HiRA Upgrade -- Instrumentation for FRIB

To get firmer ideas about instrument packages that will be proposed at the FRIB Workshop, Feb, 20-22, 2010, we request that each collaboration to fill in the following questionnaire. These should be e-mailed to Kim Lister (Lister@anl.gov) and copied to Brad Sherrill at (Sherrill@frib.msu.edu) and Rick Casten (Rick@riviera.physics.yale.edu) *no later* than Feb 12, 2010. The recommended **length** is **2 pages**, plus two additional figures. One figure should present the instrument and the other should indicate its location, size, etc on the floor at FRIB by using the attached floor plan template.

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1) What is the primary physics motivation and experimental capability of the proposed instrument and why is this important for FRIB science?

The High Resolution Array, HiRA and its potential upgrades would allow high resolution measurements of direct reactions, resonance spectroscopy, and reaction mechanisms with the fast beams at FRIB. HiRA currently provides such capabilities at the CCF/NSCL facility, but its resolution and efficiency can be improved with suitable upgrades.

2) What are the unique capabilities of this device that are not available in existing equipment? Is this instrument stand alone or is it to be used (solely or partially) in conjunction with other instruments. Could it be used at NSCL or other laboratories before FRIB?

This device can be used both as a stand alone device or in conjunction with other devices such as the S800 Spectrometer, the ATTPC, or other devices. It is ~~moveable~~ portable and has been used at the NSCL and at the Cyclotron Institute at Texas A&M.

3) Describe the instrument in some detail – how does it meet the scientific requirements and what are the (estimated) performance specifications? Be brief but as detailed as you can. Is the design fixed or are multiple options still being discussed and encouraged?

Currently, HiRA consists of 20 silicon, silicon, CsI(Tl) telescopes, with thicknesses of 65μm, 1.5 mm and 4.0 cm, respectively, a pitch of 2 mm and an active area of 6.4x6.4 cm^2 per telescope. It allows transfer reactions to be measured in inverse kinematics with a maximum geometical efficiency of about 65%. The number of telescopes, however, ~~are~~ is insufficient to cover the total available solid angel with this efficiency and the typical coverage is closer to 30% in order to optimize angular resolutions. Increasing the number of silicon detectors and optimizing the design for a single distance could close to double the solid angle coverage, while maintaining its resolution. The design ~~is~~ has not been fixed, and several options ~~can~~ will be considered. Changes in the CsI(Tl) detectors geometry can provide an increase in the granularity for penetrating particles and an improved efficiency for decay spectroscopy.

4) What is the current stage of development of your project ?

Different options are being considered and discussed, but have not crystalized in a design.

5) What is the approximate cost of the project: discuss possible sources of funding.

An upgraded HiRA would cost about $500k based on the present price of silicon and CsI(Tl) detectors and their electronics.

6) Please provide a brief list of collaborators and institutions. Spokesperson(s) provide contact info.

Michigan State University - William Lynch, ~~Manyee~~ Betty Tsang
Washington University - Lee Sobotka, Robert Charity, Jon Elson
Indiana University - Romualdo de Souza, Silvie Hudan
Western Michigan University - Michael Famiano
Southern University at Edwardsville - George Engel.
~~Spokesperson ??~~

7) Please can you outline how your collaboration has been developing your project and how you are growing your collaboration (How many meetings? Participants?, Circular mailings? Have you a web-site?)

HiRA is a working collaboration with regular meetings and experiments. The HiRA web-site can be found at: http://groups.nscl.msu.edu/hira/

8) Did you consider alternative designs? What alternatives were considered? How did you arrive at a final design?

We are considering alternative designs.

9) What existing equipment exists in the US Community that has similar goals and characteristics, even if inferior in performance.

The present HiRA array exists. There is also the ORRUBA being developed jointly by Rutgers University and Oak Ridge National Laboratory and the ANASEN array being developed jointly by Louisiana State University and Florida State University. Both devices are designed for low energy measurements with reaccelerated beams. Neither device is suitable for fast beams at FRIB.

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