Polarized Deep Inelastic Scattering as $x \to 1$

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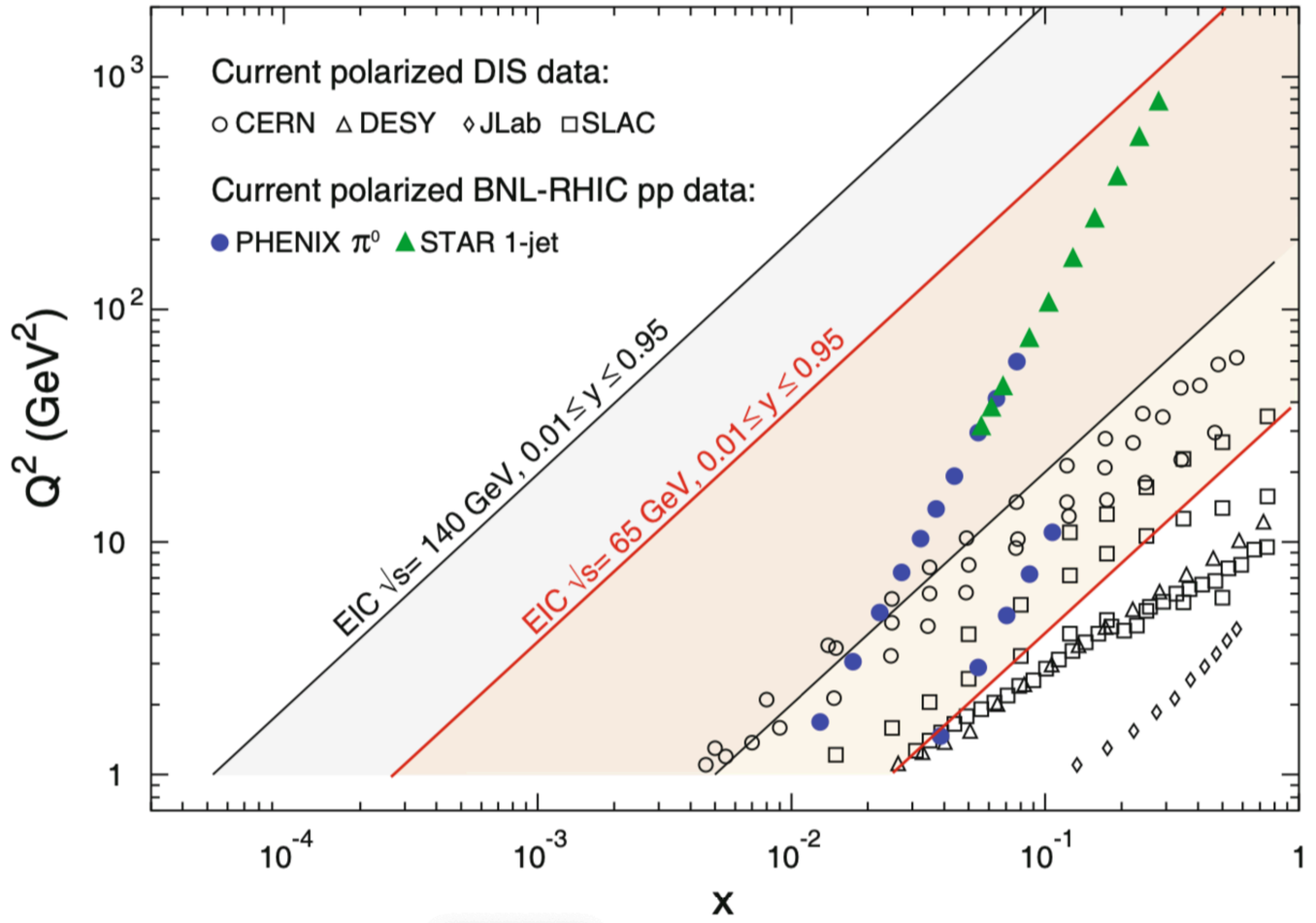
Jai Grewal

2503.07175 with Aneesh Manohar and Jyotirmoy Roy

UC San Diego

Motivation

- Will be studied at the upcoming Electron-Ion Collider at Brookhaven NL



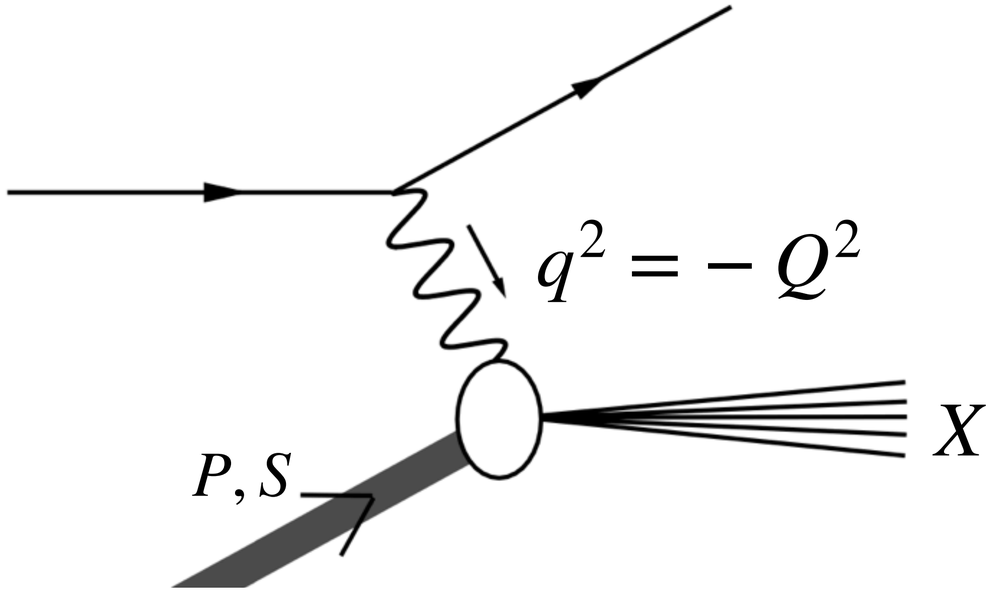
Deep Inelastic Scattering

Overview

$$d\sigma \propto L_{\mu\nu} W^{\mu\nu}$$

Leptonic part

Hadronic part



$$W_{\mu\nu}(P,S,q) = \frac{1}{4\pi}\int dx\, e^{iqx}\langle P,S\,|\,[J_\mu^\dagger(x), J_\nu(0)]\,|\,P,S\rangle$$

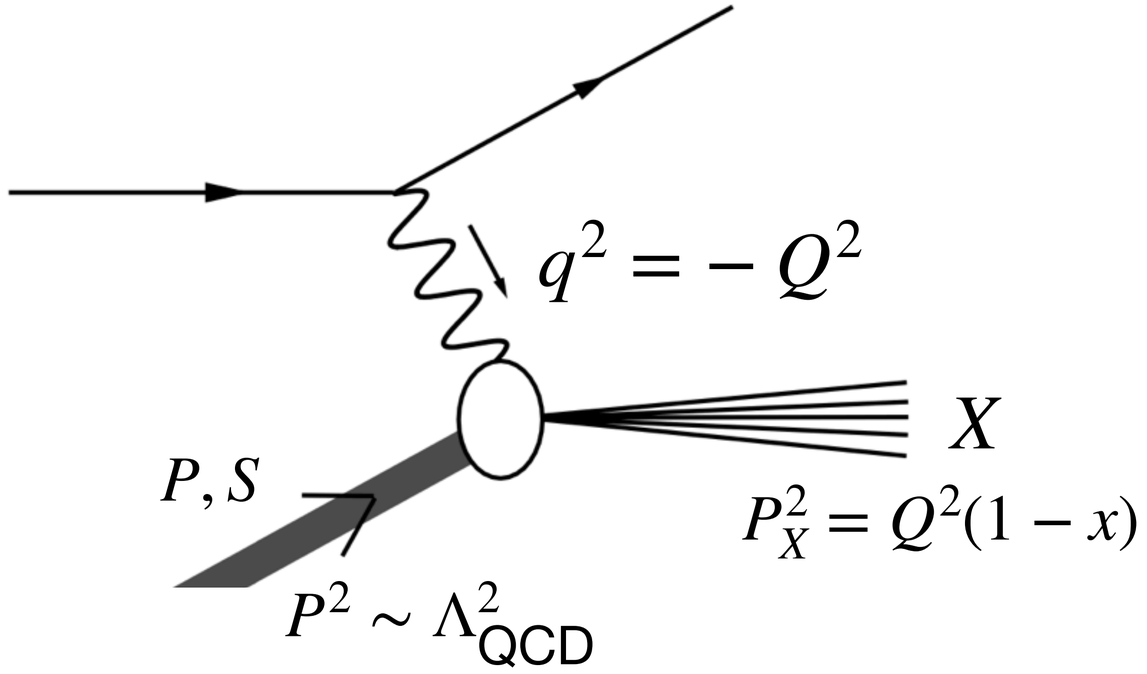
$$= -g_{\mu\nu}\,F_1(x,Q^2) + \frac{P_\mu P_\nu}{P\,.\,q}\,F_2(x,Q^2) \quad \longleftarrow \text{unpolarized}$$

$$+ i\epsilon_{\mu\nu\alpha\beta}\frac{q^\alpha S^\beta}{P\,.\,q}\,g_1(x,Q^2) + i\epsilon_{\mu\nu\alpha\beta}\frac{q^\alpha}{(P\,.\,q)^2}\left(P\,.\,q\,S^\beta - S\,.\,q\,P^\beta\right) g_2(x,Q^2) \quad \longleftarrow \text{polarized}$$

Deep Inelastic Scattering

Corrections to $W^{\mu\nu}$

- Scales:
  - $Q^2 \gg Q^2(1-x) \gg \Lambda^2_{\text{QCD}}$
  - $x = -q^2/2P\,.\,q, \quad 0 \leq x \leq 1$

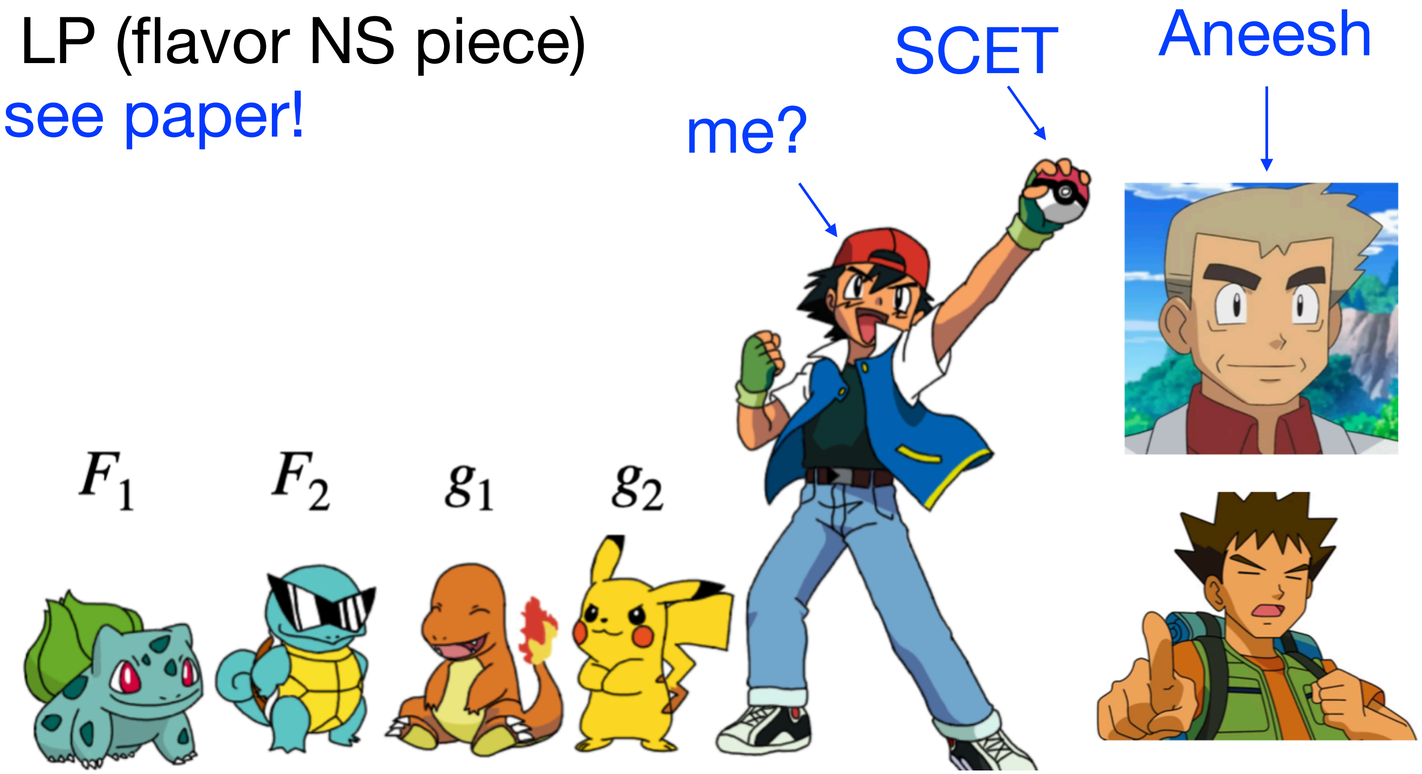


- QCD loops generate $\alpha_s^n \log^{2n}(1-x)$
  - Sudakov logs blow up as $x \to 1$
  - ???

Gotta Resum 'em All

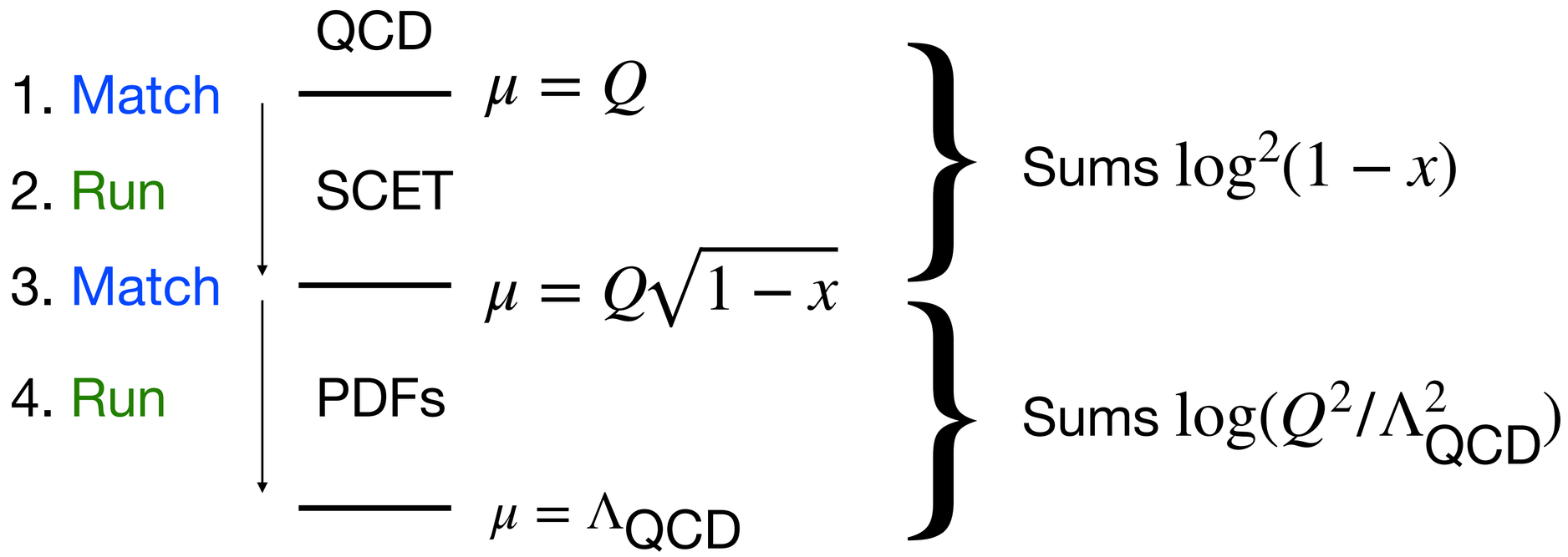
Using SCET

- F_1, F_2 ⟵ done before
- g_1, g_2 ⟵ to $O(\alpha_s)$ and LP (flavor NS piece)
  done by us - see paper!



Outline of Calculation

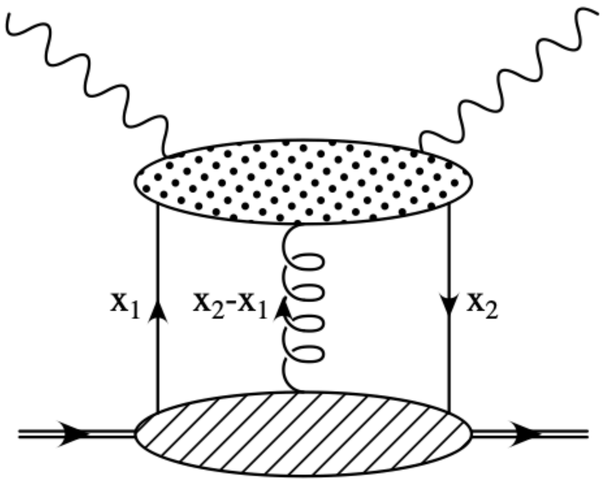
Match, Run, Repeat



Factorization Formulae

$$M_N(g_1) = (C_J(Q))^2 \; e^{2\,\Gamma_J(Q,\mu_J)} \; M_N\left[\mathcal{M}\left(\mu_J\right)\right] \; e^{\Gamma_{qq,N}(\mu_J,\mu_0)} \; A_{q,N}(\mu_0)$$

$$M_N[x\,(g_1(x)+g_2(x))] = C_J(Q)\, e^{2\Gamma_J(Q,\mu_J)}\, M_N\left[\mathcal{M}\left(\mu_J\right)\right] e^{\Gamma_{qq,N}(\mu_J,\mu_0)} \times \int_0^1 du \int_0^1 \mathrm{d}w \; C^{(1B)}(u,Q)\, \widetilde{\Gamma}^{(1B)}(u,w|Q,\mu_0)\, h_N(w,\mu_0)$$



Thank You!