What is the primary physics motivation and experimental capability of the proposed instrument and why is this important for FRIB science? A gas-filled magnetic separator for compound nucleus recoils will be one of the "workhorse" instruments at FRIB. Compound nucleus reaction products travel in the (radioactive) beam direction. A compound nucleus separator will be used to separate the compound nuclei from the unreacted beam, scattered beam, and projectile-like and target-like products of transfer reactions. Without such a separation, the radioactive decay of the projectiles and scattered projectile will render most detection devices useless. A gas-filled magnetic separator is the most efficient means for removal of projectiles. Gas-filled separators work best for compound nucleus products in the upper half of the chart of nuclides, and for relatively asymmetric "normal kinematics" reactions.

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? A new gas-filled separator built with superconducting magnets will be superior to existing compound nucleus separators in the following ways: 1) Angular acceptance will be approximately double that of the best existing separators, allowing higher compound nucleus efficiencies. This is especially important in the more asymmetric reactions with projectiles from C through Ar, where angular scattering of the compound nucleus recoils in the target material is important. 2) Superconducting magnets will allow sufficient separation with a much shorter flight path length. This will reduce the adverse effects of scattering in the gas on the optics, resulting in smaller focal plane images, while maintaining a large magnetic dispersion. A gas-filled separator will be a stand-alone instrument (to be used with a variety of detector set-ups). It could be built and tested at MSU or elsewhere before FRIB. The smaller size compared to existing compound nucleus recoil separators will make it more portable.

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? The favored design is a relatively simple magnetic configuration consisting of two 90-degree flat-field dipole magnets. One dipole will bend the recoils in the horizontal direction, and the second will bend the recoils in the vertical direction. While the optics resulting from this two-dimensional magnetic dispersion configuration are more complicated, the device and its operation are simplified because all focusing (vertical and horizontal) is geometric (no focusing elements such as quadrupoles are needed).

What is the current stage of development of your project ? Capabilities and operation of gas-filled compound nucleus separators are well understood. The design of a new gas-filled separator is in the conceptual design stages.

What is the approximate cost of the project: discuss possible sources of funding.
Rough estimate of cost is $5M. FRIB equipment funds are the only funding source considered so far.

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

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?)

Did you consider alternative designs? What alternatives were considered? How did you arrive at a final design? Gas-filled magnetic separators give orders of magnitude better suppression of scattered beam. Different magnetic configurations can be considered.

What existing equipment exists in the US Community that has similar goals and characteristics, even if inferior in performance? The Berkeley Gas-filled Separator (BGS) has capabilities that would work well at FRIB. However, the BGS was constructed from old magnets in 1996-1999. By the startup of FRIB, the BGS will be an extremely old machine.