homology program JavaKh-v2 is an update of Jeremy Green's program JavaKh-v1, written by Scott Morrison in 2008 at Microsoft Station Q.

$$\frac{1}{q^3} + \frac{1}{q} + \frac{1}{q^9 t^3} + \frac{1}{q^5 t^2}$$

```
With[{K = Knot[3, 1], program = "JavaKh-v1"},
  Kh[K, Program → program][q, t] - Kh[K, Program → program, Modulus → 2][q, t]]
-  $\frac{1}{q^7 t^3} - \frac{1}{q^7 t^2}$ 
```

```
With[{K = Knot[3, 1], program = "JavaKh-v2"},
  Kh[K, Program → program][q, t] - Kh[K, Program → program, Modulus → 2][q, t]]
-  $\frac{1}{q^7 t^3} - \frac{1}{q^7 t^2}$ 
```

```
Clear[BenchmarkData]
```

```
BenchmarkData[tag_String] := {}
```

```
BenchmarkData[tag_String, n_] := Cases[BenchmarkData[tag], {_, n, ___}]
```

```
KnotWidth[K_] := First[BR[K]]
```

```
KnotLength[K_] := Length[BR[K][[2]]]
```

```
echo[x_] := (Print[x]; x)
```

```
Off[Unset::norep]
```

```
Off[Unset::write]
```

```
Clear[benchmark]
```

```
benchmark[tag_, invariantFunction_, K_] := Module[{data},
  If[MemberQ[BenchmarkData[tag], {K, ___}], Return[]];
  data = {K, KnotWidth[K], KnotLength[K],
    Sequence@@(AbsoluteTiming[invariantFunction[BR[K]]] /. Second → 1)};
  invariantFunction[K] =.;
  If[data[[4]] > 0.5,
    Print[data];
    AppendTo[BenchmarkData[tag], data];
  ];
];
```

```
benchmark[tag_, invariantFunction_, knots_List] :=
  (benchmark[tag, invariantFunction, #] & /@ knots);
```

```
benchmark["FastKh", Kh[#, Program → "FastKh", "chaff" → Random[]][q, t] &,
  Take[AllKnots[{11, 11}], -10]]
```

KnotTheory::loading: Loading precomputed data in DTCode4KnotsTo11`.

KnotTheory::credits: The GaussCode to PD conversion was written by Siddarth Sankaran at the University of Toronto in the summer of 2005.

KnotTheory::credits: Vogel's algorithm was implemented by Dan Carney in the summer of 2005 at the University of Toronto.

$$\left\{ \text{Knot}[11, \text{NonAlternating}, 176], 4, 11, 10.486992, \frac{2}{q^3} + \frac{4}{q} + \frac{1}{q^{19}t^8} + \frac{2}{q^{17}t^7} + \frac{1}{q^{15}t^7} + \frac{4}{q^{15}t^6} + \frac{2}{q^{13}t^6} + \frac{5}{q^{13}t^5} + \frac{4}{q^{11}t^5} + \frac{5}{q^{11}t^4} + \frac{5}{q^9t^4} + \frac{6}{q^9t^3} + \frac{5}{q^7t^3} + \frac{4}{q^7t^2} + \frac{6}{q^5t^2} + \frac{3}{q^5t} + \frac{4}{q^3t} + qt \right\}$$

$$\left\{ \text{Knot}[11, \text{NonAlternating}, 177], 4, 11, 5.671079, 8q + 7q^3 + \frac{1}{q^7t^4} + \frac{3}{q^5t^3} + \frac{1}{q^3t^3} + \frac{5}{q^3t^2} + \frac{3}{qt^2} + \frac{6}{qt} + \frac{5q}{t} + 7q^3t + 7q^5t + 6q^5t^2 + 7q^7t^2 + 4q^7t^3 + 6q^9t^3 + 2q^9t^4 + 4q^{11}t^4 + 2q^{13}t^5 \right\}$$

$$\left\{ \text{Knot}[11, \text{NonAlternating}, 178], 4, 11, 12.453166, 5q + 3q^3 + \frac{2}{qt} + 7q^3t + 4q^5t + 8q^5t^2 + 7q^7t^2 + 8q^7t^3 + 8q^9t^3 + 8q^9t^4 + 8q^{11}t^4 + 5q^{11}t^5 + 8q^{13}t^5 + 4q^{13}t^6 + 5q^{15}t^6 + q^{15}t^7 + 4q^{17}t^7 + q^{19}t^8 \right\}$$

\$Aborted

```
Khv1 = Function[{K}, Kh[K, Program -> "JavaKh-v1", "chaff" -> Random[]][q, t]];
Khv2 = Function[{K}, Kh[K, Program -> "JavaKh-v2", "chaff" -> Random[]][q, t]];

```

```
KhU = Function[{K}, UniversalKh[PD[K]]];

```

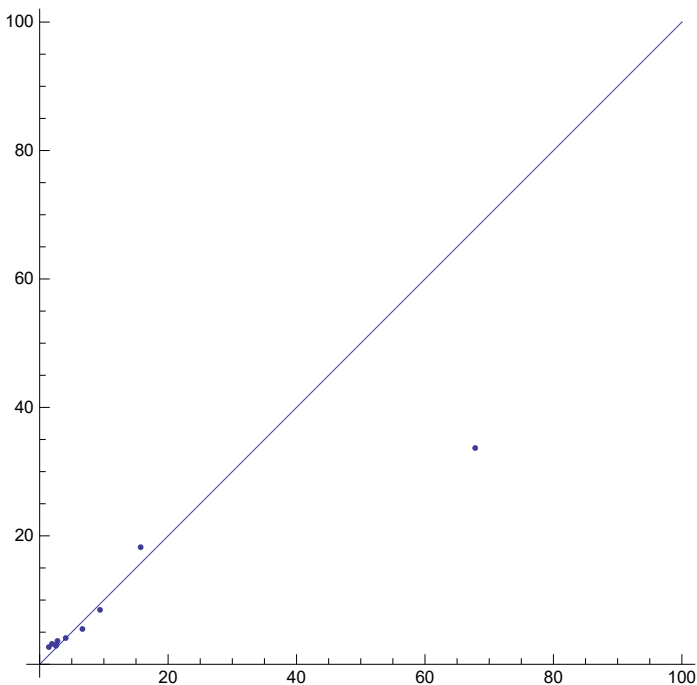
```
benchmarkComparison := Show[Plot[x, {x, 0, 100}], ListPlot[

```

```
  Cases[Flatten[BenchmarkData["JavaKh-v1"] /. {K_, w_, L_, T1_, Except[$Failed[q, t]]} ->
    Cases[BenchmarkData["JavaKh-v2"], {K, w, L, T2_, Except[$Failed[q, t]]} -> {T1, T2}],
    1], {_, _}], AspectRatio -> 1, PlotRange -> All]

```

benchmarkComparison



```

Cases[Flatten[BenchmarkData["UniversalKh"] /.
  {K_, w_, L_, T1_, Except[$Failed[q, t]]} => Cases[BenchmarkData["JavaKh-v2"],
    {K, w, L, T2_, Except[$Failed[q, t]]} => {T1, T2}], 1], {_, _}]
{{10.489661, 6.618100}, {34.334558, 5.545078}, {198.031880, 5.731359},
 {12.333347, 5.609656}, {11.491778, 6.130841}, {19.394953, 7.662614},
 {47.122912, 12.517523}, {8.786689, 4.790217}, {17.378746, 5.883860}}

% /. {a_, b_} => a/b
{1.584996, 6.191898, 34.55234, 2.198592, 1.874421, 2.531114, 3.764556, 1.834299, 2.953630}

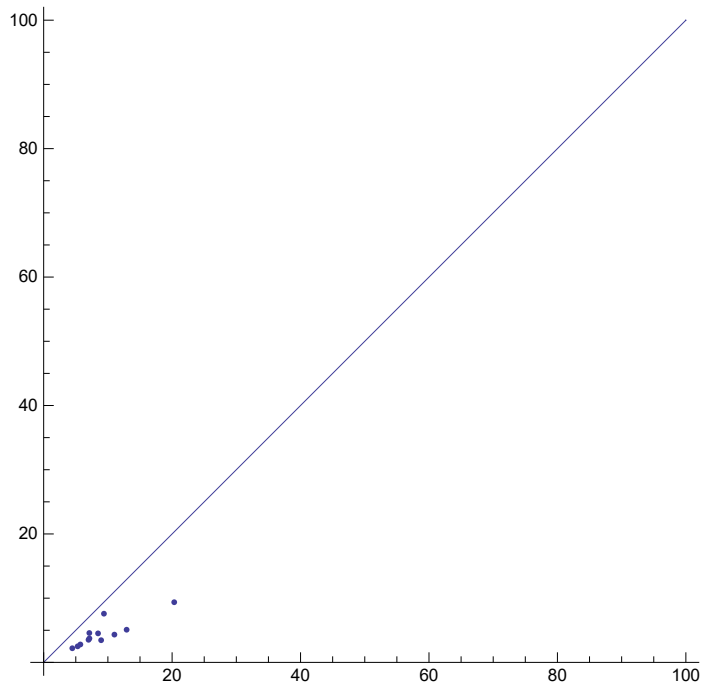
```

```

benchmarkComparision2 := Show[Plot[x, {x, 0, 100}], ListPlot[
  Cases[Flatten[BenchmarkData["UniversalKh"] /. {K_, w_, L_, T1_, Except[$Failed[q, t]]} =>
    Cases[BenchmarkData["JavaKh-v2"], {K, w, L, T2_, Except[$Failed[q, t]]} => {T1, T2}],
  1], {_, _}]], AspectRatio -> 1, PlotRange -> All]

```

benchmarkComparision2



```
SetDirectory[ToFileName[ToFileName[KnotTheoryDirectory[], "."], "testing"]]

```

```
/Users/scott/projects/KnotTheory/trunk/testing

```

```
FileNames["*.m"]

```

```
{benchmarkdata.m}

```

```
<< benchmarkdata.m;

```

```
Save["benchmarkdata.m", BenchmarkData]

```

```

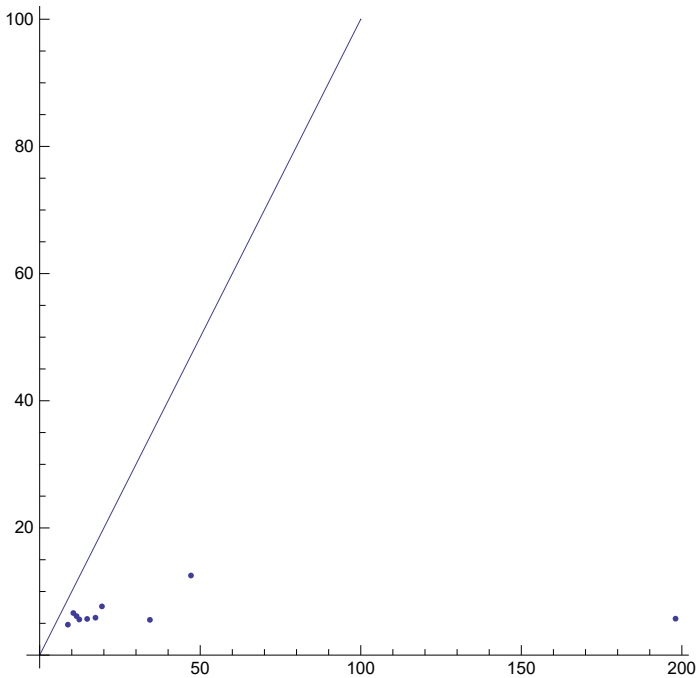
({benchmark["JavaKh-v1", Khv1, #],
  benchmark["JavaKh-v2", Khv2, #], benchmark["UniversalKh", KhU, #]};
 Print[benchmarkComparision2]) & /@RandomSample[AllKnots[{15, 15}], 40]

```

$$\left\{ \text{Knot}[15, \text{Alternating}, 40117], 4, 15, 5.676630, \right. \\ \left. \frac{33}{q^3} + \frac{35}{q} + \frac{1}{q^{19}t^8} + \frac{3}{q^{17}t^7} + \frac{1}{q^{15}t^7} + \frac{7}{q^{15}t^6} + \frac{3}{q^{13}t^6} + \frac{13}{q^{13}t^5} + \frac{7}{q^{11}t^5} + \frac{20}{q^{11}t^4} + \right. \\ \left. \frac{13}{q^9t^4} + \frac{27}{q^9t^3} + \frac{20}{q^7t^3} + \frac{32}{q^7t^2} + \frac{27}{q^5t^2} + \frac{34}{q^5t} + \frac{32}{q^3t} + \frac{28t}{q} + 32qt + 21qt^2 + 28q^3t^2 + \right. \\ \left. 14q^3t^3 + 21q^5t^3 + 8q^5t^4 + 14q^7t^4 + 4q^7t^5 + 8q^9t^5 + q^9t^6 + 4q^{11}t^6 + q^{13}t^7 \right\}$$

$$\left\{ \text{Knot}[15, \text{Alternating}, 40117], 4, 15, 5.690756, \right. \\ \left. \frac{33}{q^3} + \frac{35}{q} + \frac{1}{q^{19}t^8} + \frac{3}{q^{17}t^7} + \frac{1}{q^{15}t^7} + \frac{7}{q^{15}t^6} + \frac{3}{q^{13}t^6} + \frac{13}{q^{13}t^5} + \frac{7}{q^{11}t^5} + \frac{20}{q^{11}t^4} + \right. \\ \left. \frac{13}{q^9t^4} + \frac{27}{q^9t^3} + \frac{20}{q^7t^3} + \frac{32}{q^7t^2} + \frac{27}{q^5t^2} + \frac{34}{q^5t} + \frac{32}{q^3t} + \frac{28t}{q} + 32qt + 21qt^2 + 28q^3t^2 + \right. \\ \left. 14q^3t^3 + 21q^5t^3 + 8q^5t^4 + 14q^7t^4 + 4q^7t^5 + 8q^9t^5 + q^9t^6 + 4q^{11}t^6 + q^{13}t^7 \right\}$$

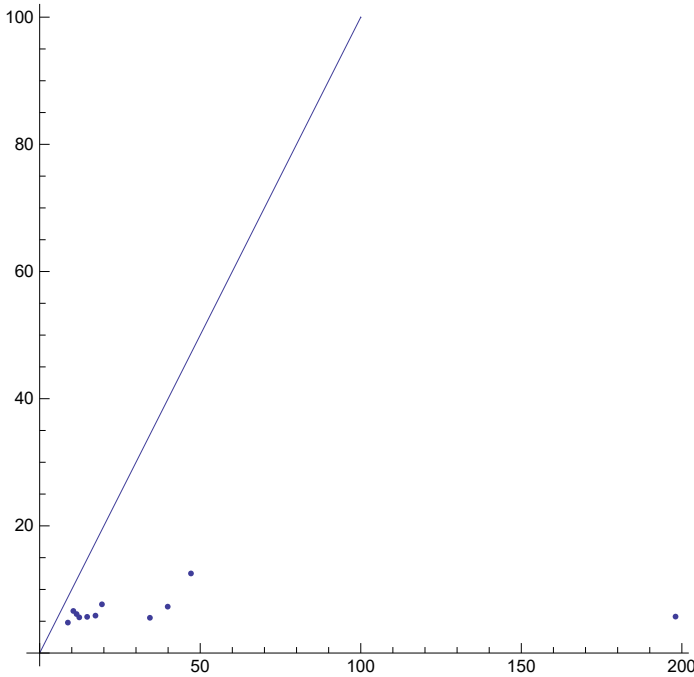
$$\left\{ \text{Knot}[15, \text{Alternating}, 40117], 4, 15, 14.785627, \frac{\text{KhE}}{q^2} + \frac{34 \text{KhC}[1]}{q^2} + \frac{\text{KhC}[1]}{q^{16}t^7} + \right. \\ \left. \frac{3 \text{KhC}[1]}{q^{14}t^6} + \frac{7 \text{KhC}[1]}{q^{12}t^5} + \frac{13 \text{KhC}[1]}{q^{10}t^4} + \frac{20 \text{KhC}[1]}{q^8t^3} + \frac{27 \text{KhC}[1]}{q^6t^2} + \frac{32 \text{KhC}[1]}{q^4t} + 32t \text{KhC}[1] + \right. \\ \left. 28q^2t^2 \text{KhC}[1] + 21q^4t^3 \text{KhC}[1] + 14q^6t^4 \text{KhC}[1] + 8q^8t^5 \text{KhC}[1] + 4q^{10}t^6 \text{KhC}[1] + q^{12}t^7 \text{KhC}[1] \right\}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 112333], 6, 25, 7.694977, \right. \\ \left. \frac{7}{q^5} + \frac{13}{q^3} + \frac{1}{q^{25}t^{10}} + \frac{2}{q^{23}t^9} + \frac{1}{q^{21}t^9} + \frac{6}{q^{21}t^8} + \frac{2}{q^{19}t^8} + \frac{10}{q^{19}t^7} + \frac{6}{q^{17}t^7} + \frac{15}{q^{17}t^6} + \frac{10}{q^{15}t^6} + \frac{19}{q^{15}t^5} + \right. \\ \left. \frac{15}{q^{13}t^5} + \frac{20}{q^{13}t^4} + \frac{19}{q^{11}t^4} + \frac{20}{q^{11}t^3} + \frac{20}{q^9t^3} + \frac{15}{q^9t^2} + \frac{20}{q^7t^2} + \frac{12}{q^7t} + \frac{15}{q^5t} + \frac{3t}{q^3} + \frac{6t}{q} + \frac{t^2}{q} + 3qt^2 + q^3t^3 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 112333], 6, 25, 7.296688, \right. \\ \left. \frac{7}{q^5} + \frac{13}{q^3} + \frac{1}{q^{25}t^{10}} + \frac{2}{q^{23}t^9} + \frac{1}{q^{21}t^9} + \frac{6}{q^{21}t^8} + \frac{2}{q^{19}t^8} + \frac{10}{q^{19}t^7} + \frac{6}{q^{17}t^7} + \frac{15}{q^{17}t^6} + \frac{10}{q^{15}t^6} + \frac{19}{q^{15}t^5} + \right. \\ \left. \frac{15}{q^{13}t^5} + \frac{20}{q^{13}t^4} + \frac{19}{q^{11}t^4} + \frac{20}{q^{11}t^3} + \frac{20}{q^9t^3} + \frac{15}{q^9t^2} + \frac{20}{q^7t^2} + \frac{12}{q^7t} + \frac{15}{q^5t} + \frac{3t}{q^3} + \frac{6t}{q} + \frac{t^2}{q} + 3qt^2 + q^3t^3 \right\}$$

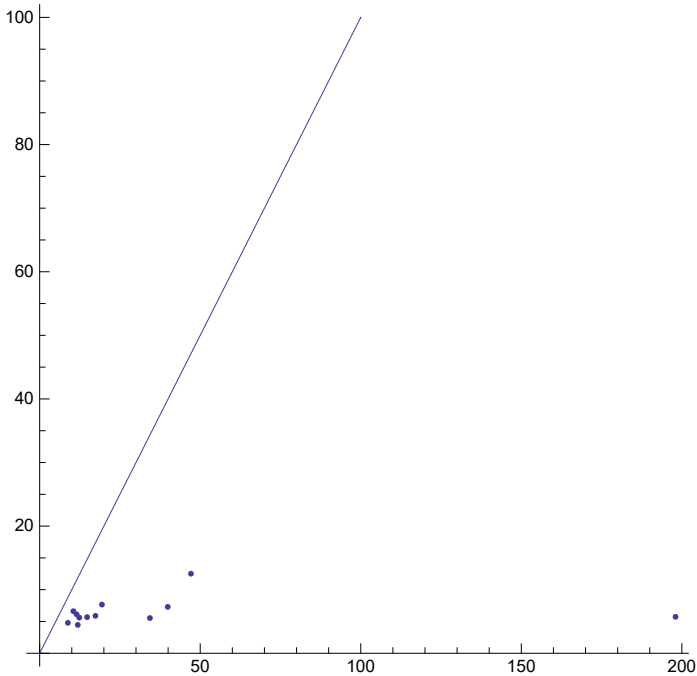
$$\left\{ \text{Knot}[15, \text{NonAlternating}, 112333], 6, 25, 39.876647, \right. \\ \left. \frac{\text{KhE}}{q^4} + \frac{12 \text{KhC}[1]}{q^4} + \frac{\text{KhC}[1]}{q^{22}t^9} + \frac{2 \text{KhC}[1]}{q^{20}t^8} + \frac{6 \text{KhC}[1]}{q^{18}t^7} + \frac{10 \text{KhC}[1]}{q^{16}t^6} + \frac{15 \text{KhC}[1]}{q^{14}t^5} + \right. \\ \left. \frac{19 \text{KhC}[1]}{q^{12}t^4} + \frac{20 \text{KhC}[1]}{q^{10}t^3} + \frac{20 \text{KhC}[1]}{q^8t^2} + \frac{15 \text{KhC}[1]}{q^6t} + \frac{6t \text{KhC}[1]}{q^2} + 3t^2 \text{KhC}[1] + q^2t^3 \text{KhC}[1] \right\}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 63220], 6, 25, 6.182779, 21q + 18q^3 + \frac{1}{q^9t^5} + \frac{3}{q^7t^4} + \frac{1}{q^5t^4} + \right. \\ \left. \frac{7}{q^5t^3} + \frac{3}{q^3t^3} + \frac{11}{q^3t^2} + \frac{7}{qt^2} + \frac{17}{qt} + \frac{11q}{t} + 23q^3t + 20q^5t + 22q^5t^2 + 23q^7t^2 + 17q^7t^3 + \right. \\ \left. 22q^9t^3 + 14q^9t^4 + 17q^{11}t^4 + 7q^{11}t^5 + 14q^{13}t^5 + 4q^{13}t^6 + 7q^{15}t^6 + q^{15}t^7 + 4q^{17}t^7 + q^{19}t^8 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 63220], 6, 25, 4.459862, 21q + 18q^3 + \frac{1}{q^9t^5} + \frac{3}{q^7t^4} + \frac{1}{q^5t^4} + \right. \\ \left. \frac{7}{q^5t^3} + \frac{3}{q^3t^3} + \frac{11}{q^3t^2} + \frac{7}{qt^2} + \frac{17}{qt} + \frac{11q}{t} + 23q^3t + 20q^5t + 22q^5t^2 + 23q^7t^2 + 17q^7t^3 + \right. \\ \left. 22q^9t^3 + 14q^9t^4 + 17q^{11}t^4 + 7q^{11}t^5 + 14q^{13}t^5 + 4q^{13}t^6 + 7q^{15}t^6 + q^{15}t^7 + 4q^{17}t^7 + q^{19}t^8 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 63220], 6, 25, 11.871430, \right. \\ \left. \text{KhE} q^2 + 17q^2 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^6t^4} + \frac{3 \text{KhC}[1]}{q^4t^3} + \frac{7 \text{KhC}[1]}{q^2t^2} + \frac{11 \text{KhC}[1]}{t} + 20q^4t \text{KhC}[1] + 23q^6t^2 \text{KhC}[1] + \right. \\ \left. 22q^8t^3 \text{KhC}[1] + 17q^{10}t^4 \text{KhC}[1] + 14q^{12}t^5 \text{KhC}[1] + 7q^{14}t^6 \text{KhC}[1] + 4q^{16}t^7 \text{KhC}[1] + q^{18}t^8 \text{KhC}[1] \right\}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
  org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
  at org.katlas.JavaKh.LCCC.<init> (LCCC.java:19)
  at org.katlas.JavaKh.LCCC.compose (LCCC.java:152)
  at org.katlas.JavaKh.Komplex.compose (Komplex.java:1176)
  at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1092)
  at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
  at org.katlas.JavaKh.Cap.compose2 (Cap.java:143)
  at org.katlas.JavaKh.Cap$ComposeOutput.<init> (Cap.java:281)
  at org.katlas.JavaKh.Cap.compose (Cap.java:98)
  at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:723)
  at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:136)
  at org.katlas.JavaKh.Komplex.compose (Komplex.java:1857)
  at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1713)
  at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
  at java.math.MutableBigInteger.<init> (MutableBigInteger.java:99)
  at java.math.BigInteger.gcd (BigInteger.java:1390)
  at org.katlas.JavaKh.Rational.<init> (Rational.java:13)
  at org.katlas.JavaKh.Rational.multiply (Rational.java:28)
  at org.katlas.JavaKh.LCCC.compose (LCCC.java:143)
  at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:525)
  at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
  at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
  at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
  at java.math.BigInteger.trustedStripLeadingZeroInts (BigInteger.java:2840)
  at java.math.BigInteger.multiply (BigInteger.java:1167)
  at org.katlas.JavaKh.Rational.multiply (Rational.java:28)
  at org.katlas.JavaKh.LCCC.compose (LCCC.java:143)
```

```

    at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:514)
    at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at java.math.BigInteger.multiply (BigInteger.java:1168)
    at org.katlas.JavaKh.Rational.multiply (Rational.java:28)
    at org.katlas.JavaKh.LCCC.compose (LCCC.java:143)
    at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:525)
    at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:736)
    at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:136)
    at org.katlas.JavaKh.Komplex.compose (Komplex.java:1857)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1715)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at org.katlas.JavaKh.CannedCobordism$ComposeOutput.get (CannedCobordism.java:1334)
    at org.katlas.JavaKh.CannedCobordism.compose (CannedCobordism.java:401)
    at org.katlas.JavaKh.LCCC.compose (LCCC.java:142)
    at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:525)
    at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at org.katlas.JavaKh.CannedCobordism.compose (CannedCobordism.java:749)
    at org.katlas.JavaKh.LCCC.compose (LCCC.java:159)
    at org.katlas.JavaKh.Komplex.compose (Komplex.java:1176)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1094)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at java.math.MutableBigInteger.<init> (MutableBigInteger.java:62)
    at java.math.MutableBigInteger.hybridGCD (MutableBigInteger.java:977)
    at java.math.BigInteger.gcd (BigInteger.java:1393)
    at org.katlas.JavaKh.algebra.rings.Rational.<init> (Rational.java:21)
    at org.katlas.JavaKh.algebra.rings.Rational.multiply (Rational.java:35)
    at org.katlas.JavaKh.algebra.rings.Rational.multiply (Rational.java:1)
    at org.katlas.JavaKh.algebra.implementations.LinearComboMap.multiply (LinearComboMap.java:126)
    at org.katlas.JavaKh.algebra.implementations.LinearComboMap.multiply (LinearComboMap.java:1)
    at org.katlas.JavaKh.Komplex.compose (Komplex.java:1862)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1715)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at org.katlas.JavaKh.CannedCobordism.compose (CannedCobordism.java:749)
    at org.katlas.JavaKh.LCCC.compose (LCCC.java:159)
    at org.katlas.JavaKh.Komplex.compose (Komplex.java:1176)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1092)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
    at org.katlas.JavaKh.Cap.compose2 (Cap.java:134)
    at org.katlas.JavaKh.Cap$ComposeOutput.<init> (Cap.java:281)
    at org.katlas.JavaKh.Cap.compose (Cap.java:98)
    at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:723)
    at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:136)
    at org.katlas.JavaKh.Komplex.compose (Komplex.java:1857)
    at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1713)
    at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space

```



```

at org.katlas.JavaKh.CannedCobordism$ComposeOutput.get (CannedCobordism.java:1334)
at org.katlas.JavaKh.CannedCobordism.compose (CannedCobordism.java:401)
at org.katlas.JavaKh.LCCC.compose (LCCC.java:142)
at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:525)
at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
at java.math.MutableBigInteger.<init> (MutableBigInteger.java:62)
at java.math.MutableBigInteger.hybridGCD (MutableBigInteger.java:978)
at java.math.BigInteger.gcd (BigInteger.java:1393)
at org.katlas.JavaKh.algebra.rings.Rational.<init> (Rational.java:21)
at org.katlas.JavaKh.algebra.rings.Rational.multiply (Rational.java:35)
at org.katlas.JavaKh.algebra.rings.Rational.multiply (Rational.java:1)
at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:143)
at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:168)
at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:1)
at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:1)
at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:712)
at org.katlas.JavaKh.Komplex.reduce (Komplex.java:513)
at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1732)
at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
at java.math.MutableBigInteger.<init> (MutableBigInteger.java:99)
at java.math.BigInteger.gcd (BigInteger.java:1391)
at org.katlas.JavaKh.Rational.<init> (Rational.java:13)
at org.katlas.JavaKh.Rational.multiply (Rational.java:28)
at org.katlas.JavaKh.LCCC.compose (LCCC.java:143)
at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:525)
at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
at org.katlas.JavaKh.CannedCobordismImpl.composeWithoutCache (CannedCobordismImpl.java:355)
at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:341)
at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:1)
at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:142)
at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:168)
at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:1)
at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:1)
at org.katlas.JavaKh.CobMatrix.compose (CobMatrix.java:190)
at org.katlas.JavaKh.Komplex.blockReductionLemma (Komplex.java:1346)
at org.katlas.JavaKh.Komplex.blockReductionLemma (Komplex.java:1066)
at org.katlas.JavaKh.Komplex.reduce (Komplex.java:525)
at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1732)
at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
at java.math.BigInteger.trustedStripLeadingZeroInts (BigInteger.java:2840)
at java.math.BigInteger.multiply (BigInteger.java:1167)
at org.katlas.JavaKh.Rational.multiply (Rational.java:28)
at org.katlas.JavaKh.LCCC.compose (LCCC.java:143)
at org.katlas.JavaKh.Komplex.deLoop (Komplex.java:514)
at org.katlas.JavaKh.Komplex.reduce (Komplex.java:437)
at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1110)
at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
at org.katlas.JavaKh.CannedCobordismImpl.reverseMaps (CannedCobordismImpl.java:163)
at org.katlas.JavaKh.CannedCobordismImpl.composeWithoutCache (CannedCobordismImpl.java:555)
at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:341)
at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:1)

```

```

at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:142)
at org.katlas.JavaKh.LCCCMMap.compose (LCCCMMap.java:168)
at org.katlas.JavaKh.LCCCMMap.compose (LCCCMMap.java:1)
at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:1)
at org.katlas.JavaKh.CobMatrix.compose (CobMatrix.java:190)
at org.katlas.JavaKh.Komplex.blockReductionLemma (Komplex.java:1346)
at org.katlas.JavaKh.Komplex.blockReductionLemma (Komplex.java:1066)
at org.katlas.JavaKh.Komplex.reduce (Komplex.java:525)
at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1732)
at org.katlas.JavaKh.JavaKh.main (JavaKh.java:114)

```

{Knot[15, Alternating, 84498], 8, 39, 56.526882, \$Failed[q, t]}

Something went wrong running JavaKh; nothing was returned. The command line was:

```

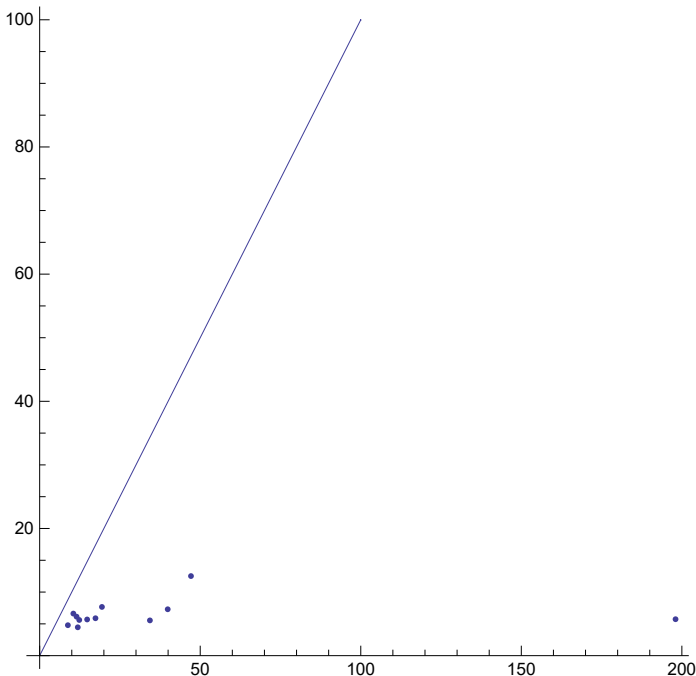
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log

```

There may have been an error log produced by Java:

{Knot[15, Alternating, 84498], 8, 39, 195.604699, \$Failed[q, t]}

$$\{Knot[15, Alternating, 84498], 8, 39, 141.201949, \\
KhE q^8 + 3 q^{12} t^2 KhC[1] + 5 q^{14} t^3 KhC[1] + 10 q^{16} t^4 KhC[1] + 15 q^{18} t^5 KhC[1] + \\
20 q^{20} t^6 KhC[1] + 25 q^{22} t^7 KhC[1] + 25 q^{24} t^8 KhC[1] + 25 q^{26} t^9 KhC[1] + 20 q^{28} t^{10} KhC[1] + \\
16 q^{30} t^{11} KhC[1] + 9 q^{32} t^{12} KhC[1] + 6 q^{34} t^{13} KhC[1] + 2 q^{36} t^{14} KhC[1] + q^{38} t^{15} KhC[1]\}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```

!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log

```

There may have been an error log produced by Java:

```
{Knot[15, NonAlternating, 143071], 8, 37, 145.776741, $Failed[q, t]}
{Knot[15, NonAlternating, 143071], 8, 37, 182.974860,
15 q + 9 q^3 + 1/q^5 t^3 + 4/q^3 t^2 + 1/q t^2 + 8/q t + 4 q/t + 20 q^3 t + 14 q^5 t + 22 q^5 t^2 + 20 q^7 t^2 + 22 q^7 t^3 + 22 q^9 t^3 +
20 q^9 t^4 + 22 q^11 t^4 + 14 q^11 t^5 + 20 q^13 t^5 + 9 q^13 t^6 + 14 q^15 t^6 + 4 q^15 t^7 + 9 q^17 t^7 + q^17 t^8 + 4 q^19 t^8 + q^21 t^9}
```

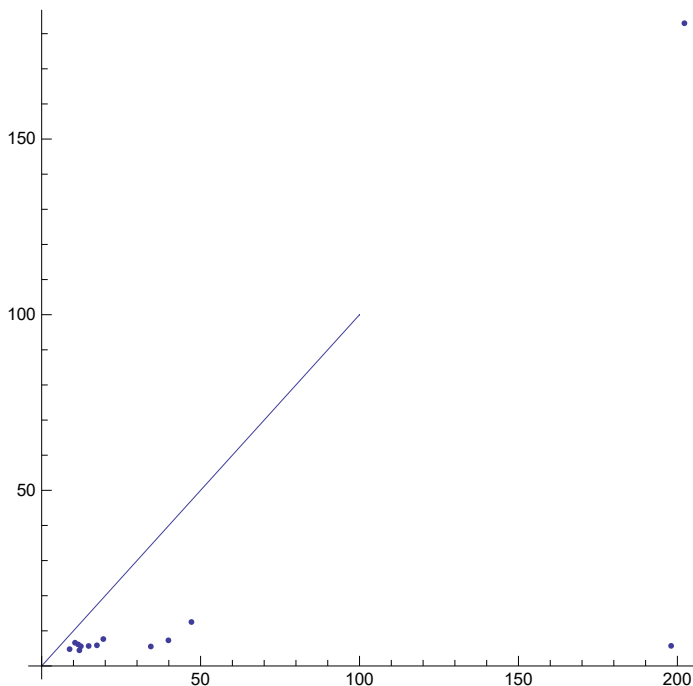
Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

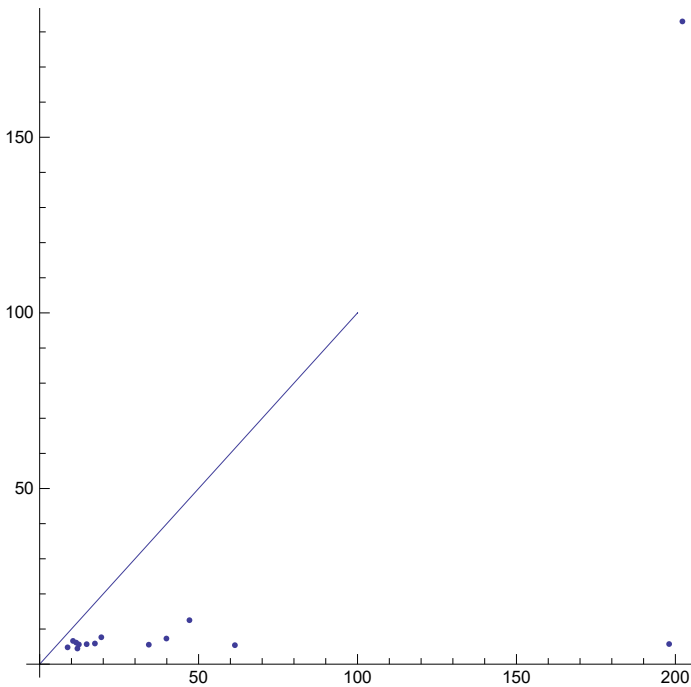
```
{Knot[15, NonAlternating, 143071], 8, 37,
202.208372, KnotTheory`UniversalKh`Private`DecomposeComplex[
KnotTheory`UniversalKh`Private`GradingsList[$Failed],
KnotTheory`UniversalKh`Private`Matrices[$Failed]]}
```



$$\left\{ \text{Knot}[15, \text{Alternating}, 59227], 6, 23, 13.065633, \right. \\ \frac{76}{q} + 75q + \frac{1}{q^{15}t^7} + \frac{6}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{16}{q^{11}t^5} + \frac{6}{q^9t^5} + \frac{31}{q^9t^4} + \frac{16}{q^7t^4} + \frac{48}{q^7t^3} + \frac{31}{q^5t^3} + \\ \frac{64}{q^5t^2} + \frac{48}{q^3t^2} + \frac{74}{q^3t} + \frac{64}{qt} + 69qt + 75q^3t + 54q^3t^2 + 69q^5t^2 + 37q^5t^3 + 54q^7t^3 + \\ \left. 22q^7t^4 + 37q^9t^4 + 10q^9t^5 + 22q^{11}t^5 + 4q^{11}t^6 + 10q^{13}t^6 + q^{13}t^7 + 4q^{15}t^7 + q^{17}t^8 \right\}$$

$$\left\{ \text{Knot}[15, \text{Alternating}, 59227], 6, 23, 5.405484, \right. \\ \frac{76}{q} + 75q + \frac{1}{q^{15}t^7} + \frac{6}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{16}{q^{11}t^5} + \frac{6}{q^9t^5} + \frac{31}{q^9t^4} + \frac{16}{q^7t^4} + \frac{48}{q^7t^3} + \frac{31}{q^5t^3} + \\ \frac{64}{q^5t^2} + \frac{48}{q^3t^2} + \frac{74}{q^3t} + \frac{64}{qt} + 69qt + 75q^3t + 54q^3t^2 + 69q^5t^2 + 37q^5t^3 + 54q^7t^3 + \\ \left. 22q^7t^4 + 37q^9t^4 + 10q^9t^5 + 22q^{11}t^5 + 4q^{11}t^6 + 10q^{13}t^6 + q^{13}t^7 + 4q^{15}t^7 + q^{17}t^8 \right\}$$

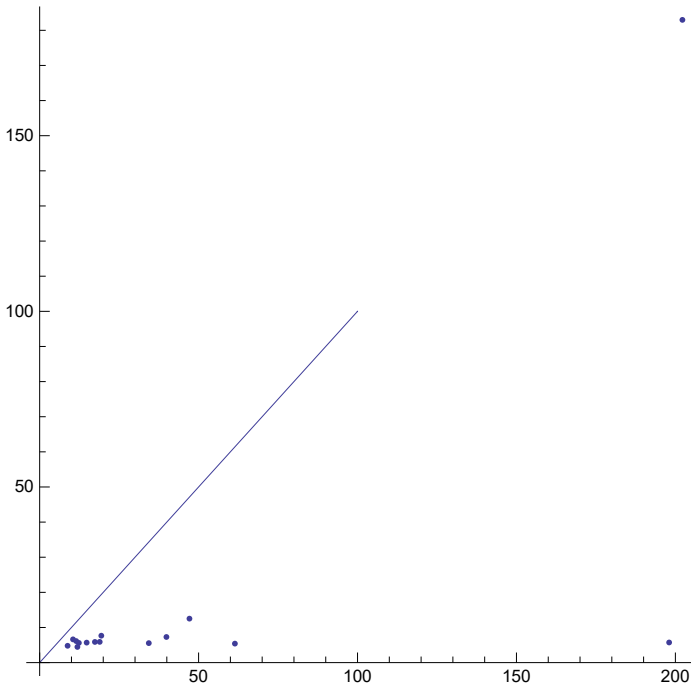
$$\left\{ \text{Knot}[15, \text{Alternating}, 59227], 6, 23, 61.422115, \right. \\ \text{KhE} + 74 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^{12}t^6} + \frac{6 \text{KhC}[1]}{q^{10}t^5} + \frac{16 \text{KhC}[1]}{q^8t^4} + \frac{31 \text{KhC}[1]}{q^6t^3} + \frac{48 \text{KhC}[1]}{q^4t^2} + \\ \frac{64 \text{KhC}[1]}{q^2t} + 75q^2t \text{KhC}[1] + 69q^4t^2 \text{KhC}[1] + 54q^6t^3 \text{KhC}[1] + 37q^8t^4 \text{KhC}[1] + \\ \left. 22q^{10}t^5 \text{KhC}[1] + 10q^{12}t^6 \text{KhC}[1] + 4q^{14}t^7 \text{KhC}[1] + q^{16}t^8 \text{KhC}[1] \right\}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 129801], 6, 23, 9.509510, \right. \\ 21q + 19q^3 + \frac{3}{q^7t^4} + \frac{7}{q^5t^3} + \frac{3}{q^3t^3} + \frac{13}{q^3t^2} + \frac{7}{qt^2} + \frac{18}{qt} + \frac{13q}{t} + 22q^3t + 20q^5t + 19q^5t^2 + \\ \left. 22q^7t^2 + 14q^7t^3 + 19q^9t^3 + 9q^9t^4 + 14q^{11}t^4 + 3q^{11}t^5 + 9q^{13}t^5 + q^{13}t^6 + 3q^{15}t^6 + q^{17}t^7 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 129801], 6, 23, 5.901609, \right. \\ \left. 21q + 19q^3 + \frac{3}{q^7 t^4} + \frac{7}{q^5 t^3} + \frac{3}{q^3 t^3} + \frac{13}{q^3 t^2} + \frac{7}{q t^2} + \frac{18}{q t} + \frac{13q}{t} + 22q^3 t + 20q^5 t + 19q^5 t^2 + \right. \\ \left. 22q^7 t^2 + 14q^7 t^3 + 19q^9 t^3 + 9q^9 t^4 + 14q^{11} t^4 + 3q^{11} t^5 + 9q^{13} t^5 + q^{13} t^6 + 3q^{15} t^6 + q^{17} t^7 \right\}$$

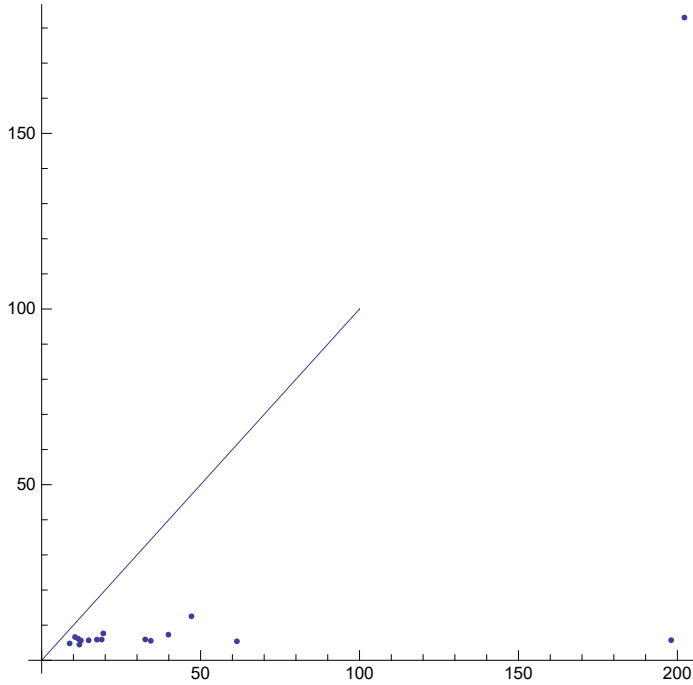
$$\left\{ \text{Knot}[15, \text{NonAlternating}, 129801], 6, 23, 18.892209, \right. \\ \left. \text{KhE} q^2 + 18q^2 \text{KhC}[1] + \frac{3 \text{KhC}[1]}{q^4 t^3} + \frac{7 \text{KhC}[1]}{q^2 t^2} + \frac{13 \text{KhC}[1]}{t} + 20q^4 t \text{KhC}[1] + 22q^6 t^2 \text{KhC}[1] + \right. \\ \left. 19q^8 t^3 \text{KhC}[1] + 14q^{10} t^4 \text{KhC}[1] + 9q^{12} t^5 \text{KhC}[1] + 3q^{14} t^6 \text{KhC}[1] + q^{16} t^7 \text{KhC}[1] \right\}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 155156], 6, 23, 9.327513, \right. \\ \left. \frac{18}{q^5} + \frac{31}{q^3} + \frac{1}{q^{25} t^{10}} + \frac{5}{q^{23} t^9} + \frac{1}{q^{21} t^9} + \frac{12}{q^{21} t^8} + \frac{5}{q^{19} t^8} + \frac{23}{q^{19} t^7} + \frac{12}{q^{17} t^7} + \frac{35}{q^{17} t^6} + \frac{23}{q^{15} t^6} + \frac{45}{q^{15} t^5} + \frac{35}{q^{13} t^5} + \right. \\ \left. \frac{50}{q^{13} t^4} + \frac{45}{q^{11} t^4} + \frac{48}{q^{11} t^3} + \frac{50}{q^9 t^3} + \frac{41}{q^9 t^2} + \frac{48}{q^7 t^2} + \frac{30}{q^7 t} + \frac{41}{q^5 t} + \frac{9t}{q^3} + \frac{17t}{q} + \frac{2t^2}{q} + 9qt^2 + 2q^3 t^3 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 155156], 6, 23, 5.943537, \right. \\ \left. \frac{18}{q^5} + \frac{31}{q^3} + \frac{1}{q^{25} t^{10}} + \frac{5}{q^{23} t^9} + \frac{1}{q^{21} t^9} + \frac{12}{q^{21} t^8} + \frac{5}{q^{19} t^8} + \frac{23}{q^{19} t^7} + \frac{12}{q^{17} t^7} + \frac{35}{q^{17} t^6} + \frac{23}{q^{15} t^6} + \frac{45}{q^{15} t^5} + \frac{35}{q^{13} t^5} + \right. \\ \left. \frac{50}{q^{13} t^4} + \frac{45}{q^{11} t^4} + \frac{48}{q^{11} t^3} + \frac{50}{q^9 t^3} + \frac{41}{q^9 t^2} + \frac{48}{q^7 t^2} + \frac{30}{q^7 t} + \frac{41}{q^5 t} + \frac{9t}{q^3} + \frac{17t}{q} + \frac{2t^2}{q} + 9qt^2 + 2q^3 t^3 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 155156], 6, 23, 32.590847, \right. \\ \left. \text{KhE} \frac{30 \text{KhC}[1]}{q^4} + \frac{\text{KhC}[1]}{q^4} + \frac{\text{KhC}[1]}{q^{22} t^9} + \frac{5 \text{KhC}[1]}{q^{20} t^8} + \frac{12 \text{KhC}[1]}{q^{18} t^7} + \frac{23 \text{KhC}[1]}{q^{16} t^6} + \frac{35 \text{KhC}[1]}{q^{14} t^5} + \frac{45 \text{KhC}[1]}{q^{12} t^4} + \right. \\ \left. \frac{50 \text{KhC}[1]}{q^{10} t^3} + \frac{48 \text{KhC}[1]}{q^8 t^2} + \frac{41 \text{KhC}[1]}{q^6 t} + \frac{17 t \text{KhC}[1]}{q^2} + 9t^2 \text{KhC}[1] + 2q^2 t^3 \text{KhC}[1] \right\}$$



{Knot[15, NonAlternating, 11941], 6, 23, 4.339319,

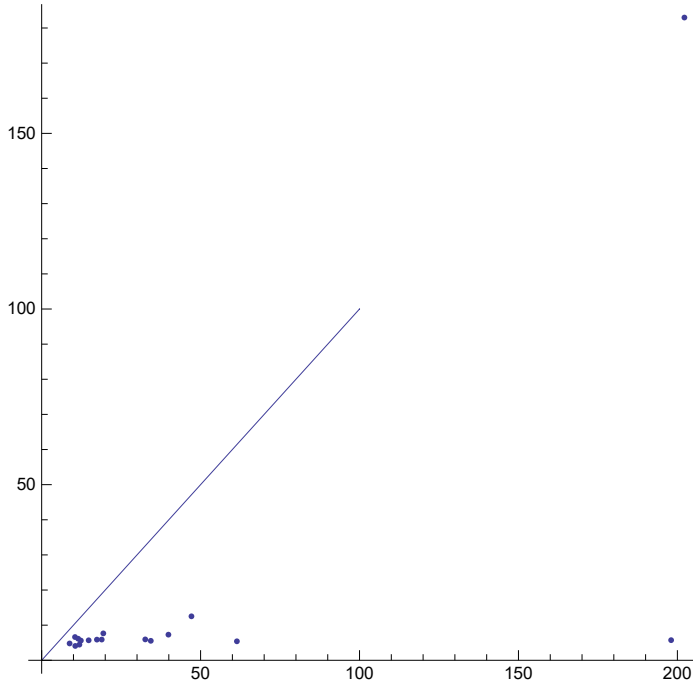
$$q^5 + q^7 + q^7 t + 2 q^9 t^2 + q^{11} t^2 + q^{11} t^3 + 2 q^{13} t^3 + q^{11} t^4 + 3 q^{13} t^4 + q^{15} t^4 + q^{13} t^5 + 2 q^{15} t^5 + 3 q^{17} t^5 + 2 q^{15} t^6 + 2 q^{17} t^6 + q^{19} t^6 + 2 q^{17} t^7 + 3 q^{19} t^7 + q^{21} t^7 + 3 q^{19} t^8 + 2 q^{21} t^8 + q^{23} t^8 + 3 q^{21} t^9 + 3 q^{23} t^9 + 2 q^{23} t^{10} + 3 q^{25} t^{10} + 2 q^{25} t^{11} + 2 q^{27} t^{11} + q^{27} t^{12} + 2 q^{29} t^{12} + q^{31} t^{13}$$

{Knot[15, NonAlternating, 11941], 6, 23, 4.085083,

$$q^5 + q^7 + q^7 t + 2 q^9 t^2 + q^{11} t^2 + q^{11} t^3 + 2 q^{13} t^3 + q^{11} t^4 + 3 q^{13} t^4 + q^{15} t^4 + q^{13} t^5 + 2 q^{15} t^5 + 3 q^{17} t^5 + 2 q^{15} t^6 + 2 q^{17} t^6 + q^{19} t^6 + 2 q^{17} t^7 + 3 q^{19} t^7 + q^{21} t^7 + 3 q^{19} t^8 + 2 q^{21} t^8 + q^{23} t^8 + 3 q^{21} t^9 + 3 q^{23} t^9 + 2 q^{23} t^{10} + 3 q^{25} t^{10} + 2 q^{25} t^{11} + 2 q^{27} t^{11} + q^{27} t^{12} + 2 q^{29} t^{12} + q^{31} t^{13}$$

{Knot[15, NonAlternating, 11941], 6, 23, 10.576193,

$$\text{KhE } q^6 + q^{10} t^2 \text{ KhC}[1] + 2 q^{12} t^3 \text{ KhC}[1] + q^{14} t^4 \text{ KhC}[1] + 2 q^{16} t^5 \text{ KhC}[1] + q^{16} t^6 \text{ KhC}[1] + q^{18} t^6 \text{ KhC}[1] + 2 q^{18} t^7 \text{ KhC}[1] + q^{20} t^7 \text{ KhC}[1] + 2 q^{20} t^8 \text{ KhC}[1] + q^{22} t^8 \text{ KhC}[1] + 3 q^{22} t^9 \text{ KhC}[1] + 3 q^{24} t^{10} \text{ KhC}[1] + 2 q^{26} t^{11} \text{ KhC}[1] + 2 q^{28} t^{12} \text{ KhC}[1] + q^{30} t^{13} \text{ KhC}[1] + q^{16} t^5 \text{ KhC}[2]$$



{Knot [15, NonAlternating, 126 081], 4, 15, 3.371669,

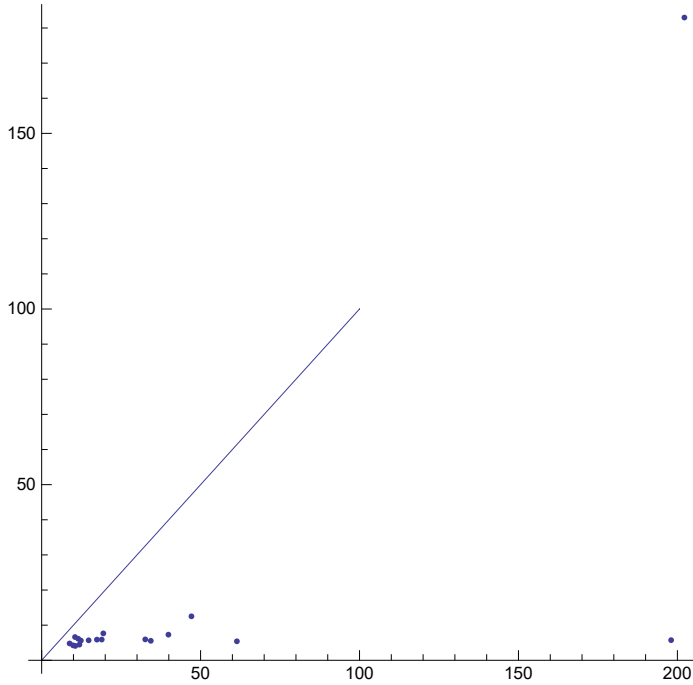
$$6 q^3 + 3 q^5 + \frac{1}{q t^2} + \frac{2 q}{t} + \frac{q^3}{t} + 10 q^5 t + 5 q^7 t + 14 q^7 t^2 + 10 q^9 t^2 + 18 q^9 t^3 + 14 q^{11} t^3 + 20 q^{11} t^4 + 18 q^{13} t^4 + 18 q^{13} t^5 + 20 q^{15} t^5 + 16 q^{15} t^6 + 18 q^{17} t^6 + 11 q^{17} t^7 + 16 q^{19} t^7 + 7 q^{19} t^8 + 11 q^{21} t^8 + 3 q^{21} t^9 + 7 q^{23} t^9 + q^{23} t^{10} + 3 q^{25} t^{10} + q^{27} t^{11} \}$$

{Knot [15, NonAlternating, 126 081], 4, 15, 4.260404,

$$6 q^3 + 3 q^5 + \frac{1}{q t^2} + \frac{2 q}{t} + \frac{q^3}{t} + 10 q^5 t + 5 q^7 t + 14 q^7 t^2 + 10 q^9 t^2 + 18 q^9 t^3 + 14 q^{11} t^3 + 20 q^{11} t^4 + 18 q^{13} t^4 + 18 q^{13} t^5 + 20 q^{15} t^5 + 16 q^{15} t^6 + 18 q^{17} t^6 + 11 q^{17} t^7 + 16 q^{19} t^7 + 7 q^{19} t^8 + 11 q^{21} t^8 + 3 q^{21} t^9 + 7 q^{23} t^9 + q^{23} t^{10} + 3 q^{25} t^{10} + q^{27} t^{11} \}$$

{Knot [15, NonAlternating, 126 081], 4, 15, 9.882056,

$$\text{KhE } q^4 + 2 q^4 \text{ KhC}[1] + \frac{q^2 \text{ KhC}[1]}{t} + 5 q^6 t \text{ KhC}[1] + 10 q^8 t^2 \text{ KhC}[1] + 14 q^{10} t^3 \text{ KhC}[1] + 18 q^{12} t^4 \text{ KhC}[1] + 20 q^{14} t^5 \text{ KhC}[1] + 18 q^{16} t^6 \text{ KhC}[1] + 16 q^{18} t^7 \text{ KhC}[1] + 11 q^{20} t^8 \text{ KhC}[1] + 7 q^{22} t^9 \text{ KhC}[1] + 3 q^{24} t^{10} \text{ KhC}[1] + q^{26} t^{11} \text{ KhC}[1] \}$$



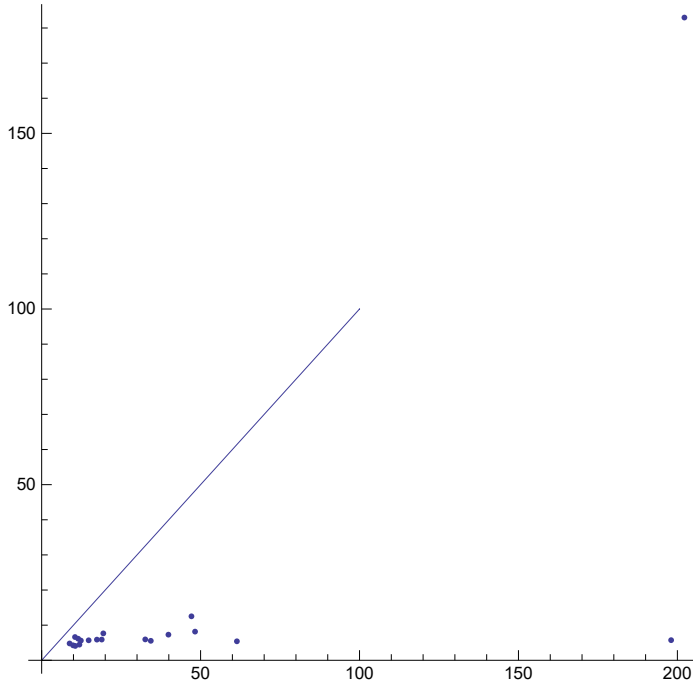
{Knot [15, Alternating, 7755], 6, 23, 12.765224,

$$\frac{66}{q} + 72q + \frac{1}{q^{17}t^8} + \frac{5}{q^{15}t^7} + \frac{1}{q^{13}t^7} + \frac{14}{q^{13}t^6} + \frac{5}{q^{11}t^6} + \frac{28}{q^{11}t^5} + \frac{14}{q^9t^5} + \frac{44}{q^9t^4} + \frac{28}{q^7t^4} + \frac{59}{q^7t^3} + \frac{44}{q^5t^3} + \frac{69}{q^5t^2} + \frac{59}{q^3t^2} + \frac{71}{q^3t} + \frac{69}{qt} + 52qt + 65q^3t + 36q^3t^2 + 52q^5t^2 + 21q^5t^3 + 36q^7t^3 + 10q^7t^4 + 21q^9t^4 + 4q^9t^5 + 10q^{11}t^5 + q^{11}t^6 + 4q^{13}t^6 + q^{15}t^7 \}$$

{Knot [15, Alternating, 7755], 6, 23, 8.162477,

$$\frac{66}{q} + 72q + \frac{1}{q^{17}t^8} + \frac{5}{q^{15}t^7} + \frac{1}{q^{13}t^7} + \frac{14}{q^{13}t^6} + \frac{5}{q^{11}t^6} + \frac{28}{q^{11}t^5} + \frac{14}{q^9t^5} + \frac{44}{q^9t^4} + \frac{28}{q^7t^4} + \frac{59}{q^7t^3} + \frac{44}{q^5t^3} + \frac{69}{q^5t^2} + \frac{59}{q^3t^2} + \frac{71}{q^3t} + \frac{69}{qt} + 52qt + 65q^3t + 36q^3t^2 + 52q^5t^2 + 21q^5t^3 + 36q^7t^3 + 10q^7t^4 + 21q^9t^4 + 4q^9t^5 + 10q^{11}t^5 + q^{11}t^6 + 4q^{13}t^6 + q^{15}t^7 \}$$

$$\left\{ \text{Knot [15, Alternating, 7755], 6, 23, 48.256582, KhC [1] + 71 KhC [1] + } \frac{\text{KhC [1]}}{q^{14}t^7} + \frac{5 \text{ KhC [1]}}{q^{12}t^6} + \frac{14 \text{ KhC [1]}}{q^{10}t^5} + \frac{28 \text{ KhC [1]}}{q^8t^4} + \frac{44 \text{ KhC [1]}}{q^6t^3} + \frac{59 \text{ KhC [1]}}{q^4t^2} + \frac{69 \text{ KhC [1]}}{q^2t} + 65q^2t \text{ KhC [1]} + 52q^4t^2 \text{ KhC [1]} + 36q^6t^3 \text{ KhC [1]} + 21q^8t^4 \text{ KhC [1]} + 10q^{10}t^5 \text{ KhC [1]} + 4q^{12}t^6 \text{ KhC [1]} + q^{14}t^7 \text{ KhC [1]} \right\}$$



{Knot [15, NonAlternating, 111 795], 6, 23, 11.777314,

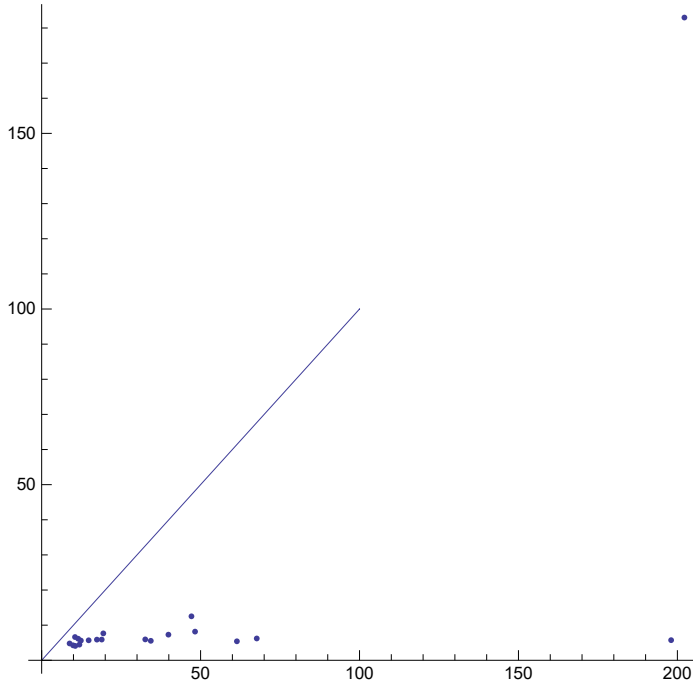
$$17q + 10q^3 + \frac{1}{q^5 t^3} + \frac{4}{q^3 t^2} + \frac{1}{q t^2} + \frac{9}{q t} + \frac{4q}{t} + 24q^3 t + 16q^5 t + 30q^5 t^2 + 24q^7 t^2 + 31q^7 t^3 + 30q^9 t^3 + 30q^9 t^4 + 31q^{11} t^4 + 24q^{11} t^5 + 30q^{13} t^5 + 17q^{13} t^6 + 24q^{15} t^6 + 10q^{15} t^7 + 17q^{17} t^7 + 4q^{17} t^8 + 10q^{19} t^8 + q^{19} t^9 + 4q^{21} t^9 + q^{23} t^{10}$$

{Knot [15, NonAlternating, 111 795], 6, 23, 6.212051,

$$17q + 10q^3 + \frac{1}{q^5 t^3} + \frac{4}{q^3 t^2} + \frac{1}{q t^2} + \frac{9}{q t} + \frac{4q}{t} + 24q^3 t + 16q^5 t + 30q^5 t^2 + 24q^7 t^2 + 31q^7 t^3 + 30q^9 t^3 + 30q^9 t^4 + 31q^{11} t^4 + 24q^{11} t^5 + 30q^{13} t^5 + 17q^{13} t^6 + 24q^{15} t^6 + 10q^{15} t^7 + 17q^{17} t^7 + 4q^{17} t^8 + 10q^{19} t^8 + q^{19} t^9 + 4q^{21} t^9 + q^{23} t^{10}$$

{Knot [15, NonAlternating, 111 795], 6, 23, 67.666664, KhE q^2 + 9 q^2 KhC [1] + $\frac{\text{KhC}[1]}{q^2 t^2}$ +

$$\frac{4 \text{KhC}[1]}{t} + 16q^4 t \text{KhC}[1] + 24q^6 t^2 \text{KhC}[1] + 30q^8 t^3 \text{KhC}[1] + 31q^{10} t^4 \text{KhC}[1] + 30q^{12} t^5 \text{KhC}[1] + 24q^{14} t^6 \text{KhC}[1] + 17q^{16} t^7 \text{KhC}[1] + 10q^{18} t^8 \text{KhC}[1] + 4q^{20} t^9 \text{KhC}[1] + q^{22} t^{10} \text{KhC}[1]}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 162604], 6, 23, 7.052663, \right.$$

$$\frac{14}{q^3} + \frac{17}{q} + \frac{1}{q^{19}t^8} + \frac{2}{q^{17}t^7} + \frac{1}{q^{15}t^7} + \frac{5}{q^{15}t^6} + \frac{2}{q^{13}t^6} + \frac{8}{q^{13}t^5} + \frac{5}{q^{11}t^5} + \frac{12}{q^{11}t^4} + \frac{8}{q^9t^4} + \frac{15}{q^9t^3} + \frac{12}{q^7t^3} +$$

$$\left. \frac{17}{q^7t^2} + \frac{15}{q^5t^2} + \frac{16}{q^5t} + \frac{17}{q^3t} + \frac{11t}{q} + 13qt + 6qt^2 + 11q^3t^2 + 4q^3t^3 + 6q^5t^3 + q^5t^4 + 4q^7t^4 + q^9t^5 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 162604], 6, 23, 5.331360, \right.$$

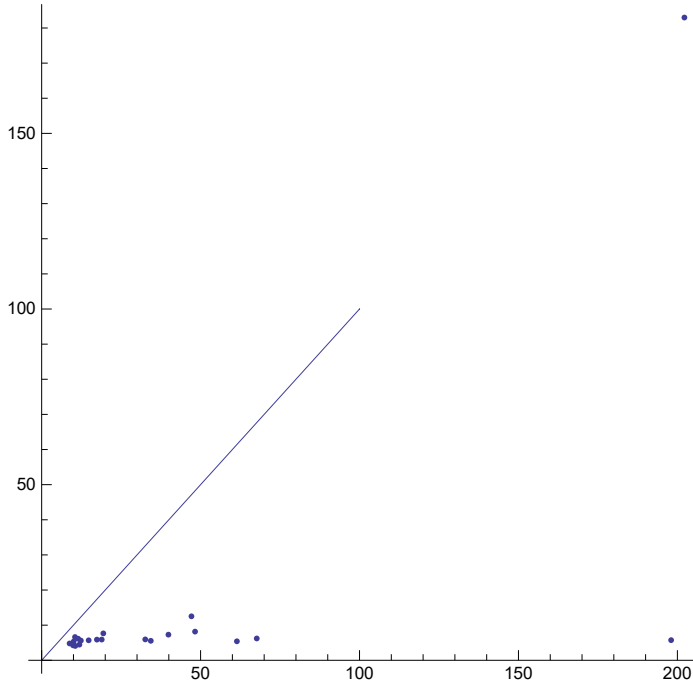
$$\frac{14}{q^3} + \frac{17}{q} + \frac{1}{q^{19}t^8} + \frac{2}{q^{17}t^7} + \frac{1}{q^{15}t^7} + \frac{5}{q^{15}t^6} + \frac{2}{q^{13}t^6} + \frac{8}{q^{13}t^5} + \frac{5}{q^{11}t^5} + \frac{12}{q^{11}t^4} + \frac{8}{q^9t^4} + \frac{15}{q^9t^3} + \frac{12}{q^7t^3} +$$

$$\left. \frac{17}{q^7t^2} + \frac{15}{q^5t^2} + \frac{16}{q^5t} + \frac{17}{q^3t} + \frac{11t}{q} + 13qt + 6qt^2 + 11q^3t^2 + 4q^3t^3 + 6q^5t^3 + q^5t^4 + 4q^7t^4 + q^9t^5 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 162604], 6, 23, 10.055772, \right.$$

$$\frac{\text{KhE}}{q^2} + \frac{16 \text{KhC}[1]}{q^2} + \frac{\text{KhC}[1]}{q^{16}t^7} + \frac{2 \text{KhC}[1]}{q^{14}t^6} + \frac{5 \text{KhC}[1]}{q^{12}t^5} + \frac{8 \text{KhC}[1]}{q^{10}t^4} + \frac{12 \text{KhC}[1]}{q^8t^3} + \frac{15 \text{KhC}[1]}{q^6t^2} +$$

$$\left. \frac{17 \text{KhC}[1]}{q^4t} + 13t \text{KhC}[1] + 11q^2t^2 \text{KhC}[1] + 6q^4t^3 \text{KhC}[1] + 4q^6t^4 \text{KhC}[1] + q^8t^5 \text{KhC}[1] \right\}$$



{Knot [15, NonAlternating, 20721], 6, 17, 2.571960,

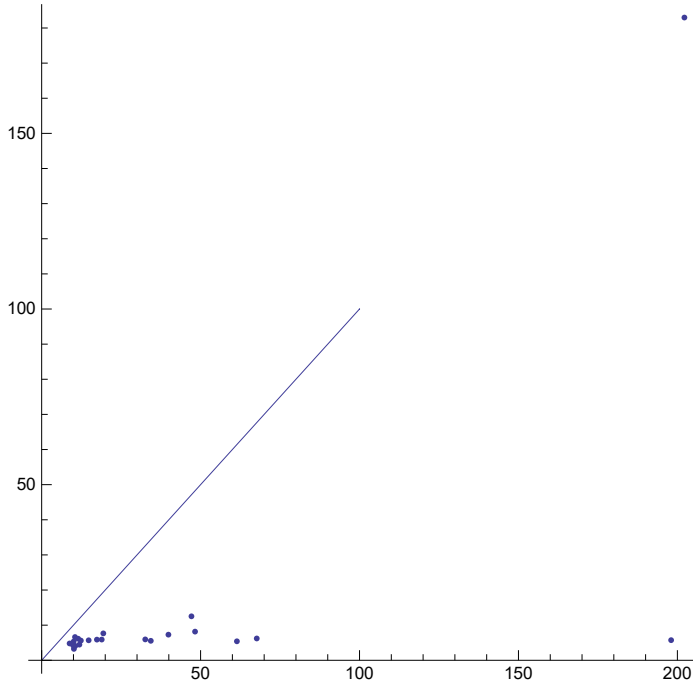
$$7q + 6q^3 + q^5 + \frac{1}{q^9 t^6} + \frac{1}{q^7 t^5} + \frac{1}{q^5 t^5} + \frac{1}{q^5 t^4} + \frac{1}{q^3 t^4} + \frac{1}{q^3 t^3} + \frac{2}{q t^3} + \frac{3}{q^3 t^2} + \frac{1}{q t^2} + \frac{2q}{t^2} + \frac{4}{q t} + \frac{4q}{t} + \frac{q^3}{t} + 8q^3 t + 6q^5 t + q^7 t + 8q^5 t^2 + 8q^7 t^2 + 7q^7 t^3 + 8q^9 t^3 + 5q^9 t^4 + 7q^{11} t^4 + 3q^{11} t^5 + 5q^{13} t^5 + q^{13} t^6 + 3q^{15} t^6 + q^{17} t^7 \}$$

{Knot [15, NonAlternating, 20721], 6, 17, 3.247636,

$$7q + 6q^3 + q^5 + \frac{1}{q^9 t^6} + \frac{1}{q^7 t^5} + \frac{1}{q^5 t^5} + \frac{1}{q^5 t^4} + \frac{1}{q^3 t^4} + \frac{2}{q^3 t^3} + \frac{1}{q t^3} + \frac{3}{q^3 t^2} + \frac{1}{q t^2} + \frac{2q}{t^2} + \frac{4}{q t} + \frac{4q}{t} + \frac{q^3}{t} + 8q^3 t + 6q^5 t + q^7 t + 8q^5 t^2 + 8q^7 t^2 + 7q^7 t^3 + 8q^9 t^3 + 5q^9 t^4 + 7q^{11} t^4 + 3q^{11} t^5 + 5q^{13} t^5 + q^{13} t^6 + 3q^{15} t^6 + q^{17} t^7 \}$$

{Knot [15, NonAlternating, 20721], 6, 17, 10.147349,

$$\text{KhE } q^2 + 4q^2 \text{KhC}[1] + q^4 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^6 t^5} + \frac{\text{KhC}[1]}{q^4 t^4} + \frac{\text{KhC}[1]}{q^2 t^3} + \frac{2 \text{KhC}[1]}{t^2} + \frac{3 \text{KhC}[1]}{t} + \frac{q^2 \text{KhC}[1]}{t} + 6q^4 t \text{KhC}[1] + q^6 t \text{KhC}[1] + 8q^6 t^2 \text{KhC}[1] + 8q^8 t^3 \text{KhC}[1] + 7q^{10} t^4 \text{KhC}[1] + 5q^{12} t^5 \text{KhC}[1] + 3q^{14} t^6 \text{KhC}[1] + q^{16} t^7 \text{KhC}[1] \}$$



{Knot [15, NonAlternating, 76 700], 6, 25, 13.364374,

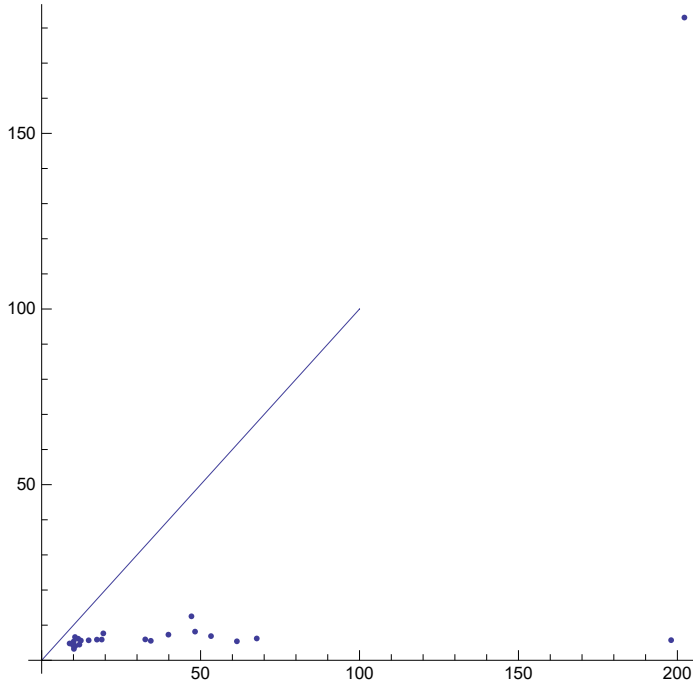
$$3 q^3 + 3 q^5 + 2 q^7 + \frac{1}{q^3 t^4} + \frac{1}{q t^3} + \frac{q}{t^3} + \frac{2 q}{t^2} + \frac{q^3}{t^2} + \frac{2 q^3}{t} + \frac{2 q^5}{t} + 6 q^5 t + 4 q^7 t + 2 q^9 t + 12 q^7 t^2 + 7 q^9 t^2 + 2 q^{11} t^2 + 15 q^9 t^3 + 13 q^{11} t^3 + q^{13} t^3 + 19 q^{11} t^4 + 15 q^{13} t^4 + q^{15} t^4 + 19 q^{13} t^5 + 19 q^{15} t^5 + 17 q^{15} t^6 + 19 q^{17} t^6 + 13 q^{17} t^7 + 17 q^{19} t^7 + 8 q^{19} t^8 + 13 q^{21} t^8 + 4 q^{21} t^9 + 8 q^{23} t^9 + q^{23} t^{10} + 4 q^{25} t^{10} + q^{27} t^{11} \}$$

{Knot [15, NonAlternating, 76 700], 6, 25, 6.883899,

$$3 q^3 + 3 q^5 + 2 q^7 + \frac{1}{q^3 t^4} + \frac{1}{q t^3} + \frac{q}{t^3} + \frac{2 q}{t^2} + \frac{q^3}{t^2} + \frac{2 q^3}{t} + \frac{2 q^5}{t} + 6 q^5 t + 4 q^7 t + 2 q^9 t + 12 q^7 t^2 + 7 q^9 t^2 + 2 q^{11} t^2 + 15 q^9 t^3 + 13 q^{11} t^3 + q^{13} t^3 + 19 q^{11} t^4 + 15 q^{13} t^4 + q^{15} t^4 + 19 q^{13} t^5 + 19 q^{15} t^5 + 17 q^{15} t^6 + 19 q^{17} t^6 + 13 q^{17} t^7 + 17 q^{19} t^7 + 8 q^{19} t^8 + 13 q^{21} t^8 + 4 q^{21} t^9 + 8 q^{23} t^9 + q^{23} t^{10} + 4 q^{25} t^{10} + q^{27} t^{11} \}$$

{Knot [15, NonAlternating, 76 700], 6, 25, 53.274416,

$$\text{KhE } q^4 + 2 q^6 \text{ KhC}[1] + \frac{\text{KhC}[1]}{t^3} + \frac{q^2 \text{ KhC}[1]}{t^2} + \frac{2 q^4 \text{ KhC}[1]}{t} + 2 q^6 t \text{ KhC}[1] + 2 q^8 t \text{ KhC}[1] + 6 q^8 t^2 \text{ KhC}[1] + 2 q^{10} t^2 \text{ KhC}[1] + 12 q^{10} t^3 \text{ KhC}[1] + q^{12} t^3 \text{ KhC}[1] + 15 q^{12} t^4 \text{ KhC}[1] + q^{14} t^4 \text{ KhC}[1] + 19 q^{14} t^5 \text{ KhC}[1] + 19 q^{16} t^6 \text{ KhC}[1] + 17 q^{18} t^7 \text{ KhC}[1] + 13 q^{20} t^8 \text{ KhC}[1] + 8 q^{22} t^9 \text{ KhC}[1] + 4 q^{24} t^{10} \text{ KhC}[1] + q^{26} t^{11} \text{ KhC}[1] \}$$



{Knot [15, NonAlternating, 21097], 6, 23, 10.715335,

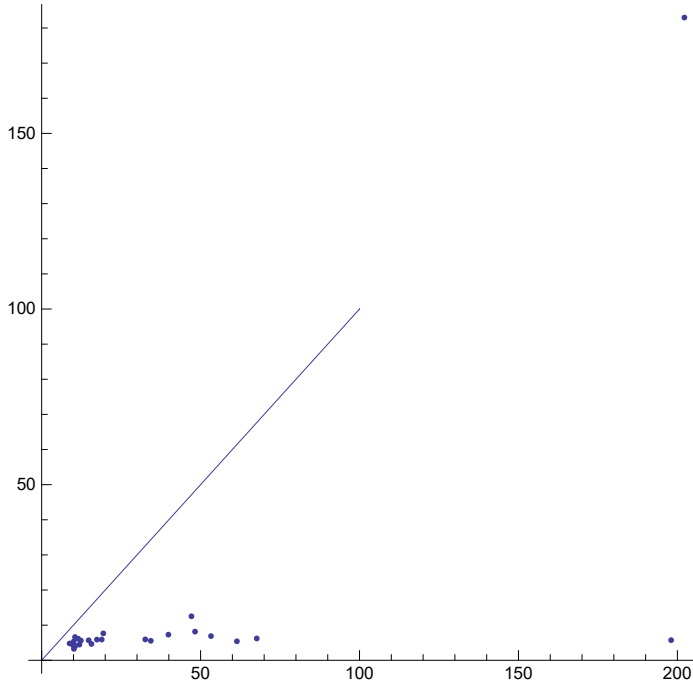
$$6 q^3 + 3 q^5 + \frac{2 q}{t} + 14 q^5 t + 5 q^7 t + 23 q^7 t^2 + 14 q^9 t^2 + 31 q^9 t^3 + 23 q^{11} t^3 + 39 q^{11} t^4 + 31 q^{13} t^4 + 38 q^{13} t^5 + 39 q^{15} t^5 + 36 q^{15} t^6 + 38 q^{17} t^6 + 28 q^{17} t^7 + 36 q^{19} t^7 + 19 q^{19} t^8 + 28 q^{21} t^8 + 10 q^{21} t^9 + 19 q^{23} t^9 + 4 q^{23} t^{10} + 10 q^{25} t^{10} + q^{25} t^{11} + 4 q^{27} t^{11} + q^{29} t^{12}$$

{Knot [15, NonAlternating, 21097], 6, 23, 4.648471,

$$6 q^3 + 3 q^5 + \frac{2 q}{t} + 14 q^5 t + 5 q^7 t + 23 q^7 t^2 + 14 q^9 t^2 + 31 q^9 t^3 + 23 q^{11} t^3 + 39 q^{11} t^4 + 31 q^{13} t^4 + 38 q^{13} t^5 + 39 q^{15} t^5 + 36 q^{15} t^6 + 38 q^{17} t^6 + 28 q^{17} t^7 + 36 q^{19} t^7 + 19 q^{19} t^8 + 28 q^{21} t^8 + 10 q^{21} t^9 + 19 q^{23} t^9 + 4 q^{23} t^{10} + 10 q^{25} t^{10} + q^{25} t^{11} + 4 q^{27} t^{11} + q^{29} t^{12}$$

{Knot [15, NonAlternating, 21097], 6, 23, 15.663444,

$$\text{KhE } q^4 + 2 q^4 \text{KhC}[1] + 5 q^6 t \text{KhC}[1] + 14 q^8 t^2 \text{KhC}[1] + 23 q^{10} t^3 \text{KhC}[1] + 31 q^{12} t^4 \text{KhC}[1] + 39 q^{14} t^5 \text{KhC}[1] + 38 q^{16} t^6 \text{KhC}[1] + 36 q^{18} t^7 \text{KhC}[1] + 28 q^{20} t^8 \text{KhC}[1] + 19 q^{22} t^9 \text{KhC}[1] + 10 q^{24} t^{10} \text{KhC}[1] + 4 q^{26} t^{11} \text{KhC}[1] + q^{28} t^{12} \text{KhC}[1]$$



{Knot [15, NonAlternating, 148910], 8, 37, 7.184901,

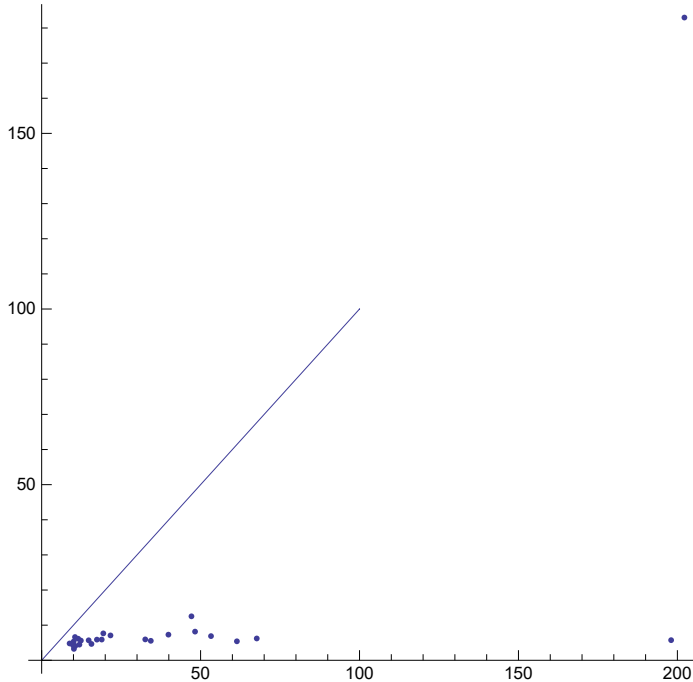
$$18q + 19q^3 + \frac{1}{q^{13}t^7} + \frac{4}{q^{11}t^6} + \frac{1}{q^9t^6} + \frac{8}{q^9t^5} + \frac{4}{q^7t^5} + \frac{12}{q^7t^4} + \frac{8}{q^5t^4} + \frac{17}{q^5t^3} + \frac{12}{q^3t^3} + \frac{19}{q^3t^2} + \frac{17}{qt^2} + \frac{18}{qt} + \frac{19q}{t} + 12q^3t + 17q^5t + 8q^5t^2 + 12q^7t^2 + 4q^7t^3 + 8q^9t^3 + q^9t^4 + 4q^{11}t^4 + q^{13}t^5 \}$$

{Knot [15, NonAlternating, 148910], 8, 37, 7.077813,

$$18q + 19q^3 + \frac{1}{q^{13}t^7} + \frac{4}{q^{11}t^6} + \frac{1}{q^9t^6} + \frac{8}{q^9t^5} + \frac{4}{q^7t^5} + \frac{12}{q^7t^4} + \frac{8}{q^5t^4} + \frac{17}{q^5t^3} + \frac{12}{q^3t^3} + \frac{19}{q^3t^2} + \frac{17}{qt^2} + \frac{18}{qt} + \frac{19q}{t} + 12q^3t + 17q^5t + 8q^5t^2 + 12q^7t^2 + 4q^7t^3 + 8q^9t^3 + q^9t^4 + 4q^{11}t^4 + q^{13}t^5 \}$$

{Knot [15, NonAlternating, 148910], 8, 37, 21.649390,

$$\text{KhE } q^2 + 18q^2 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^{10}t^6} + \frac{4 \text{KhC}[1]}{q^8t^5} + \frac{8 \text{KhC}[1]}{q^6t^4} + \frac{12 \text{KhC}[1]}{q^4t^3} + \frac{17 \text{KhC}[1]}{q^2t^2} + \frac{19 \text{KhC}[1]}{t} + 17q^4t \text{KhC}[1] + 12q^6t^2 \text{KhC}[1] + 8q^8t^3 \text{KhC}[1] + 4q^{10}t^4 \text{KhC}[1] + q^{12}t^5 \text{KhC}[1] \}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

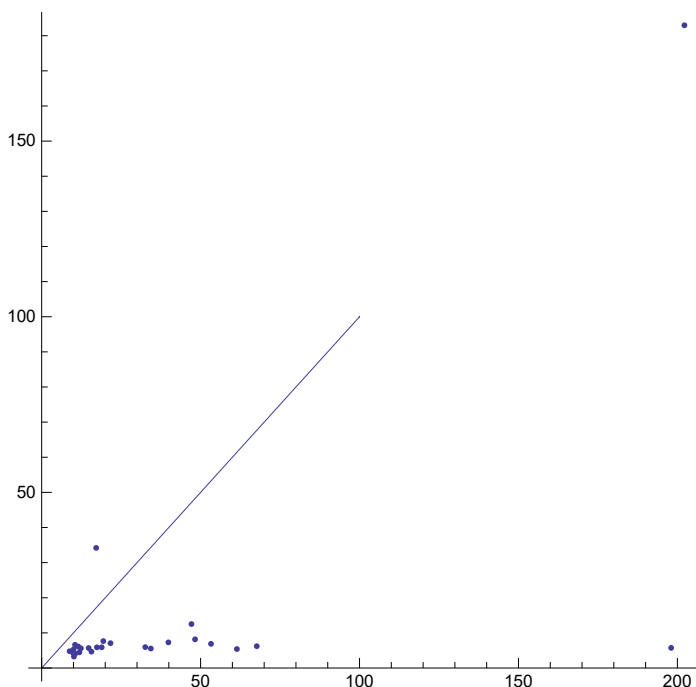
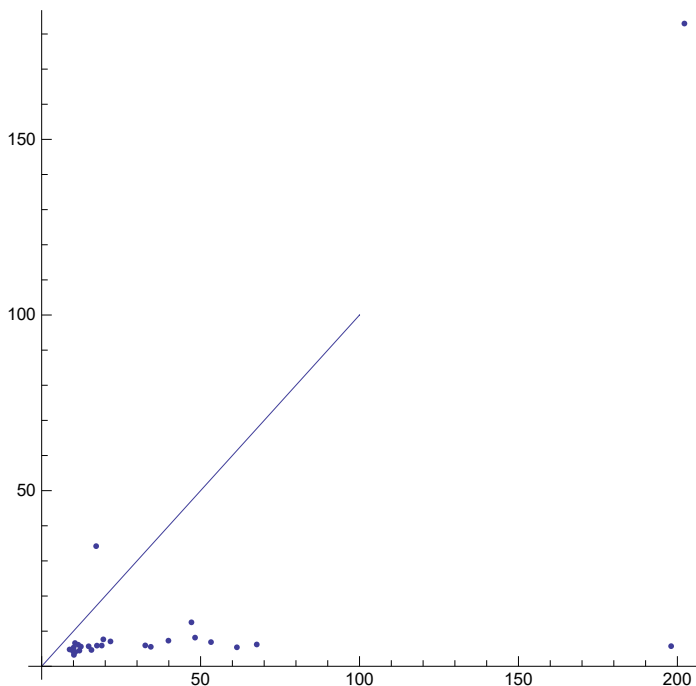
{Knot[15, Alternating, 39 605], 6, 25, 70.028555, \$Failed[q, t]}

{Knot[15, Alternating, 39 605], 6, 25, 34.201370,

$$32q + 24q^3 + \frac{1}{q^9 t^5} + \frac{3}{q^7 t^4} + \frac{1}{q^5 t^4} + \frac{8}{q^5 t^3} + \frac{3}{q^3 t^3} + \frac{15}{q^3 t^2} + \frac{8}{q t^2} + \frac{23}{q t} + \frac{15q}{t} + 37q^3 t + 31q^5 t + 39q^5 t^2 + 37q^7 t^2 + 36q^7 t^3 + 39q^9 t^3 + 30q^9 t^4 + 36q^{11} t^4 + 21q^{11} t^5 + 30q^{13} t^5 + 14q^{13} t^6 + 21q^{15} t^6 + 7q^{15} t^7 + 14q^{17} t^7 + 3q^{17} t^8 + 7q^{19} t^8 + q^{19} t^9 + 3q^{21} t^9 + q^{23} t^{10}$$

{Knot[15, Alternating, 39 605], 6, 25, 17.140177,

$$\text{KhE } q^2 + 23q^2 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^6 t^4} + \frac{3 \text{KhC}[1]}{q^4 t^3} + \frac{8 \text{KhC}[1]}{q^2 t^2} + \frac{15 \text{KhC}[1]}{t} + 31q^4 t \text{KhC}[1] + 37q^6 t^2 \text{KhC}[1] + 39q^8 t^3 \text{KhC}[1] + 36q^{10} t^4 \text{KhC}[1] + 30q^{12} t^5 \text{KhC}[1] + 21q^{14} t^6 \text{KhC}[1] + 14q^{16} t^7 \text{KhC}[1] + 7q^{18} t^8 \text{KhC}[1] + 3q^{20} t^9 \text{KhC}[1] + q^{22} t^{10} \text{KhC}[1]$$



{Knot [15, NonAlternating, 61288], 6, 21, 7.109746,

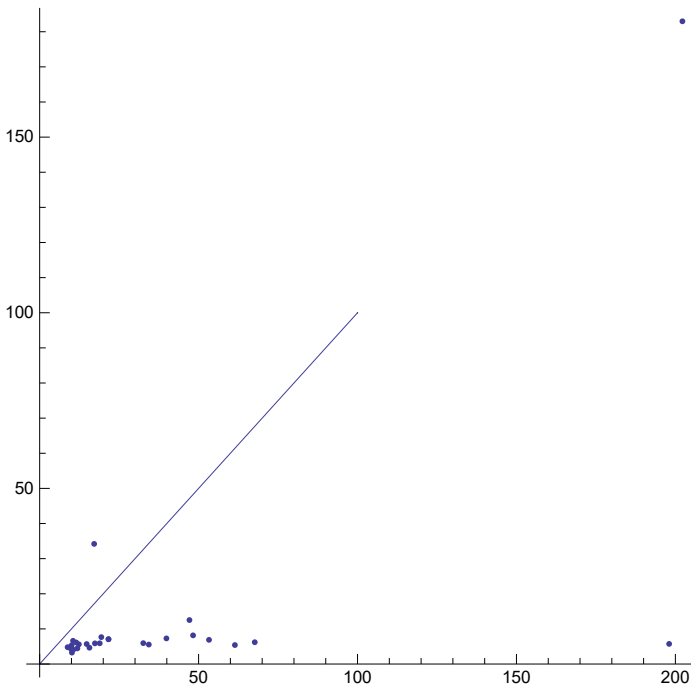
$$\begin{aligned}
 & 18q + 10q^3 + \frac{1}{q^5 t^3} + \frac{3}{q^3 t^2} + \frac{1}{q t^2} + \frac{9}{q t} + \frac{3q}{t} + 26q^3 t + 17q^5 t + 32q^5 t^2 + \\
 & 26q^7 t^2 + 34q^7 t^3 + 32q^9 t^3 + 33q^9 t^4 + 34q^{11} t^4 + 26q^{11} t^5 + 33q^{13} t^5 + 19q^{13} t^6 + \\
 & 26q^{15} t^6 + 10q^{15} t^7 + 19q^{17} t^7 + 4q^{17} t^8 + 10q^{19} t^8 + q^{19} t^9 + 4q^{21} t^9 + q^{23} t^{10} \}
 \end{aligned}$$

{Knot[15, NonAlternating, 61288], 6, 21, 7.049818,

$$18q + 10q^3 + \frac{1}{q^5 t^3} + \frac{3}{q^3 t^2} + \frac{1}{q t^2} + \frac{9}{q t} + \frac{3q}{t} + 26q^3 t + 17q^5 t + 32q^5 t^2 + 26q^7 t^2 + 34q^7 t^3 + 32q^9 t^3 + 33q^9 t^4 + 34q^{11} t^4 + 26q^{11} t^5 + 33q^{13} t^5 + 19q^{13} t^6 + 26q^{15} t^6 + 10q^{15} t^7 + 19q^{17} t^7 + 4q^{17} t^8 + 10q^{19} t^8 + q^{19} t^9 + 4q^{21} t^9 + q^{23} t^{10}$$

{Knot[15, NonAlternating, 61288], 6, 21, 21.655737, KhE q^2 + 9 q^2 KhC[1] + $\frac{\text{KhC}[1]}{q^2 t^2}$ +

$$\frac{3 \text{KhC}[1]}{t} + 17 q^4 t \text{KhC}[1] + 26 q^6 t^2 \text{KhC}[1] + 32 q^8 t^3 \text{KhC}[1] + 34 q^{10} t^4 \text{KhC}[1] + 33 q^{12} t^5 \text{KhC}[1] + 26 q^{14} t^6 \text{KhC}[1] + 19 q^{16} t^7 \text{KhC}[1] + 10 q^{18} t^8 \text{KhC}[1] + 4 q^{20} t^9 \text{KhC}[1] + q^{22} t^{10} \text{KhC}[1]}$$



{Knot[15, NonAlternating, 163482], 4, 15, 4.342974,

$$\frac{2}{q^5} + \frac{9}{q^3} + \frac{9}{q} + \frac{2}{q^{17} t^7} + \frac{5}{q^{15} t^6} + \frac{2}{q^{13} t^6} + \frac{9}{q^{13} t^5} + \frac{5}{q^{11} t^5} + \frac{10}{q^{11} t^4} + \frac{9}{q^9 t^4} + \frac{12}{q^9 t^3} + \frac{10}{q^7 t^3} + \frac{1}{q^9 t^2} + \frac{12}{q^7 t^2} + \frac{12}{q^5 t^2} + \frac{2}{q^7 t} + \frac{9}{q^5 t} + \frac{12}{q^3 t} + \frac{3t}{q^3} + \frac{5t}{q} + 6qt + \frac{3t^2}{q} + 3qt^2 + 3q^3 t^2 + 2qt^3 + 3q^3 t^3 + 2q^3 t^4 + 2q^5 t^4 + q^5 t^5 + 2q^7 t^5 + q^9 t^6$$

{Knot[15, NonAlternating, 163482], 4, 15, 4.965602,

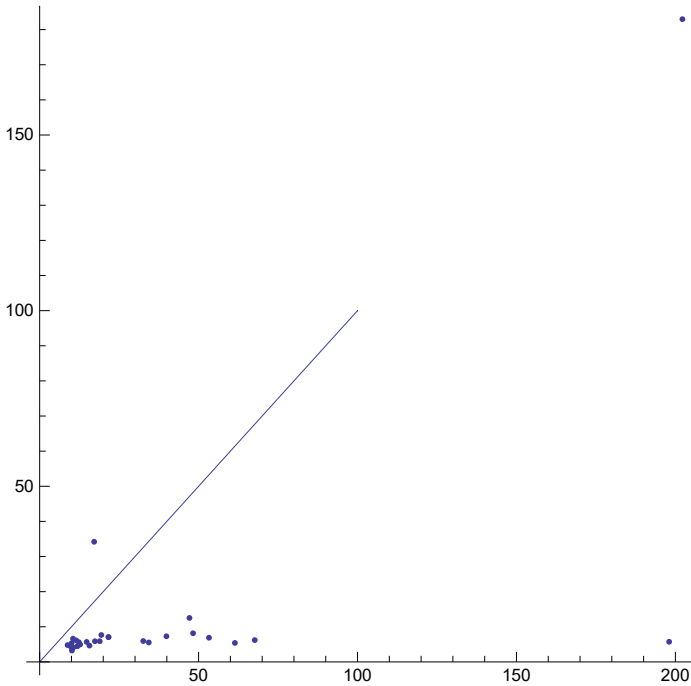
$$\frac{2}{q^5} + \frac{9}{q^3} + \frac{9}{q} + \frac{2}{q^{17} t^7} + \frac{5}{q^{15} t^6} + \frac{2}{q^{13} t^6} + \frac{9}{q^{13} t^5} + \frac{5}{q^{11} t^5} + \frac{10}{q^{11} t^4} + \frac{9}{q^9 t^4} + \frac{12}{q^9 t^3} + \frac{10}{q^7 t^3} + \frac{1}{q^9 t^2} + \frac{12}{q^7 t^2} + \frac{12}{q^5 t^2} + \frac{2}{q^7 t} + \frac{9}{q^5 t} + \frac{12}{q^3 t} + \frac{3t}{q^3} + \frac{5t}{q} + 6qt + \frac{3t^2}{q} + 3qt^2 + 3q^3 t^2 + 2qt^3 + 3q^3 t^3 + 2q^3 t^4 + 2q^5 t^4 + q^5 t^5 + 2q^7 t^5 + q^9 t^6$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 163482], 4, 15, 12.744099, \right.$$

$$\frac{\text{KhE}}{q^2} + \frac{2 \text{KhC}[1]}{q^4} + \frac{8 \text{KhC}[1]}{q^2} + \frac{2 \text{KhC}[1]}{q^{14} t^6} + \frac{5 \text{KhC}[1]}{q^{12} t^5} + \frac{9 \text{KhC}[1]}{q^{10} t^4} + \frac{10 \text{KhC}[1]}{q^8 t^3} +$$

$$\frac{12 \text{KhC}[1]}{q^6 t^2} + \frac{\text{KhC}[1]}{q^6 t} + \frac{12 \text{KhC}[1]}{q^4 t} + 6 t \text{KhC}[1] + \frac{2 t \text{KhC}[1]}{q^2} + 3 t^2 \text{KhC}[1] +$$

$$\left. 3 q^2 t^2 \text{KhC}[1] + 3 q^2 t^3 \text{KhC}[1] + 2 q^4 t^4 \text{KhC}[1] + 2 q^6 t^5 \text{KhC}[1] + q^8 t^6 \text{KhC}[1] \right\}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
  org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, Alternating, 46513], 8, 35, 165.518848, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

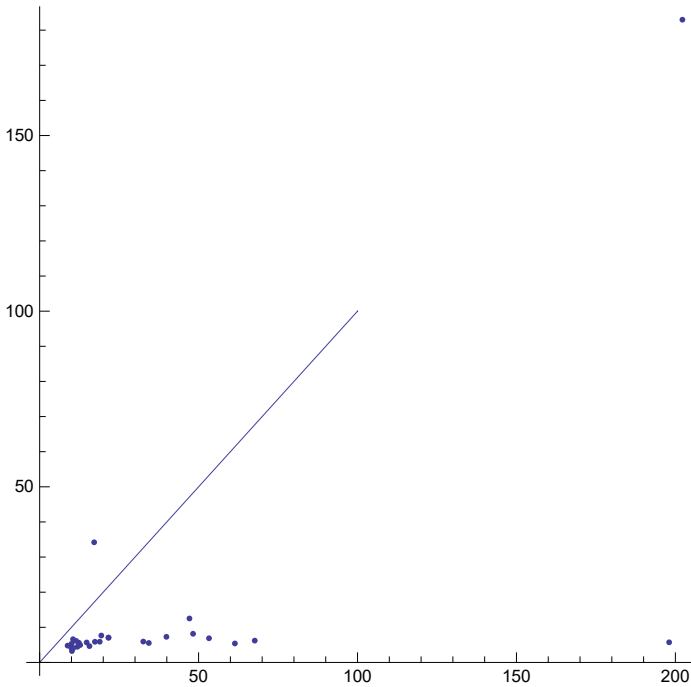
```
!java -classpath
  "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
  KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
  KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory
  /trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
  trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
  org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, Alternating, 46513], 8, 35, 51.606729, $Failed[q, t]}
```

{Knot[15, Alternating, 46513], 8, 35, 26.273400,

$$\text{KhE } q^4 + 8 q^4 \text{KhC}[1] + \frac{\text{KhC}[1]}{t^2} + \frac{4 q^2 \text{KhC}[1]}{t} + 16 q^6 t \text{KhC}[1] + 25 q^8 t^2 \text{KhC}[1] + 35 q^{10} t^3 \text{KhC}[1] + 42 q^{12} t^4 \text{KhC}[1] + 45 q^{14} t^5 \text{KhC}[1] + 43 q^{16} t^6 \text{KhC}[1] + 37 q^{18} t^7 \text{KhC}[1] + 27 q^{20} t^8 \text{KhC}[1] + 18 q^{22} t^9 \text{KhC}[1] + 10 q^{24} t^{10} \text{KhC}[1] + 4 q^{26} t^{11} \text{KhC}[1] + q^{28} t^{12} \text{KhC}[1] \}$$

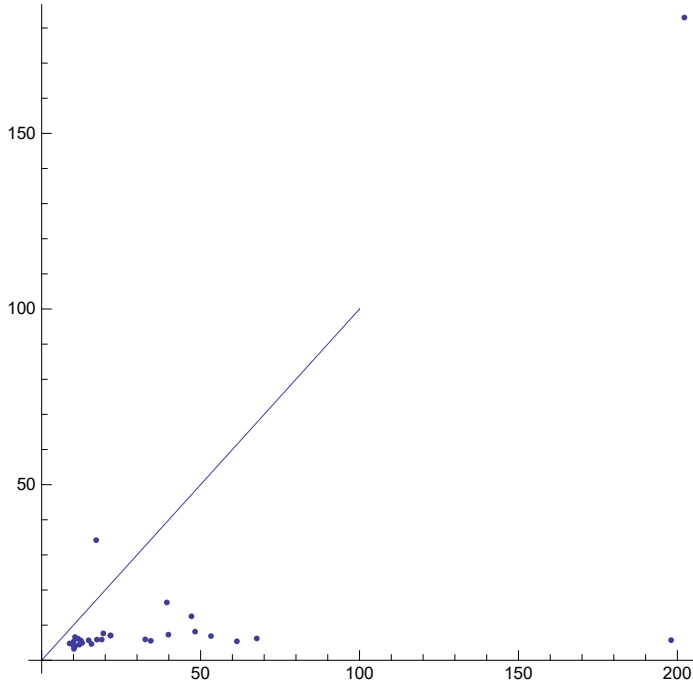


{Knot[15, NonAlternating, 28667], 8, 35, 30.903637, $22 q + 14 q^3 + \frac{1}{q^7 t^4} + \frac{3}{q^5 t^3} + \frac{1}{q^3 t^3} + \frac{9}{q^3 t^2} + \frac{3}{q t^2} + \frac{13}{q t} + \frac{9 q}{t} + 25 q^3 t + 21 q^5 t + 27 q^5 t^2 + 25 q^7 t^2 + 26 q^7 t^3 + 27 q^9 t^3 + 20 q^9 t^4 + 26 q^{11} t^4 + 15 q^{11} t^5 + 20 q^{13} t^5 + 8 q^{13} t^6 + 15 q^{15} t^6 + 4 q^{15} t^7 + 8 q^{17} t^7 + q^{17} t^8 + 4 q^{19} t^8 + q^{21} t^9$ }

{Knot[15, NonAlternating, 28667], 8, 35, 16.469884, $22 q + 14 q^3 + \frac{1}{q^7 t^4} + \frac{3}{q^5 t^3} + \frac{1}{q^3 t^3} + \frac{9}{q^3 t^2} + \frac{3}{q t^2} + \frac{13}{q t} + \frac{9 q}{t} + 25 q^3 t + 21 q^5 t + 27 q^5 t^2 + 25 q^7 t^2 + 26 q^7 t^3 + 27 q^9 t^3 + 20 q^9 t^4 + 26 q^{11} t^4 + 15 q^{11} t^5 + 20 q^{13} t^5 + 8 q^{13} t^6 + 15 q^{15} t^6 + 4 q^{15} t^7 + 8 q^{17} t^7 + q^{17} t^8 + 4 q^{19} t^8 + q^{21} t^9$ }

{Knot[15, NonAlternating, 28667], 8, 35, 39.385503,

$$\text{KhE } q^2 + 13 q^2 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^4 t^3} + \frac{3 \text{KhC}[1]}{q^2 t^2} + \frac{9 \text{KhC}[1]}{t} + 21 q^4 t \text{KhC}[1] + 25 q^6 t^2 \text{KhC}[1] + 27 q^8 t^3 \text{KhC}[1] + 26 q^{10} t^4 \text{KhC}[1] + 20 q^{12} t^5 \text{KhC}[1] + 15 q^{14} t^6 \text{KhC}[1] + 8 q^{16} t^7 \text{KhC}[1] + 4 q^{18} t^8 \text{KhC}[1] + q^{20} t^9 \text{KhC}[1] \}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 67059], 6, 21, 8.464520, \right.$$

$$\frac{20}{q^3} + \frac{26}{q} + \frac{3}{q^{17}t^7} + \frac{9}{q^{15}t^6} + \frac{3}{q^{13}t^6} + \frac{16}{q^{13}t^5} + \frac{9}{q^{11}t^5} + \frac{23}{q^{11}t^4} + \frac{16}{q^9t^4} + \frac{28}{q^9t^3} + \frac{23}{q^7t^3} +$$

$$\left. \frac{28}{q^7t^2} + \frac{28}{q^5t^2} + \frac{25}{q^5t} + \frac{28}{q^3t} + \frac{12t}{q} + 19qt + 5qt^2 + 12q^3t^2 + q^3t^3 + 5q^5t^3 + q^7t^4 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 67059], 6, 21, 5.109760, \right.$$

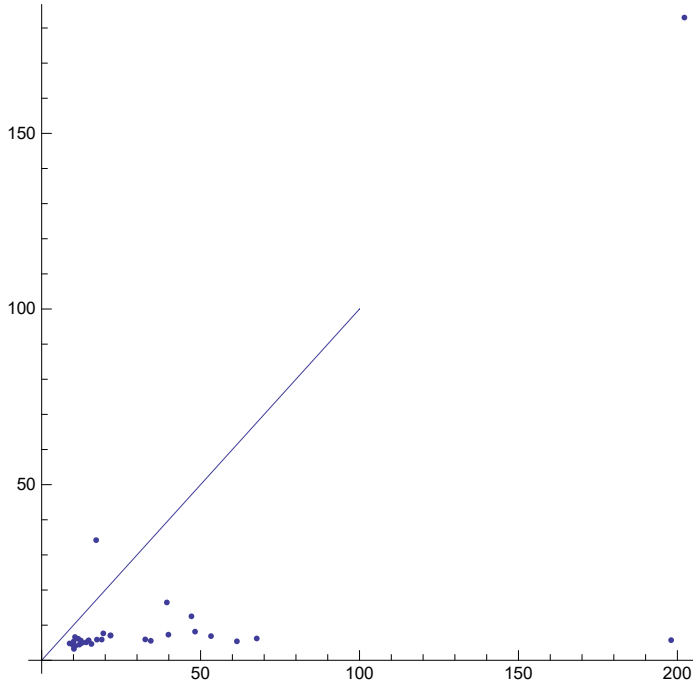
$$\frac{20}{q^3} + \frac{26}{q} + \frac{3}{q^{17}t^7} + \frac{9}{q^{15}t^6} + \frac{3}{q^{13}t^6} + \frac{16}{q^{13}t^5} + \frac{9}{q^{11}t^5} + \frac{23}{q^{11}t^4} + \frac{16}{q^9t^4} + \frac{28}{q^9t^3} + \frac{23}{q^7t^3} +$$

$$\left. \frac{28}{q^7t^2} + \frac{28}{q^5t^2} + \frac{25}{q^5t} + \frac{28}{q^3t} + \frac{12t}{q} + 19qt + 5qt^2 + 12q^3t^2 + q^3t^3 + 5q^5t^3 + q^7t^4 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 67059], 6, 21, 14.013471, \right.$$

$$\frac{\text{KhE}}{q^2} + \frac{25 \text{KhC}[1]}{q^2} + \frac{3 \text{KhC}[1]}{q^{14}t^6} + \frac{9 \text{KhC}[1]}{q^{12}t^5} + \frac{16 \text{KhC}[1]}{q^{10}t^4} + \frac{23 \text{KhC}[1]}{q^8t^3} + \frac{28 \text{KhC}[1]}{q^6t^2} +$$

$$\left. \frac{28 \text{KhC}[1]}{q^4t} + 19t \text{KhC}[1] + 12q^2t^2 \text{KhC}[1] + 5q^4t^3 \text{KhC}[1] + q^6t^4 \text{KhC}[1] \right\}$$



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```
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org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

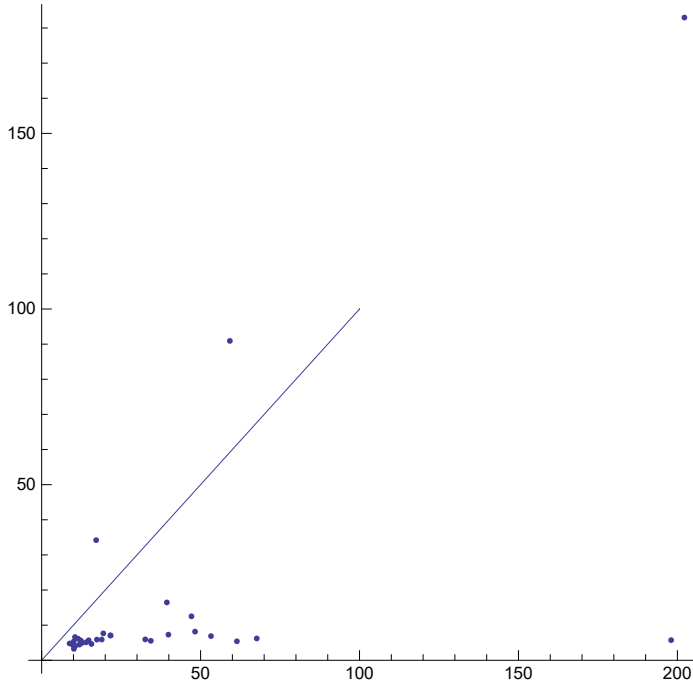
{Knot[15, NonAlternating, 14894], 8, 39, 291.542290, \$Failed[q, t]}

{Knot[15, NonAlternating, 14894], 8, 39, 90.922619,

$$3q + 11q^3 + 8q^5 + \frac{1}{q^7 t^5} + \frac{2}{q^5 t^4} + \frac{1}{q^3 t^4} + \frac{5}{q^3 t^3} + \frac{2}{q t^3} + \frac{6}{q t^2} + \frac{5q}{t^2} + \frac{1}{q t} + \frac{8q}{t} + \frac{6q^3}{t} + 6q^3 t + 9q^5 t + 9q^7 t + 7q^5 t^2 + 13q^7 t^2 + 7q^9 t^2 + 8q^7 t^3 + 11q^9 t^3 + 7q^{11} t^3 + 10q^9 t^4 + 10q^{11} t^4 + 4q^{13} t^4 + 7q^{11} t^5 + 11q^{13} t^5 + 2q^{15} t^5 + 7q^{13} t^6 + 7q^{15} t^6 + q^{17} t^6 + 4q^{15} t^7 + 7q^{17} t^7 + 2q^{17} t^8 + 4q^{19} t^8 + q^{19} t^9 + 2q^{21} t^9 + q^{23} t^{10}}$$

{Knot[15, NonAlternating, 14894], 8, 39, 59.213099,

$$\text{KhE } q^2 + q^2 \text{KhC}[1] + 8q^4 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^4 t^4} + \frac{2 \text{KhC}[1]}{q^2 t^3} + \frac{5 \text{KhC}[1]}{t^2} + \frac{6q^2 \text{KhC}[1]}{t} + 2q^4 t \text{KhC}[1] + 9q^6 t \text{KhC}[1] + 6q^6 t^2 \text{KhC}[1] + 7q^8 t^2 \text{KhC}[1] + 7q^8 t^3 \text{KhC}[1] + 7q^{10} t^3 \text{KhC}[1] + 8q^{10} t^4 \text{KhC}[1] + 4q^{12} t^4 \text{KhC}[1] + 10q^{12} t^5 \text{KhC}[1] + 2q^{14} t^5 \text{KhC}[1] + 7q^{14} t^6 \text{KhC}[1] + q^{16} t^6 \text{KhC}[1] + 7q^{16} t^7 \text{KhC}[1] + 4q^{18} t^8 \text{KhC}[1] + 2q^{20} t^9 \text{KhC}[1] + q^{22} t^{10} \text{KhC}[1]}$$



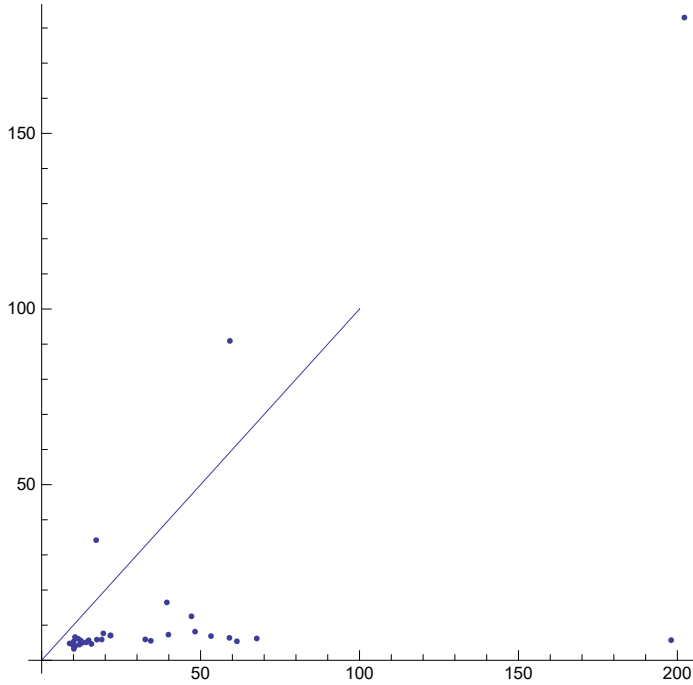
{Knot [15, Alternating, 80747], 6, 23, 11.182976,

$$\frac{54}{q} + 64q + \frac{1}{q^{19}t^9} + \frac{4}{q^{17}t^8} + \frac{1}{q^{15}t^8} + \frac{11}{q^{15}t^7} + \frac{4}{q^{13}t^7} + \frac{22}{q^{13}t^6} + \frac{11}{q^{11}t^6} + \frac{38}{q^{11}t^5} + \frac{22}{q^9t^5} + \frac{52}{q^9t^4} + \frac{38}{q^7t^4} + \frac{63}{q^7t^3} + \frac{52}{q^5t^3} + \frac{68}{q^5t^2} + \frac{63}{q^3t^2} + \frac{63}{q^3t} + \frac{68}{qt} + 38qt + 53q^3t + 23q^3t^2 + 38q^5t^2 + 11q^5t^3 + 23q^7t^3 + 4q^7t^4 + 11q^9t^4 + q^9t^5 + 4q^{11}t^5 + q^{13}t^6 \}$$

{Knot [15, Alternating, 80747], 6, 23, 6.390182,

$$\frac{54}{q} + 64q + \frac{1}{q^{19}t^9} + \frac{4}{q^{17}t^8} + \frac{1}{q^{15}t^8} + \frac{11}{q^{15}t^7} + \frac{4}{q^{13}t^7} + \frac{22}{q^{13}t^6} + \frac{11}{q^{11}t^6} + \frac{38}{q^{11}t^5} + \frac{22}{q^9t^5} + \frac{52}{q^9t^4} + \frac{38}{q^7t^4} + \frac{63}{q^7t^3} + \frac{52}{q^5t^3} + \frac{68}{q^5t^2} + \frac{63}{q^3t^2} + \frac{63}{q^3t} + \frac{68}{qt} + 38qt + 53q^3t + 23q^3t^2 + 38q^5t^2 + 11q^5t^3 + 23q^7t^3 + 4q^7t^4 + 11q^9t^4 + q^9t^5 + 4q^{11}t^5 + q^{13}t^6 \}$$

$$\left\{ \text{Knot [15, Alternating, 80747], 6, 23, 59.066944, KhE} + 63 \text{ KhC [1]} + \frac{\text{KhC [1]}}{q^{16}t^8} + \frac{4 \text{ KhC [1]}}{q^{14}t^7} + \frac{11 \text{ KhC [1]}}{q^{12}t^6} + \frac{22 \text{ KhC [1]}}{q^{10}t^5} + \frac{38 \text{ KhC [1]}}{q^8t^4} + \frac{52 \text{ KhC [1]}}{q^6t^3} + \frac{63 \text{ KhC [1]}}{q^4t^2} + \frac{68 \text{ KhC [1]}}{q^2t} + 53q^2t \text{ KhC [1]} + 38q^4t^2 \text{ KhC [1]} + 23q^6t^3 \text{ KhC [1]} + 11q^8t^4 \text{ KhC [1]} + 4q^{10}t^5 \text{ KhC [1]} + q^{12}t^6 \text{ KhC [1]} \right\}$$



{Knot [15, NonAlternating, 65 272], 6, 23, 14.979381,

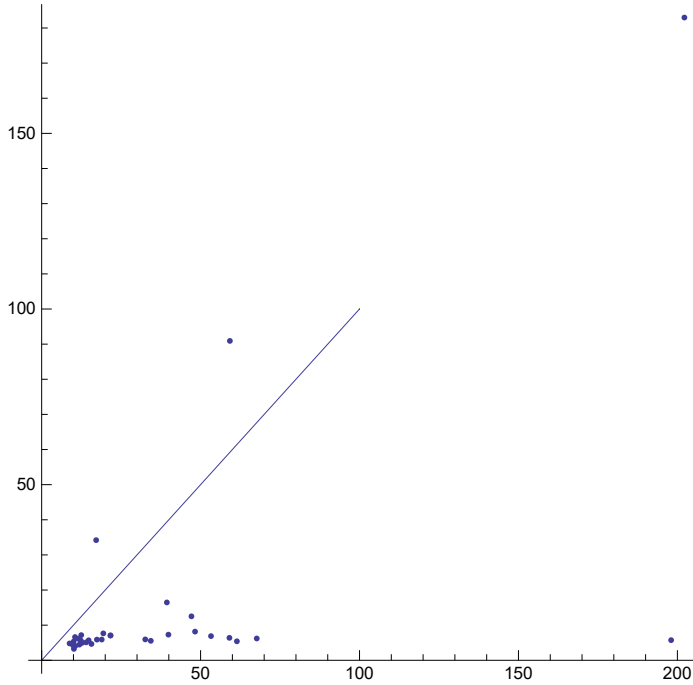
$$\left\{ \frac{23}{q^3} + \frac{24}{q} + \frac{1}{q^{15} t^6} + \frac{4}{q^{13} t^5} + \frac{1}{q^{11} t^5} + \frac{9}{q^{11} t^4} + \frac{4}{q^9 t^4} + \frac{15}{q^9 t^3} + \frac{9}{q^7 t^3} + \frac{20}{q^7 t^2} + \frac{15}{q^5 t^2} + \frac{23}{q^5 t} + \frac{20}{q^3 t} + \frac{20 t}{q} + 22 q t + 15 q t^2 + 20 q^3 t^2 + 9 q^3 t^3 + 15 q^5 t^3 + 4 q^5 t^4 + 9 q^7 t^4 + q^7 t^5 + 4 q^9 t^5 + q^{11} t^6 \right\}$$

{Knot [15, NonAlternating, 65 272], 6, 23, 7.165891,

$$\left\{ \frac{23}{q^3} + \frac{24}{q} + \frac{1}{q^{15} t^6} + \frac{4}{q^{13} t^5} + \frac{1}{q^{11} t^5} + \frac{9}{q^{11} t^4} + \frac{4}{q^9 t^4} + \frac{15}{q^9 t^3} + \frac{9}{q^7 t^3} + \frac{20}{q^7 t^2} + \frac{15}{q^5 t^2} + \frac{23}{q^5 t} + \frac{20}{q^3 t} + \frac{20 t}{q} + 22 q t + 15 q t^2 + 20 q^3 t^2 + 9 q^3 t^3 + 15 q^5 t^3 + 4 q^5 t^4 + 9 q^7 t^4 + q^7 t^5 + 4 q^9 t^5 + q^{11} t^6 \right\}$$

{Knot [15, NonAlternating, 65 272], 6, 23, 12.455620,

$$\left\{ \frac{\text{KhE}}{q^2} + \frac{23 \text{KhC}[1]}{q^2} + \frac{\text{KhC}[1]}{q^{12} t^5} + \frac{4 \text{KhC}[1]}{q^{10} t^4} + \frac{9 \text{KhC}[1]}{q^8 t^3} + \frac{15 \text{KhC}[1]}{q^6 t^2} + \frac{20 \text{KhC}[1]}{q^4 t} + 22 t \text{KhC}[1] + 20 q^2 t^2 \text{KhC}[1] + 15 q^4 t^3 \text{KhC}[1] + 9 q^6 t^4 \text{KhC}[1] + 4 q^8 t^5 \text{KhC}[1] + q^{10} t^6 \text{KhC}[1] \right\}$$



{Knot [15, NonAlternating, 147992], 6, 25, 7.590873,

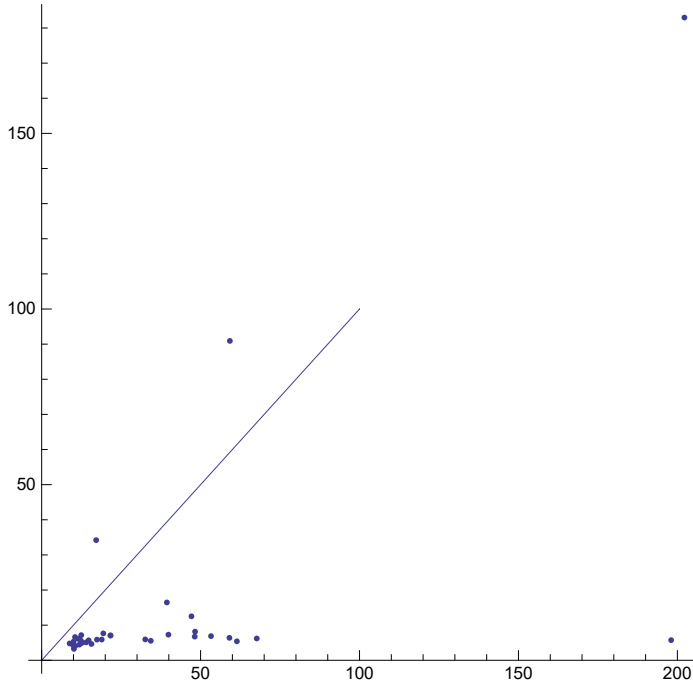
$$39q + 38q^3 + \frac{1}{q^{11}t^6} + \frac{5}{q^9t^5} + \frac{1}{q^7t^5} + \frac{12}{q^7t^4} + \frac{5}{q^5t^4} + \frac{22}{q^5t^3} + \frac{12}{q^3t^3} + \frac{30}{q^3t^2} + \frac{22}{qt^2} + \frac{37}{qt} + \frac{30q}{t} + 36q^3t + 38q^5t + 29q^5t^2 + 36q^7t^2 + 18q^7t^3 + 29q^9t^3 + 11q^9t^4 + 18q^{11}t^4 + 3q^{11}t^5 + 11q^{13}t^5 + q^{13}t^6 + 3q^{15}t^6 + q^{17}t^7 \}$$

{Knot [15, NonAlternating, 147992], 6, 25, 6.737771,

$$39q + 38q^3 + \frac{1}{q^{11}t^6} + \frac{5}{q^9t^5} + \frac{1}{q^7t^5} + \frac{12}{q^7t^4} + \frac{5}{q^5t^4} + \frac{22}{q^5t^3} + \frac{12}{q^3t^3} + \frac{30}{q^3t^2} + \frac{22}{qt^2} + \frac{37}{qt} + \frac{30q}{t} + 36q^3t + 38q^5t + 29q^5t^2 + 36q^7t^2 + 18q^7t^3 + 29q^9t^3 + 11q^9t^4 + 18q^{11}t^4 + 3q^{11}t^5 + 11q^{13}t^5 + q^{13}t^6 + 3q^{15}t^6 + q^{17}t^7 \}$$

{Knot [15, NonAlternating, 147992], 6, 25, 48.152280,

$$\text{KhE } q^2 + 37q^2 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^8t^5} + \frac{5\text{KhC}[1]}{q^6t^4} + \frac{12\text{KhC}[1]}{q^4t^3} + \frac{22\text{KhC}[1]}{q^2t^2} + \frac{30\text{KhC}[1]}{t} + 38q^4t \text{KhC}[1] + 36q^6t^2 \text{KhC}[1] + 29q^8t^3 \text{KhC}[1] + 18q^{10}t^4 \text{KhC}[1] + 11q^{12}t^5 \text{KhC}[1] + 3q^{14}t^6 \text{KhC}[1] + q^{16}t^7 \text{KhC}[1] \}$$



{Knot [15, NonAlternating, 70427], 8, 35, 16.701379,

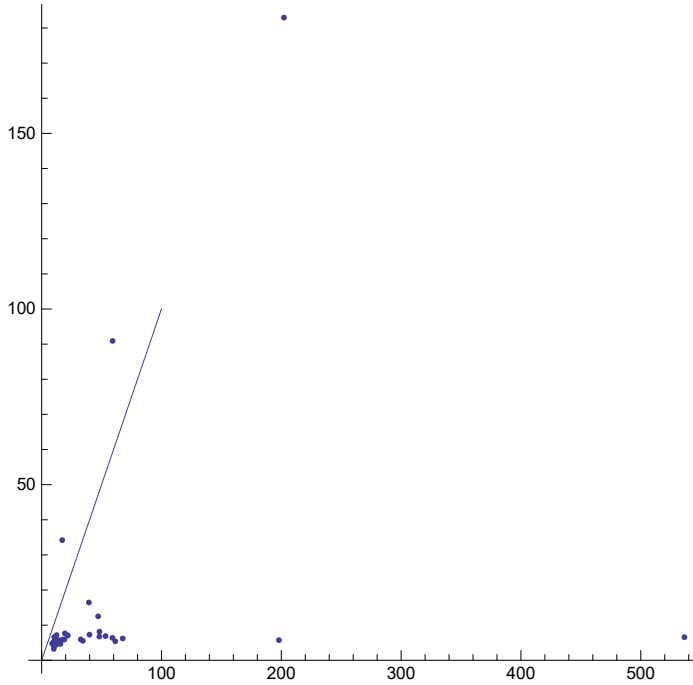
$$\left\{ \frac{25}{q} + 26q + \frac{1}{q^{15}t^7} + \frac{3}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{7}{q^{11}t^5} + \frac{3}{q^9t^5} + \frac{13}{q^9t^4} + \frac{7}{q^7t^4} + \frac{18}{q^7t^3} + \frac{13}{q^5t^3} + \frac{24}{q^5t^2} + \frac{18}{q^3t^2} + \frac{25}{q^3t} + \frac{24}{qt} + 21qt + 24q^3t + 14q^3t^2 + 21q^5t^2 + 9q^5t^3 + 14q^7t^3 + 4q^7t^4 + 9q^9t^4 + q^9t^5 + 4q^{11}t^5 + q^{13}t^6 \right\}$$

{Knot [15, NonAlternating, 70427], 8, 35, 6.577672,

$$\left\{ \frac{25}{q} + 26q + \frac{1}{q^{15}t^7} + \frac{3}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{7}{q^{11}t^5} + \frac{3}{q^9t^5} + \frac{13}{q^9t^4} + \frac{7}{q^7t^4} + \frac{18}{q^7t^3} + \frac{13}{q^5t^3} + \frac{24}{q^5t^2} + \frac{18}{q^3t^2} + \frac{25}{q^3t} + \frac{24}{qt} + 21qt + 24q^3t + 14q^3t^2 + 21q^5t^2 + 9q^5t^3 + 14q^7t^3 + 4q^7t^4 + 9q^9t^4 + q^9t^5 + 4q^{11}t^5 + q^{13}t^6 \right\}$$

{Knot [15, NonAlternating, 70427], 8, 35, 536.427138,

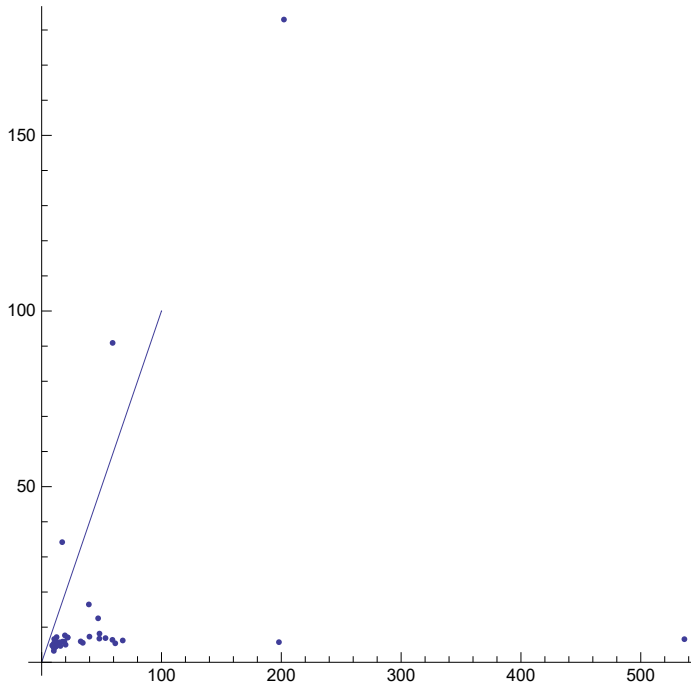
$$\left\{ \text{KhE} + 25 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^{12}t^6} + \frac{3 \text{KhC}[1]}{q^{10}t^5} + \frac{7 \text{KhC}[1]}{q^8t^4} + \frac{13 \text{KhC}[1]}{q^6t^3} + \frac{18 \text{KhC}[1]}{q^4t^2} + \frac{24 \text{KhC}[1]}{q^2t} + 24q^2t \text{KhC}[1] + 21q^4t^2 \text{KhC}[1] + 14q^6t^3 \text{KhC}[1] + 9q^8t^4 \text{KhC}[1] + 4q^{10}t^5 \text{KhC}[1] + q^{12}t^6 \text{KhC}[1] \right\}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 54875], 6, 23, 9.979942, \right. \\ \left. \frac{29}{q} + 27q + \frac{1}{q^{13}t^6} + \frac{3}{q^{11}t^5} + \frac{1}{q^9t^5} + \frac{8}{q^9t^4} + \frac{3}{q^7t^4} + \frac{14}{q^7t^3} + \frac{8}{q^5t^3} + \frac{21}{q^5t^2} + \frac{14}{q^3t^2} + \frac{26}{q^3t} + \frac{21}{qt} + 27qt + 28q^3t + \right. \\ \left. 22q^3t^2 + 27q^5t^2 + 16q^5t^3 + 22q^7t^3 + 9q^7t^4 + 16q^9t^4 + 4q^9t^5 + 9q^{11}t^5 + q^{11}t^6 + 4q^{13}t^6 + q^{15}t^7 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 54875], 6, 23, 5.003532, \right. \\ \left. \frac{29}{q} + 27q + \frac{1}{q^{13}t^6} + \frac{3}{q^{11}t^5} + \frac{1}{q^9t^5} + \frac{8}{q^9t^4} + \frac{3}{q^7t^4} + \frac{14}{q^7t^3} + \frac{8}{q^5t^3} + \frac{21}{q^5t^2} + \frac{14}{q^3t^2} + \frac{26}{q^3t} + \frac{21}{qt} + 27qt + 28q^3t + \right. \\ \left. 22q^3t^2 + 27q^5t^2 + 16q^5t^3 + 22q^7t^3 + 9q^7t^4 + 16q^9t^4 + 4q^9t^5 + 9q^{11}t^5 + q^{11}t^6 + 4q^{13}t^6 + q^{15}t^7 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 54875], 6, 23, 19.945382, \right. \\ \text{KhE} + 26 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^{10}t^5} + \frac{3 \text{KhC}[1]}{q^8t^4} + \frac{8 \text{KhC}[1]}{q^6t^3} + \frac{14 \text{KhC}[1]}{q^4t^2} + \frac{21 \text{KhC}[1]}{q^2t} + 28q^2t \text{KhC}[1] + \\ \left. 27q^4t^2 \text{KhC}[1] + 22q^6t^3 \text{KhC}[1] + 16q^8t^4 \text{KhC}[1] + 9q^{10}t^5 \text{KhC}[1] + 4q^{12}t^6 \text{KhC}[1] + q^{14}t^7 \text{KhC}[1] \right\}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, Alternating, 35 849], 8, 33, 1512.595974, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

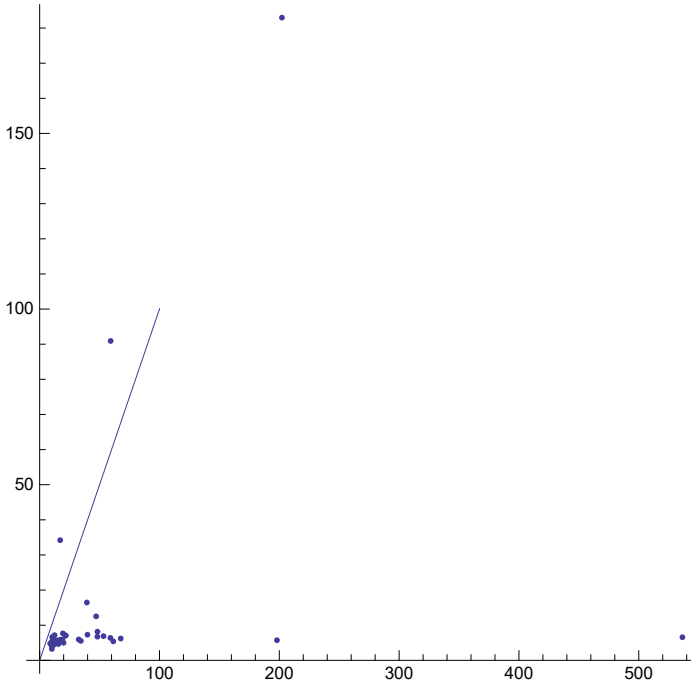
```
{Knot[15, Alternating, 35 849], 8, 33, 67.608817, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

Something went wrong running JavaKh; nothing was returned. The command line was:

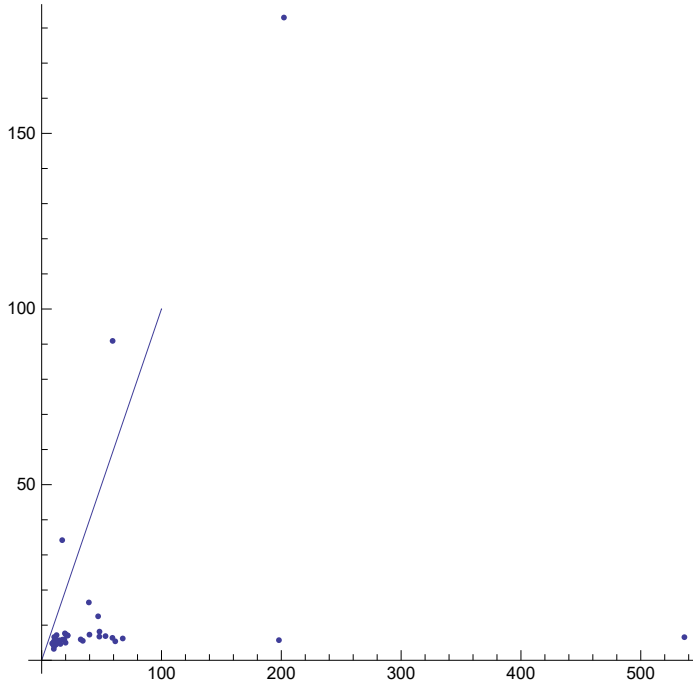
```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
{Knot[15, Alternating, 35 849], 8, 33, 219.212502,
KnotTheory`UniversalKh`Private`DecomposeComplex[KnotTheory`UniversalKh`Private`GradingList[
$Failed], KnotTheory`UniversalKh`Private`Matrices[$Failed]]}
```



$$\{ \text{Knot}[15, \text{NonAlternating}, 106\ 054], 6, 23, 7.874669, \frac{8}{q^5} + \frac{15}{q^3} + \frac{1}{q^{25}t^{10}} + \frac{3}{q^{23}t^9} + \frac{1}{q^{21}t^9} + \frac{8}{q^{21}t^8} + \frac{3}{q^{19}t^8} + \frac{15}{q^{19}t^7} + \frac{8}{q^{17}t^7} + \frac{21}{q^{17}t^6} + \frac{15}{q^{15}t^6} + \frac{26}{q^{15}t^5} + \frac{21}{q^{13}t^5} + \frac{27}{q^{13}t^4} + \frac{26}{q^{11}t^4} + \frac{26}{q^{11}t^3} + \frac{27}{q^9t^3} + \frac{20}{q^9t^2} + \frac{26}{q^7t^2} + \frac{14}{q^7t} + \frac{20}{q^5t} + \frac{3t}{q^3} + \frac{7t}{q} + \frac{t^2}{q} + 3qt^2 + q^3t^3 \}$$

$$\{ \text{Knot}[15, \text{NonAlternating}, 106\ 054], 6, 23, 7.384231, \frac{8}{q^5} + \frac{15}{q^3} + \frac{1}{q^{25}t^{10}} + \frac{3}{q^{23}t^9} + \frac{1}{q^{21}t^9} + \frac{8}{q^{21}t^8} + \frac{3}{q^{19}t^8} + \frac{15}{q^{19}t^7} + \frac{8}{q^{17}t^7} + \frac{21}{q^{17}t^6} + \frac{15}{q^{15}t^6} + \frac{26}{q^{15}t^5} + \frac{21}{q^{13}t^5} + \frac{27}{q^{13}t^4} + \frac{26}{q^{11}t^4} + \frac{26}{q^{11}t^3} + \frac{27}{q^9t^3} + \frac{20}{q^9t^2} + \frac{26}{q^7t^2} + \frac{14}{q^7t} + \frac{20}{q^5t} + \frac{3t}{q^3} + \frac{7t}{q} + \frac{t^2}{q} + 3qt^2 + q^3t^3 \}$$

$$\{ \text{Knot}[15, \text{NonAlternating}, 106\ 054], 6, 23, 20.031023, \frac{\text{KhE}}{q^4} + \frac{14 \text{KhC}[1]}{q^4} + \frac{\text{KhC}[1]}{q^{22}t^9} + \frac{3 \text{KhC}[1]}{q^{20}t^8} + \frac{8 \text{KhC}[1]}{q^{18}t^7} + \frac{15 \text{KhC}[1]}{q^{16}t^6} + \frac{21 \text{KhC}[1]}{q^{14}t^5} + \frac{26 \text{KhC}[1]}{q^{12}t^4} + \frac{27 \text{KhC}[1]}{q^{10}t^3} + \frac{26 \text{KhC}[1]}{q^8t^2} + \frac{20 \text{KhC}[1]}{q^6t} + \frac{7t \text{KhC}[1]}{q^2} + 3t^2 \text{KhC}[1] + q^2t^3 \text{KhC}[1] \}$$



{Knot [15, NonAlternating, 48 773], 8, 37, 9.235397,

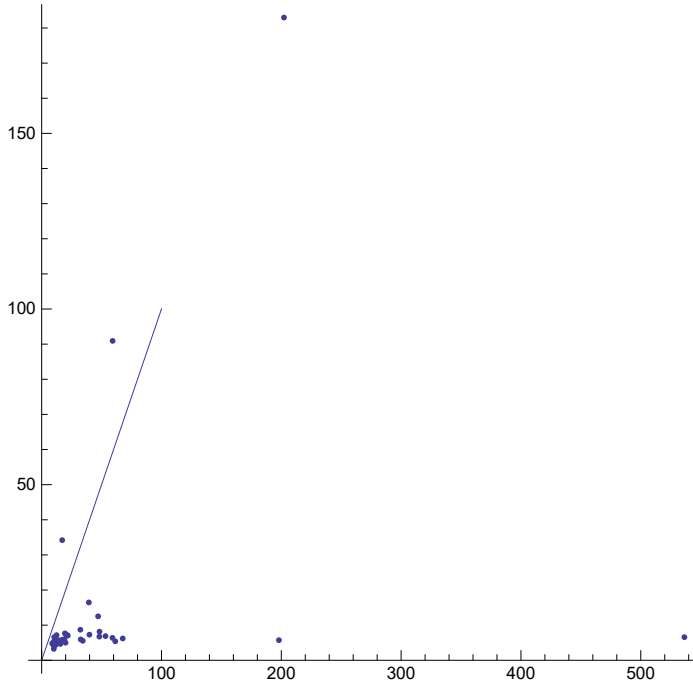
$$\frac{8}{q} + 10q + \frac{1}{q^{17}t^8} + \frac{1}{q^{15}t^7} + \frac{1}{q^{13}t^7} + \frac{4}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{5}{q^{11}t^5} + \frac{4}{q^9t^5} + \frac{8}{q^9t^4} + \frac{5}{q^7t^4} + \frac{9}{q^7t^3} + \frac{8}{q^5t^3} + \frac{10}{q^5t^2} + \frac{9}{q^3t^2} + \frac{9}{q^3t} + \frac{10}{qt} + 6qt + 7q^3t + 2q^3t^2 + 6q^5t^2 + 2q^5t^3 + 2q^7t^3 + 2q^9t^4 \}$$

{Knot [15, NonAlternating, 48 773], 8, 37, 8.695275,

$$\frac{8}{q} + 10q + \frac{1}{q^{17}t^8} + \frac{1}{q^{15}t^7} + \frac{1}{q^{13}t^7} + \frac{4}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{5}{q^{11}t^5} + \frac{4}{q^9t^5} + \frac{8}{q^9t^4} + \frac{5}{q^7t^4} + \frac{9}{q^7t^3} + \frac{8}{q^5t^3} + \frac{10}{q^5t^2} + \frac{9}{q^3t^2} + \frac{9}{q^3t} + \frac{10}{qt} + 6qt + 7q^3t + 2q^3t^2 + 6q^5t^2 + 2q^5t^3 + 2q^7t^3 + 2q^9t^4 \}$$

{Knot [15, NonAlternating, 48 773], 8, 37, 32.292911,

$$\text{KhE} + 9 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^{14}t^7} + \frac{\text{KhC}[1]}{q^{12}t^6} + \frac{4 \text{KhC}[1]}{q^{10}t^5} + \frac{5 \text{KhC}[1]}{q^8t^4} + \frac{8 \text{KhC}[1]}{q^6t^3} + \frac{9 \text{KhC}[1]}{q^4t^2} + \frac{10 \text{KhC}[1]}{q^2t} + 7q^2t \text{KhC}[1] + 6q^4t^2 \text{KhC}[1] + 2q^6t^3 \text{KhC}[1] + 2q^8t^4 \text{KhC}[1] \}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 135498], 8, 35, 11.215747, \right.$$

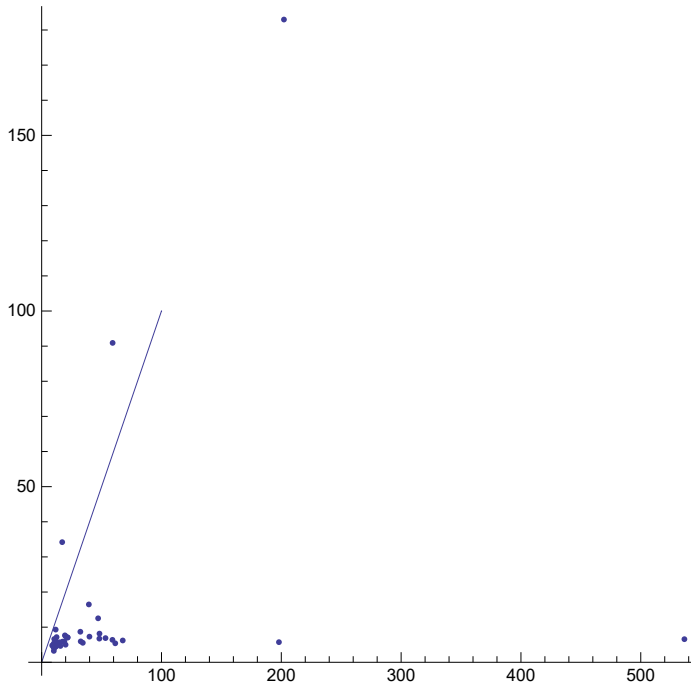
$$\left. \frac{15}{q^3} + \frac{14}{q} + \frac{2}{q^{13}t^5} + \frac{4}{q^{11}t^4} + \frac{2}{q^9t^4} + \frac{8}{q^9t^3} + \frac{4}{q^7t^3} + \frac{12}{q^7t^2} + \frac{8}{q^5t^2} + \frac{13}{q^5t} + \frac{12}{q^3t} + \frac{13t}{q} + 14qt + 10qt^2 + 13q^3t^2 + 7q^3t^3 + 10q^5t^3 + 3q^5t^4 + 7q^7t^4 + q^7t^5 + 3q^9t^5 + q^{11}t^6 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 135498], 8, 35, 9.310119, \right.$$

$$\left. \frac{15}{q^3} + \frac{14}{q} + \frac{2}{q^{13}t^5} + \frac{4}{q^{11}t^4} + \frac{2}{q^9t^4} + \frac{8}{q^9t^3} + \frac{4}{q^7t^3} + \frac{12}{q^7t^2} + \frac{8}{q^5t^2} + \frac{13}{q^5t} + \frac{12}{q^3t} + \frac{13t}{q} + 14qt + 10qt^2 + 13q^3t^2 + 7q^3t^3 + 10q^5t^3 + 3q^5t^4 + 7q^7t^4 + q^7t^5 + 3q^9t^5 + q^{11}t^6 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 135498], 8, 35, 11.701577, \right.$$

$$\left. \frac{\text{KhE}}{q^2} + \frac{13 \text{KhC}[1]}{q^2} + \frac{2 \text{KhC}[1]}{q^{10}t^4} + \frac{4 \text{KhC}[1]}{q^8t^3} + \frac{8 \text{KhC}[1]}{q^6t^2} + \frac{12 \text{KhC}[1]}{q^4t} + 14t \text{KhC}[1] + 13q^2t^2 \text{KhC}[1] + 10q^4t^3 \text{KhC}[1] + 7q^6t^4 \text{KhC}[1] + 3q^8t^5 \text{KhC}[1] + q^{10}t^6 \text{KhC}[1] \right\}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, Alternating, 29631], 8, 37, 191.238289, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

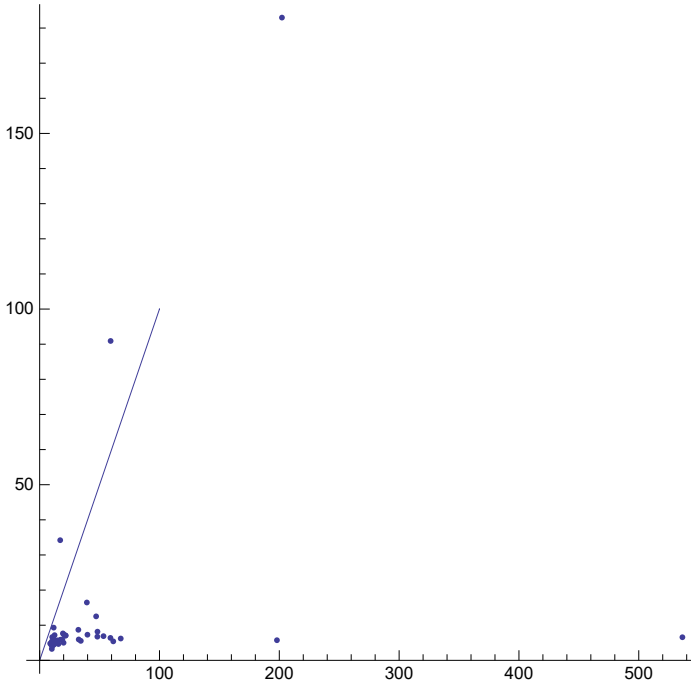
```
{Knot[15, Alternating, 29631], 8, 37, 56.927752, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
{Knot[15, Alternating, 29631], 8, 37, 160.913812,
KnotTheory`UniversalKh`Private`DecomposeComplex[KnotTheory`UniversalKh`Private`GradingsList[
$Failed], KnotTheory`UniversalKh`Private`Matrices[$Failed]]}
```



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, NonAlternating, 25015], 8, 35, 66.424601, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

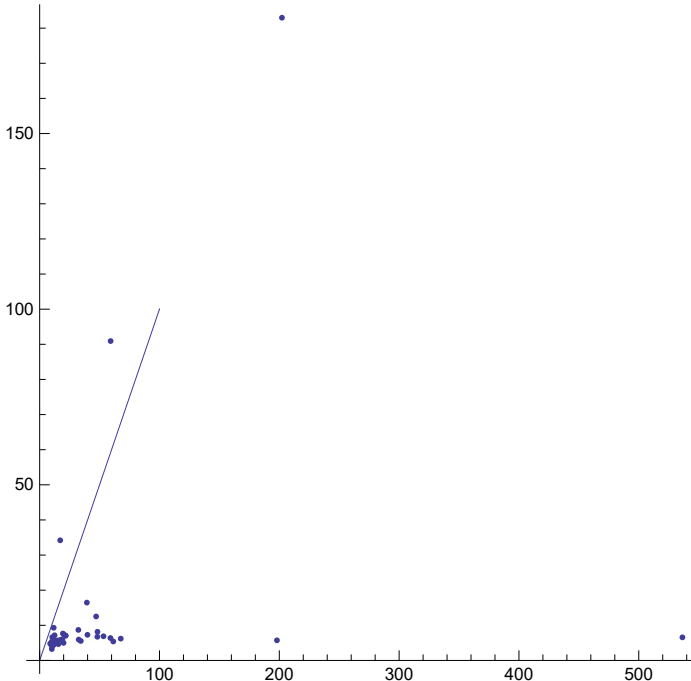
```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, NonAlternating, 25015], 8, 35, 56.973875, $Failed[q, t]}
```


{Knot[15, NonAlternating, 25015], 8, 35, 255.893876,

$$\text{KhE } q^4 + 17 q^4 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^2 t^3} + \frac{3 \text{KhC}[1]}{t^2} + \frac{9 q^2 \text{KhC}[1]}{t} + 28 q^6 t \text{KhC}[1] + 37 q^8 t^2 \text{KhC}[1] + 43 q^{10} t^3 \text{KhC}[1] + 42 q^{12} t^4 \text{KhC}[1] + 37 q^{14} t^5 \text{KhC}[1] + 28 q^{16} t^6 \text{KhC}[1] + 17 q^{18} t^7 \text{KhC}[1] + 8 q^{20} t^8 \text{KhC}[1] + 2 q^{22} t^9 \text{KhC}[1] \}$$



{Knot[15, Alternating, 40339], 6, 23, 10.380332,

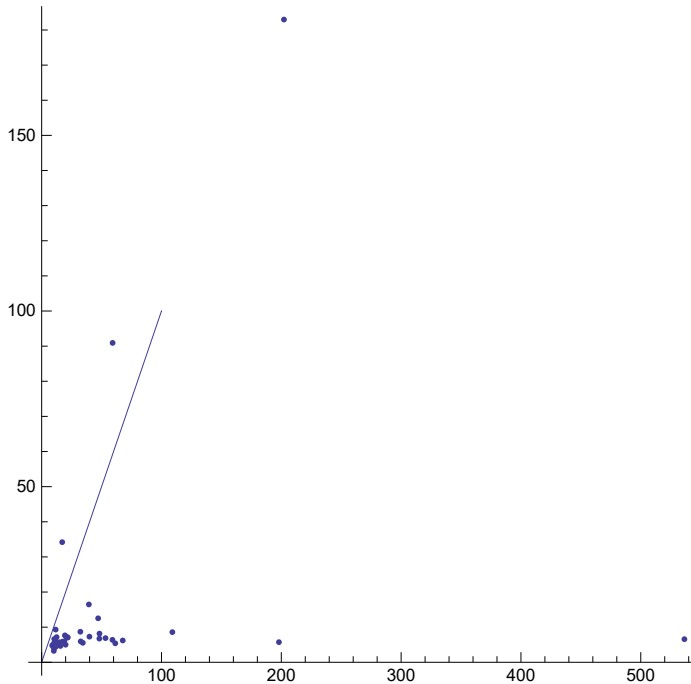
$$\frac{56}{q} + 47 q + \frac{1}{q^{13} t^6} + \frac{4}{q^{11} t^5} + \frac{1}{q^9 t^5} + \frac{10}{q^9 t^4} + \frac{4}{q^7 t^4} + \frac{21}{q^7 t^3} + \frac{10}{q^5 t^3} + \frac{33}{q^5 t^2} + \frac{21}{q^3 t^2} + \frac{46}{q^3 t} + \frac{33}{q t} + 59 q t + 55 q^3 t + 56 q^3 t^2 + 59 q^5 t^2 + 46 q^5 t^3 + 56 q^7 t^3 + 34 q^7 t^4 + 46 q^9 t^4 + 21 q^9 t^5 + 34 q^{11} t^5 + 11 q^{11} t^6 + 21 q^{13} t^6 + 4 q^{13} t^7 + 11 q^{15} t^7 + q^{15} t^8 + 4 q^{17} t^8 + q^{19} t^9 \}$$

{Knot[15, Alternating, 40339], 6, 23, 8.585257,

$$\frac{56}{q} + 47 q + \frac{1}{q^{13} t^6} + \frac{4}{q^{11} t^5} + \frac{1}{q^9 t^5} + \frac{10}{q^9 t^4} + \frac{4}{q^7 t^4} + \frac{21}{q^7 t^3} + \frac{10}{q^5 t^3} + \frac{33}{q^5 t^2} + \frac{21}{q^3 t^2} + \frac{46}{q^3 t} + \frac{33}{q t} + 59 q t + 55 q^3 t + 56 q^3 t^2 + 59 q^5 t^2 + 46 q^5 t^3 + 56 q^7 t^3 + 34 q^7 t^4 + 46 q^9 t^4 + 21 q^9 t^5 + 34 q^{11} t^5 + 11 q^{11} t^6 + 21 q^{13} t^6 + 4 q^{13} t^7 + 11 q^{15} t^7 + q^{15} t^8 + 4 q^{17} t^8 + q^{19} t^9 \}$$

{Knot[15, Alternating, 40339], 6, 23, 109.077532,

$$\text{KhE} + 46 \text{KhC}[1] + \frac{\text{KhC}[1]}{q^{10} t^5} + \frac{4 \text{KhC}[1]}{q^8 t^4} + \frac{10 \text{KhC}[1]}{q^6 t^3} + \frac{21 \text{KhC}[1]}{q^4 t^2} + \frac{33 \text{KhC}[1]}{q^2 t} + 55 q^2 t \text{KhC}[1] + 59 q^4 t^2 \text{KhC}[1] + 56 q^6 t^3 \text{KhC}[1] + 46 q^8 t^4 \text{KhC}[1] + 34 q^{10} t^5 \text{KhC}[1] + 21 q^{12} t^6 \text{KhC}[1] + 11 q^{14} t^7 \text{KhC}[1] + 4 q^{16} t^8 \text{KhC}[1] + q^{18} t^9 \text{KhC}[1] \}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, Alternating, 4860], 8, 37, 105.228180, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, Alternating, 4860], 8, 37, 250.333105, $Failed[q, t]}
```

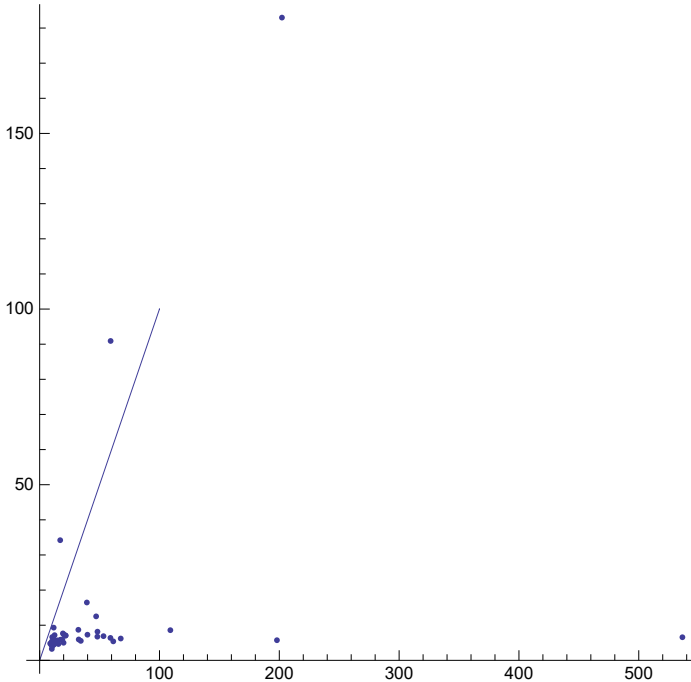
Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

```
{Knot[15, Alternating, 4860], 8, 37, 147.938758,
KnotTheory`UniversalKh`Private`DecomposeComplex[KnotTheory`UniversalKh`Private`GradingList[
$Failed], KnotTheory`UniversalKh`Private`Matrices[$Failed]]}
```



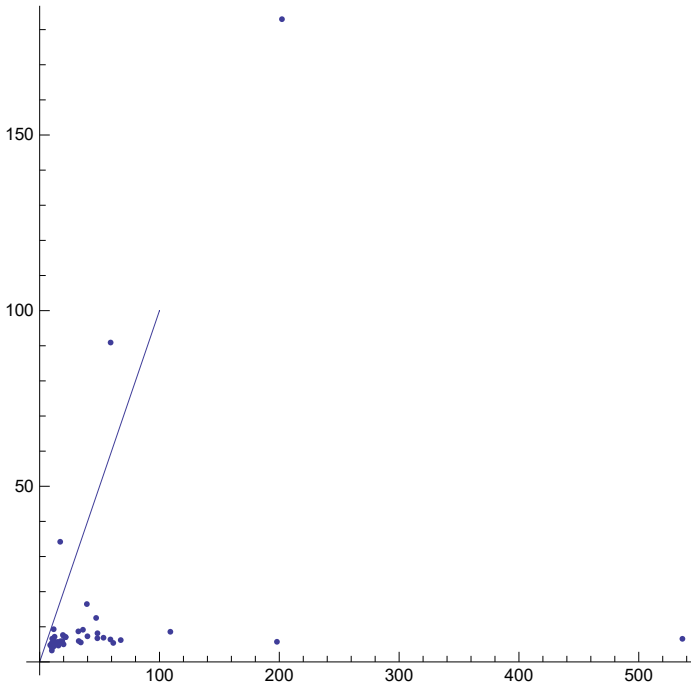
```
{Knot[15, NonAlternating, 2371], 6, 23, 10.638309,
```

$$\left\{ \frac{7}{q^3} + \frac{10}{q} + 8q + \frac{1}{q^{19}t^9} + \frac{3}{q^{17}t^8} + \frac{1}{q^{15}t^8} + \frac{7}{q^{15}t^7} + \frac{3}{q^{13}t^7} + \frac{10}{q^{13}t^6} + \frac{7}{q^{11}t^6} + \frac{13}{q^{11}t^5} + \frac{10}{q^9t^5} + \frac{14}{q^9t^4} + \frac{13}{q^7t^4} + \frac{2}{q^9t^3} + \frac{13}{q^7t^3} + \frac{14}{q^5t^3} + \frac{4}{q^7t^2} + \frac{13}{q^5t^2} + \frac{13}{q^3t^2} + \frac{5}{q^5t} + \frac{11}{q^3t} + \frac{11}{qt} + \frac{7t}{q} + 8qt + 4q^3t + 6qt^2 + 7q^3t^2 + q^5t^2 + 5q^3t^3 + 6q^5t^3 + 3q^5t^4 + 5q^7t^4 + q^7t^5 + 3q^9t^5 + q^{11}t^6 \right\}$$

```
{Knot[15, NonAlternating, 2371], 6, 23, 9.157364,
```

$$\left\{ \frac{7}{q^3} + \frac{10}{q} + 8q + \frac{1}{q^{19}t^9} + \frac{3}{q^{17}t^8} + \frac{1}{q^{15}t^8} + \frac{7}{q^{15}t^7} + \frac{3}{q^{13}t^7} + \frac{10}{q^{13}t^6} + \frac{7}{q^{11}t^6} + \frac{13}{q^{11}t^5} + \frac{10}{q^9t^5} + \frac{14}{q^9t^4} + \frac{13}{q^7t^4} + \frac{2}{q^9t^3} + \frac{13}{q^7t^3} + \frac{14}{q^5t^3} + \frac{4}{q^7t^2} + \frac{13}{q^5t^2} + \frac{13}{q^3t^2} + \frac{5}{q^5t} + \frac{11}{q^3t} + \frac{11}{qt} + \frac{7t}{q} + 8qt + 4q^3t + 6qt^2 + 7q^3t^2 + q^5t^2 + 5q^3t^3 + 6q^5t^3 + 3q^5t^4 + 5q^7t^4 + q^7t^5 + 3q^9t^5 + q^{11}t^6 \right\}$$

$$\{ \text{Knot}[15, \text{NonAlternating}, 2371], 6, 23, 36.119206, \\ \text{KhE} + 7 \text{KhC}[1] + \frac{5 \text{KhC}[1]}{q^2} + \frac{\text{KhC}[1]}{q^{16} t^8} + \frac{3 \text{KhC}[1]}{q^{14} t^7} + \frac{7 \text{KhC}[1]}{q^{12} t^6} + \frac{10 \text{KhC}[1]}{q^{10} t^5} + \frac{13 \text{KhC}[1]}{q^8 t^4} + \\ \frac{14 \text{KhC}[1]}{q^6 t^3} + \frac{2 \text{KhC}[1]}{q^6 t^2} + \frac{13 \text{KhC}[1]}{q^4 t^2} + \frac{4 \text{KhC}[1]}{q^4 t} + \frac{11 \text{KhC}[1]}{q^2 t} + 7 t \text{KhC}[1] + 4 q^2 t \text{KhC}[1] + \\ 7 q^2 t^2 \text{KhC}[1] + q^4 t^2 \text{KhC}[1] + 6 q^4 t^3 \text{KhC}[1] + 5 q^6 t^4 \text{KhC}[1] + 3 q^8 t^5 \text{KhC}[1] + q^{10} t^6 \text{KhC}[1] \}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v1"
  org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, NonAlternating, 71360], 10, 49, 124.847863, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
  "/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
  KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
  KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
  /trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
  trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar"
  org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
{Knot[15, NonAlternating, 71360], 10, 49, 139.873633, $Failed[q, t]}
```

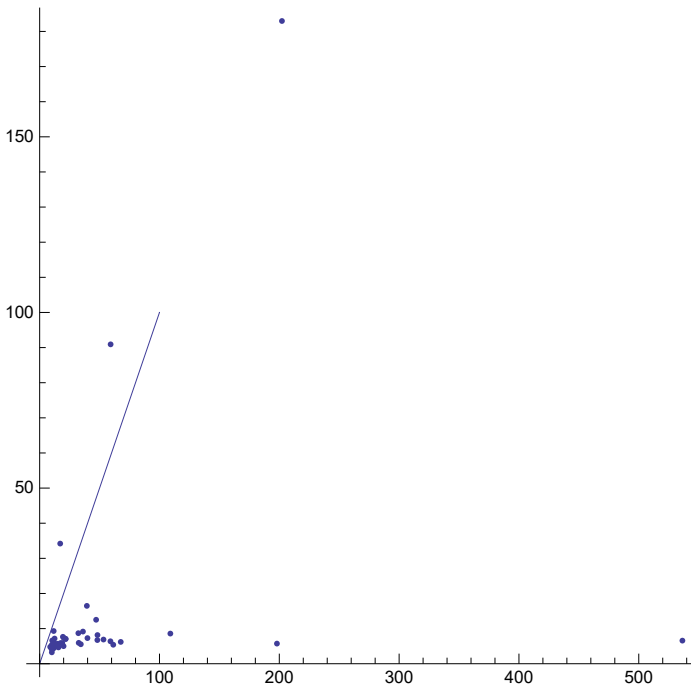
Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath
"/Users/scott/projects/KnotTheory/trunk/KnotTheory/JavaKh-v2/bin:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-cli-1.0.jar:/Users/scott/projects/
KnotTheory/trunk/KnotTheory/JavaKh-v2/jars/commons-io-1.2.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/commons-logging-1.1.jar:/Users/scott/projects/KnotTheory/
/trunk/KnotTheory/JavaKh-v2/jars/log4j-1.2.12.jar" org.katlas.JavaKh.JavaKh -U -Q < pd
```

```
{Knot[15, NonAlternating, 71360], 10, 49,
341.507487, KnotTheory`UniversalKh`Private`DecomposeComplex[
KnotTheory`UniversalKh`Private`GradingsList[$Failed],
KnotTheory`UniversalKh`Private`Matrices[$Failed]]}
```



```
{Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null,
Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null,
Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null, Null}
```

```
({benchmark["JavaKh-v1", Khv1, #], benchmark["JavaKh-v2", Khv2, #]};
Print[benchmarkComparison] & /@ RandomSample[AllKnots[{12, 15}], 100])
```

$$\left\{ \text{Knot}[15, \text{Alternating}, 23519], 4, 15, 9.3750000, \right.$$

$$\frac{65}{q} + 61q + \frac{1}{q^{15}t^7} + \frac{4}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{10}{q^{11}t^5} + \frac{4}{q^9t^5} + \frac{21}{q^9t^4} + \frac{10}{q^7t^4} + \frac{35}{q^7t^3} + \frac{21}{q^5t^3} +$$

$$\frac{49}{q^5t^2} + \frac{35}{q^3t^2} + \frac{60}{q^3t} + \frac{49}{qt} + 62qt + 64q^3t + 52q^3t^2 + 62q^5t^2 + 38q^5t^3 + 52q^7t^3 +$$

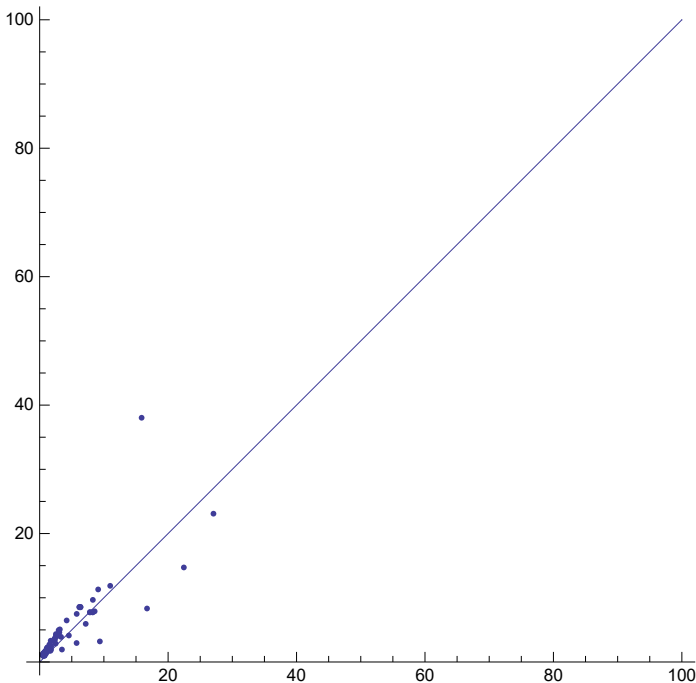
$$\left. 24q^7t^4 + 38q^9t^4 + 12q^9t^5 + 24q^{11}t^5 + 5q^{11}t^6 + 12q^{13}t^6 + q^{13}t^7 + 5q^{15}t^7 + q^{17}t^8 \right\}$$

$$\left\{ \text{Knot}[15, \text{Alternating}, 23519], 4, 15, 3.2031250, \right.$$

$$\frac{65}{q} + 61q + \frac{1}{q^{15}t^7} + \frac{4}{q^{13}t^6} + \frac{1}{q^{11}t^6} + \frac{10}{q^{11}t^5} + \frac{4}{q^9t^5} + \frac{21}{q^9t^4} + \frac{10}{q^7t^4} + \frac{35}{q^7t^3} + \frac{21}{q^5t^3} +$$

$$\frac{49}{q^5t^2} + \frac{35}{q^3t^2} + \frac{60}{q^3t} + \frac{49}{qt} + 62qt + 64q^3t + 52q^3t^2 + 62q^5t^2 + 38q^5t^3 + 52q^7t^3 +$$

$$\left. 24q^7t^4 + 38q^9t^4 + 12q^9t^5 + 24q^{11}t^5 + 5q^{11}t^6 + 12q^{13}t^6 + q^{13}t^7 + 5q^{15}t^7 + q^{17}t^8 \right\}$$



$$\left\{ \text{Knot}[15, \text{NonAlternating}, 134534], 6, 25, 0.9218750, \right.$$

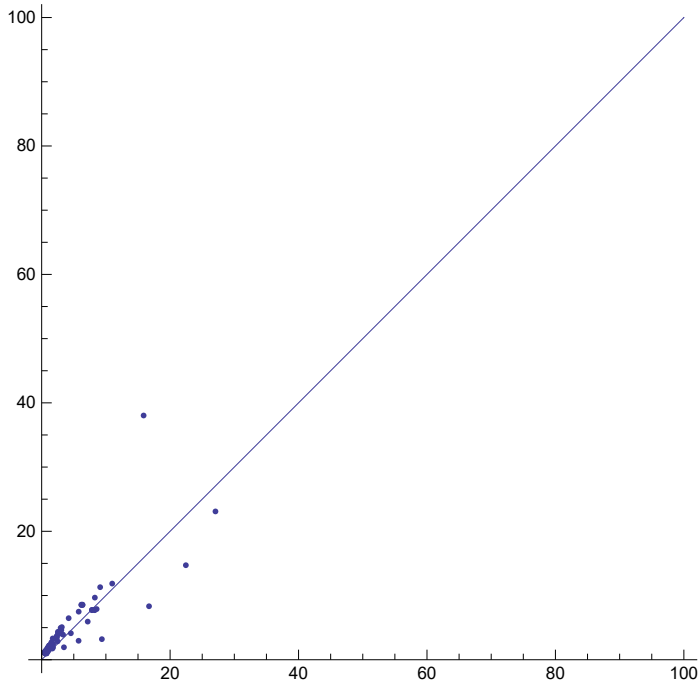
$$4q^3 + 2q^5 + q^7 + \frac{1}{q^3t^4} + \frac{q}{t^3} + \frac{q}{t^2} + \frac{q}{t} + \frac{q^3}{t} + \frac{q^5}{t} + 4q^5t + 4q^7t + 6q^7t^2 + 4q^9t^2 + q^{11}t^2 + 6q^9t^3 +$$

$$\left. 6q^{11}t^3 + 6q^{11}t^4 + 6q^{13}t^4 + 4q^{13}t^5 + 6q^{15}t^5 + 3q^{15}t^6 + 4q^{17}t^6 + q^{17}t^7 + 3q^{19}t^7 + q^{21}t^8 \right\}$$

$$\left\{ \text{Knot}[15, \text{NonAlternating}, 134534], 6, 25, 1.8750000, \right.$$

$$4q^3 + 2q^5 + q^7 + \frac{1}{q^3t^4} + \frac{q}{t^3} + \frac{q}{t^2} + \frac{q}{t} + \frac{q^3}{t} + \frac{q^5}{t} + 4q^5t + 4q^7t + 6q^7t^2 + 4q^9t^2 + q^{11}t^2 + 6q^9t^3 +$$

$$\left. 6q^{11}t^3 + 6q^{11}t^4 + 6q^{13}t^4 + 4q^{13}t^5 + 6q^{15}t^5 + 3q^{15}t^6 + 4q^{17}t^6 + q^{17}t^7 + 3q^{19}t^7 + q^{21}t^8 \right\}$$

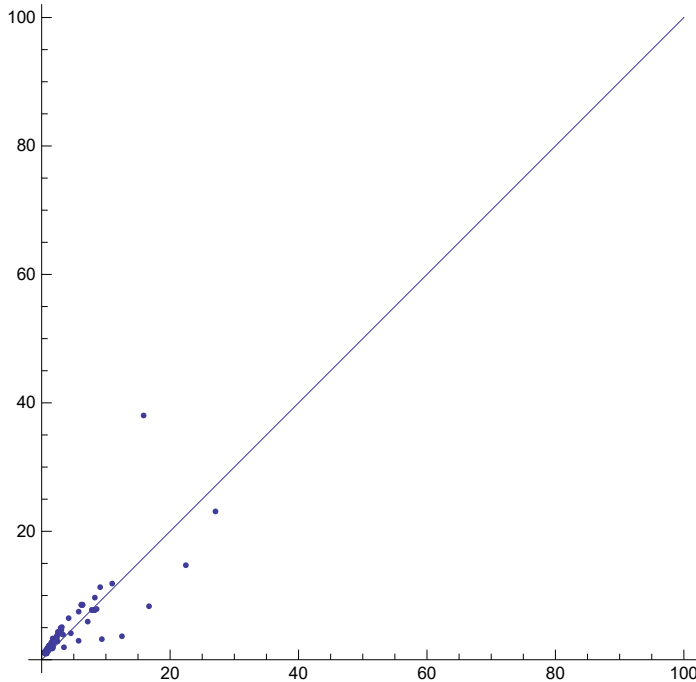


{Knot [15, Alternating, 28 027], 4, 15, 12.5000000,

$$69q + 56q^3 + \frac{1}{q^{11}t^6} + \frac{4}{q^9t^5} + \frac{1}{q^7t^5} + \frac{11}{q^7t^4} + \frac{4}{q^5t^4} + \frac{24}{q^5t^3} + \frac{11}{q^3t^3} + \frac{39}{q^3t^2} + \frac{24}{qt^2} + \frac{55}{qt} + \frac{39q}{t} + 73q^3t + 68q^5t + 70q^5t^2 + 73q^7t^2 + 58q^7t^3 + 70q^9t^3 + 43q^9t^4 + 58q^{11}t^4 + 26q^{11}t^5 + 43q^{13}t^5 + 13q^{13}t^6 + 26q^{15}t^6 + 5q^{15}t^7 + 13q^{17}t^7 + q^{17}t^8 + 5q^{19}t^8 + q^{21}t^9 \}$$

{Knot [15, Alternating, 28 027], 4, 15, 3.6562500,

$$69q + 56q^3 + \frac{1}{q^{11}t^6} + \frac{4}{q^9t^5} + \frac{1}{q^7t^5} + \frac{11}{q^7t^4} + \frac{4}{q^5t^4} + \frac{24}{q^5t^3} + \frac{11}{q^3t^3} + \frac{39}{q^3t^2} + \frac{24}{qt^2} + \frac{55}{qt} + \frac{39q}{t} + 73q^3t + 68q^5t + 70q^5t^2 + 73q^7t^2 + 58q^7t^3 + 70q^9t^3 + 43q^9t^4 + 58q^{11}t^4 + 26q^{11}t^5 + 43q^{13}t^5 + 13q^{13}t^6 + 26q^{15}t^6 + 5q^{15}t^7 + 13q^{17}t^7 + q^{17}t^8 + 5q^{19}t^8 + q^{21}t^9 \}$$



Something went wrong running JavaKh; nothing was returned. The command line was:

```
!java -classpath "C:\scott\projects\KnotTheory\trunk\KnotTheory\JavaKh1"
org.katlas.JavaKh.JavaKh -mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

```
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
  at org.katlas.JavaKh.LCCC.<init> (LCCC.java:19)
  at org.katlas.JavaKh.LCCC.compose (LCCC.java:152)
  at org.katlas.JavaKh.Komplex.compose (Komplex.java:1176)
  at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1092)
  at org.katlas.JavaKh.JavaKh.main (JavaKh.java:43)
Exception in thread "main" java.lang.OutOfMemoryError: Java heap space
  at org.katlas.JavaKh.CannedCobordismImpl.reverseMaps (CannedCobordismImpl.java:163)
  at org.katlas.JavaKh.CannedCobordismImpl.composeWithoutCache (CannedCobordismImpl.java:555)
  at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:341)
  at org.katlas.JavaKh.CannedCobordismImpl.compose (CannedCobordismImpl.java:1)
  at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:142)
  at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:163)
  at org.katlas.JavaKh.LCCCMap.compose (LCCCMap.java:1)
  at org.katlas.JavaKh.algebra.implementations.LinearComboMap.compose (LinearComboMap.java:1)
  at org.katlas.JavaKh.CobMatrix.compose (CobMatrix.java:173)
  at org.katlas.JavaKh.Komplex.blockReductionLemma (Komplex.java:1285)
  at org.katlas.JavaKh.Komplex.blockReductionLemma (Komplex.java:1014)
  at org.katlas.JavaKh.Komplex.reduce (Komplex.java:506)
  at org.katlas.JavaKh.Komplex.generateFast (Komplex.java:1659)
  at org.katlas.JavaKh.JavaKh.main (JavaKh.java:111)
```

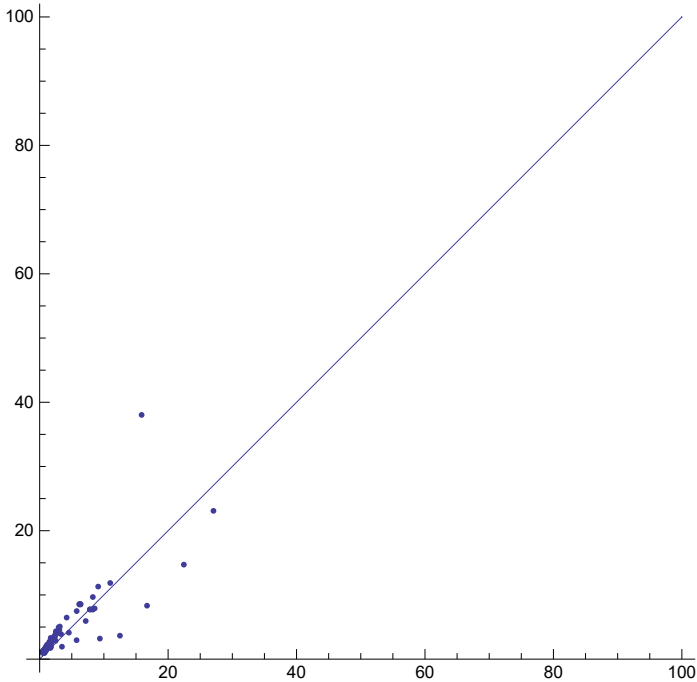
```
{Knot[15, NonAlternating, 128085], 8, 35, 818.3281250, $Failed[q, t]}
```

Something went wrong running JavaKh; nothing was returned. The command line was:


```
!java -classpath
"C:\scott\projects\KnotTheory\trunk\KnotTheory\JavaKh2\bin;C:\scott\projects\KnotTheory\trunk\
KnotTheory\JavaKh2\jars\commons-cli-1.0.jar;C:\scott\projects\KnotTheory\trunk\KnotTheory\
JavaKh2\jars\commons-io-1.2.jar;C:\scott\projects\KnotTheory\trunk\KnotTheory\JavaKh2\jars\
commons-logging-1.1.jar;C:\scott\projects\KnotTheory\trunk\KnotTheory\JavaKh2\jars\log4j-1.2
.12.jar;C:\scott\projects\KnotTheory\trunk\KnotTheory\JavaKh2\jars\trove-2.0.4.jar"
org.katlas.JavaKh.JavaKh --mod 0 < pd 2> JavaKh.log
```

There may have been an error log produced by Java:

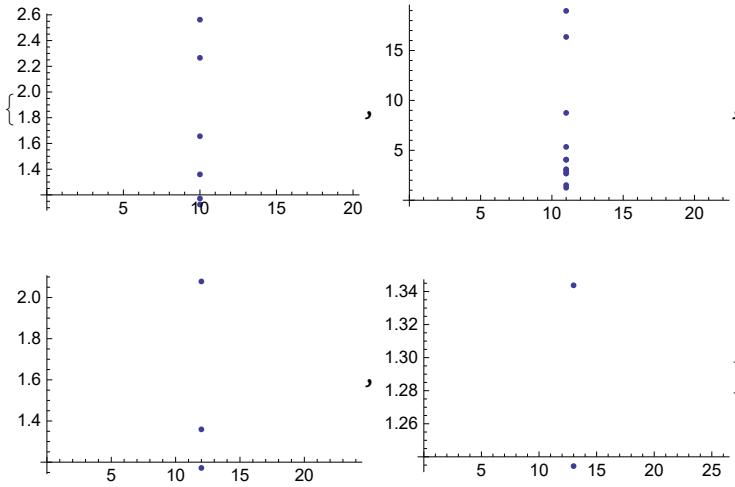
```
{Knot[15, NonAlternating, 128085], 8, 35, 140.3593750, $Failed[q, t]}
```



```
Map[{{#[3], #[4]} &, Split[SortBy[BenchmarkData["FastKh"], #[2] &], #1[2] == #2[2] &], {2}]
{{{10, 1.3593750}, {10, 1.6562500}, {10, 1.1718750}}, {{11, 1.5156250}, {11, 1.2500000}},
{{12, 1.1718750}, {12, 2.0781250}, {12, 1.3593750}}, {{13, 1.3437500}, {13, 1.2343750}}}
```

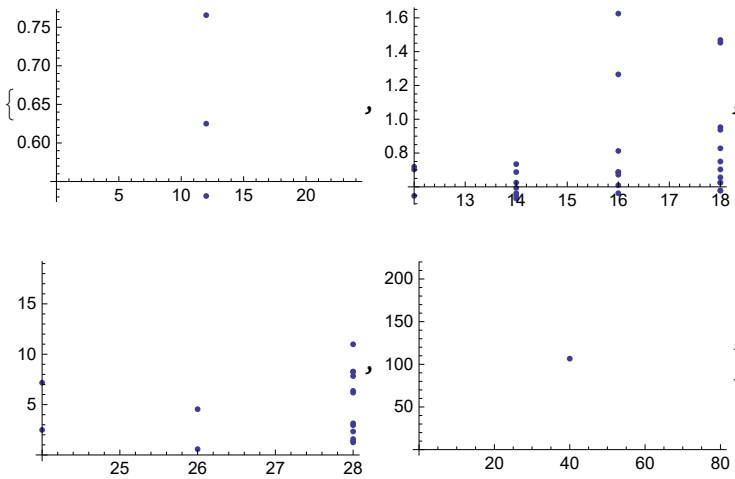
ListPlot /@

```
Map[ {#[[3]], #[[4]]} &, Split[SortBy[BenchmarkData["FastKh"], #[[2]] &], #1[[2]] == #2[[2]] &], {2}]
```

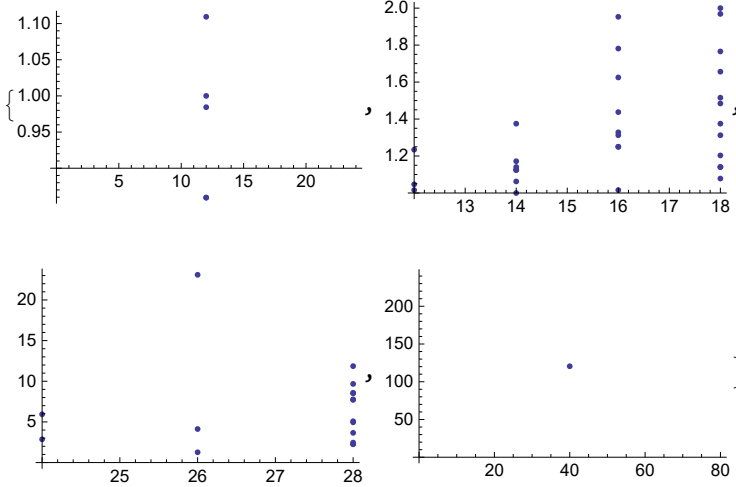


ListPlot /@ Map[{#[[3]], #[[4]]} &, Split[SortBy[

```
DeleteCases[BenchmarkData["JavaKh-v1"], $Failed[q, t]], #[[2]] &], #1[[2]] == #2[[2]] &], {2}]
```



```
ListPlot[Map[#[[3]], #[[4]]] &, Split[SortBy[
DeleteCases[BenchmarkData["JavaKh-v2"], $Failed[q, t]], #[[2]] &], #1[[2]] == #2[[2]] &], {2}]
```



```
RandomKnot[n_] := Module[{k},
k = Random[Integer, {1, NumberOfKnots[n]}];
If[k ≤ NumberOfKnots[n, Alternating],
Knot[n, Alternating, k],
Knot[n, NonAlternating, k - NumberOfKnots[n, Alternating]]
]
]
```

```
QuantumKnotInvariantSplit[K, Γ, Irrep[Γ][λ]]
```

```
QuantumKnotInvariantSplit[#, A2, Irrep[A2][{1, 0}]] & [Knot[7, 2]]
```

$$q^2 + q^6 + q^8 + q^{16} + q^{18} - q^{24} - q^{26}$$

```
benchmark["QuantumA2", QuantumKnotInvariantSplit[#, A2, Irrep[A2][{1, 0}]] &,
Table[TorusKnot[n, 5], {n, 5, 100}]]
```

14 dim: 30 mem: 12381448 time: 1454.79

12 dim: 30 mem: 12382008 time: 1454.89

8 dim: 30 mem: 12382336 time: 1455.

17 dim: 20 mem: 12382664 time: 1455.13

11 dim: 20 mem: 12382928 time: 1455.19

6 dim: 20 mem: 12383192 time: 1455.24

Unset::write: Tag Function in (QuantumKnotInvariantSplit[#, A2, Irrep[A2][{1, 0}]] &)[TorusKnot[5, 5]] is Protected. More...

{TorusKnot[5, 5], 5, 20, 2.3225752}

Unset::write: Tag Function in (QuantumKnotInvariantSplit[#, A2, Irrep[A2][{1, 0}]] &)[TorusKnot[6, 5]] is Protected. More...

14 dim: 30 mem: 12404776 time: 1455.53

12 dim: 30 mem: 12405096 time: 1456.61

8 dim: 30 mem: 12405424 time: 1457.82

17 dim: 20 mem: 12405752 time: 1458.82

11 dim: 20 mem: 12406016 time: 1459.08

6 dim: 20 mem: 12406280 time: 1459.39

Unset::write : Tag Function in (QuantumKnotInvariantSplit[#1, A₂, Irrep[A₂][{1, 0}]] &)[TorusKnot[10, 5]]
is Protected. More...

General::stop : Further output of Unset::write will be suppressed during this calculation. More...

```
{TorusKnot[10, 5], 5, 40, 16.4582484}
14 dim: 30 mem: 12436896 time: 1460.13
12 dim: 30 mem: 12437080 time: 1464.24
8 dim: 30 mem: 12437240 time: 1471.16
17 dim: 20 mem: 12437400 time: 1477.49
11 dim: 20 mem: 12437560 time: 1479.01
6 dim: 20 mem: 12437720 time: 1480.51
{TorusKnot[14, 5], 5, 56, 42.8074636}
14 dim: 30 mem: 12448536 time: 1482.98
12 dim: 30 mem: 12449000 time: 1499.16
8 dim: 30 mem: 12449328 time: 1516.37
17 dim: 20 mem: 12449656 time: 1533.83
11 dim: 20 mem: 12449920 time: 1537.64
6 dim: 20 mem: 12450184 time: 1541.42
{TorusKnot[15, 5], 5, 60, 74.2222954}
14 dim: 30 mem: 12493152 time: 1548.26
12 dim: 30 mem: 12493448 time: 1555.01
8 dim: 30 mem: 12493608 time: 1567.04
17 dim: 20 mem: 12493768 time: 1578.95
11 dim: 20 mem: 12493928 time: 1581.68
6 dim: 20 mem: 12494088 time: 1584.38
{TorusKnot[16, 5], 5, 64, 41.1356099}
14 dim: 30 mem: 12506752 time: 1587.99
12 dim: 30 mem: 12507048 time: 1623.82
8 dim: 30 mem: 12507208 time: 1662.14
17 dim: 20 mem: 12507368 time: 1700.02
11 dim: 20 mem: 12507528 time: 1707.78
6 dim: 20 mem: 12507688 time: 1715.47
{TorusKnot[17, 5], 5, 68, 154.5513618}
14 dim: 30 mem: 12517520 time: 1728.47
$Aborted
```

```
benchmark["Jones", Jones, TorusKnots[100]]
```

```
{TorusKnot[8, 7], 7, 48, 47.7186160}
{TorusKnot[12, 5], 5, 48, 5.1273728}
{TorusKnot[25, 3], 3, 50, 0.6208928}
{TorusKnot[17, 4], 4, 51, 1.8025920}
{TorusKnot[13, 5], 5, 52, 6.8498496}
{TorusKnot[26, 3], 3, 52, 0.6008640}
{TorusKnot[9, 7], 7, 54, 67.5371136}
{TorusKnot[11, 6], 6, 55, 23.3035088}
$Aborted
```

benchmark["HOMFLYPT", HOMFLYPT, TorusKnots[100]]

KnotTheory::credits: The HOMFLYPT program was written by Scott Morrison.

```
{TorusKnot[15, 2], 2, 15, 0.9113104}
{TorusKnot[8, 3], 3, 16, 1.0715408}
{TorusKnot[17, 2], 2, 17, 2.4735568}
{TorusKnot[19, 2], 2, 19, 6.8698784}
{TorusKnot[10, 3], 3, 20, 14.0201600}
{TorusKnot[7, 4], 4, 21, 27.8400320}
{TorusKnot[21, 2], 2, 21, 19.1275040}
{TorusKnot[11, 3], 3, 22, 22.9930624}
{TorusKnot[23, 2], 2, 23, 53.5269680}
{TorusKnot[6, 5], 5, 24, 109.5875792}
$Aborted
```

benchmark["A2Invariant", A2Invariant, TorusKnots[100]]

```
{TorusKnot[7, 3], 3, 14, 1.3219008}
{TorusKnot[5, 4], 4, 15, 36.4123584}
{TorusKnot[8, 3], 3, 16, 1.8726928}
{TorusKnot[10, 3], 3, 20, 3.7453856}
{TorusKnot[7, 4], 4, 21, 241.9078464}
{TorusKnot[11, 3], 3, 22, 5.3476896}
$Aborted
```

benchmark["A2Invariant", A2Invariant, Table[TorusKnot[n, 4], {n, 6, 100}]]

```
{TorusKnot[6, 4], 4, 18, 105.2213008}
$Aborted
```

BenchmarkData["A2Invariant"]

```
{ {TorusKnot[7, 3], 3, 14, 1.3219008}, {TorusKnot[5, 4], 4, 15, 36.4123584},
  {TorusKnot[8, 3], 3, 16, 1.8726928}, {TorusKnot[10, 3], 3, 20, 3.7453856},
  {TorusKnot[7, 4], 4, 21, 241.9078464}, {TorusKnot[11, 3], 3, 22, 5.3476896} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{\#[[3]]^2}$ } & /@ **BenchmarkData**["A2Invariant"]]

```
{ {3, 14, 0.006744392}, {3, 16, 0.007315206}, {3, 20, 0.0093634640}, {3, 22, 0.0110489455},
  {3, 26, 0.0137475787}, {3, 28, 0.0147533571}, {3, 30, 0.0155668284},
  {3, 32, 0.0159897891}, {3, 34, 0.0168928028}, {4, 15, 0.161832704}, {4, 21, 0.5485438694} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{\#[[3]]^3}$ } & /@ **BenchmarkData**["A2Invariant"]]

```
{ {3, 14, 0.0004817423}, {3, 16, 0.00045720039}, {3, 20, 0.00046817320},
  {3, 22, 0.00050222479}, {3, 26, 0.00052875303}, {3, 28, 0.00052690561},
  {3, 30, 0.00051889428}, {3, 32, 0.00049968091}, {3, 34, 0.000496847140},
  {4, 15, 0.0107888469}, {4, 18, 0.01804206118}, {4, 21, 0.02612113664} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{\#[[3]]^{5.5}}$ } & /@ **BenchmarkData**["A2Invariant"]]

```
{ {3, 14, 6.56893 × 10-7}, {3, 16, 4.46485 × 10-7}, {3, 20, 2.61717 × 10-7},
  {3, 22, 2.21229 × 10-7}, {3, 26, 1.53398 × 10-7}, {3, 28, 1.2701 × 10-7},
  {3, 30, 1.05263 × 10-7}, {3, 32, 8.62617 × 10-8}, {3, 34, 7.37098 × 10-8},
  {4, 15, 0.0000123807}, {4, 18, 0.0000131252}, {4, 21, 0.0000129254} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{\#[[3]]^3}$ } & /@ **BenchmarkData**["QuantumA2", 3]]

```
{ {3, 44, 6.701033 × 10-6}, {3, 46, 6.584631 × 10-6},
  {3, 50, 6.729677 × 10-6}, {3, 52, 6.766102 × 10-6} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{\#[[3]]^{4.5}}$ } & /@ **BenchmarkData**["QuantumA2", 4]]

```
{ {4, 27, 1.99458 × 10-7}, {4, 33, 1.73458 × 10-7},
  {4, 39, 1.72597 × 10-7}, {4, 45, 1.68922 × 10-7}, {4, 51, 1.74323 × 10-7} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{\#[[3]]^{9.5}}$ } & /@ **BenchmarkData**["HOMFLYPT", 2]]

```
{ {2, 15, 6.12068 × 10-12}, {2, 17, 5.05891 × 10-12},
  {2, 19, 4.88416 × 10-12}, {2, 21, 5.25503 × 10-12}, {2, 23, 6.19667 × 10-12} }
```

Sort [{ #[[2]], #[[3]], $\frac{\#[[4]]}{(1.67)^{\#[[3]]}}$ } & /@ **BenchmarkData**["HOMFLYPT", 2]]

```
{ {2, 15, 0.000415833}, {2, 17, 0.000404708},
  {2, 19, 0.000403029}, {2, 21, 0.000402358}, {2, 23, 0.000403733} }
```

```

{EstimatedVariance, BestFitParameters} /.
  NonlinearRegress[BenchmarkData["Jones", 5] [[All, {2, 3}]],  $\alpha 1^n$ , {1},
    { $\alpha$ , n}, RegressionReport → {BestFitParameters, EstimatedVariance}]
{133.486, { $\alpha \rightarrow 9.27742$ ,  $n \rightarrow 0.871394$ }}

Sort[{#[[2]], #[[3]],  $\frac{\#[[4]]}{\#[[3]]^{2.6}}$ } & /@ BenchmarkData["Jones", 5]]
{{5, 24, 0.000198869}, {5, 28, 0.000193746}, {5, 32, 0.000209041},
  {5, 36, 0.000197098}, {5, 44, 0.000220596}, {5, 48, 0.000218106}, {5, 52, 0.000236631}}

model[power] := { $\alpha 1^n$ , {1}, { $\alpha$ , n}}

<< Statistics`NonlinearFit`

tryModel[tag_, width_, model_List] := {EstimatedVariance, BestFitParameters} /.
  NonlinearRegress[BenchmarkData[tag, width] [[All, {3, 4}]], Sequence @@ model,
    RegressionReport → {BestFitParameters, EstimatedVariance}]

tryModel["A2Invariant", 3, model[power]]
{0.10467, { $\alpha \rightarrow 0.0006245270$ ,  $n \rightarrow 2.9387925$ }}

<< Graphics`Graphics3D`

graphModel[tag_, width_, model_List, options___] :=
  Module[{f = model[[1]] /. tryModel[tag, width, model] [[2]], modulePlot, dataPlot},
    modelPlot =
      Plot[f, Evaluate[{1, Min[#], Max[#]} & [BenchmarkData[tag, width] [[All, {3, 4}]]],
        PlotRange → All, DisplayFunction → Identity];
    dataPlot = ListPlot[BenchmarkData[tag, width] [[All, {3, 4}]],
      PlotJoined → True, DisplayFunction → Identity];
    Show[modelPlot, dataPlot, options, DisplayFunction → $DisplayFunction]
  ]

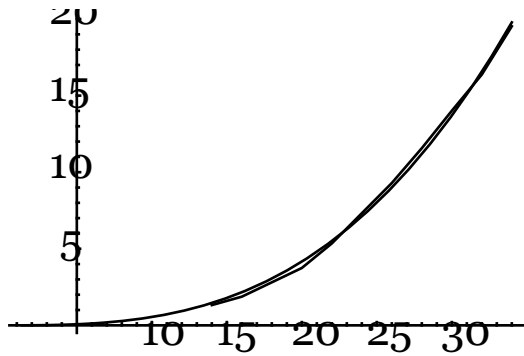
BenchmarkData["A2Invariant", 3]
{{TorusKnot[7, 3], 3, 14, 1.3219008},
  {TorusKnot[8, 3], 3, 16, 1.8726928}, {TorusKnot[10, 3], 3, 20, 3.7453856},
  {TorusKnot[11, 3], 3, 22, 5.3476896}, {TorusKnot[13, 3], 3, 26, 9.2933632},
  {TorusKnot[14, 3], 3, 28, 11.5666320}, {TorusKnot[15, 3], 3, 30, 14.0101456},
  {TorusKnot[16, 3], 3, 32, 16.3735440}, {TorusKnot[17, 3], 3, 34, 19.5280800}}

tryModel["A2Invariant", 3, model[power]]
{0.10467, { $\alpha \rightarrow 0.0006245270$ ,  $n \rightarrow 2.9387925$ }}

```



```
graphModel["A2Invariant", 3, model[power]]
```



- Graphics -

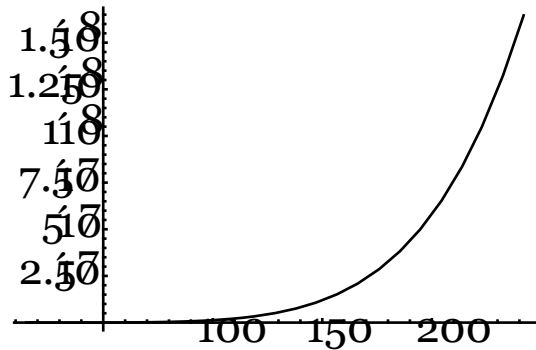
```
BenchmarkData["A2Invariant", 4]
```

```
{{TorusKnot[5, 4], 4, 15, 36.4123584},
 {TorusKnot[7, 4], 4, 21, 241.9078464}, {TorusKnot[6, 4], 4, 18, 105.2213008}}
```

```
tryModel["A2Invariant", 4, model[power]]
```

```
{4.96447, { $\alpha \rightarrow 0.0000131542018$ ,  $n \rightarrow 5.49467113$ }}
```

```
graphModel["A2Invariant", 4, model[power]]
```



- Graphics -

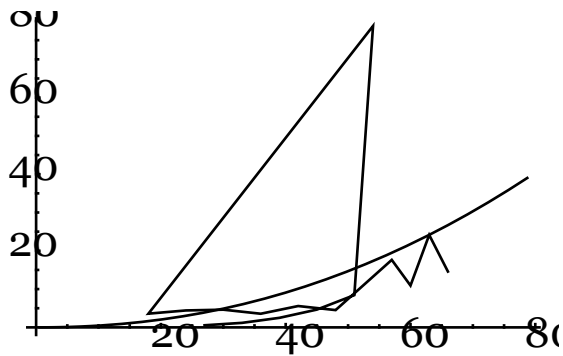
```
BenchmarkData["QuantumA2", 4]
```

```
{{TorusKnot[9, 4], 4, 27, 0.5507920}, {TorusKnot[11, 4], 4, 33, 1.1816992},
 {TorusKnot[13, 4], 4, 39, 2.4935856}, {TorusKnot[15, 4], 4, 45, 4.6466816},
 {TorusKnot[17, 4], 4, 51, 8.4221104}, {TorusKnot[18, 4], 4, 54, 78.7162808},
 {TorusKnot[6, 4], 4, 18, 3.5834726}, {TorusKnot[8, 4], 4, 24, 4.4242874},
 {TorusKnot[10, 4], 4, 30, 4.6244814}, {TorusKnot[12, 4], 4, 36, 3.5634532},
 {TorusKnot[14, 4], 4, 42, 5.5754029}, {TorusKnot[16, 4], 4, 48, 4.5143747},
 {TorusKnot[19, 4], 4, 57, 17.6270817}, {TorusKnot[20, 4], 4, 60, 10.9205827},
 {TorusKnot[21, 4], 4, 63, 24.1433964}, {TorusKnot[22, 4], 4, 66, 14.5841329}}
```

```
tryModel["QuantumA2", 4, model[power]]
```

```
{308.869, { $\alpha \rightarrow 0.003222899$ ,  $n \rightarrow 2.153418$ }}
```

`graphModel["QuantumA2", 4, model[power]]`



- Graphics -

`Sort[BenchmarkData["QuantumA2", 5]]`

```
{ {TorusKnot[5, 5], 5, 20, 2.3225752}, {TorusKnot[7, 5], 5, 28, 1.1015840},
  {TorusKnot[8, 5], 5, 32, 1.1816992}, {TorusKnot[9, 5], 5, 36, 4.0358032},
  {TorusKnot[10, 5], 5, 40, 16.4582484}, {TorusKnot[11, 5], 5, 44, 11.4865168},
  {TorusKnot[12, 5], 5, 48, 8.4521536}, {TorusKnot[13, 5], 5, 52, 28.7112848},
  {TorusKnot[14, 5], 5, 56, 42.8074636}, {TorusKnot[15, 5], 5, 60, 74.2222954},
  {TorusKnot[16, 5], 5, 64, 41.1356099}, {TorusKnot[17, 5], 5, 68, 154.5513618} }
```

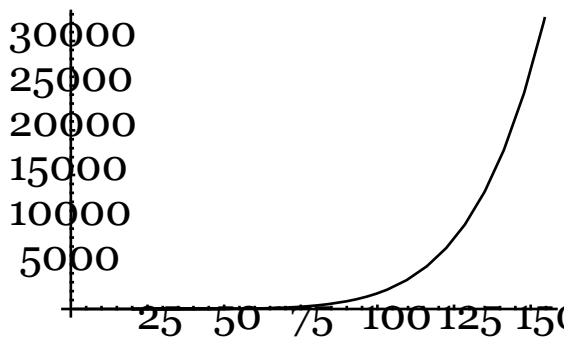
`tryModel["QuantumA2", 5, model[power]]`

FindFit::cvmit: Failed to converge to the requested accuracy or precision within 100 iterations. More...

```
{329.599, {α → 6.730601 × 10-11, n → 6.708082} }
```

`graphModel["QuantumA2", 5, model[power]]`

FindFit::cvmit: Failed to converge to the requested accuracy or precision within 100 iterations. More...



- Graphics -