# The W-Quark Portal

Katherine Schwind

PIKIMO 21, Nov 7th 2026




Based on work with L. M. Carpenter and T. Murphy

arXiv: 2512.06084

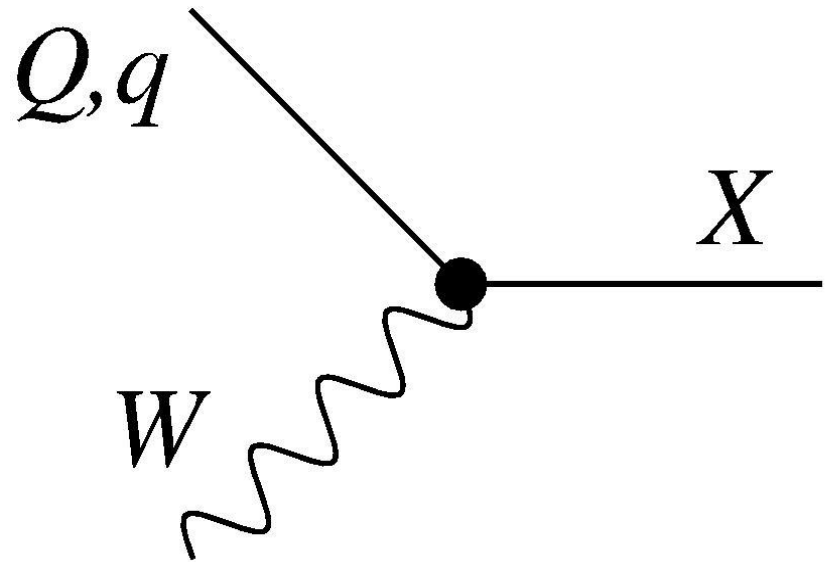
# LEX-EFT

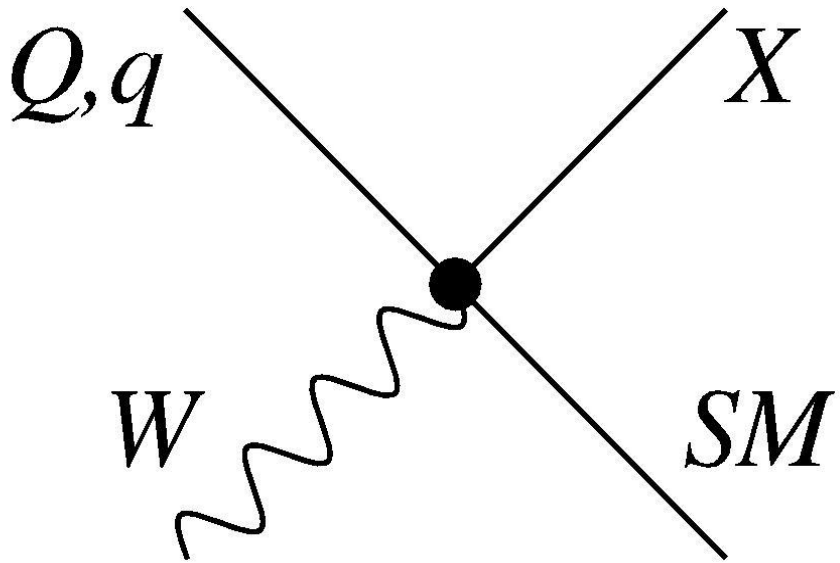
- SM particles + new "light" states
- Portal-Based Approach
  - Specify some SM states required in the interaction
  - Conserve all SM charges

$$L \supset \frac{1}{\Lambda^n} \underbrace{\Psi_i \ldots \Psi_n}_{\text{Exotic}} \underbrace{\phi_\alpha \phi_\beta}_{\text{SM}} \ldots$$

# W-Quark Portal

- Exploring the potential of BSM states with unusual SM charges
  - Includes scalars, pseudoscalars, and fermions
- Effective operators up to dimension six

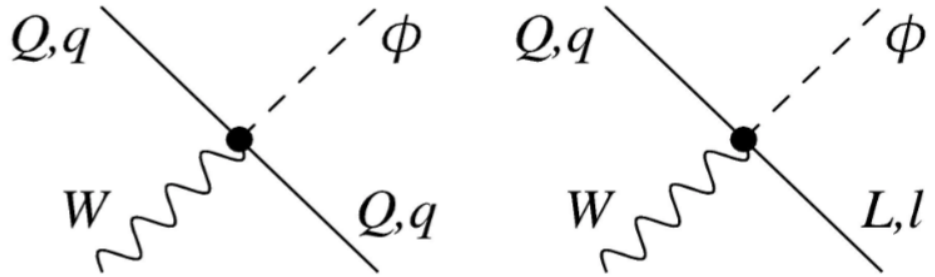



- Focusing on single production

# Operators with Scalar LEX States

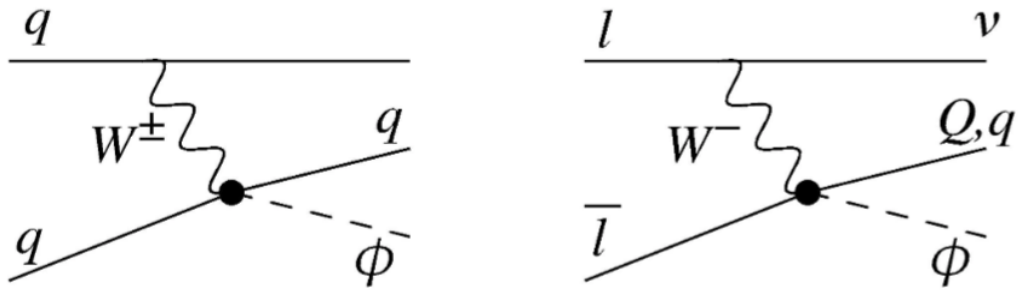
- Operators of types $Qf\phi W$




$$\frac{1}{\Lambda^2}\overline{Q_L^c}^i \sigma^{\mu\nu} Q_L^j \phi_{ijkl} W_{\mu\nu}^{kl}$$

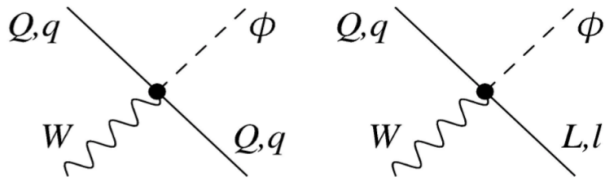
SU(3),SU(2),U(1) = (8, 5, −1/3)
Charged states (5/3, 2/3,
−1/3, −4/3, −7/3)

- Collider processes:



# Operators with Scalar LEX States

- Operators of types $Qf\phi W$

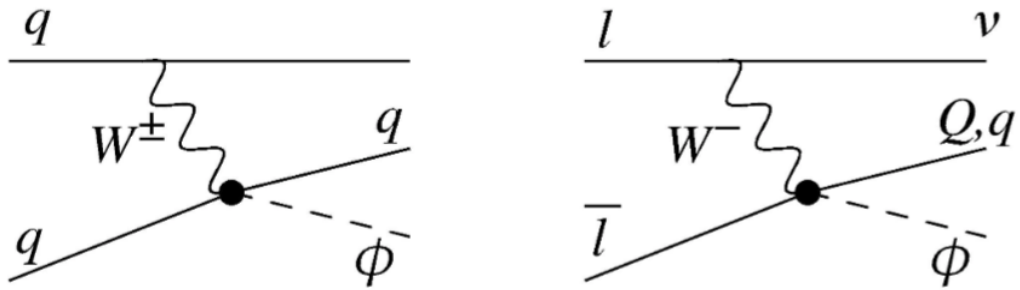



- Operators of types D$Qf\phi$, D$Qf\phi H$
- Other operator types are redundant
  - Ex: $DDQf\phi$

$$\frac{1}{\Lambda^2} D_\mu \overline{Q_L}^i \gamma^\mu Q_{Lj} \phi_i^{jk} H_k$$

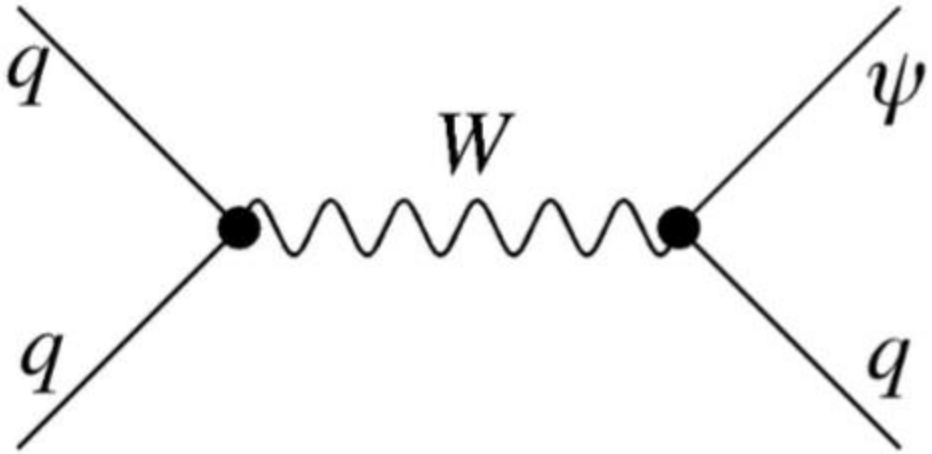
SU(3),SU(2),U(1) = (8, 4, −1/2)
Charged states (1, 0, −1, −2)

Collider processes:



# Operators with Fermionic LEX States

- Includes operators of types *QΨW, QΨWH*



# Operators with Fermionic LEX States

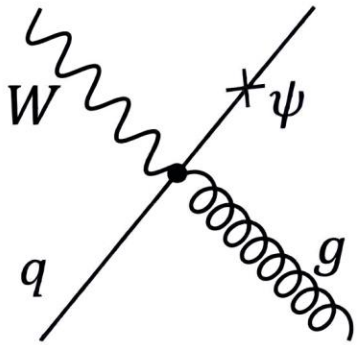
- Operators of types *QΨW, QΨWH*
- Operators of types *QDΨF, QDΨ, QDΨH, QDΨHH*

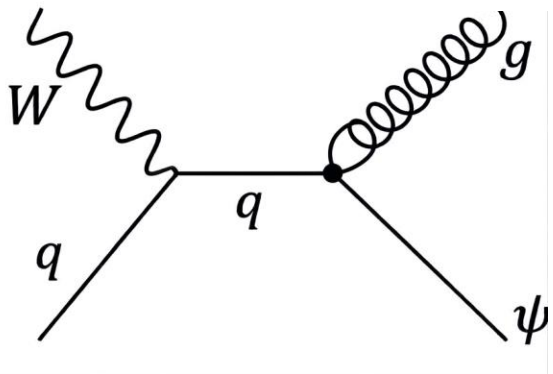
$$\overline{Q_L}^{i}\gamma^{\mu}\overleftarrow{D^{\nu}}\psi_i G_{\mu\nu} \;\Big|\; \begin{array}{c}(15,2,1/6)\,,(\bar{6},2,1/6)\,,\\(3,2,1/6)\end{array}$$

# Operators with Fermionic LEX States

- Operators of types *QΨW, QΨWH*
- Operators of types *QDΨF, QDΨ, QDΨH, QDΨHH*
- Choice of basis

$$G_{\mu\nu}\overline{\psi}\gamma^{\mu}D^{\nu}u_R = \frac{1}{4}G_{\mu\nu}\overline{\psi}\gamma^{\mu}\gamma^{\nu}yH^{\dagger}Q + \frac{1}{4}M\overline{\psi}\gamma^{\mu}\gamma^{\nu}u_RG_{\mu\nu} + \frac{1}{4}\overline{\psi}\gamma_{\rho}\gamma^{\mu}\gamma^{\nu}u_RD^{\rho}G_{\mu\nu}$$



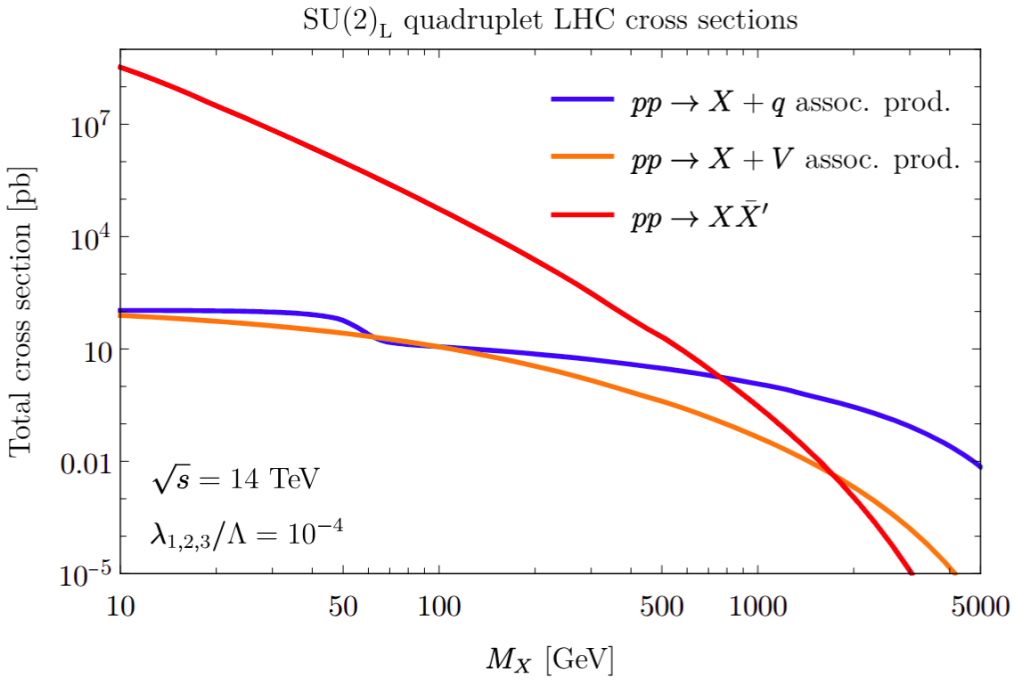
# An SU(2) Quadruplet

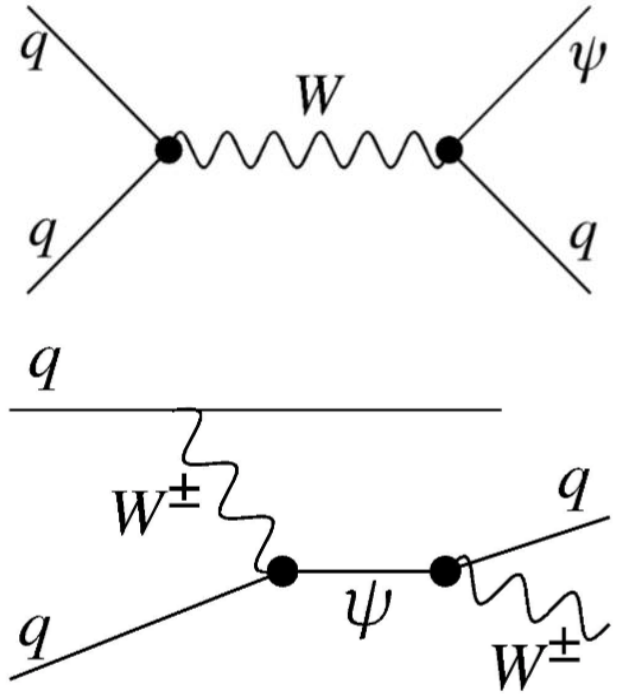
- Dimension 5 operator
- $\psi$-> real scalar
  (3,4,1/6) representation
- Also include mass and kinetic terms
- Electric charges (5/3, 2/3, −1/3, −4/3)

$$\frac{1}{\Lambda}\overline{Q}^{k}\sigma^{\mu\nu}\psi_{ijk}W^{ij}_{\mu\nu}$$

# An SU(2) Quadruplet

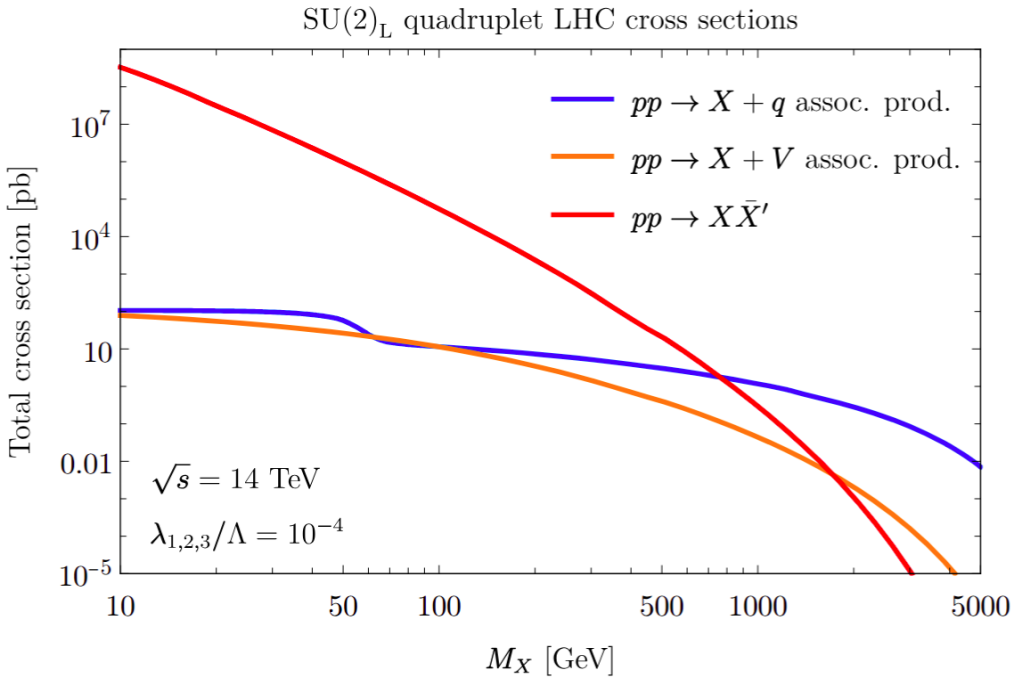
$$\frac{1}{\Lambda}\overline{Q}^{k}\sigma^{\mu\nu}\psi_{ijk}W^{ij}_{\mu\nu}$$

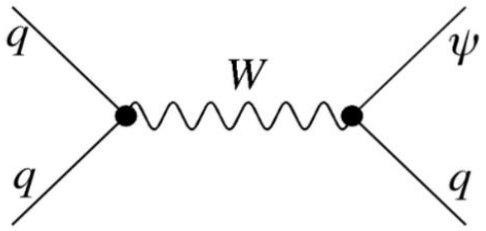


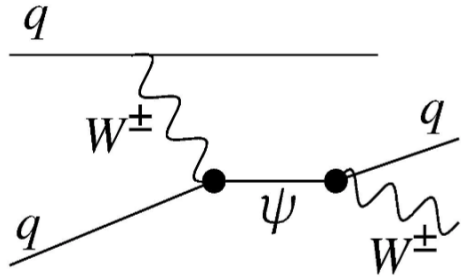



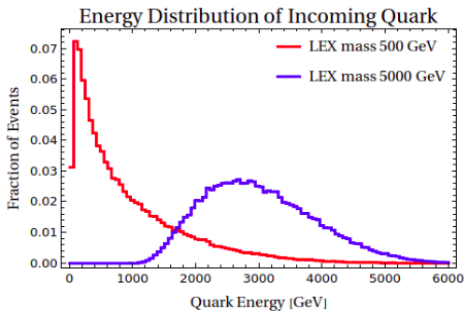
# An SU(2) Quadruplet

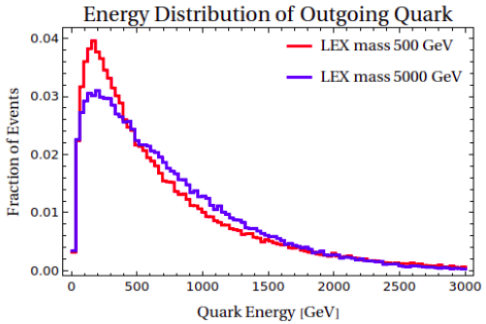
$$\frac{1}{\Lambda}\overline{Q}^{k}\sigma^{\mu\nu}\psi_{ijk}W^{ij}_{\mu\nu}$$



# Extensions

- UV Completions
- Full EFT building
- Collider studies of specific operators
- Other LEX portals

# Thank you!!!

Questions?

# References + Acknowledgements

- Based on work done with L. M. Carpenter and T. Murphy

L. M. Carpenter, K. Schwind, and T. Murphy, Portals to New Physics: The W-Quark Portal, arXiv:2512.06084.