

Distinguishing BSM Signatures in Present and Future Colliders

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Based on

- ▶ Priyotosh Bandyopadhyay, SD, Anirban Karan, (EPJC **80** (2020) 573)
- ▶ Priyotosh Bandyopadhyay, SD, Anirban Karan, (doi: 10.1140/epjc/s10052-021-09090-z)
- ▶ Priyotosh Bandyopadhyay, SD, Anirban Karan, (under communication)

Observables

- ▶ Decay Products
- ▶ Resonances
- ▶ Spins

Leptoquarks: Motivations

- ▶ Lepton Flavour Universality Violation

- ▶ $R_{D^*} = \frac{\mathcal{B}(B \rightarrow D^* \tau \nu_\tau)}{\mathcal{B}(B \rightarrow D^* l \nu_l)} \quad (+ 3.3 \sigma)$

- ▶ $R_K = \frac{\mathcal{B}(B \rightarrow K \mu^+ \mu^-)}{\mathcal{B}(B \rightarrow K e^+ e^-)} \quad (- 2.6 \sigma)$

- ▶ Stability of Electroweak Vacuum

- ▶ Anomalous Magnetic Moments ($a_\ell = \frac{(g-2)_\ell}{2}$)

- ▶ $\Delta a_e (+ 1.9 \sigma)$

- ▶ $\Delta a_\mu (+ 3.7 \sigma)$

- ▶ Mass to the neutrinos

Leptoquarks: Models

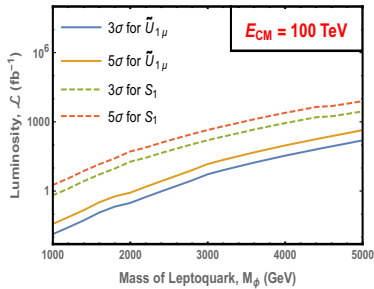
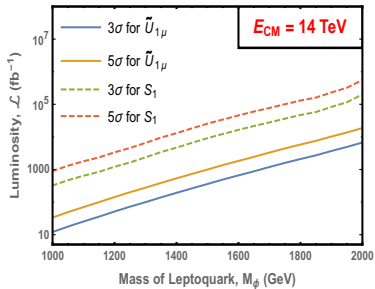
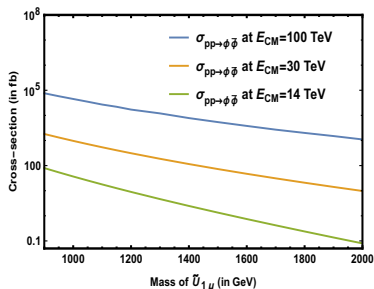
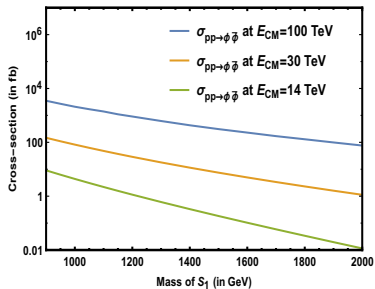
▶ Scalars

- ▶ S_1 (3, 1, $-2/3$)
- ▶ \tilde{S}_1 (3, 1, $+8/3$)
- ▶ R_2 (3, 2, $+7/3$)
- ▶ \tilde{R}_2 (3, 2, $+1/3$)
- ▶ S_3 (3, 3, $+2/3$)

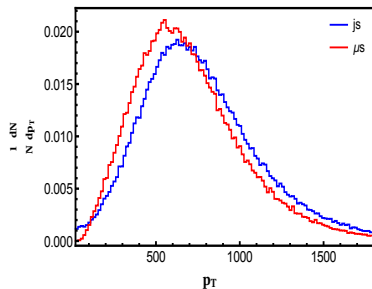
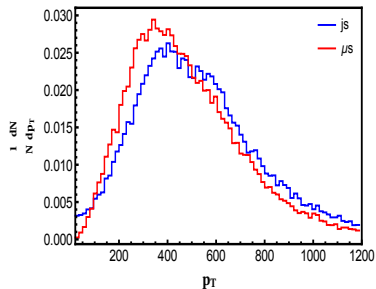
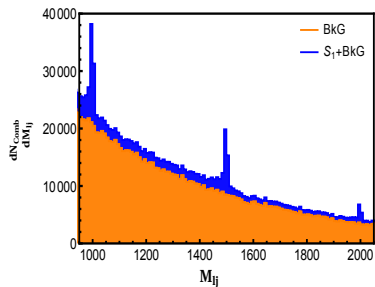
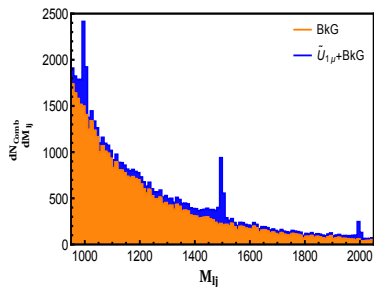
▶ Vectors

- ▶ $U_{1\mu}$ (3, 1, $+4/3$)
- ▶ $\tilde{U}_{1\mu}$ (3, 1, $+10/3$)
- ▶ $V_{2\mu}$ (3, 2, $+5/3$)
- ▶ $\tilde{V}_{2\mu}$ (3, 2, $-1/3$)
- ▶ $U_{3\mu}$ (3, 3, $+4/3$)

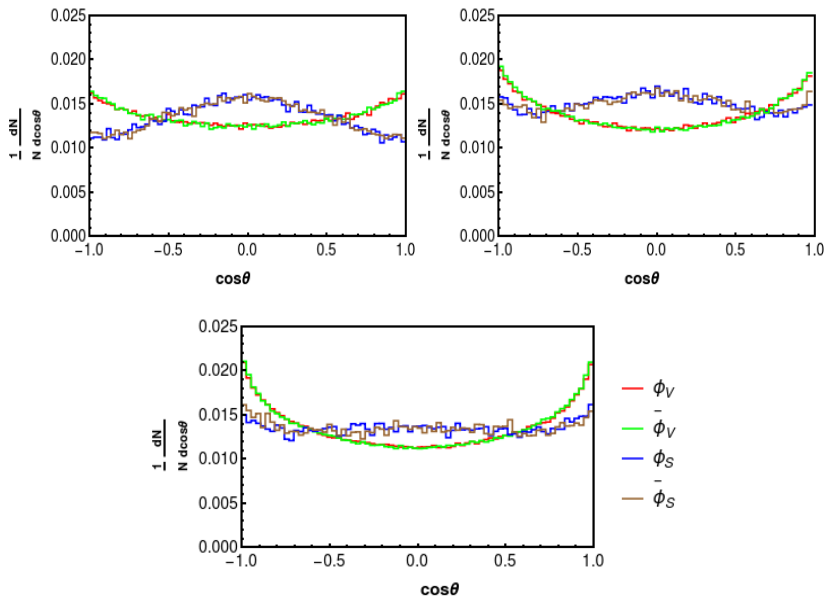
Probes at LHC



Probes at LHC



Leptoquark Spins at LHC

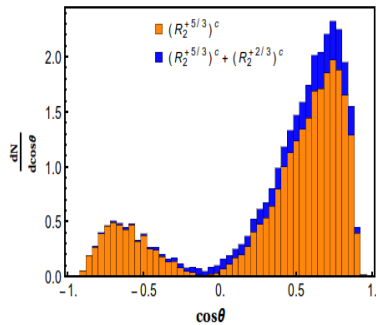
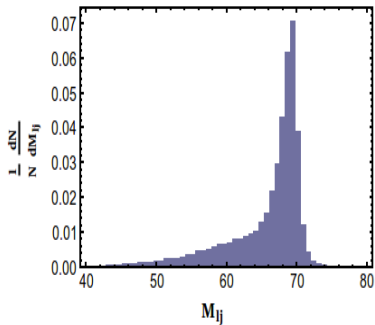
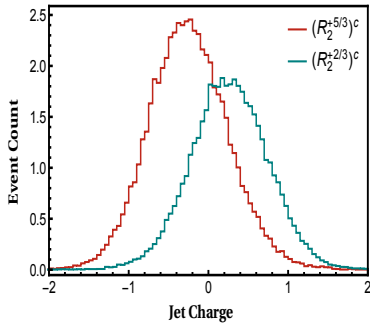


Probing the Gauge Representations of Leptoquarks

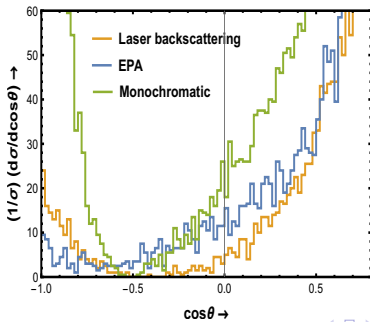
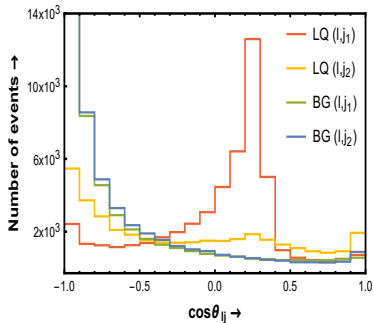
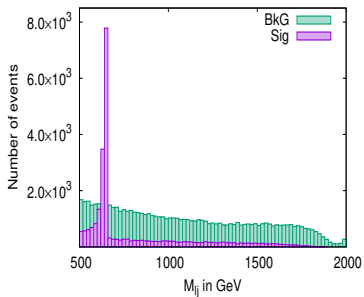
- ▶ Radiation Amplitude Zero (RAZ)
 - ▶ $e^- p \rightarrow \phi \gamma$
 - ▶ $e^- \gamma \rightarrow \phi q$

- ▶ Complementarity of two Colliders in the Observation of RAZ
 - ▶ $0 < |Q_\phi| < 1$ at $e\gamma$
 - ▶ $|Q_\phi| > 1$ at ep

Probes at ep Collision



Probes at $e\gamma$ Collision



Conclusions

1. Angular Distribution an efficient observable
2. Boost Back to the rest frame of interaction yields fruitful results for completely reconstructible scattered states
3. Quest for analogous efficient observables for resonant decays to undetectable particle species
4. Generalisation beyond $2 \rightarrow 2$ scattering processes

*Thank
you!*