SPC Summary on Nucleon Matrix Elements

- Cold Nuclear Physics

  - Nucleon Matrix Elements

  - Parton Distribution Function and Moments

  - Hadron Spectroscopy

  - Hadron Interactions and Nuclei

- Experimental facilities

  - Present: JLab 12 GeV, RHIC, ATLAS, Fermilab
  - Future: FRIB, EIC

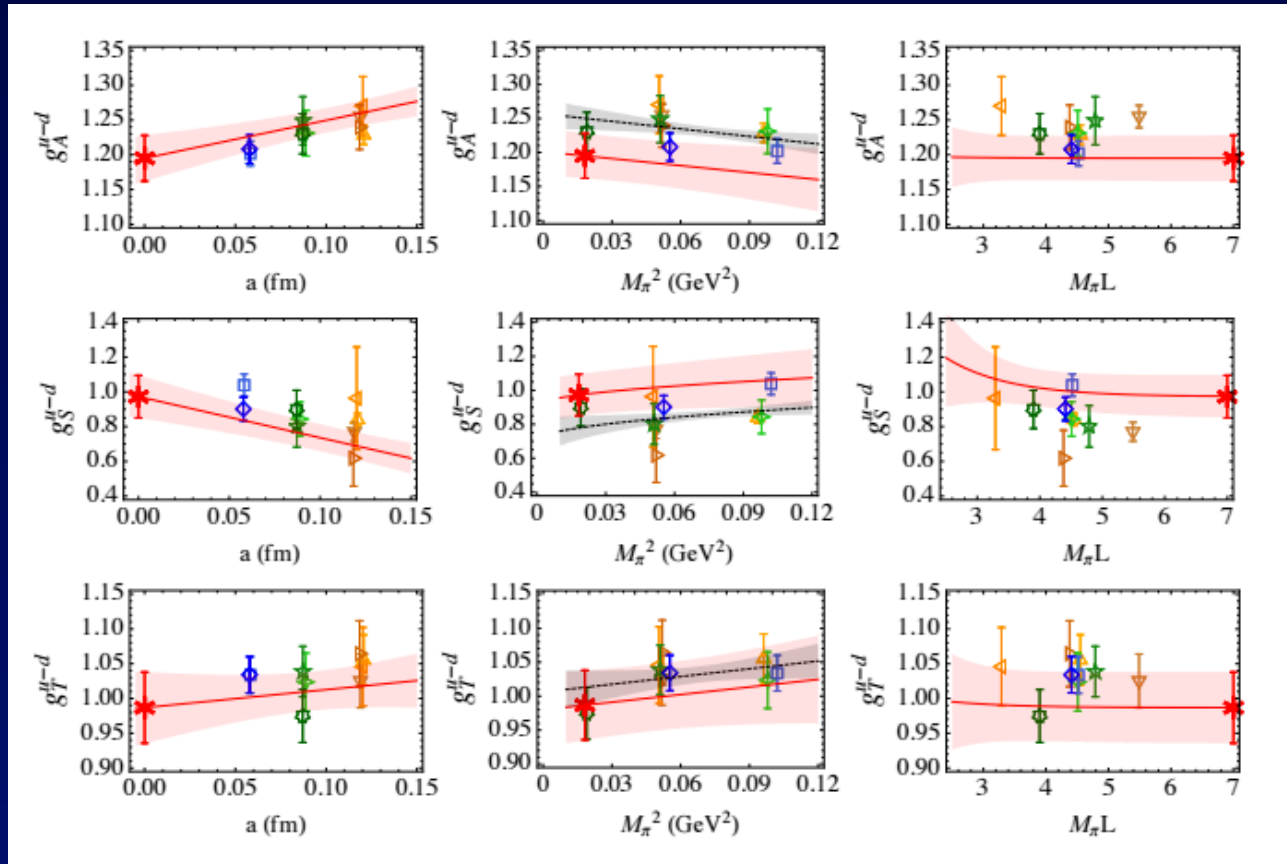
Keh-Fei Liu

All Hands Meeting

JLab, Apr. 28-29, 2017

Request of Computer Time

PI	Title	CPU Request (J/Ψ hrs)	GPU request (C2050 hrs)
Bhattacharya	Taming quark chromo EDM contribution to the neutron EDM	43 M (Fermilab)	
Engelhardt	Nucleon quark-gluon structure with Clover-Wilson fermion	12 M	806 K
Kronfeld	The Nucleon Axial-Vector Form Factor at the Physical Point with the HISQ Ensembles	51 M (Fermilab)	
Liang	Neutron electric dipole moment from lattice QCD with θ term	12 M (12s) 32 M (KNL)	
Syritsyn	Calculation of nucleon axial form factors, proton decay amplitudes, and nucleon EDMs induced by QCD theta term and quark chromo-EDM using domain wall fermions	71 M (cluster)	
Yang	Quark Spin from Anomalous Ward Identify and Conserved Axial-vector Current		1460 K (BNL)

Proposals on Nucleon Matrix Elements

- Bhattacharya – cEDM, $g_A(q^2)$, colver on HISQ, m_π = 310 MeV

- Engelhardt – TMD, $g_A(q^2)$, EMFF, scalar and tensor charges, clover on clover, m_π = 285 - 172 MeV

- Kronfeld – $g_A(q^2)$, HISQ on HISQ, m_π = 306 - 134 MeV

- Liang – nEDM with the θ term, overlap on DWF, cluster decomposition, m_π = 170 MeV

- Syritsyn – cEDM and nEDM from θ term, proton decay ME, $g_A(q^2)$, EMFF, DWF on DWF, m_π = 139 MeV

- Yang – Qaurk spin, $g_A(q^2)$ from AWI and from exact chiral current, overlap on DWF, m_π = 170 MeV
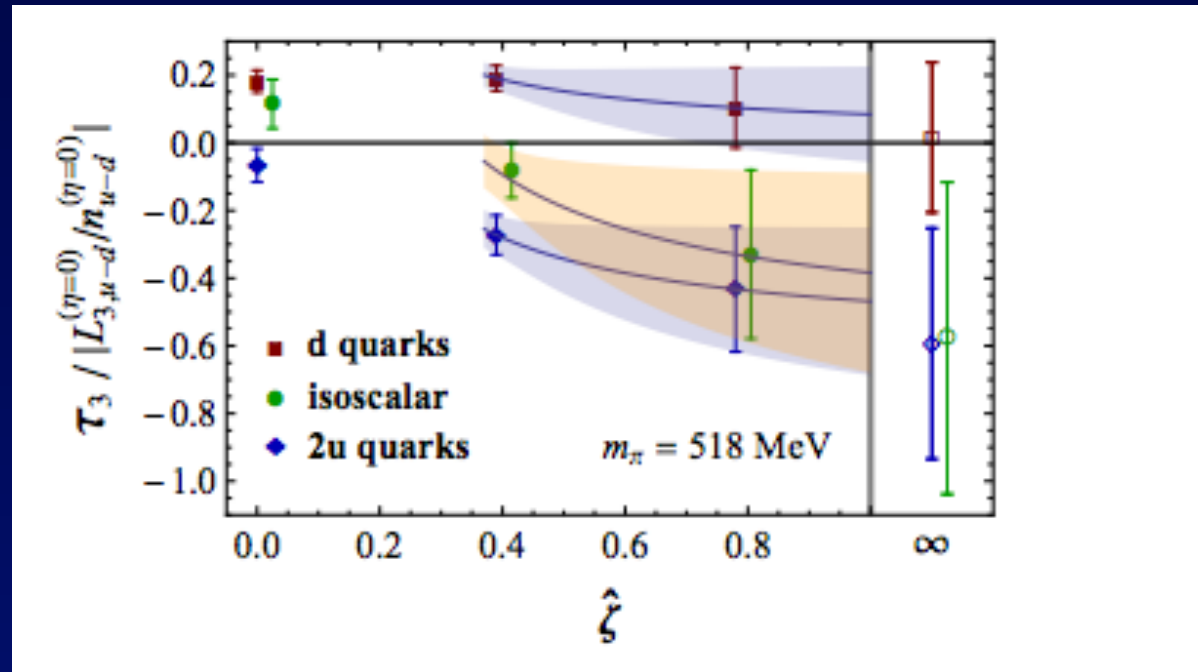
Highlights

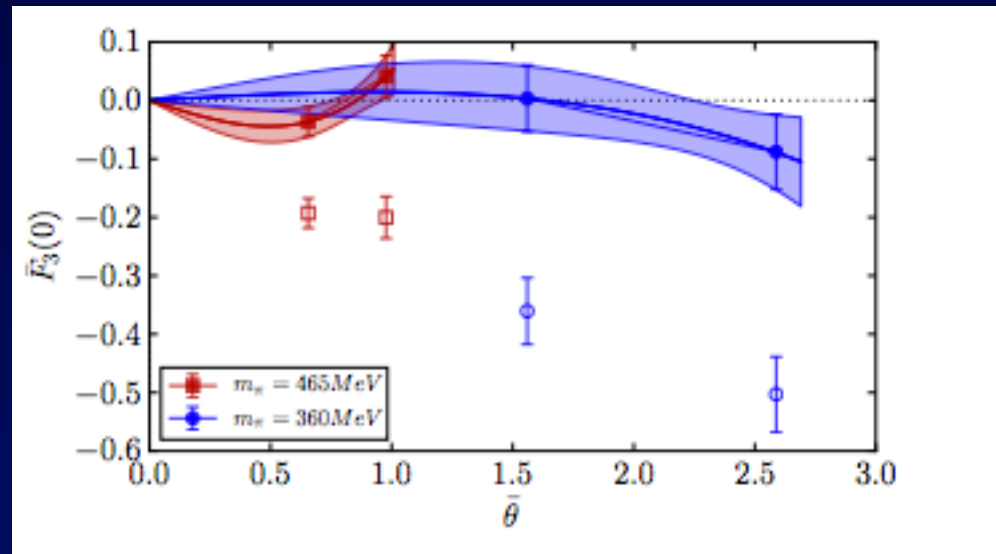PNDME, T. Bhattacharya, 10.1103/PhysRevD.94.054508

g_A^{u-d} , g_S^{u-d} , g_T^{u-d}

Quark Orbital Angular Momentum

M. Engelhardt, arXiv: 1701.01536

Corrected nEDM formula

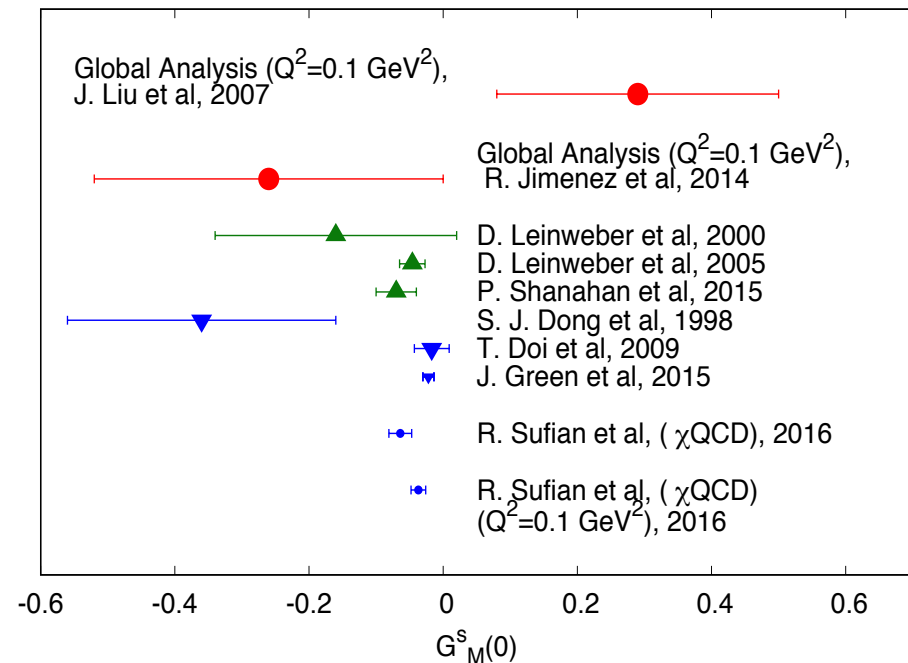M. Abramczyk, S. Aoki, T. Blum, T. Izubuchi, H. Ohki, S. Syritsyn, arXiv: 1701.07792
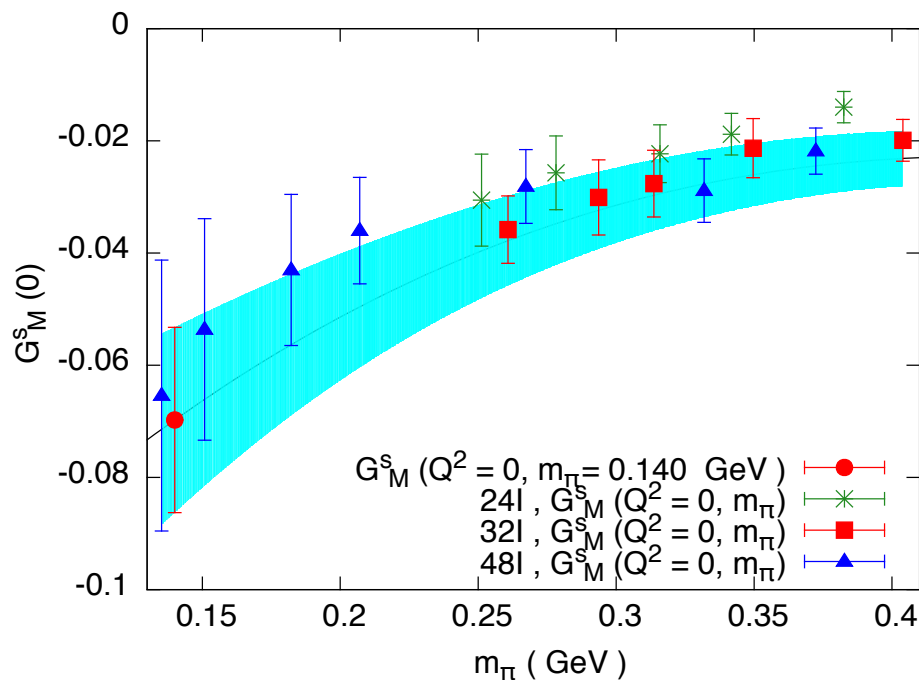
$$\tilde{F}_3 = F_3 - 2\alpha_5 F_2$$
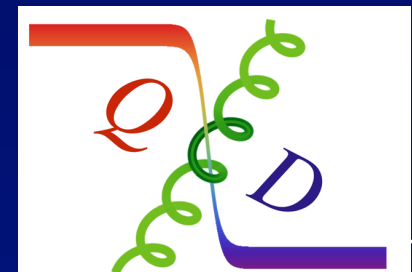
Note: Q $\propto \sqrt{V}$

Strange quark magnetic moment

Parity-violating ep scattering with
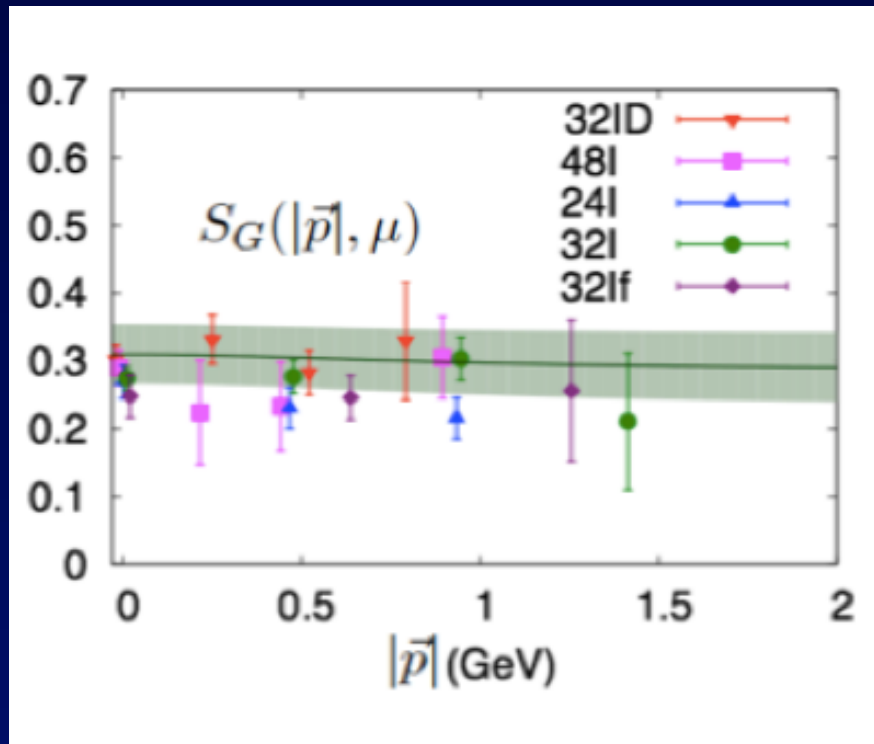radiative correction

R. Sufian et al, 1606.07075
PRL – editor's choice
Nature – Ross Young

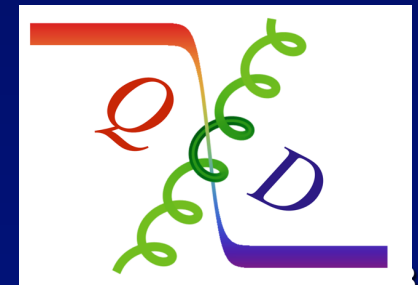$$G_M{}^S(0) = - 0.064(14)(9) \ \mu_N$$

Glue Spin

$$S_G = 0.251(47)(16)$$

Y. Yang et al, PRL 118, 102001 (2017), 1609.05837
Editor's choice

Physics ViewPoint: Steve Bass

g_A

- Issue (value smaller than expt.) still not settled – recent work with DWF valence (E. Berkowitz et al., 1704.01114) obtains g_A = 1.278(21)(26), yet PNDME (T. Bhattacharya et al., 1606.07049) with Clover valence obtains g_A = 1.195(33)(20). They are based on the same HISQ configurations.

- To be calculated in 5 proposals from this year.

- Systematic errors: excited state, physical pion mass, infinite volume and continuum limits.

- O(a) error of the local axial-vector current (Martinelli et al., Nucl. Phys. B358, 212 (1991) for clover fermion), J. Liang et al., (1612.04388) for overlap fermion).