Lattice data

- Wilson-clover fermion on 2+1 flavor HISQ configurations.

$a = 0.06$ fm | $a = 0.04$ fm

$P_z = 0$ GeV | $P_z = 0$ GeV

$48^3 \times 64$ | $64^3 \times 64$

$m_\pi = 300$ MeV | $m_\pi = 300$ MeV

- X. Gao, et al., PRD102 (2020).

- RI′/MOM renormalization factors.

$n_z=(p^x,p^y,p^z,p^t)$
={{2, 2, 4, 2}, {2, 2, 5, 2}, {2, 2, 6, 2}, {3, 3, 4, 0}, {3, 3, 5, 0}, {3, 3, 6, 0}, {3, 3, 4, 3}, {3, 3, 5, 3}, {3, 3, 6, 3}, {4, 4, 4, 0}, {4, 4, 5, 0}, {4, 4, 6, 0}, {4, 4, 4, 4}, {4, 4, 5, 4}, {4, 4, 6, 4}}

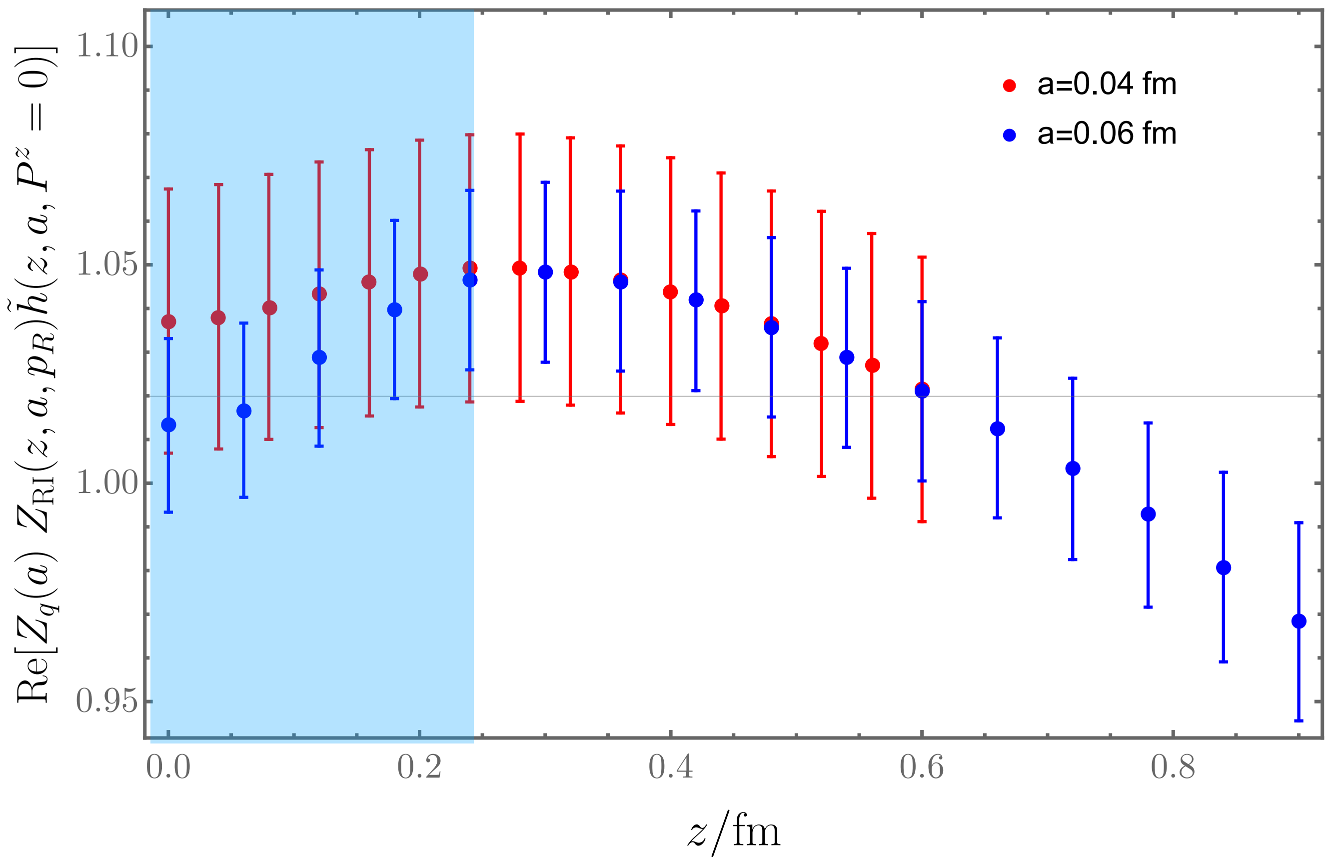
$$p_R(a=0.04) = (4,4,4,4) \propto (9.8,9.8,9.8,9.8) \qquad p_R^2(a=0.04) \propto 19.635$$

$$p_R(a=0.06) = (4,4,6,4) = (8.7,8.7,13.1,6.5) \qquad p_R^2(a=0.04) \propto 19.144$$

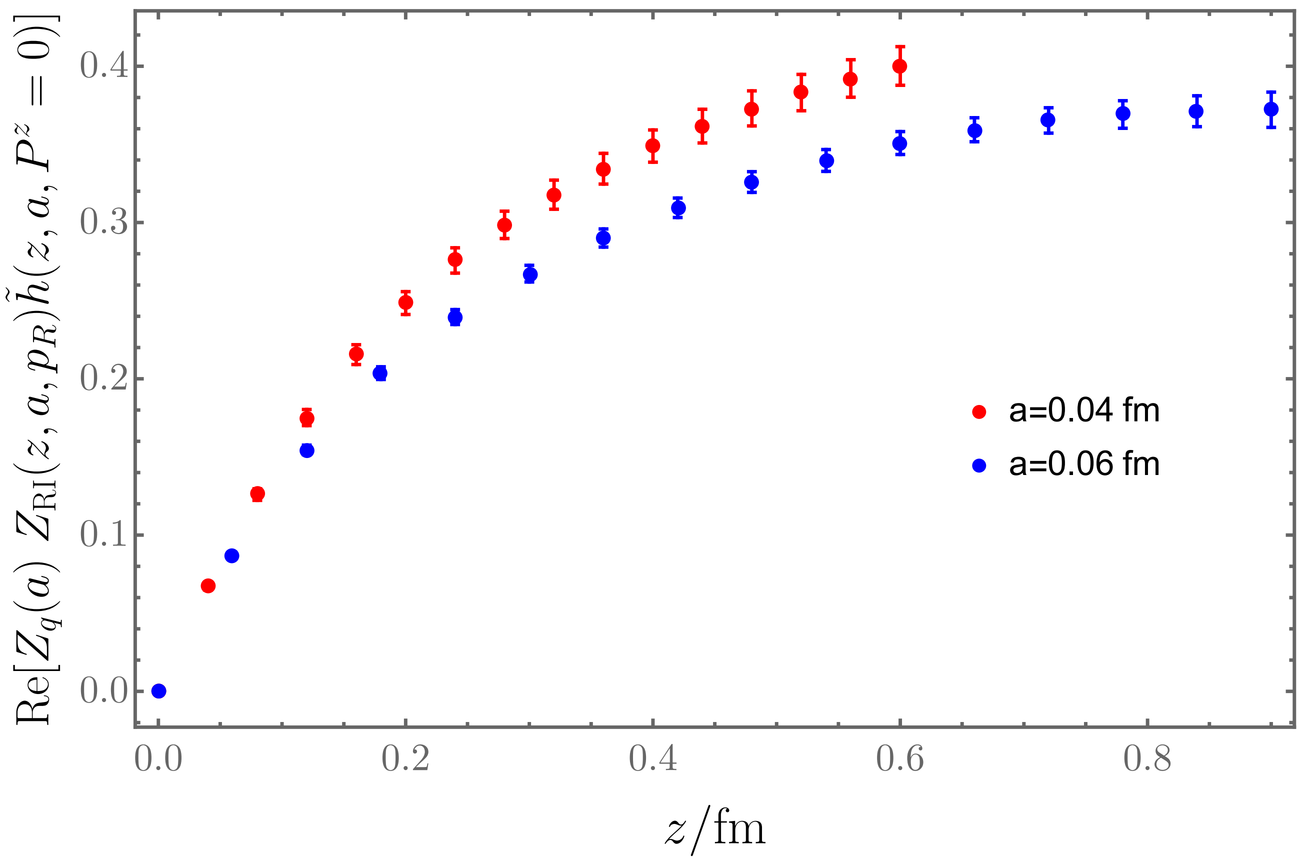
RI'/MOM renormalized matrix element

$$Z_q(a)\ Z_{\rm RI}(z, p_R\,, a)\ \tilde{h}(z, P^z=0,\ a)$$

Re



Im



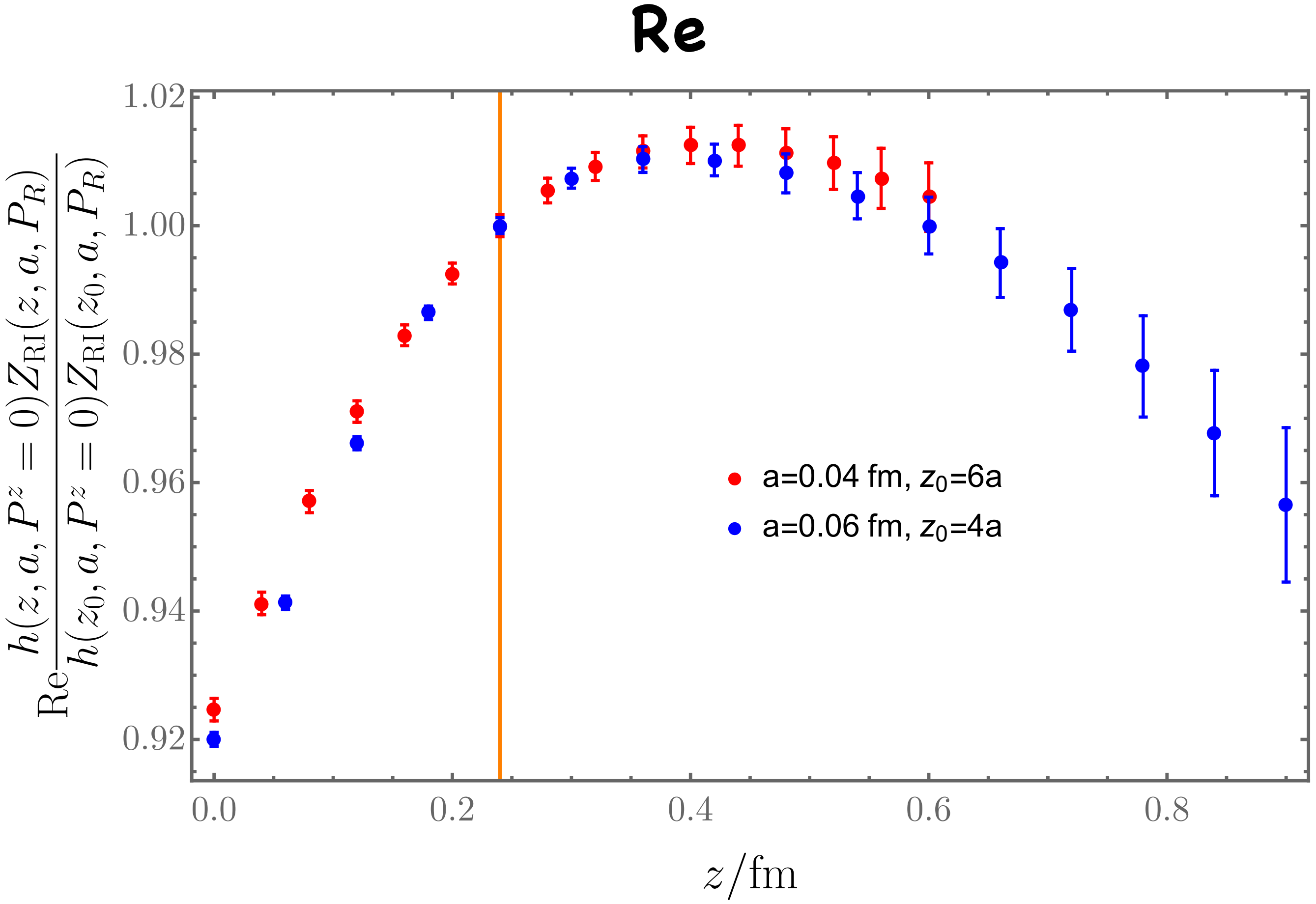
- Error dominated by that of Zq(a);
- Discretization effect at small z considerable;
- Can we normalize to 1.0 at z=0 by using the z=0 matrix element?

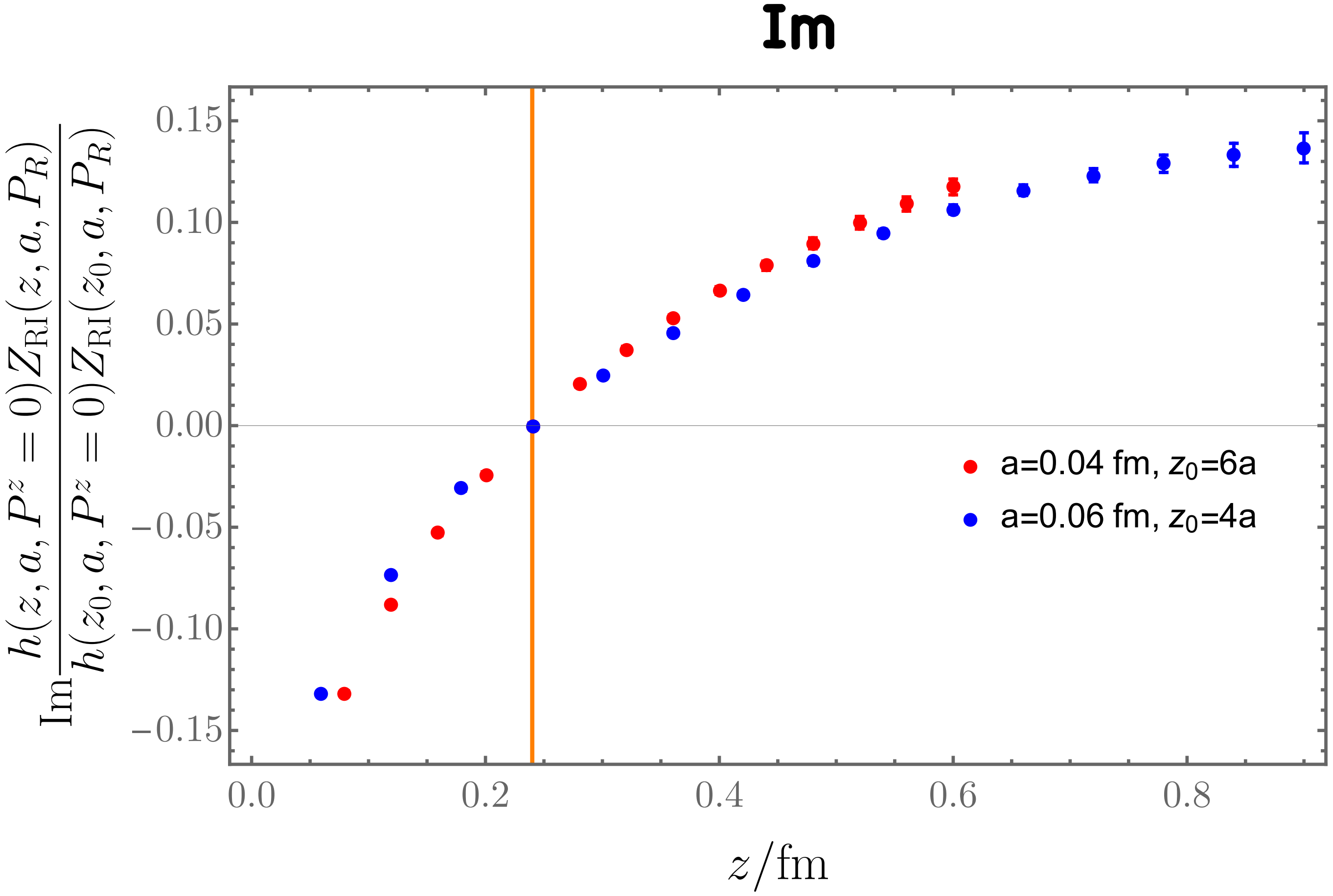
$$Z_q = Z_q^0 + B/(ap_R)^2 + C(ap_R)^2(1 + c_4\Delta^{(4)} + c_6\Delta^{(6)})$$

$$Z_q\Big|_{a=0.04\ \mathrm{fm}} = 1.03(3) \qquad Z_q\Big|_{a=0.04\ \mathrm{fm}} = 1.02(2)$$

Ratio of RI'/MOM renormalized matrix elements

$$\frac{Z_q(a)\, Z_{\rm RI}(z, p_R\,, a)\; \tilde h(z, P^z = 0,\ a)}{Z_q(a)\, Z_{\rm RI}(z_0, p_R\,, a)\; \tilde h(z_0, P^z = 0,\ a)} = \frac{Z_{\rm RI}(z, p_R\,, a)\; \tilde h(z, P^z = 0,\ a)}{Z_{\rm RI}(z_0, p_R\,, a)\; \tilde h(z_0, P^z = 0,\ a)}$$





- Subpercent level difference mainly because the RI'/MOM renormalized matrix element differs by less than 1% at a=0.06fm and a=0.04fm.

Wilson-line mass renormalization

- Check of continuum limit:

$$O_B^\Gamma(z,a) = e^{\delta m|z|}\, Z_{j_1}(a) Z_{j_2}(a) O_R^\Gamma(z)$$

δm determined from static quark-antiquark potential.

A. Bazavov et al., TUMQCD, PRD98 (2018).

$$\lim_{a\to 0} e^{-\delta m(z-z_0)} \frac{\tilde{h}(z,a,P^z=0)}{\tilde{h}(z_0,a,P^z=0)} = \text{finite} \qquad z, z_0 \gg a$$