

```

In[ ]:= Bs = {r_{1,-1}[3, 4]}
Out[ ]:= {r_{1,-1}[3, 4]}

In[ ]:= BBs = Bs /. e_^-p -> Sequence @@ Table[e, {p}]
Out[ ]:= {r_{1,-1}[3, 4]}

In[ ]:= es = Union @@ (List @@@ BBs)
Out[ ]:= {3, 4}

In[ ]:= nes = Table[v@es[[i]] = ToExpression["i$" <> ToString[i]], {i, Length@es}]
Out[ ]:= {i$1, i$2}

In[ ]:= nBBs = Replace[BBs, Thread[es -> v /@ es], {2}]
Out[ ]:= {r_{1,-1}[i$1, i$2]}

In[ ]:= d = 2
Out[ ]:= 2

In[ ]:= Simplify@ZipJoin@@Table[{{p_{1,\alpha}, p_{2,\alpha}, x_{1,\alpha}, x_{2,\alpha}}, {\alpha, nes}}] [Times [
    Times @@ (nBBs /. {
        r_{d,s}[i_, j_] -> (V[r_{d,s}[i, j]] /. {p_i -> p_{2,i}, p_j -> p_{2,j}, x_i -> x_{2,i}, x_j -> x_{2,j}}),
        \gamma_{d,\varphi}[k_] -> (V[\gamma_{d,\varphi}[k]] /. {p_k -> p_{1,k}, x_k -> x_{1,k}})
    }],
    Exp[Sum[g_{\alpha,\beta} (\pi_{1,\alpha} + \pi_{2,\alpha}) (\xi_{1,\beta} + \xi_{2,\beta}), {\alpha, nes}, {\beta, nes}] - Sum[\xi_{1,\alpha} \pi_{2,\alpha}, {\alpha, nes}]]
]]
Out[ ]:= \frac{1}{2} + \left(-1 + \frac{1}{T}\right) g_{i$2,i$1}^2 + g_{i$2,i$1} (1 + g_{i$1,i$2} - 2 g_{i$2,i$2}) + g_{i$1,i$1} \left(-1 + \frac{(-1+T) g_{i$2,i$1}}{T} + g_{i$2,i$2}\right)

```

In[ ]:= `gPair[Replace[BBS, Thread[es -> Table[Pattern[Evaluate@nes[[i], _], {i, Length@es}]], {2}]]`

**Rule:** Pattern `i$1_` appears on the right-hand side of rule `i$1_ -> i$1_`.

**Rule:** Pattern `i$1_` appears on the right-hand side of rule `i$1_ -> i$1_`.

**Pattern:** First element in pattern `Pattern[i$1_ _]` is not a valid pattern name.

**Pattern:** First element in pattern `Pattern[i$2_ _]` is not a valid pattern name.

**Pattern:** First element in pattern `Pattern[i$1_ _]` is not a valid pattern name.

**General:** Further output of `Pattern::patvar` will be suppressed during this calculation.

**Rule:** Pattern `i$1_` appears on the right-hand side of rule `i$1_ -> i$1_`.

**General:** Further output of `Rule::rhs` will be suppressed during this calculation.

**SetDelayed:** Tag Times in

$$\frac{1}{2 T} (T + 2 T p_{2, \ll 1 \gg} X_{2, \ll 7 \gg [\ll 1 \gg]} + \ll 1 \gg + p_{2, \text{Pattern}[i\$1\_]} X_{2, \text{Pattern}[i\$1\_]} (-2 T + p_{2, \text{Pattern}[\text{Pattern}[\ll 2 \gg]\_] (Plus[\ll 2 \gg] Subscript[\ll 3 \gg] + 2 T Subscript[\ll 3 \gg])))) \text{ is Protected.}$$

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$$\frac{1}{2 T} (T + 2 T p_{2, \ll 1 \gg} X_{2, \ll 7 \gg [\ll 1 \gg]} + \ll 1 \gg + p_{2, \text{Pattern}[i\$1\_]} X_{2, \text{Pattern}[i\$1\_]} (-2 T + p_{2, \text{Pattern}[\text{Pattern}[\ll 2 \gg]\_] (Plus[\ll 2 \gg] Subscript[\ll 3 \gg] + 2 T Subscript[\ll 3 \gg])))) \text{ is Protected.}$$

**SetDelayed:** Tag Times in

$$\frac{1}{2 T} (T + 2 T p_{2, \ll 1 \gg} X_{2, \ll 7 \gg [\ll 1 \gg]} + \ll 1 \gg + p_{2, \text{Pattern}[i\$1\_]} X_{2, \text{Pattern}[i\$1\_]} (-2 T + p_{2, \text{Pattern}[\text{Pattern}[\ll 2 \gg]\_] (Plus[\ll 2 \gg] Subscript[\ll 3 \gg] + 2 T Subscript[\ll 3 \gg])))) \text{ is Protected.}$$

**General:** Further output of `SetDelayed::write` will be suppressed during this calculation.

Out[ ]:=

**\$Aborted**