Questions for FRIB-TA Dialogues on Nuclear Short-range Correlations

For the upcoming Dialogues on nuclear short-range correlations, we collected some questions that might be addressed or might stimulate additional questions. We want to focus particularly on issues that directly relate to low-energy nuclear physics, even though there are many interesting questions beyond that scope. Note that there is no expectation that these questions would be addressed in the numerical order given here or at all, but feel free to address those you see fit.

Abbreviations:

- SRCs --- short-range correlations
- GCF --- generalized contact formalism
- EFT --- effective field theory; chiEFT is chiral EFT, which is commonly applied in ab initio
- RG --- renormalization group

1. **What is your definition of SRCs? Is there a definition of SRCs we all agree on?**
   - Does the short-range physics associated with SRCs have to appear in nuclear wave functions or can it appear elsewhere (in particular, in operators)?
   - What are the advantages of a "high-resolution" description of SRCs?
   - Where does SRC physics show up in "low resolution" descriptions? (E.g., shell model, energy density functionals, soft nuclear Hamiltonians.) Is it *missing* from these descriptions?
   - What is the role of SRCs in the EFT/RG paradigm?
   - Are there other low-energy observables than can inform us about SRCs?

2. **Can high-momentum nuclear distributions be measured experimentally?**
   - If you answer no, then what is measured in knock-out experiments?
   - When is the impulse approximation a good approximation? How does this depend on kinematics and scale and scheme? Can one optimize its validity?
   - Do we expect calculated high-momentum distributions in nuclei using different Hamiltonians to agree? Is one of them the "correct" distribution?
   - What parts of wave functions can be extracted from experiment? Can this be related to extracting parton distributions from experiment?

3. **When is it necessary to add SRC physics to microscopic calculations (chiEFT, shell model, EDF)?**
   - Does SRC physics need to be added to the wave functions?

4. **Scale and scheme dependence in the context of SRCs: Is there a preferred scale/scheme?**
   - What is better for extracting information from experiment? What is better for interpreting experiment?
   - How do we change the scale? Does a lower scale mean physics is lost?
   - If two different scales are used, can we relate them using RG methods?
   - How does RG resolution relate to experimental resolution?
   - What happens to high-momentum physics like SRCs with RG evolution? When you soften a Hamiltonian, do you “harden” the interaction (i.e. current) operator?
   - Does simpler structure always mean much more complicated reaction mechanism?

5. **What can SRC experiments tell us about high-density nuclear matter?**
   - Is high momentum in an SRC like high-density nucleonic matter?

6. **What is factorization in nuclei in the context of SRC physics?**
   - Is the factorization of reaction and structure always robust? How does it depend on the experiment? How does it depend on RG resolution? Can the pieces be treated separately?
   - What does it mean for structure and reaction models to be *consistent*?
   - How does "scale separation" lead to factorization? What controls scale separation in nuclei?
   - What is factorization in the GCF? What can it tell us?
   - What is factorization at low resolution (from RG evolution)? What good is it?
   - Can factorization be used to find correlations between different observables/matrix elements and explain scaling behavior?

7. **What is the nature of the quenching of spectroscopic factors (SFs)?**
   - What is the current state of affairs?
   - Should there be a scale dependence of quenching? And differences with probes, i.e. (e,e'p), (p,2p), KO, transfer?
   - Is it a problem with experiment, theory, or the concept of SFs? Is it from SRC physics?
   - What does the understanding of quenching for beta decay in ab initio calculations suggest about quenching of spectroscopic factors?
   - How is quenching explained from an RG point of view?
   - Can SFs be formulated in a model-independent (scheme-independent) way? If yes, how? If no, is this a problem or just a matter of convention?

8. **Should there be a quenching^2 in processes involving two nucleons?**
   - For example (t,p) reactions or 2n-KO?
   - How about double-beta decay rates calculated with the Shell Model?

9. **Evidence suggests that a quasi-nucleon is ~ 80% of time a single particle.**
   - What is the actual nature of the other 20%?
   - How do the IPM particles get dressed by the SRC?

10. **What is unknown about the interactions between nucleons related to SRC physics?**
    - What is not known from nucleon-nucleon scattering?
    - Is there off-shell dependence to be determined?
    - Is there a "hard core" in chiral EFT NN interactions?
    - Why are there so many chiral EFT interactions out there now? Is there a correct one?
    - What are the differences between phenomenological and EFT interactions?
    - If there are good phenomenological NN interactions, why use an EFT?

11. **What is the relevance of EMC physics for low-energy nuclear structure and reactions?**
    - How is the EMC effect viewed from the EFT perspective? Is it unexpected?

12. **Is off-shell physics measurable?**
    - If not, does that mean you can't talk about it?
    - Can off-shell dependence be exploited?
    - Is physics in the nuclear medium off-shell physics? (Could focus on three-body system.)