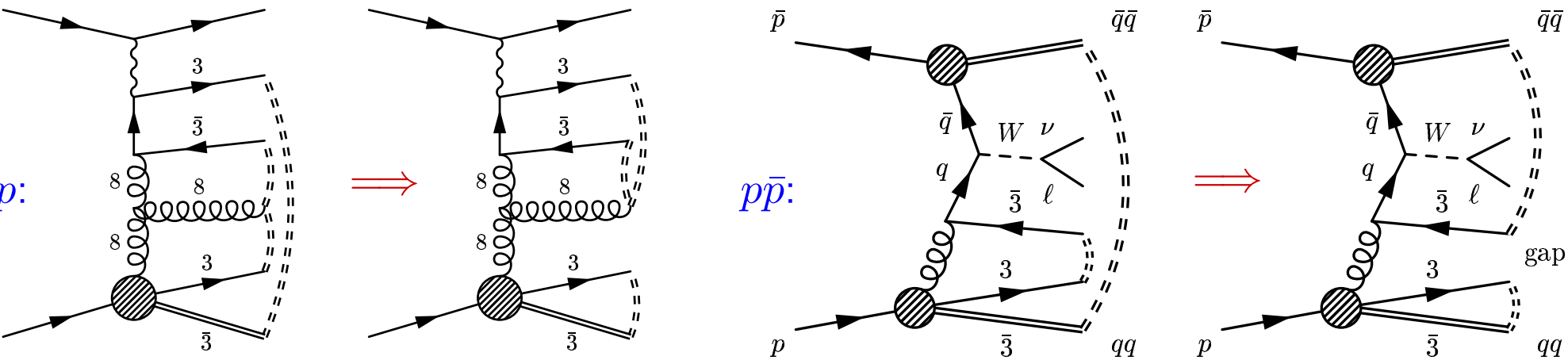
Soft Colour Interactions from QCD rescattering

Brodsky, Enberg, Hoyer, Ingelman: paper in preparation

SCI model add-on to Lund Monte Carlo's Lepto (ep) and Pythia ($p\bar{p}$)

ME + DGLAP PS $> Q_0^2$ $\rightarrow$ SCI interactions $\rightarrow$ String hadronisation $\sim \Lambda$

colour ordered parton state — rearranged colour order — modified final state



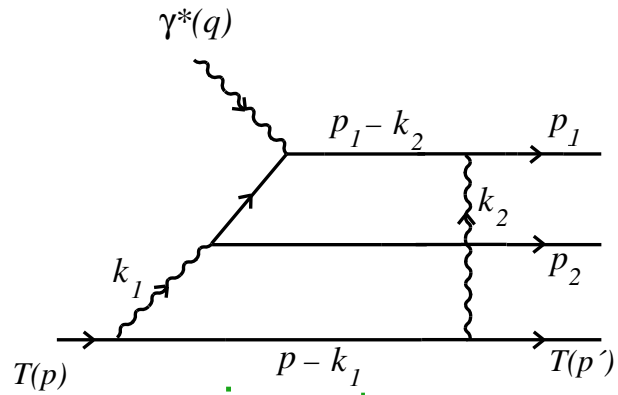
Model with *one* parameter (soft gluon exchange probability) reproduces

- HERA diffractive F_2 data
- *all* Tevatron data on hard diffraction

$\Rightarrow$ Phenomenologically successful, but lacks theoretical basis!

New theoretical understanding emerging

Rescattering interactions *à la* Brodsky-Hoyer *et al.*:



Leading twist gluon exchange between
fast outgoing partons and target 'spectators'
Instantaneous 'Coulomb' gluons (light-front/Breit frame)
→ soft rescattering on 'frozen' target

Gluon attached *after* photon vertex ⇒ no pre-existing pomeron in proton

Shadowing and diffraction are rescattering effects

SCI effective model for this!

Colour exchange → modified colour (string) field topology
→ modified hadronic final state → gaps may arise

- gluon k_2 quickly after k_1 ⇒ can screen colour giving singlet exchange
- even/odd # gluons → pomeron/odderon exchange
- path-ordered exponential of gluon field (Wilson line)
- on-shell intermediate state ⇒ imaginary amplitude ↔ diffraction
  k_2 is 'soft' → small kinematic effect
- $F_2^D \sim g_p(x_{I\!P})\, q_g(\beta)$, *i.e.* gluon distr. ↔ $I\!P$ and $g \to q\bar{q}$ gives $\left(\beta^2 + (1-\beta)^2\right)$

. . . to be continued . . .