CERN Summer School 2011

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"W-boson polarization measurement in the context of BSM searches in the CMS experiment"

CERN group on single-lepton analysis

PP collisions

- **Parton Distribution Functions (PDFs): probability density for finding a particle with a certain longitudinal momentum fraction x at momentum transfer Q^2**

- **Unknown boost of the CM frame in the beam axis in pp collisions: that's why we are studying the transverse plane**
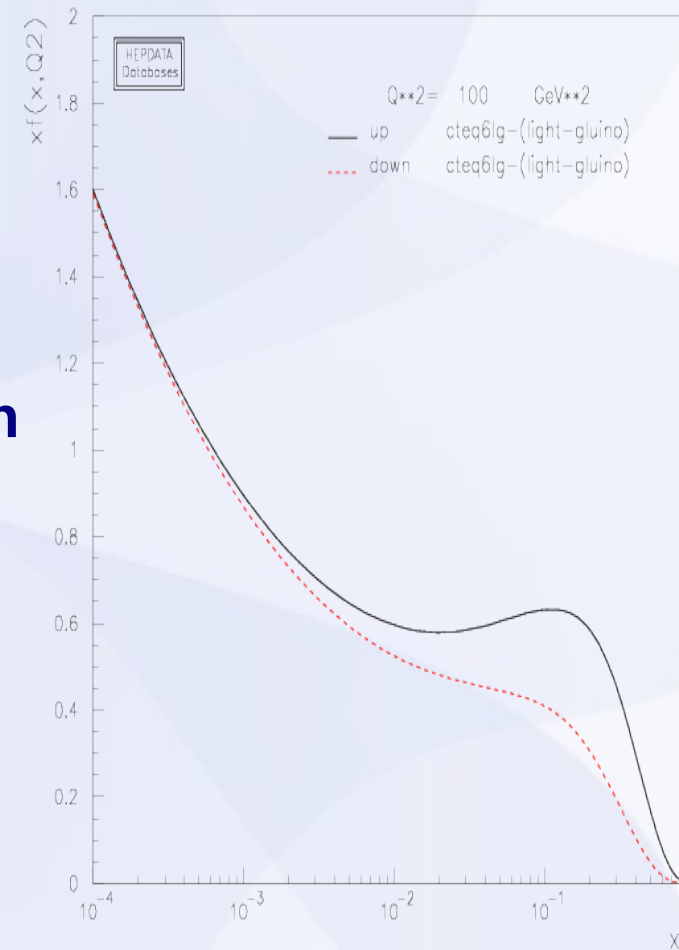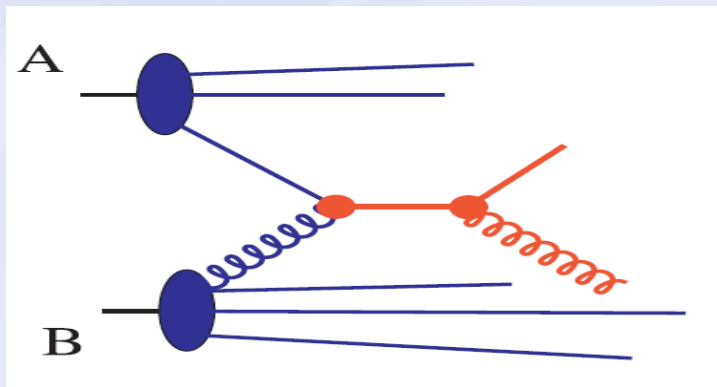
Missing Transverse Energy

- **Transverse plane: use conservation of energy to find missing transverse energy**

- **We are looking for new physics, with SUSY being a possible discovery**

- **LSP predicted by SUSY would be weakly interacting ⇨ large missing energy**

W polarization along the beam axis
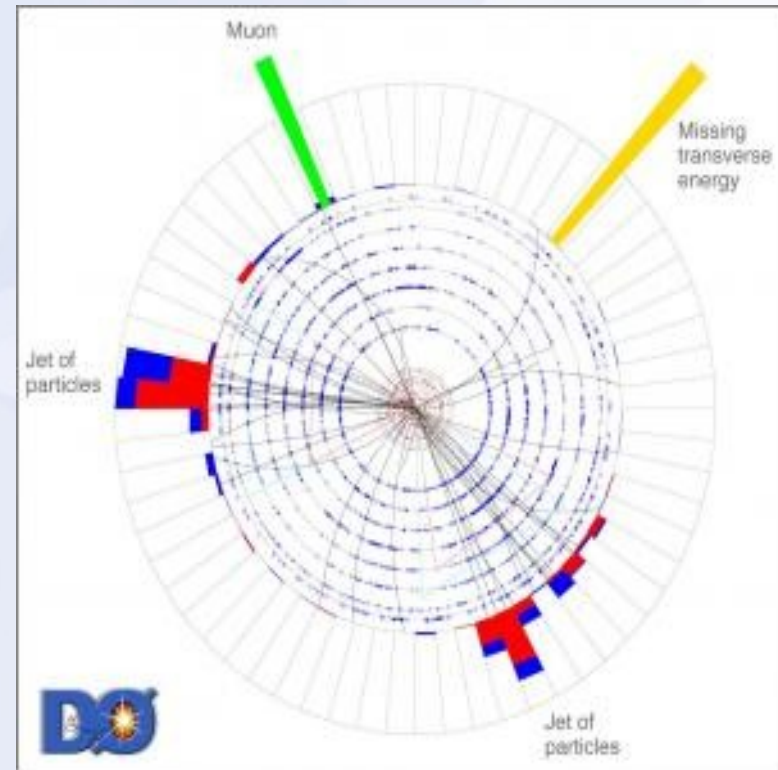
- **W flight direction: along the beam axis ⇒ PT(W)=0**

- **the W is moving in the direction of the u quark**

- **Electroweak theory: particles left-handed, antiparticles right-handed**

- **Angular momentum conservation: justifies spin direction**

- **Conclusion: the W+ produced is 100% left-handed!**
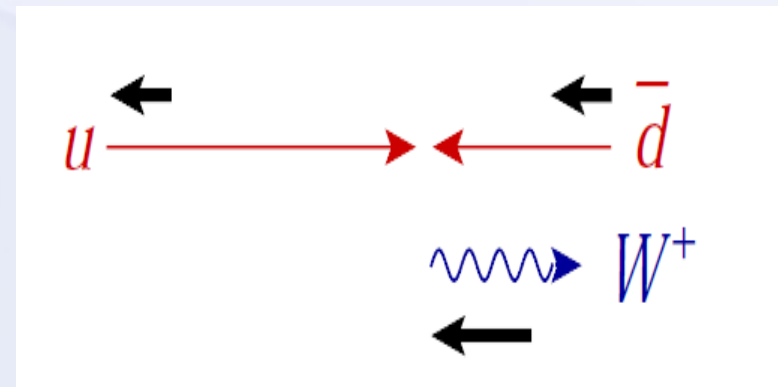
But if PT(W) is large? More complex case

- **Interesting events: those in which the W produced carries large PT and decays leptonically thus missing energy can be large**

- **Each colliding parton carries a momentum fraction according to PDFs; this determines W polarization and the amount of momentum the produced leptons end up with**

- **At high PT(W): left-handed helicity states of the W boson are dominant ⇒ we need to measure polarization when it comes to BSM searches that have high PT W bosons as a background**

- **Dominant W production mechanism at the LHC (with large PT): quark-gluon initial state**

Work Project

- **Update W polarization measurements in W+ jet events at high PT(W)**

- **Constrain W polarization uncertainties & check PDF uncertainties**

- **Implement higher PT cuts; look for SUSY in the new signal region**

$$\text{LP} = \frac{\vec{P}_T(\ell) \cdot \vec{P}_T(W)}{\left|\vec{P}_T(W)\right|^2}$$
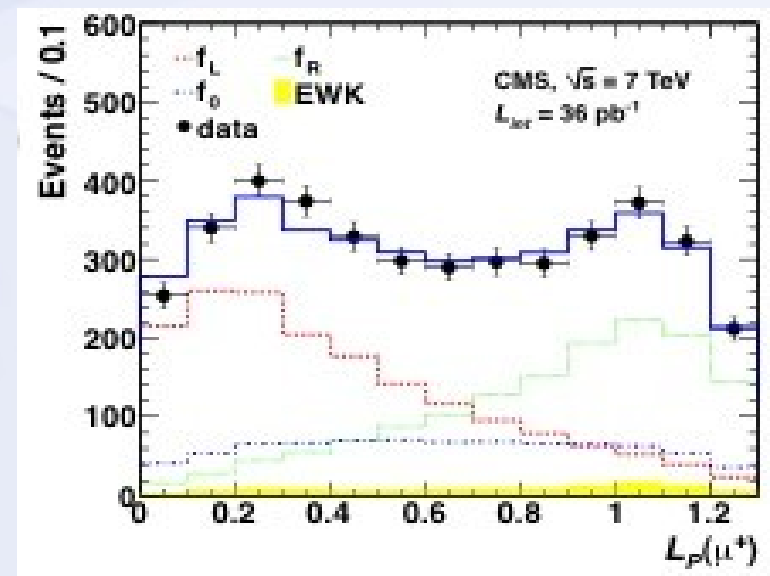
Perhaps symmetry is the answer once again...