.1 BQTOLLLLHYPERCP

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Usage:

`BrFr L1`$^+$ `L2`$^-$ `L3`$^+$ `L4`$^-$ `BQTOLLLLHYPERCP mS mP gammaS gammaP mLiiLR Fc mD23LL mD23RR mD32LL mD32RR mD13LL mD13RR mD31LL mD31RR;`

Explanation:

One of the possible BSM scenarios, where the widths of $B_{d,s} \to \mu^+\mu^-\mu^+\mu^-$ decays may be as large as 10^{-8}. The model contains light sgoldstinos (D.S. Gorbunov, Nucl.Phys. B602, pp.213-237 (2001) and S.V. Demidov and D.S. Gorbunov, Phys. Rev. D 85, 077701 (2012)). Within this model the $B_{d,s} \to (S \to \mu^+\mu^-)\ (P \to \mu^+\mu^-)$ decays are possible, where S and P are the narrow scalar and pseudoscalar sgoldstino accordingly.

The model is based on the matrix element

$$\begin{aligned} M_{tot} \;=\; & -\frac{i}{4F^2}\, C_\mu^2\, C_{\bar{B}_{s,d}}\, f_{B_{s,d}} \\ & \left[\frac{k^2-q^2}{(q^2-M_S^2+iM_S\Gamma_S)\,(k^2-M_P^2+iM_P\Gamma_P)}\ (\bar{u}(k_2)\,v(k_1))\ \left(\bar{u}(k_4)\,\gamma^5 v(k_3)\right) - \right. \\ & \left. -\frac{k'^2-q'^2}{(q'^2-M_S^2+iM_S\Gamma_S)\,(k'^2-M_P^2+iM_P\Gamma_P)}\ (\bar{u}(k_4)\,v(k_1))\ \left(\bar{u}(k_2)\,\gamma^5 v(k_3)\right)\right], \end{aligned}$$

where $C_\mu = \tilde{m}^{LR\,2}_{L_{22}}/\sqrt{2}\,F$, $C_{\bar{B}_{s,d}} = \tilde{m}^{LL\,2}_{D_{2(1)\,3}} + \tilde{m}^{RR\,2}_{D_{2(1)\,3}}$, k_1 and k_3 are the 4-momenta of the μ^+ lepton; k_2 and k_4 are the 4-momenta of the μ^- lepton and $p = k + q = (k_1 + k_2) + (k_3 + k_4)$ or $p = k' + q' = (k_1 + k_4) + (k_3 + k_2)$. The calculations were performed taking $M_P = 0.214$ GeV and $M_S = 2.5$ GeV. For the sgoldstino widths it was assumed that $\Gamma_S \approx \Gamma_P$. Two values were considered for the sgoldstino widths. The first one (10^{-4} GeV), is taken under the assumption of narrow resonances, was much less than the LHCb mass resolution. The second one (10^{-2} GeV) was of the order of mass resolution. The reason of this choice was based on the methodological issues. Values of the other parameters were taken from S.V. Demidov and D.S. Gorbunov, Phys. Rev. D 85, 077701 (2012).

The input model's parameters are:

- mS - mass of the scalar sgoldstino "S" (in GeV);
- mP - mass of the pseudoscalar sgoldstino "P" (in GeV);
- gammaS - decay width of the scalar sgoldstino "S" (in GeV);
- gammaP - decay width of the pseudoscalar sgoldstino "P" (in GeV);
- mLiiLR, mDijLL, mDijRR - the MSSM soft supersymmetry breaking terms entering squark mass matrices (in GeV), where i, $j = 1, 2, 3$, $d = 1$, $s = 2$ and $b = 3$. For the details see the paper D.S. Gorbunov, Nucl.Phys. B602, pp.213-237 (2001) and the example in current description.;

- Fc - the coupling constant (in GeV^2);

Example:

```
Define mS     2.5
Define mP     0.214
Define gammaS 0.01
Define gammaP 0.01
Define mLiiLR 1.0
Define Fc     1.0
Define mD23LL 450.0
Define mD23RR 0.0
Define mD32LL 450.0
Define mD32RR 0.0
Define mD13LL 380.0
Define mD13RR 0.0
Define mD31LL 380.0
Define mD31RR 0.0
#
Decay B_s0
   1.000   mu+  mu-  mu+  mu-   BQTOLLLLHYPERCP mS mP gammaS gammaP mLiiLR Fc
                      mD23LL mD23RR mD32LL mD32RR mD13LL mD13RR mD31LL mD31RR;
Enddecay
CDecay anti-B_s0
```

Notes:
There are no default values of input parameters in this model. And ONLY muons in the final state are taken into account in the decay matrix elements.