The 11th Circum-Pan-Pacific Symposium on High Energy Spin Physics

discussion: Lattice QCD

Yi-Bo Yang
ITP/CAS, China

中国科学院理论物理研究所
INSTITUTE OF THEORETICAL PHYSICS, CHINESE ACADEMY OF SCIENCES
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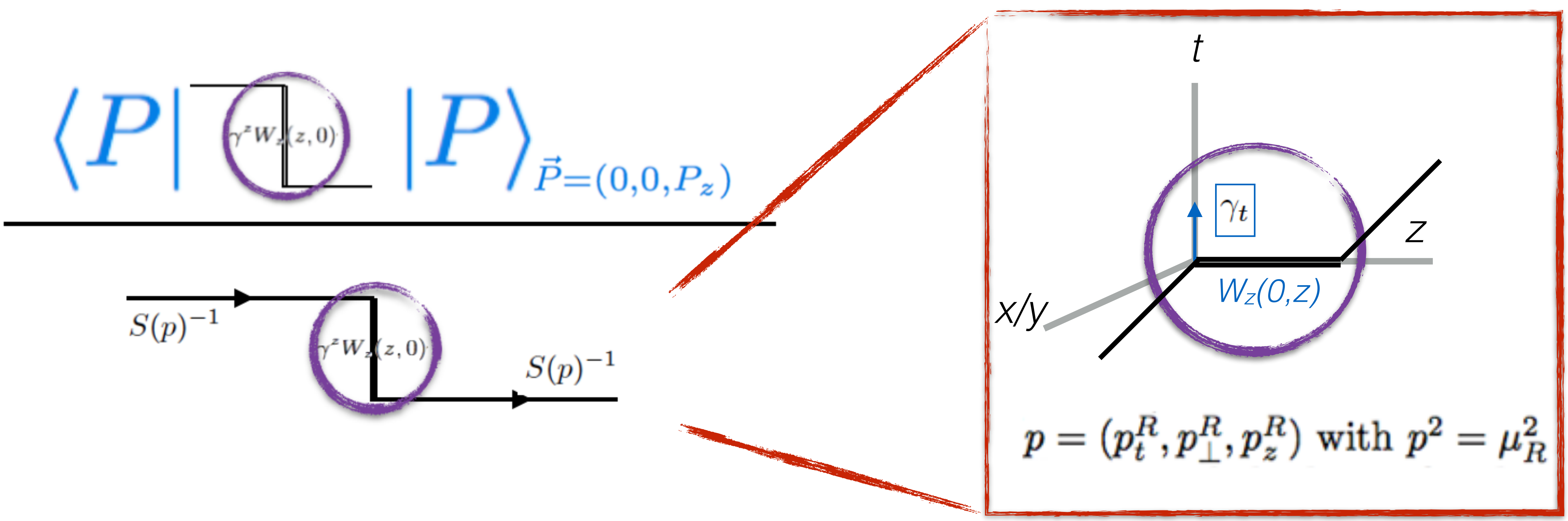
RI/MOM renormalization

*The non-perturbative renormalized quasi-PDF matrix element **$\tilde{h}^R$** in the RI/MOM scheme is defined by*

$$\tilde{h}^R(z, P_z, p_z^R, \mu_R) = \tilde{Z}^{-1}(z, p_z^R, a^{-1}, \mu_R)\tilde{h}(z, P_z, a^{-1})\Big|_{a\to 0}$$

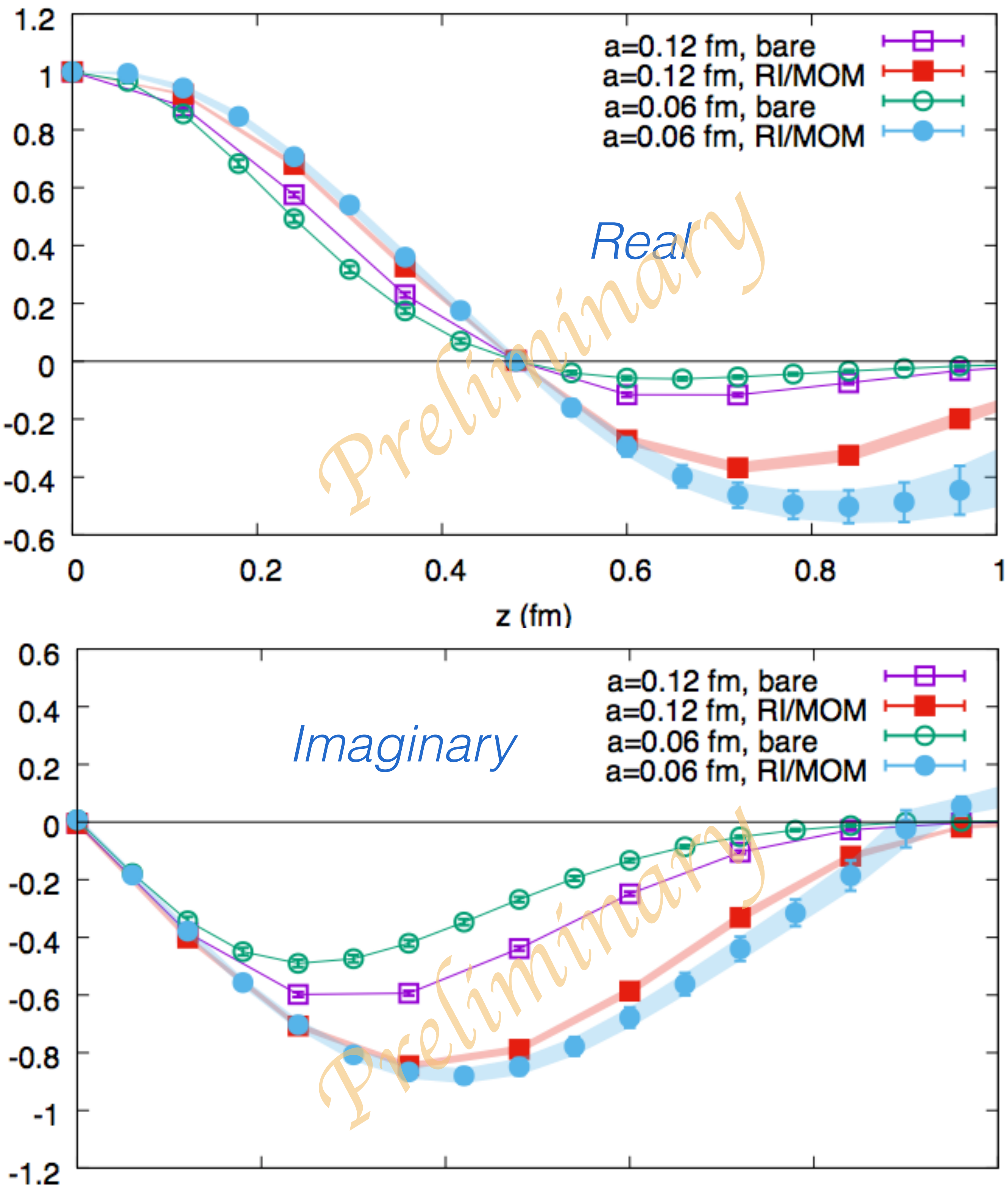
where $\tilde{h}(z, P_z, a^{-1}) = \frac{1}{2P^0}\langle P|O_{\gamma_t}(z)|P\rangle$ *is the lattice bare quasi-PDF matrix elements.*



T. Ishikawa, Y. Ma, J. Qiu, S. Yoshida, PRD96 (2017) 094019, 1707.03107
LP[3], PRD97 (2018) 014505, 1706.01295
LP[3], 1803.04393

Linear divergence cancellation

Example



- *The **RI/MOM renormalized** and normalized quasi-PDA at a=0.06/0.12 fm:*

$$\langle \eta_s(P_z = 1.3\mathrm{GeV})|\bar{\psi}(z)\gamma_z\gamma_5 U_z(z,0)\psi(0)|0\rangle$$

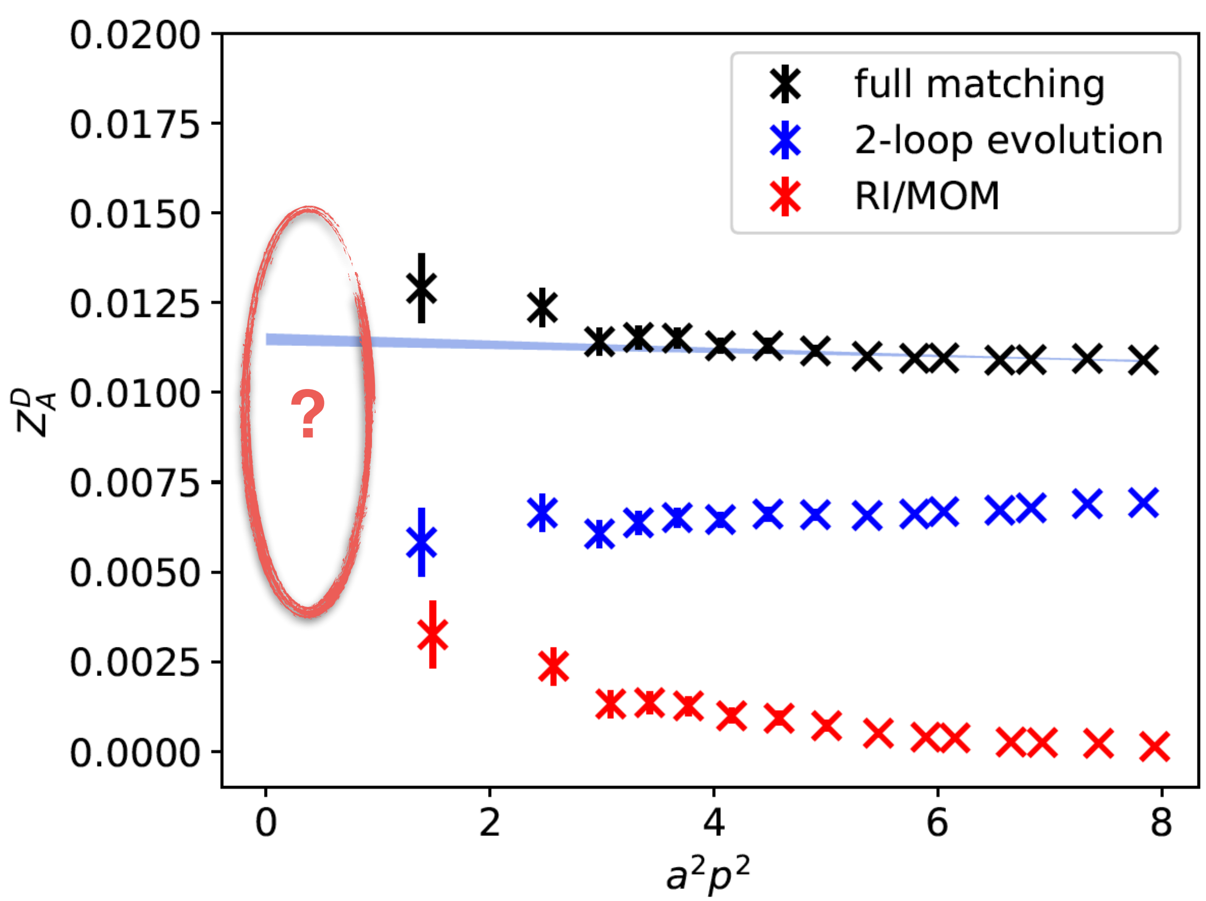
- *The renormalized results at a=0.12 fm and a=0.06 fm agree with each other well up to z~0.5 fm.*

- *The present statistics at a=0.06 fm is ~1/4 of that at a=0.12 fm. It will be improved to provide a stronger check.*

RI/MOM renormalization

at small p^2

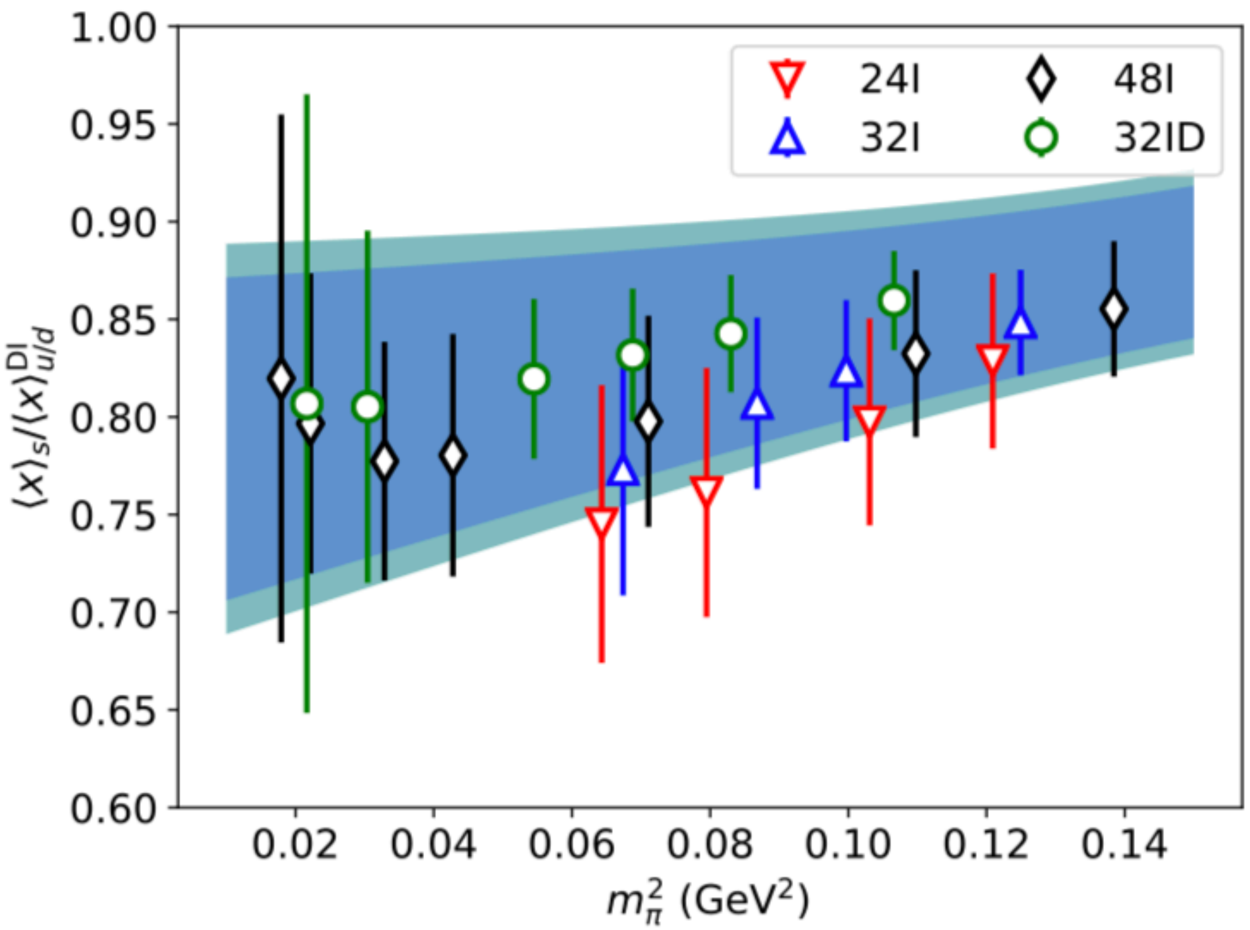
$$Z_{A,singlet}^{RI/MOM} = \frac{\mathrm{Tr}[\gamma_\mu\gamma_5\langle S^{-1}\rangle\langle S\gamma_\mu\gamma_5 S\rangle\rangle\langle S^{-1}\rangle]}{\mathrm{Tr}[\gamma_\mu\gamma_5\langle S^{-1}\rangle\langle S\gamma_\mu\gamma_5 S + N_f \mathrm{Tr}[\gamma_\mu\gamma_5 S]S\rangle\rangle\langle S^{-1}\rangle]}, \quad \langle S\rangle = \frac{-i\not{D}+m}{D^2+m^2} \xrightarrow[p^2\to\infty]{} \frac{-i\not{p}+m}{p^2+m^2}$$

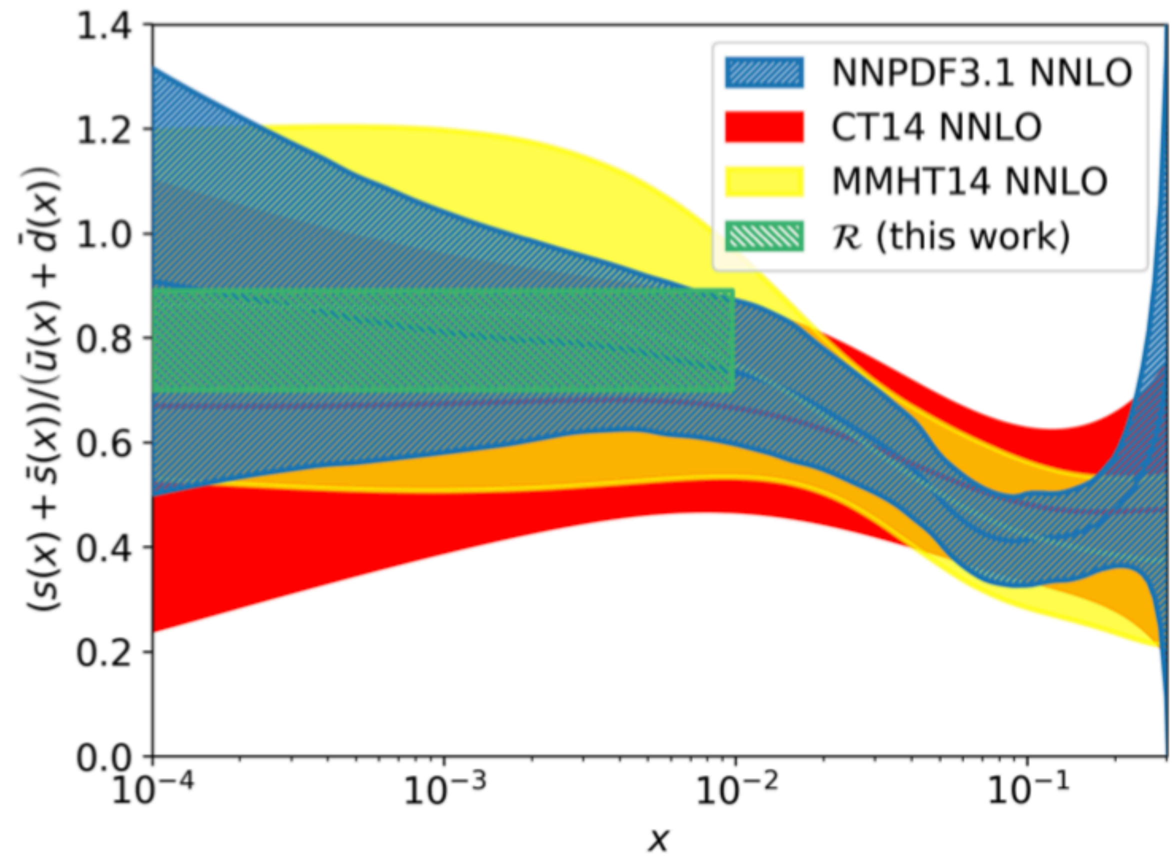


- *The calculation with very small p^2 can be done on the lattice, under the Landau gauge*
- *Such a p^2 is IR cutoff and the character scale of the RI/MOM scheme*
- *Some unique prediction can only provided by Lattice QCD*
- *Worth to think whether it can be useful.*

Rs

An approximation from latticeQCD





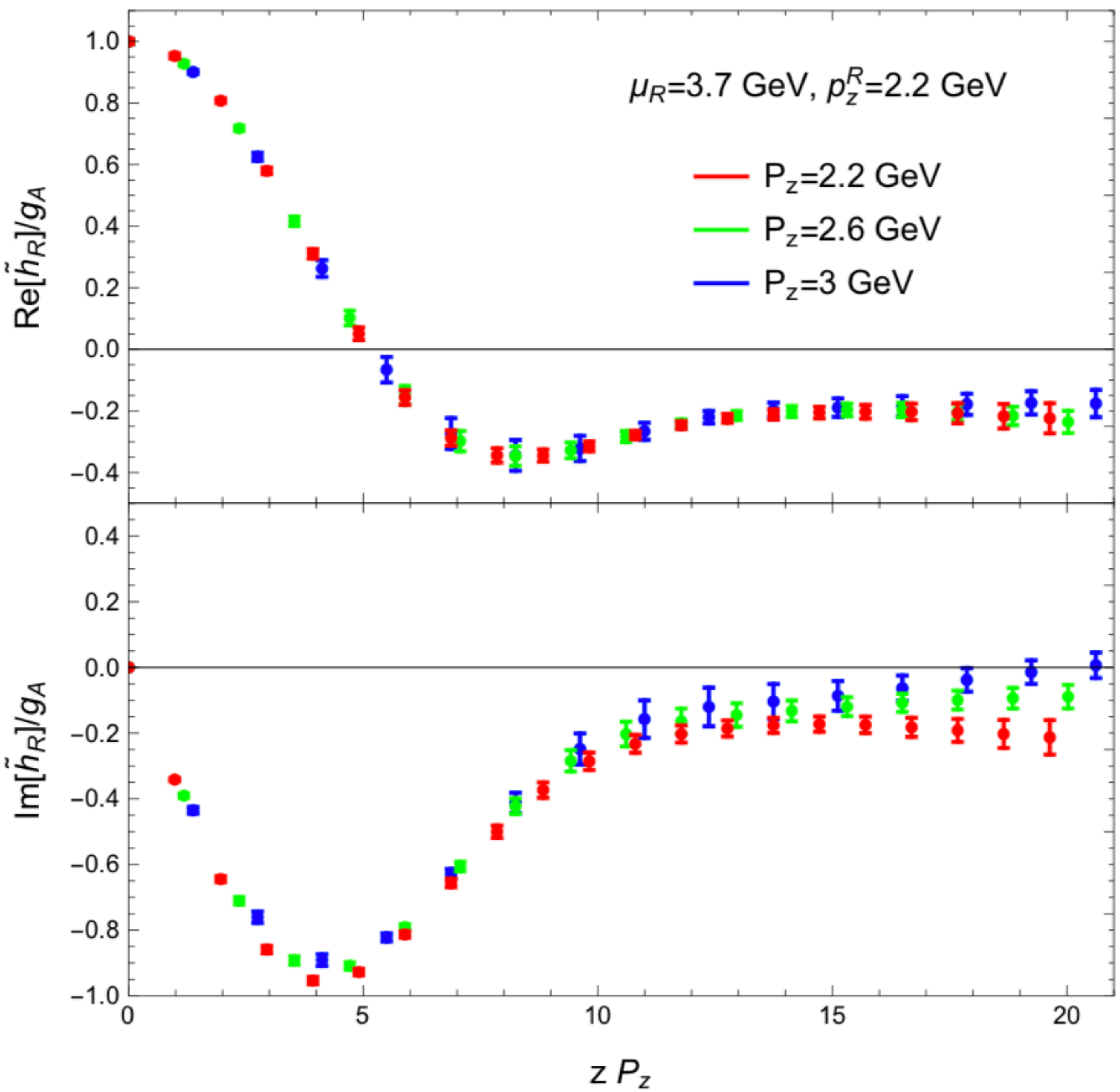
$$\mathcal{R} = \langle x \rangle_{s+\bar{s}} / \langle x \rangle_{u+\bar{u}} (\mathrm{DI})$$

MS-bar 2GeV

J. Liang, M. Sun, YBY, et al.,
χQCD collaboration, 1901.07526

Quasi-PDF

at long tail



H. Lin, et al, LP[3] Collaboration, PRL 121(2018) 242003, 1807.07431

- *The treatment at large zP_z will make prediction at small x to be different;*
- *4 GeV nucleon momentum is need to make z<1 fm when zP_z <20;*
- *The multi-state fits including the small source-sink separations~0.6 fm;*
- *We are checking the systematic uncertainties at large z.*