

Pensieve header: Scatter and Glow in OneCo. Continued pensieve://2016-01/.

In the U(T)U(H) conventions.

```
SetDirectory["C:\\drorbn\\AcademicPensieve\\2015-12"]
```

```
C:\\drorbn\\AcademicPensieve\\2015-12
```

Generalities

```
DQ[is___] := (Sort[{is}] === Union[{is}]);
OQ[is___] := OrderedQ[{is}]; (* tests for non-strict ordering;
also true when {is} is {i,i}. *)

Simp[expr_] := Simplify[expr];
S[expr_] :=
  expr /. ( $\lambda_\beta$  |  $\lambda_a$  |  $\lambda_{\delta\beta}$  |  $\lambda_{\delta a}$  |  $\lambda_c$  |  $\lambda_{ca}$  |  $\lambda_{\delta aa}$ ) => MapAt[Simp,  $\lambda$ , 1];

AutoCollecting[ $\lambda$ ] := (
   $\lambda$  /:  $\lambda[0, \_]$  = 0;
   $\lambda$  /:  $\lambda[f, r] + \lambda[g, r] := \lambda[\text{Simp}[f+g], r]$ ;
   $\lambda$  /:  $\lambda[g * f, r] := \lambda[\text{Simp}[g f], r]$ ;
);
AutoCollecting /@ { $\beta$ , a,  $\delta\beta$ , c,  $\delta a$ , ca,  $\delta aa$ };

 $\gamma[f, j, k] := \delta a[f, j, k] - c[b_j f, k]$ ;
```

Bases

```
UUBasis[T_List, H_List, f_] := Module[
  {ff = f@@Table[b_t, {t, T}]},
  UU /@ Flatten[{
     $\beta$ [ff],
    Table[{a[ff, t, h],  $\delta a$ [ff, t, h]}, {t, T}, {h, H}],
     $\delta\beta$ [ff],
    Table[c[ff, h], {h, H}],
    Table[ca[ff, h1, t, h2], {h1, H}, {t, T}, {h2, H}],
    Table[ $\delta aa$ [ff, T[[i]], H[[j]], T[[k]], H[[l]],
      {k, Length@T}, {i, k}, {l, Length@H}, {j, l}]
  ] /. 1[_] -> 1
];
UUBasis[S_List, f_] := UUBasis[S, S, f];
UUBasis[n_Integer, m_Integer, f_] := UUBasis[Range@n, Range@m, f];
UUBasis[n_Integer, f_] := UUBasis[Range@n, f];
```

δ_{aa} relations

Switch from thth to tthh indexing? (not for the moment)

```
UU[expr_] // S := UU[S[expr /. {
   $\delta_{aa}[f_, i_, j_, k_, l_] /; !OQ[j, l] \Rightarrow \delta_{aa}[f, k, l, i, j],$ 
   $\delta_{aa}[f_, i_, j_, k_, l_] /; !OQ[i, k] \wedge DQ[j, l] \wedge OQ[j, l] \Rightarrow \delta_{aa}[f, i, l, k, j] +$ 
     $ca[b_k f, l, i, j] + ca[-b_i f, l, k, j] + ca[-b_k f, j, i, l] + ca[b_i f, j, k, l],$ 
   $\delta_{aa}[f_, i_, k_, j_, k_] /; !OQ[i, j] \Rightarrow \delta_{aa}[f, j, k, i, k] +$ 
     $\delta a[-b_i f, j, k] + \delta a[b_j f, i, k]$ 
}]];
```

tm, hm, hts, dm

```
UU[expr_] // tm[x_, y_, z_] := UU[S[expr /. {
   $a[f_, x, j_] \Rightarrow a[f, z, j] + \gamma[\partial_{b_y} f, z, j],$ 
   $a[f_, y, j_] \Rightarrow a[f, z, j],$ 
   $\delta a[f_, x | y, j_] \Rightarrow \delta a[f, z, j],$ 
   $ca[f_, i_, x | y, j_] \Rightarrow ca[f, i, z, j],$ 
   $\delta_{aa}[f_, i_, j_, k_, l_] \Rightarrow \delta_{aa}[f, i /. x | y \rightarrow z, j, k /. x | y \rightarrow z, l]$ 
} /. b_{x|y} \rightarrow b_z]];
```

```
UU[expr_] // hm[x_, y_, z_] := S[UU[expr /. {
   $a[f_, i_, x | y] \Rightarrow a[f, i, z],$ 
   $c[f_, x | y] \Rightarrow c[f, z],$ 
   $\delta a[f_, i_, x | y] \Rightarrow \delta a[f, i, z],$ 
   $ca[f_, y, j_, x] \Rightarrow ca[f, z, j, z] + \gamma[f, j, z],$ 
   $ca[f_, i_, j_, k_] \Rightarrow ca[f, i /. x | y \rightarrow z, j, k /. x | y \rightarrow z],$ 
   $\delta_{aa}[f_, i_, y, k_, x] \Rightarrow \delta_{aa}[f, k, z, i, z],$ 
   $\delta_{aa}[f_, i_, j_, k_, l_] \Rightarrow \delta_{aa}[f, i, j /. x | y \rightarrow z, k, l /. x | y \rightarrow z]$ 
}]];
```

```

UU[expr_] // hts[y_, x_] := S[UU[expr /. {
  a[f_, i_, j_] => a[f, i, j] - If[j == y,  $\gamma[\partial_{b_x} f, i, y]$ , 0] -
    If[i == x & j == y,  $\beta[f b_x] + c[f, y] - \delta\beta[b_x \partial_{b_x} f]$ , 0],
   $\delta a[f_, x, y] => \delta a[f, x, y] - \delta\beta[f b_x]$ ,
  ca[f_, i_, j_, k_] => ca[f, i, j, k] + Plus[
    If[i == y & j == x,  $\gamma[f, x, k]$ , 0],
    If[j == x & k == y,  $c[-f b_x, i]$ , 0]
  ],
   $\delta aa[f_, i_, j_, k_, l_] => \delta aa[f, i, j, k, l] + Plus[
    If[i == x & j == y,  $\delta a[-b_x f, k, l]$ , 0],
    If[i == x & l == y,  $-\delta a[b_k f, x, j] + \delta a[b_x f, k, j]$ , 0],
    If[k == x & j == y,  $\epsilon_2 (\delta a[b_i f, x, l] - \delta a[b_x f, i, l])$ , 0],
    If[k == x & l == y,  $\delta a[-b_x f, i, j]$ , 0],
    If[i == x & j == l == y,  $\delta\beta[b_i b_k f]$ , 0]
  ]
}]];

dm[x_, y_, z_][expr_] := expr // hts[x, y] // tm[x, y, z] // hm[x, y, z]$ 
```

ct (contract)