H2/D2 White Paper Status

Tom Junk

H2/D2 Meeting

September 13, 2021

Current White Paper Status

- Get editable Overleaf link from Laura's e-mail
- Includes LOI text. Many thanks to everyone for work on the LOI!
- White Paper Contents: 27 pages so far (including title
- page and references)

Current Status, cont'd

Deadlines

Snowmass Deadline: March 15, 2022
https://snowmass21.org/submissions/start

Neutrino Frontier Topical Group internal report draft due date Feb. 28, 2022.
I asked Kendall Mahn about when our white paper is due. We may need to submit a draft earlier to the topical group conveners well in advance of the Snowmass deadline. I heard talk of January for another NF white paper.

Kendall is giving a talk on Neutrino Cross Sections, NF06 on Oct 7

https://snowmass21.org/neutrino/start#meetings

and wanted an advertisement for what we are doing.

Progress Since we Met Last

Bryan Ramson has submitted an LDRD (Lab Directed Research and Development) proposal to study hydrogen/deuterium bubble chambers by building a prototype over at the Proton Assembly Building at Fermilab

Sounds like a good idea!
Small bubble chambers have been constructed for DM searches and are running now.
New technologies may make the bubble chamber idea work even better now.
Lots of discussion still needed about how to make a practical neutrino target/detector

- One big one or many small ones?
- Auxiliary detectors (calorimeters, muon ID)
- Surface or underground?

Regarding polarized targets, I've been talking with Wolfgang Korsch and Dustin Keller.

Wolfgang works on polarized ^{3}He targets in electron beams at JLAB. These targets have nice properties:
-- no cryogenics, small B field in the target region (25 g).
-- only problem: the target material is ^{3}He!
Maybe there are still some ideas we can glean from this work.
Papers, theses, presentations Wolfgang pointed me to:
https://drive.google.com/drive/folders/1r6vmasK-5G8ErCsxGnw2Pqh64LrZ1b8w

Progress Since we Met Last

Talking with Dustin about active polarized targets

- NH_3, polymethyl methacrylate, polystyrene are all polarizable with Dynamic Nuclear Polarization (DNP)
- Need a strategy for integrated target and detector
  - Need a detector that works cold and in a high B field.
  - High B field → particles curl up in small loops. Need to be able to resolve short, curly tracks.
  - If the detector itself is not polarizable, it must contribute not so much to the scattering cross section as to overwhelm the parts that are polarizable.

- Some ideas for the detection technology:
  - Silicon strips
  - Silicon pixels (CCDs)
  - Scintillating fibers
  - Sandwich these with the polarized target material.
- Didn't have enough ideas for an LDRD this year, but maybe the next round. Study scintillating fiber performance at low temps and high field for example. Look for old, spare silicon-strip detectors.

Kaushik Borah – New Student working at UKY

Working with Richard Hill at UKY, and if he gets a URA fellowship, with Minerba and Tom at FNAL.

Projects:

1) Implement new nucleon vector form factors in GENIE
https://journals.aps.org/prd/abstract/10.1103/PhysRevD.102.074012

2) Electromagnetic radiative corrections
- can induce differences between muon and electron neutrino cross sections and kinematics
- would be good to work with experimentalists when putting things into GENIE

3) Study of polarization observables
- Study of how second-class currents affect predictions of measurable asymmetries
- Significant amount of work needed to compute polarized and unpolarized cross sections
- And estimate the needed uncertainties to make interesting statements. How much data do we need?

  How polarized does the target have to be? What about contamination from unpolarized nucleons, and heavier nuclei? How many events need to be collected? Systematic uncertainties?