

Cold nuclear physics white paper status and prospects

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Cold nuclear physics white paper structure

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- Main physics topics
 1. Hadron Spectroscopy
 2. Hadron Structure
 3. Nuclear Spectroscopy, Structure and Interactions
- Links to other WPs (ν A interactions, fundamental symmetries)

Experimental drivers for cold NP

- Highlight relevance of LQCD to NP experimental program
- Existing Facilities: CEBAF @ Jefferson Lab, RHIC @ BNL, ATLAS@ ANL
- Future Facilities
 - Facility for Rare Isotope Beams (FRIB) @ Michigan State
 - Electron-Ion Collider (EIC) @ BNL or JLab

- Stable light and strange hadrons
 - Precision: isospin breaking effects and EM splittings,...
- Excited state resonances in scattering phases shifts
 - Major experimental motivation from COMPASS, GlueX, CLAS12, BES III, LHCb
- Heavy mesons and baryons
 - Spectroscopy of singly/doubly/triply charm/bottom baryons
 - XYZ states: tetraquarks, pentaquarks,...

- Form factors of nucleons (and pions, kaons, etc)
 - Aim for full flavour separation, all types of local currents
 - Proton charge radius
 - Axial/pseudoscalar FFs (defer to νA WP)
- Resonance transition form factors: mesons & baryons
 - Input for GlueX and CLAS12
- Moments of PDFs, GPDs
 - Momentum, spin decomposition of proton

- Bjorken- x dependence of PDFs
 - Explosion of interest
 - Many developments
- Transverse momentum dependent parton distributions
 - 3D imaging of the proton
- Gluonic aspects of all of the above
 - Focus of EIC: “understanding the glue that binds us all”

Nuclear spectroscopy, structure and interactions

- Nuclear spectroscopy
 - push to physical mass/understand quark mass dependence of nuclei
 - extend to larger A ; p -shell nuclei
 - Further develop the connections to EFT for relating FV energy levels to infinite volume physics
- Nuclear interactions
 - YN scattering and nnn interactions relevant in n -stars
 - Electroweak interactions: $np \rightarrow d\gamma$, $pp \rightarrow dev$, extensions to three body systems

- Nuclear Structure
 - EMC-like nuclear effects in charges, (moments of) PDFs,...
 - Explore the spatial structure of nuclei through form factors
 - Non-nucleonic aspects of nuclear structure: exotic glue
- Nuclear input for neutrino physics and fundamental symmetries
 - Point out connections leaving details to the other WPs

- Plans are to summarise state of field and discuss new opportunities in each area
- Other topics to cover?
- Additional overlaps/links to other WPs?