

QCD w/ lattice gauge theory

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- We compute to sub-percent precision, starting from the QCD Lagrangian.
- Projects underway (collaborators):



calculation of the nucleon mass (Yin Lin, Aaron Meyer, Ciaran Hughes, Jim Simone, Alexei Strelchenko); paper almost done.



calculations of the nucleon axial charge & form factor (as above)—
latter needed for nuclear models estimating neutrino cross sections.



hadron tensor $W_{\mu\nu}$ of the pion (Will Jay, Tom Blum)—learning how to compute $W_{\mu\nu}$; the proton $W_{\mu\nu}$ will be needed for DUNE.

- continuing work on HVP to reach 0.2% uncertainty (Ruth Van de Water, several HPQCD, several MILCmen, Ethan Neil, Jim Simone).

- More projects underway (collaborators):



determination of the charm mass and α_s from charmonium correlators (Ruth, Johannes Weber, ...).



determination of α_s from the static potential and some clever new ideas (Nora Brambilla, Antonio Vairo, Johannes Weber, ...).



$|V_{cb}|$ crisis \leftrightarrow form factors for $B \rightarrow D^* l \nu$ (Carleton DeTar, Alex Vaquero); several conference proceedings available.



$B \rightarrow \pi l \nu$ form factors for $|V_{ub}|$ (Aida El-Khadra, Zech Gelzer).



lattice perturbation theory for clover-asqtad and clover-HISQ currents and four-quark operators (Aida, Elvira Gámiz)



$D \rightarrow \pi/K l \nu$ form factors for $|V_{ub}|$ (Will Jay, various senior cooks).



discreet and discrete quantum computing (hobby).

- Last 12 months' (journal) publications:
 - $|V_{us}|$ from K_{l3} decay and four-flavor lattice QCD:
 - most precise calculation to date; tension in CKM top-row unitarity.
 - Splittings of low-lying charmonium masses at the physical point.
 - $B_s \rightarrow K l \nu$ decay from lattice QCD: will help LHCb determine $|V_{ub}|$.
 - HVP contribution to the muon's $[g-2]$ from four-flavor lattice QCD.
 - Opportunities for lattice QCD in quark and lepton flavor physics & Lattice QCD and neutrino-nucleus scattering:
 - two (out of seven) USQCD whitepapers — when the Editor of the European (!) Physics Journal saw them, he invited all seven to be published in a **special topical issue**.