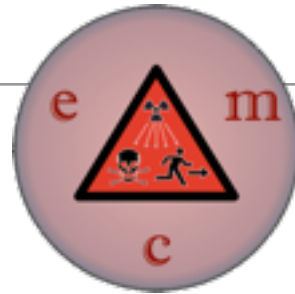


Lattice QCD Methods for Hadronic Polarizabilities

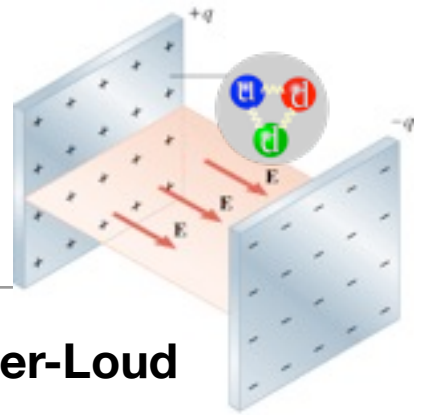
$$\alpha_E \quad \beta_M$$

$$U_\mu^{\text{e.m.}}(x) = e^{iqA_\mu(x)} \in U(1)$$



W. Detmold, B. Tiburzi, A. Walker-Loud

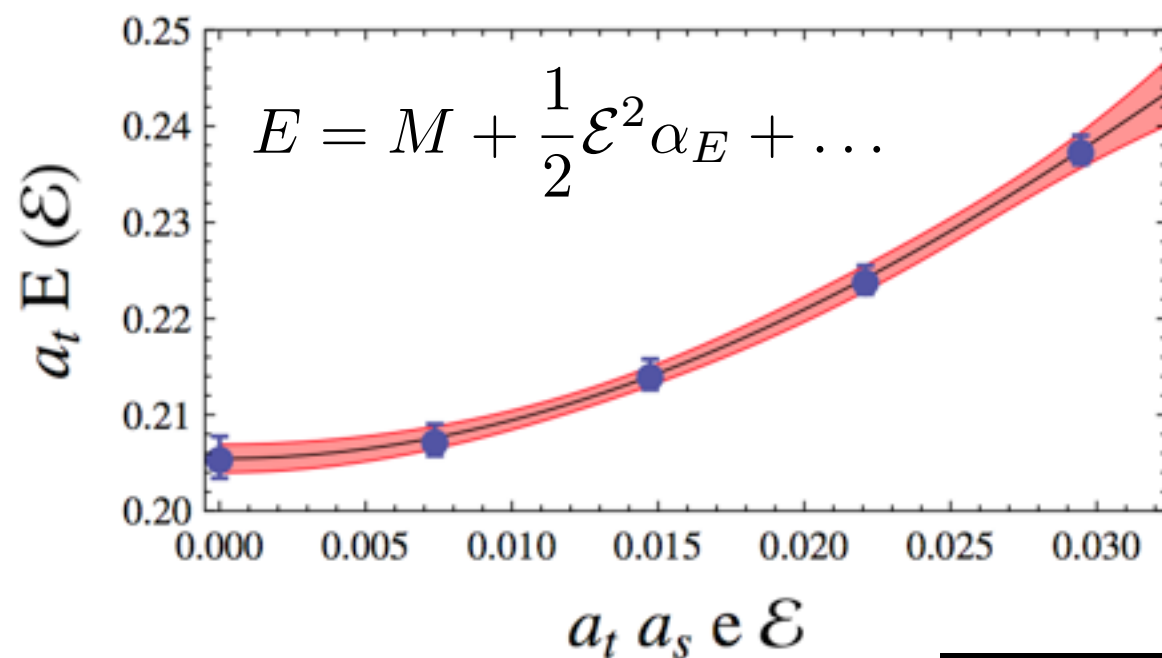
PRD 2006, 2009, 2010



- Determine E&M polarizabilities from QCD by: turning on external fields + study external field dependence of hadronic correlation functions

E.g. neutron in electric field

$$E_{\text{eff}} = M + \frac{1}{2}\mathcal{E}^2 \left(\alpha_E - \frac{\mu^2}{4M^3} \right) + \dots$$



Simultaneous fit to boost projected correlators

$$\text{Tr}[\mathcal{P}_\pm G(\tau)] = Z \left(1 \pm \frac{\mu\mathcal{E}}{2M_N^2} \right) \exp(-\tau E_{\text{eff}})$$

Anisotropic clover lattices (**HadSpec**)

$$20^3 \times 128$$

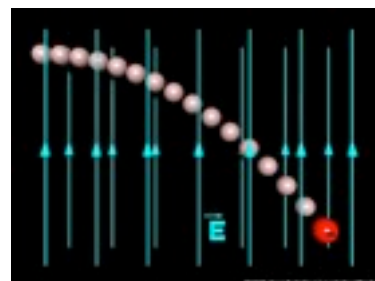
$$m_\pi = 390 \text{ MeV}$$

$$\mu_n = -1.6(1) [\mu_N]$$

$$\alpha_E^n = 3(1) \times 10^{-4} \text{ fm}^3$$

Hadrons considered

$$\pi^0, K^0, n \quad \text{and} \quad \pi^+, K^+, p$$



STATISTICAL UNCERTAINTIES ONLY
NOT FOR USE WITH EXPERIMENT

m_π

a

L

q_{sea}