Topical Collaboration for GPDs

David Richards

Jefferson Lab

Background and Context

- Third round of FOAs for topical collaborations, following those of 2010 and 2016.
- Take-aways:

Structure

All applications submitted to this FOA must be in support of multi-institutional teams. Awards under this FOA will bring together, on a temporary basis, research groups of leading nuclear theorists, leveraging the resources of small research groups, and providing expanded opportunities for the next generation of nuclear theorists. Each team will function as a hub of a network of scientists from the participating institutions, supporting sustained interaction and communication within the network, and providing a mechanism for placing new researchers in permanent positions in nuclear theory. In addition, applications submitted to this FOA must be

Science

a. Hadron spectra from Quantum Chromodynamics, including exotics
b. Photo- and electro-production of meson and baryon resonances, including exotics } spectroscopy
c. Phenomenology for semi-inclusive/exclusive electron scattering
d. Partonic and spin structure of hadrons } hadron structure
e. Properties of hot/dense strongly-interacting nuclear matter
f. Phenomenology of relativistic nuclear collisions } "Hot QCD"
g. Nucleon interactions and properties of nuclei
h. Unified description of nuclear reactions } Nuclear reactions/interactions
i. Dynamics of fusion/fission
j. Nuclear reactions in cataclysmic astrophysical events Nuclear astrophysics
k. Neutrino-nucleus interactions
l. Tests of the Standard Model using nuclei } Standard Model and BSM

Connection to NSAC LRP

Criteria

- A task that is achievable within *a five-year project*, and which will advance a long-term effort such as that represented by CNF.
- Exploiting emerging developments in experiment, theory, computation and global analysis.
- Identifying key teams within (primarily) the US community.
- Creation of new bridge positions.

Emerging Developments

- DVCS and DVMP data from 12 GeV upgrade of Jefferson Lab.
- First-principles lattice calculations to yield GFFs and GPDs facilitated in the Exascale era
- Development of global QCD analysis methods with uncertainty quantification for PDFs and TMDs, and their extension to 3D GPDs.

Our discussions

Position-space Femtography of Nucleons

"To extract Generalized Parton Distributions from extant and upcoming experimental data, and first-principles LQCD calculation, with quantified uncertainties."

1. The theoretical framework for GPDs and Generalized Form Factors (GFFs).
2. Lattice QCD calculations of GFFs, and of the 3D (x,ξ,t)-dependent GPDs.
3. Global Fitting and Error Quantification to extract GFF and GPDs, exploiting complementary of experimental data and first-principles lattice QCD calculations.
4. The internal distribution of mass, charge, and spin, and cross-connections for our understanding of the fundamental physics of the universe; confronting QCD-inspired descriptions of hadrons to identify the key DOF.
5. (Radiative Corrections in key experimental quantities.)

Institutions/Teams

- ANL [I. Cloet,…]
- Hampton University [A.Accardi, J.Goity,…]
- Jefferson Lab [W.Melnitchouk,J.Qiu, D.Richards, N.Sato, C.Weiss,..]
- Old Dominion University [A.Radyushkin,…]
- Temple University [M.Constantiou,A.Metz,..]
- University of Connecticut [L.Jin,P.Schweitzer,..]
- William and Mary [C.Monahan, K.Orginos,…]
- ……