A High Rigidity Spectrometer for FRIB

Goal

To design and build a High Rigidity Spectrometer and associated infrastructure at FRIB that provides users with access to beams of the rarest isotopes at the highest yields produced by in-flight fragmentation. The spectrometer should provide a flexible and efficient environment for performing state-of-the-art experiments with a wide variety of auxiliary detection systems, using fast rare isotope beams transported with minimal losses from the FRIB fragment separator.

Low-Energy Community Meeting
Remco G.T. Zegers for the HRS working group – Aug. 23/24, 2013

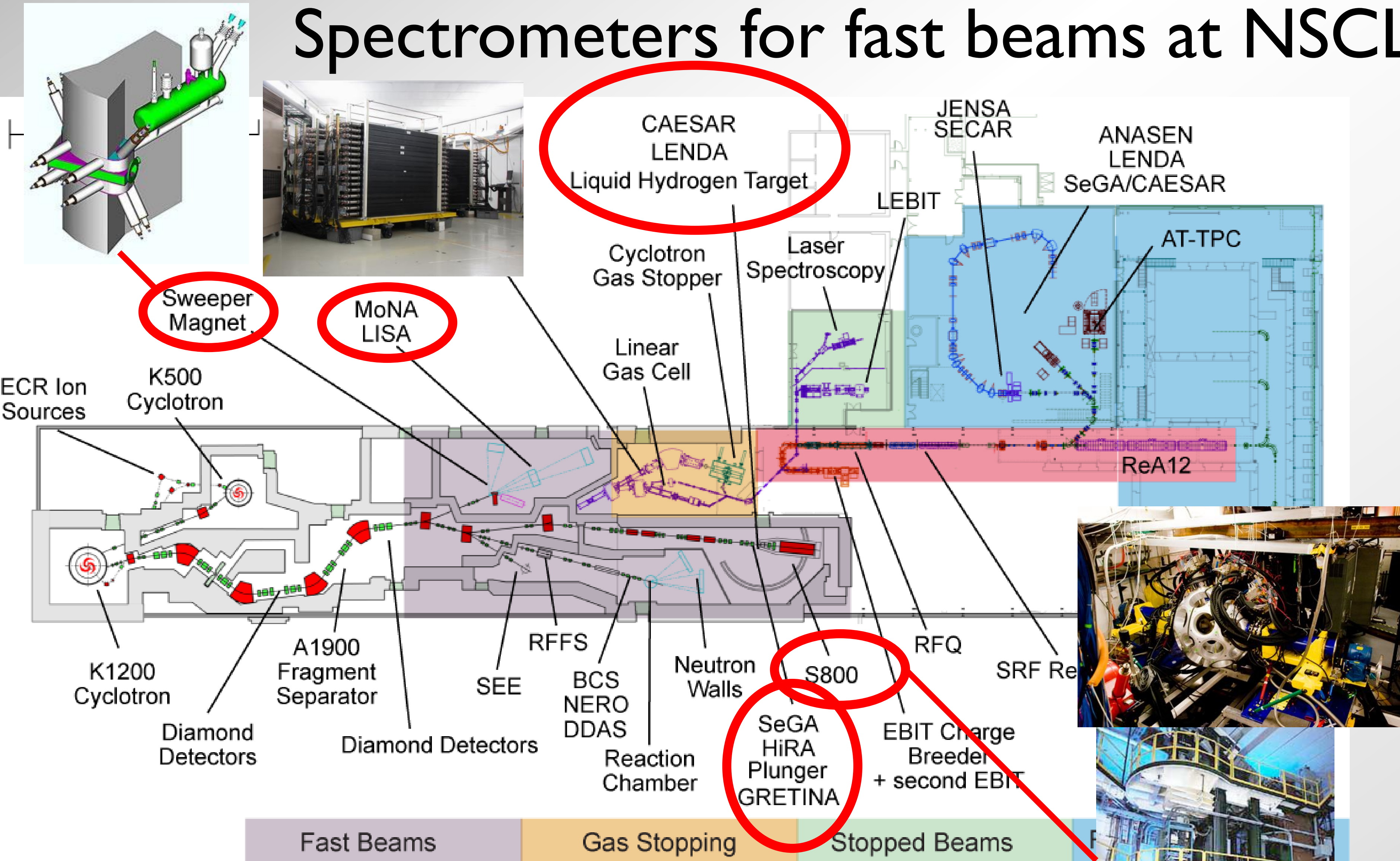
High Rigidity Spectrometer (HRS)

Build on the experiences from the very productive scientific programs with the S800 spectrometer and the Sweeper-MoNA-LISA setup at NSCL (and comparable setups (planned) at other facilities), while being cognizant that the unprecedented scientific opportunities present at FRIB will have to be matched by novel approaches in detection systems and operational techniques.

The science case for experiments with fast beams of rare isotopes is already very strong, but the design/proposal phase provides the best opportunity to consider new ideas and opportunities, and to strengthen the case even further: The whole community should be involved in the discussion about possible experiments with the rarest isotopes that can be produced at FRIB and in helping secure support and funding for the device.

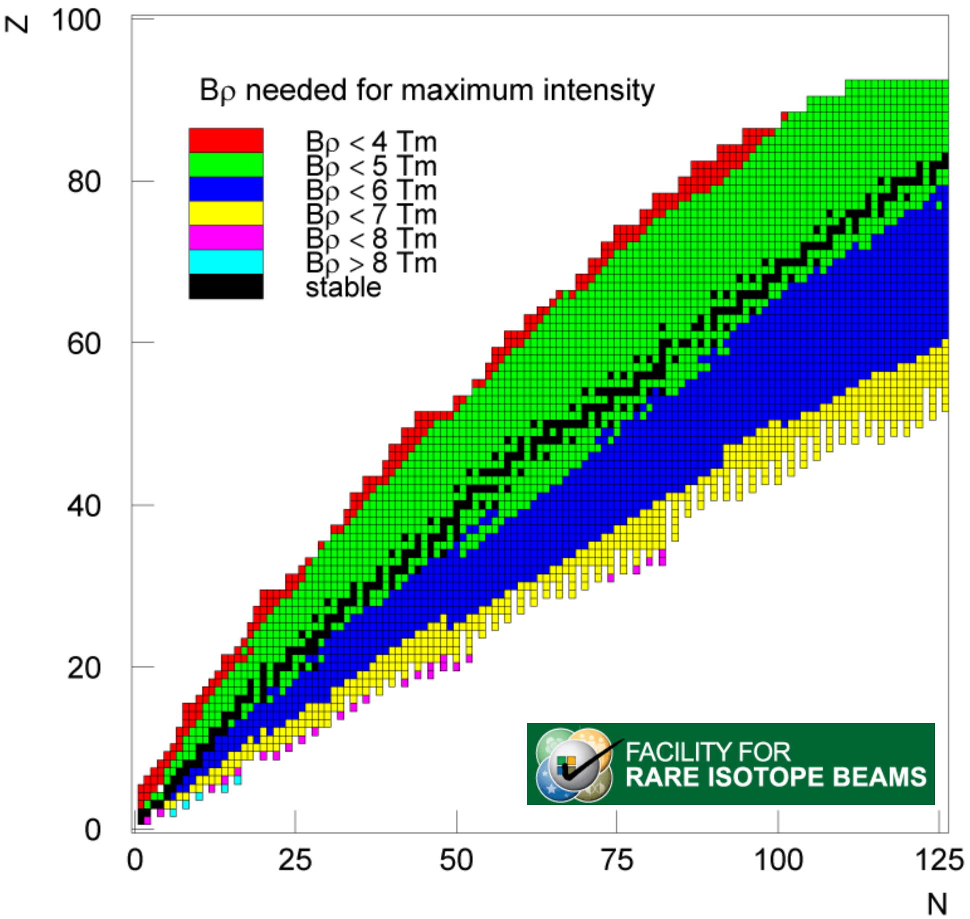
The goal in the near term (within a ~ 1 year) is to draft a whitepaper outlining the scientific case for the HRS, and that can serve as input for an upcoming Long-Range-Planning process. As part of the process, a conceptual design and cost-estimate for the HRS will be made.

Spectrometers for fast beams at NSCL



The magnetic rigidity of the S800 and Sweeper are limited to ~4 Tm.

By being able to perform experiments at rigidities at which maximum production yield is achieved, the HRS will strongly enhance the scientific output from FRIB, and will open new opportunities by allowing for experiments at higher and a wider range of beam energies.



Optimum rigidities for performing experiments with neutron-rich rare isotopes are beyond the capabilities of the S800 and Sweeper magnets.

Besides a loss in intensity, lowering the beam energy (either by starting with a lower primary beam energy, or slowing down the fragments) increases the level of contamination from other species and/or charge-states.

FRIB energy upgrade from 200 MeV/u to 400 MeV/u

High Discovery Potential

Experiments with fast beams allow for experiments closest to the neutron drip line

About 50% of NSAC RIB Taskforce benchmarks require experiments with fast beams (About 50% of experiments at NSCL require S800 spectrometer or sweeper magnet)

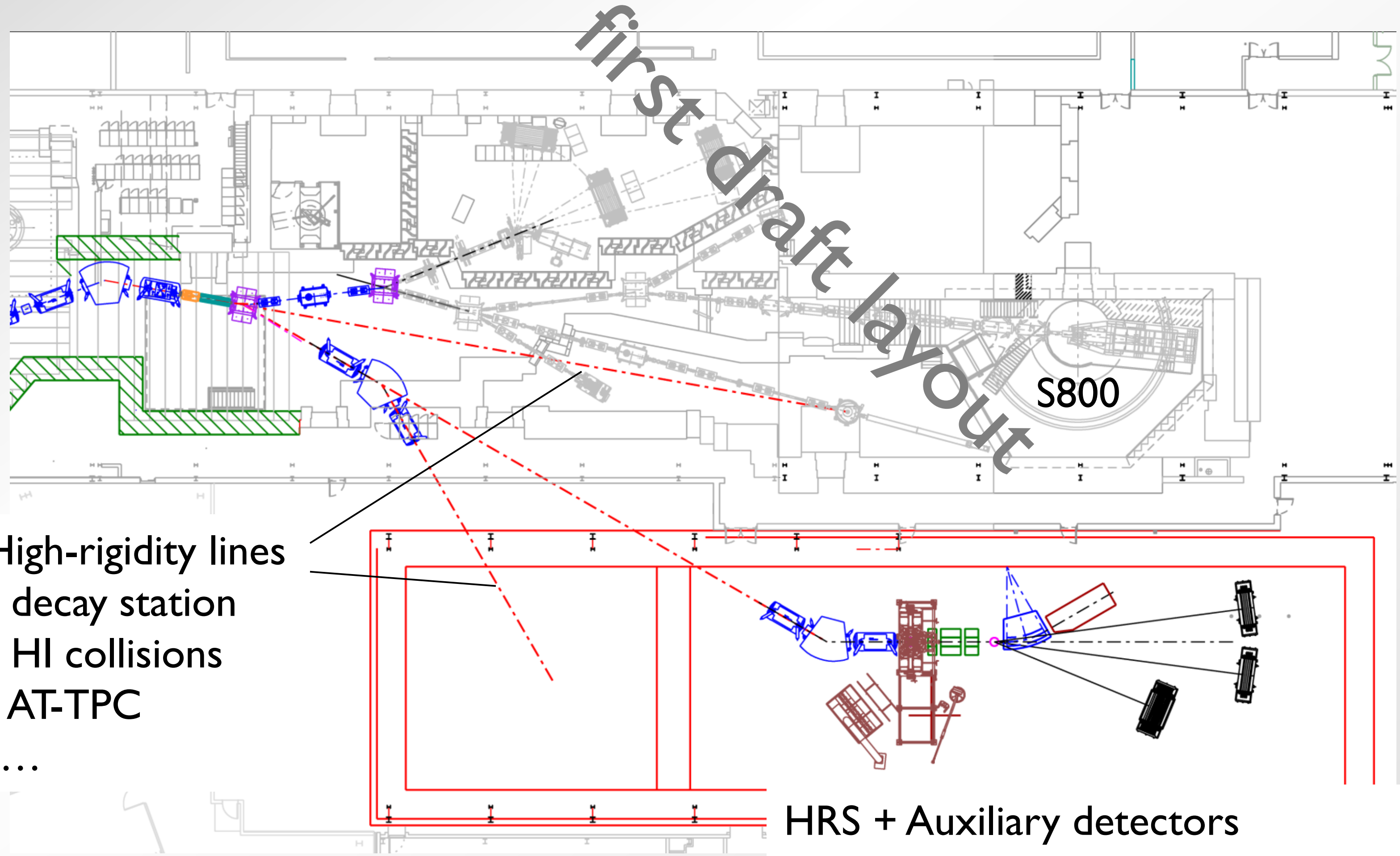
The program with the HRS at FRIB will maximize the output from other high-priority and very significant investments by DOE and NSF, such as GRET(IN)A and MoNA-LISA.

Fast-beams at FRIB

High Rigidity Spectrometer Replaces sweeper	S800	Multi-purpose station(s)
• High-Rigidity • Medium resolution • Variety of auxiliary detectors-maximize beam opportunities	• Medium rigidity (experiments at 50-100 MeV/u) • High resolution • Auxiliary detectors	• Decay Station • Heavy-ions collisions • AT-TPC • …

Be cognizant of the prospect that experiments with fast beams at FRIB should aim at, more so than ever, fully utilizing the available beam time. With the design of the HRS we have the opportunity to maximize the ways in which can study multiple channels simultaneously.

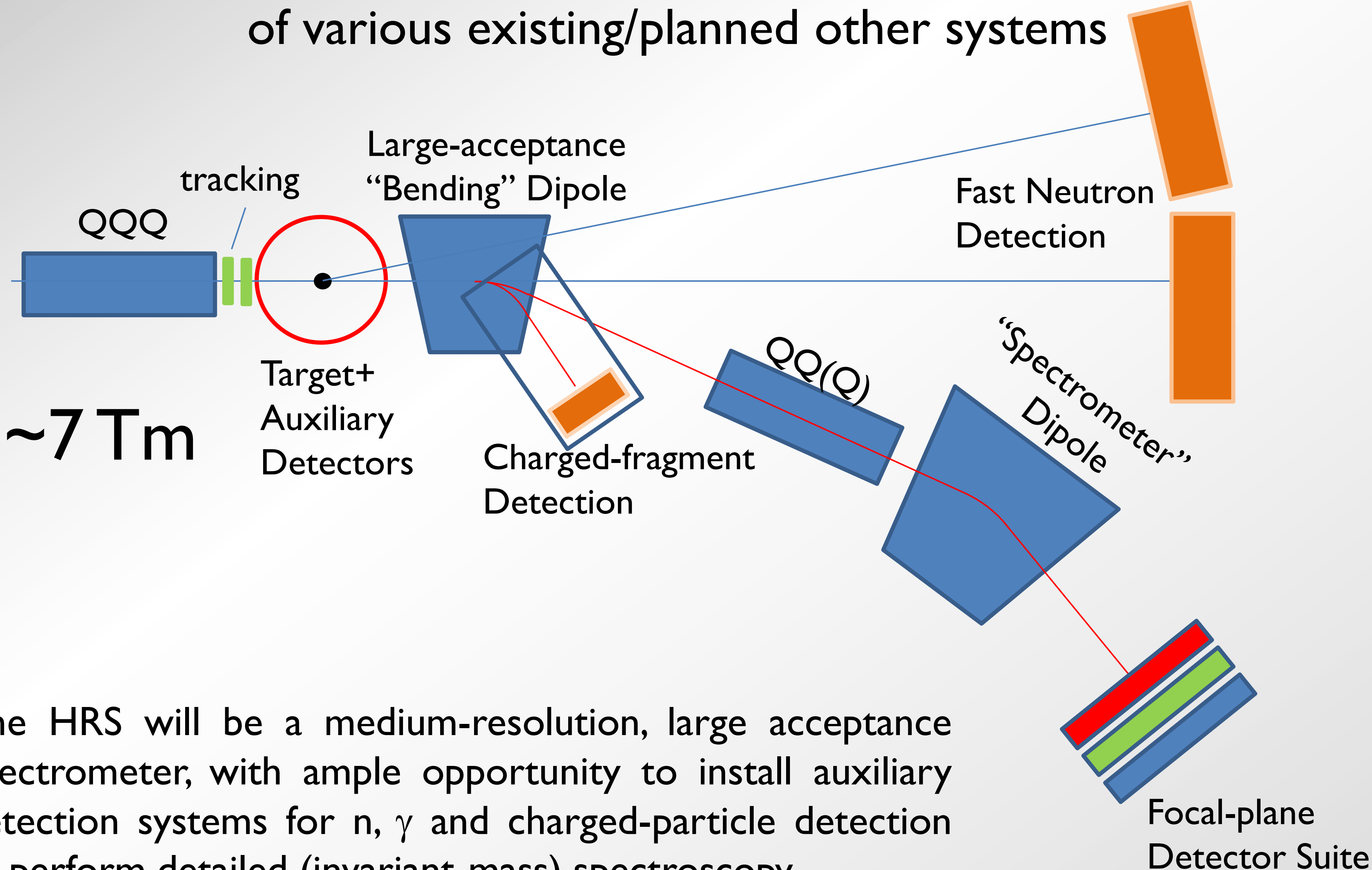
Strategic investment in laboratory infrastructure allows for the development of a high-quality and versatile experimental area for the HRS



High-rigidity lines
- decay station
- HI collisions
- AT-TPC
- …

HRS + Auxiliary detectors
(MoNA-LISA, GRET(IN)A, AT-TPC,etc.)

A very schematic layout discussed in the breakout session, evolved from an earlier preliminary design and considerations of various existing/planned other systems



The HRS will be a medium-resolution, large acceptance spectrometer, with ample opportunity to install auxiliary detection systems for n, γ and charged-particle detection to perform detailed (invariant-mass) spectroscopy.

What's next?

- White Paper focusing on the physics case – input for the Long-Range Plan
- Convergence on basic layout, followed by conceptual design
- Realistic cost estimates of the whole project, including beam lines

Make the science case, contribute to the white paper, design … and construction!

We are very interested in hearing from experts and people with experience in experiments with fast beams, as well as from people with different backgrounds that have new ideas, especially if they require very exotic isotopes, or other characteristics that might be facilitated by the HRS.

Get involved with the design and eventual construction – own part of the project – there is a lot of potential for groups working on the development of subsystems. Great way to get involved and being able to effectively use the HRS when it comes online

It is planned to have a focused workshop with people involved with the writing of the white paper and design within ~ ½ year. If you are interested, make sure to let us know!

Contact me: zegers@nscl.msu.edu or one of the other working group spokespersons: Daniel Bazin, Paul Fallon, Alexandra Gade, Ingo Wiedenhoever, Michael Thoennessen, Jim Brown.