Strange quark momentum fraction from overlap fermion

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1 Motivation

The second moment of the strange parton distribution funciton (PDF) $\langle x \rangle_s$.

- Provide insights into nucleon structure
- Not well known. Global analysis gives large uncertainty
- The disconnected contribution is a challenge to compute with full QCD.



2 Current values

- Global analysis: $0.018 < \langle x \rangle_s < 0.040$. H.L. Lai et al., JHEP 0704:089 (2007).
- Clover: $\langle x \rangle_s = 0.0144(27)$. Takumi Doi et al., (χ QCD), PoS LATTICE2008:163 (2008)
- Wilson (quenched): $\langle x \rangle_s = 0.027(6)$. Mridupawan Deka et al., (χ QCD) PRD 79:094502 (2009)



3 Matrix element

$$O_{4i}(x) = -i \overline{\psi}(x) \gamma_{\{4} \overleftarrow{D}_{i\}} \psi(x)$$

The disconnected 3-pt functions

$$-\frac{1}{p_i} \frac{\langle C_2^N(t_2, p_i) \widetilde{O}_{4i}(t_1) \rangle - \langle C_2^N(t_2, p_i) \rangle \langle \widetilde{O}_{4i}(t_1) \rangle}{\langle C_2^N(t_2, p_i) \rangle} \to \langle x \rangle_i$$





The sum method:



L. Maiani et al., Nucl. Phys. B293,420 (1987)



4 The nucleon 2pt funciton

- Smearing
- Smeared grid source with Z_3 noise
- Low mode substitution (HHH + HHL + LLH + LLL)
- 32 sources per configuration



5 The loop

- Low mode average
- High modes: sources are "4442", with even-odd. 32 sources/conf, with Z_4 noise.





6 Lattice setup

Overlap fermions on RBC/UKQCD domain wall configurations with 2 + 1 flavors

Lattice size $24^3 \times 64$

Lattice spacing 1/a = 1.77(5) GeV

Sea quark mass $m_{\text{light}} = 0.005, m_{\text{heavy}} = 0.04. m_{\pi} = 331 \text{ MeV}$

Overlap fermions Chiral symmetry, multimass

configurations 200



7 (Very) preliminary results





8 Low modes vs high modes contribution



Low modes and high modes contributions to $\langle x \rangle_s$ and $\langle N | \bar{s}s | N \rangle$ (M. Gong et al., Phys. Rev. D 88,014503 (2013)).



9 Result for different masses





10 Summary and future

- Disconnected contribution of nucleon (x) was calculated with overlap on top of DWF.
- High modes contribution is significant.
- Difference lattice size $(48^3 \times 96)$.
- $\langle x^2 \rangle$



Thank you





Figure 1 Grid-64 vs Grid-8



Charmonium, D_s and D_s^* from overlap fermion on DWF configurations

Yibo Yang et al. (XQCD), arXiv:1401.1487

