

ISLA: Isochronous Spectrometer with Large Acceptances

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NSCL / MSU

FRIB Equipment Workshop

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Physics drivers in need for a spectrometer @ ReA12

- Deep-inelastic reactions using neutron-rich beams
- in-beam γ -ray spectroscopy of high-spin states
- Transfer and resonant reactions
- Fusion-evaporation reactions for spectroscopic studies
- Fusion reactions with neutron-rich beams
- Study of fission barriers
- Astrophysics and decay studies
- ...

Requirements for a High Efficiency Spectrometer using ReA12 beams

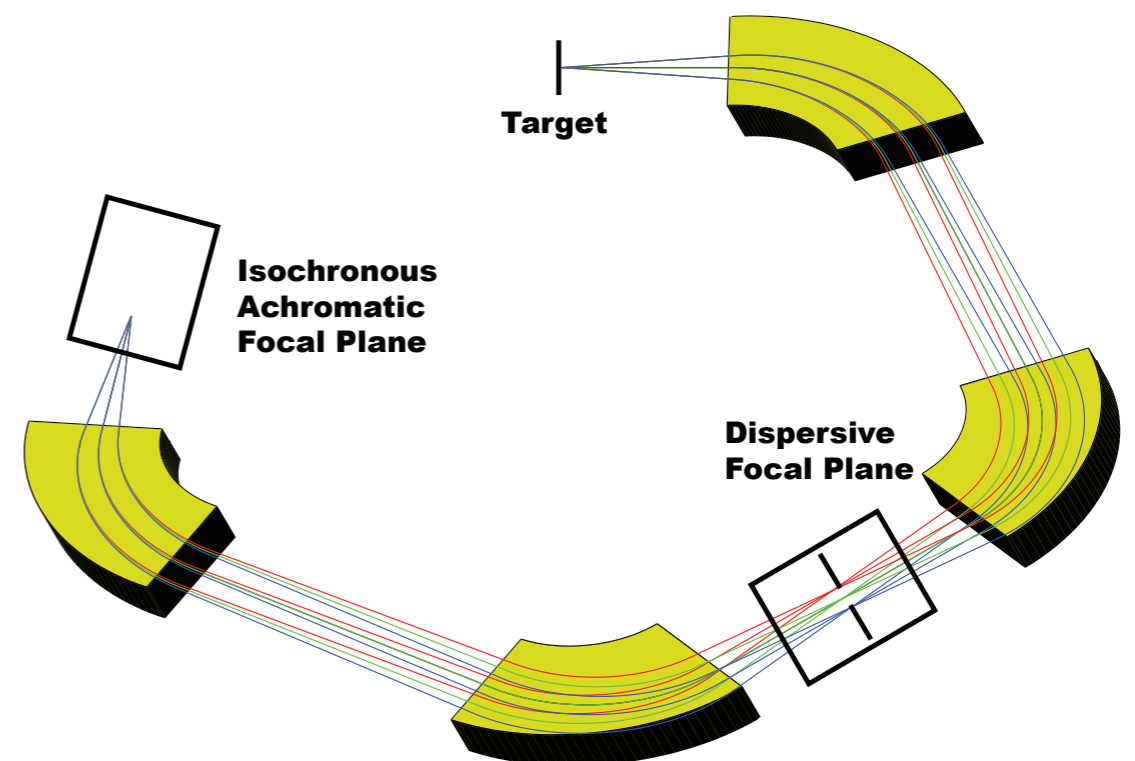
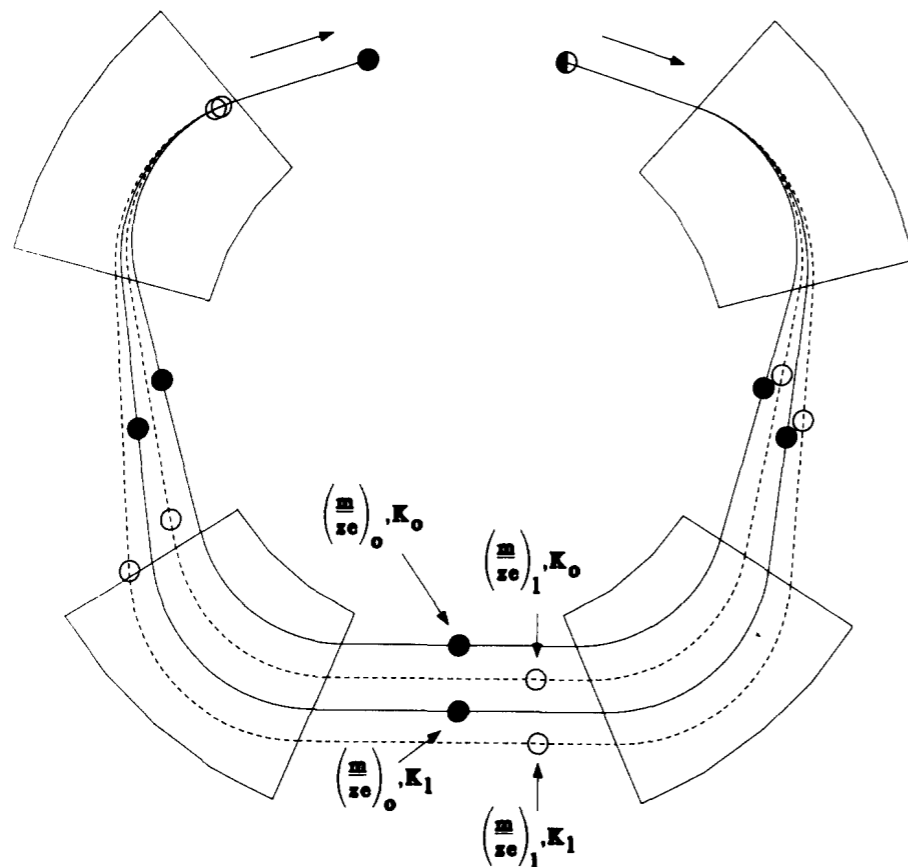
- Collect reaction products in large kinematic space
- Transmit several charge states for high efficiency
- Identify reaction products with good elemental and mass resolutions
- Reject unreacted beam
- Accommodate auxiliary detector array around target
- Possibly rotate beam around target

Existing spectrometers

- Compromises between acceptance, resolution and focal plane size
- Small acceptance spectrometers
 - Small acceptances ☹, small aberrations ☺, small focal plane ☺
 - Examples: FMA, RMS, Wien filters
- Large acceptance spectrometers
 - Large acceptances ☺, large aberrations ☹, large focal plane ☹
 - Examples: VAMOS, PRISMA, MAGNEX
- Gas-filled spectrometers
 - Large charge state acceptance ☺, poor resolution ☹

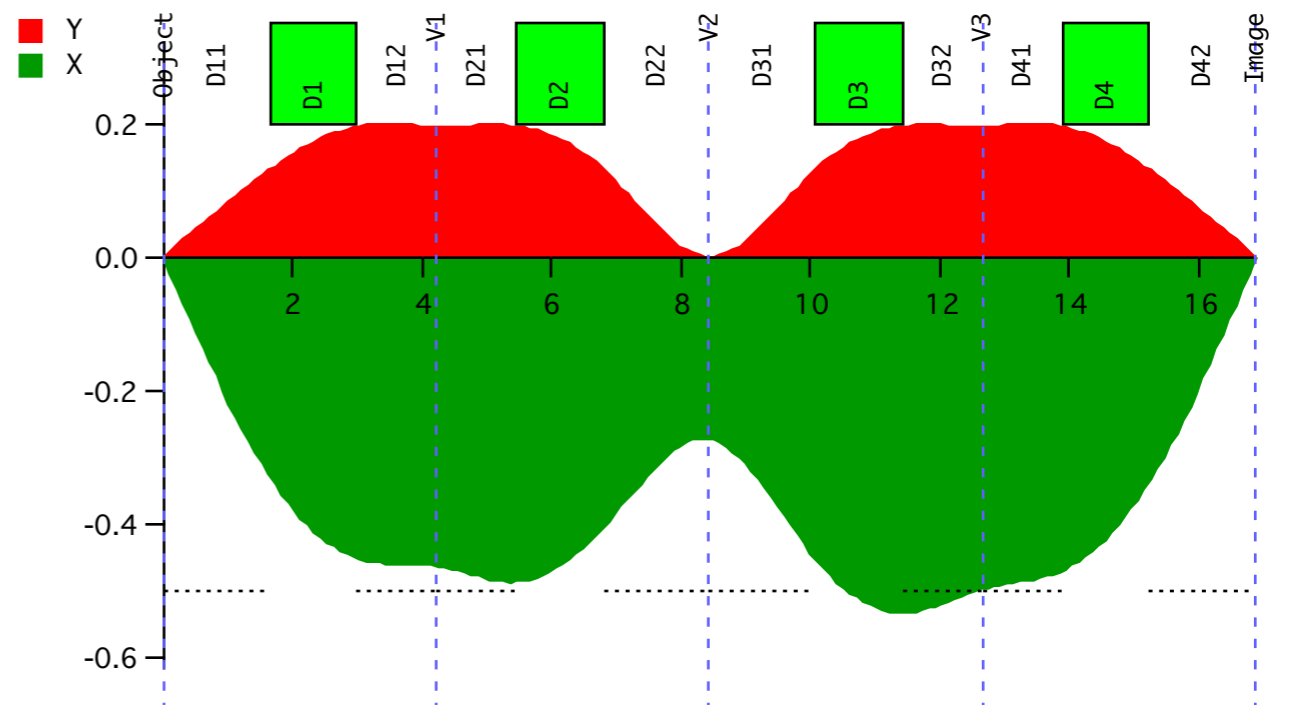
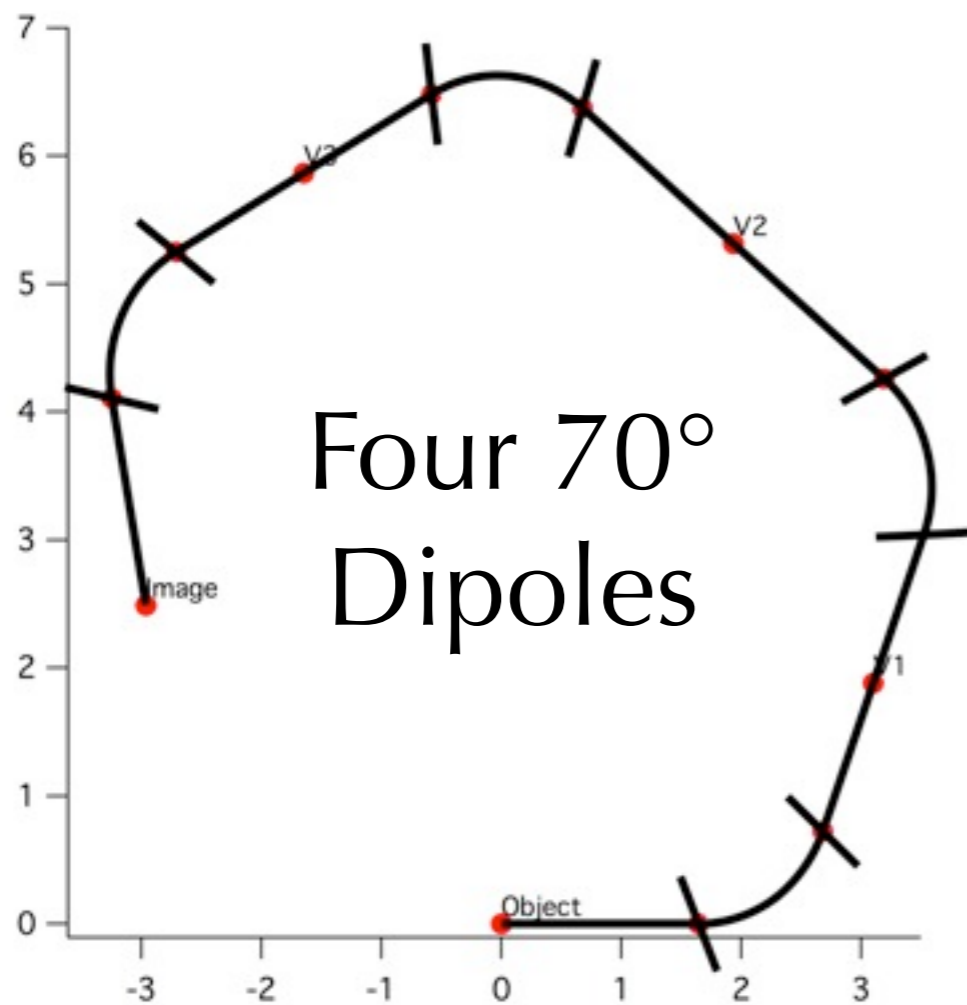
ISLA concept

- Best of both worlds
 - Large acceptances, small aberrations, high resolution, small focal plane
 - Inspired from the TOFI design (LANL), isochronous, quadrupole-free, iron-free spectrometer



Optical properties

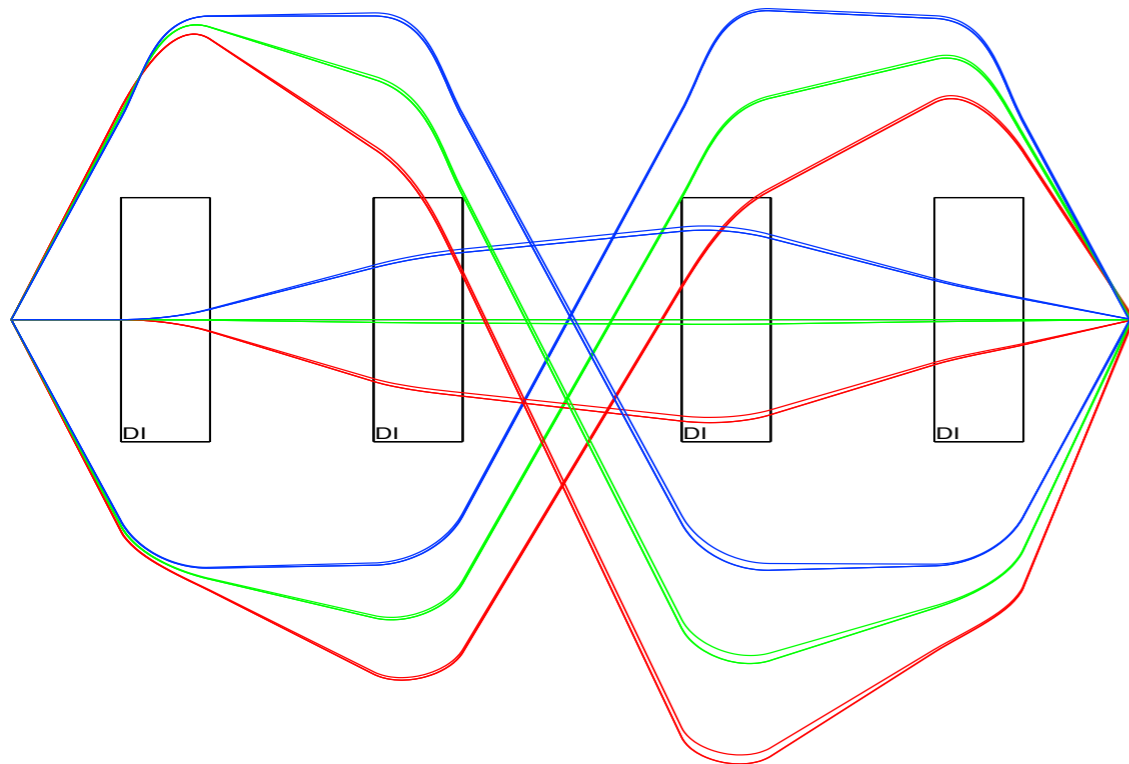
- First order optics
 - Dispersive focal plane at mid-point
 - Isochronous, achromatic final focal plane



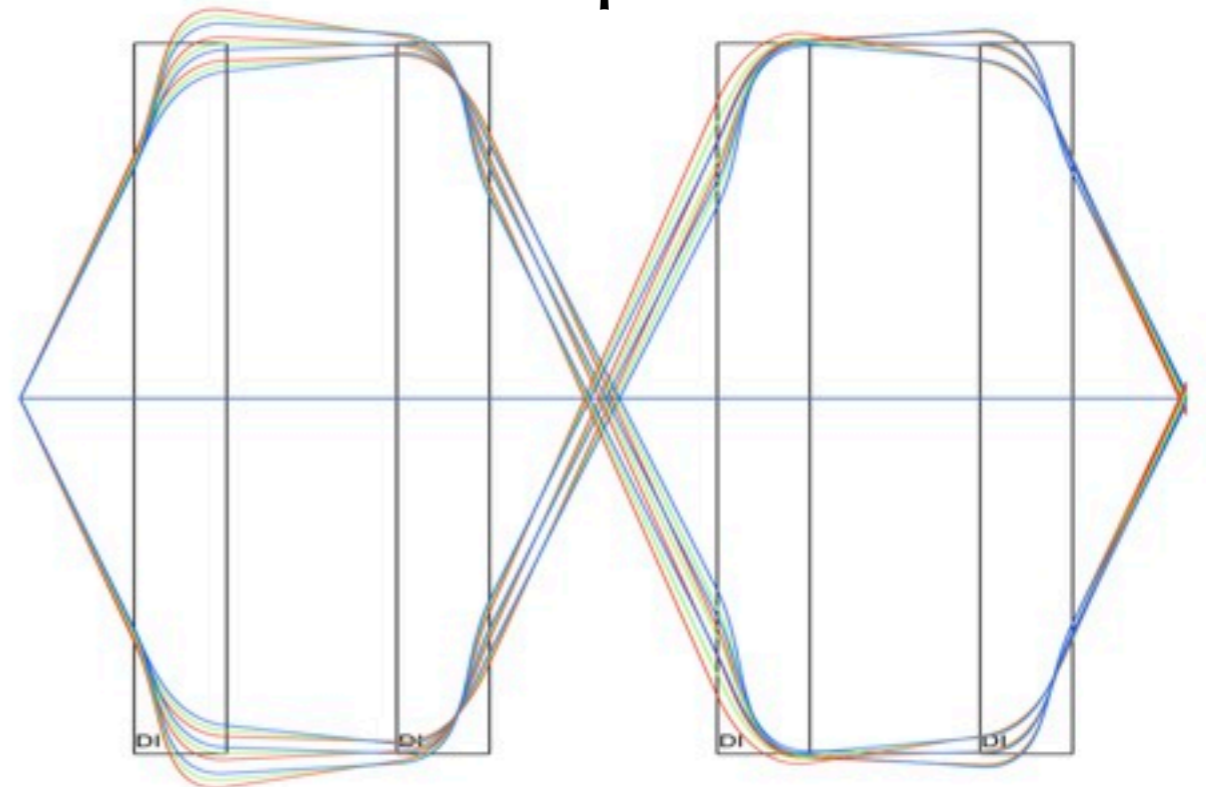
Optical qualities

- Large acceptances, small aberrations, high M/Q resolution
- 3rd order calculations using iron-free dipole design fringe fields

Dispersive



Non dispersive

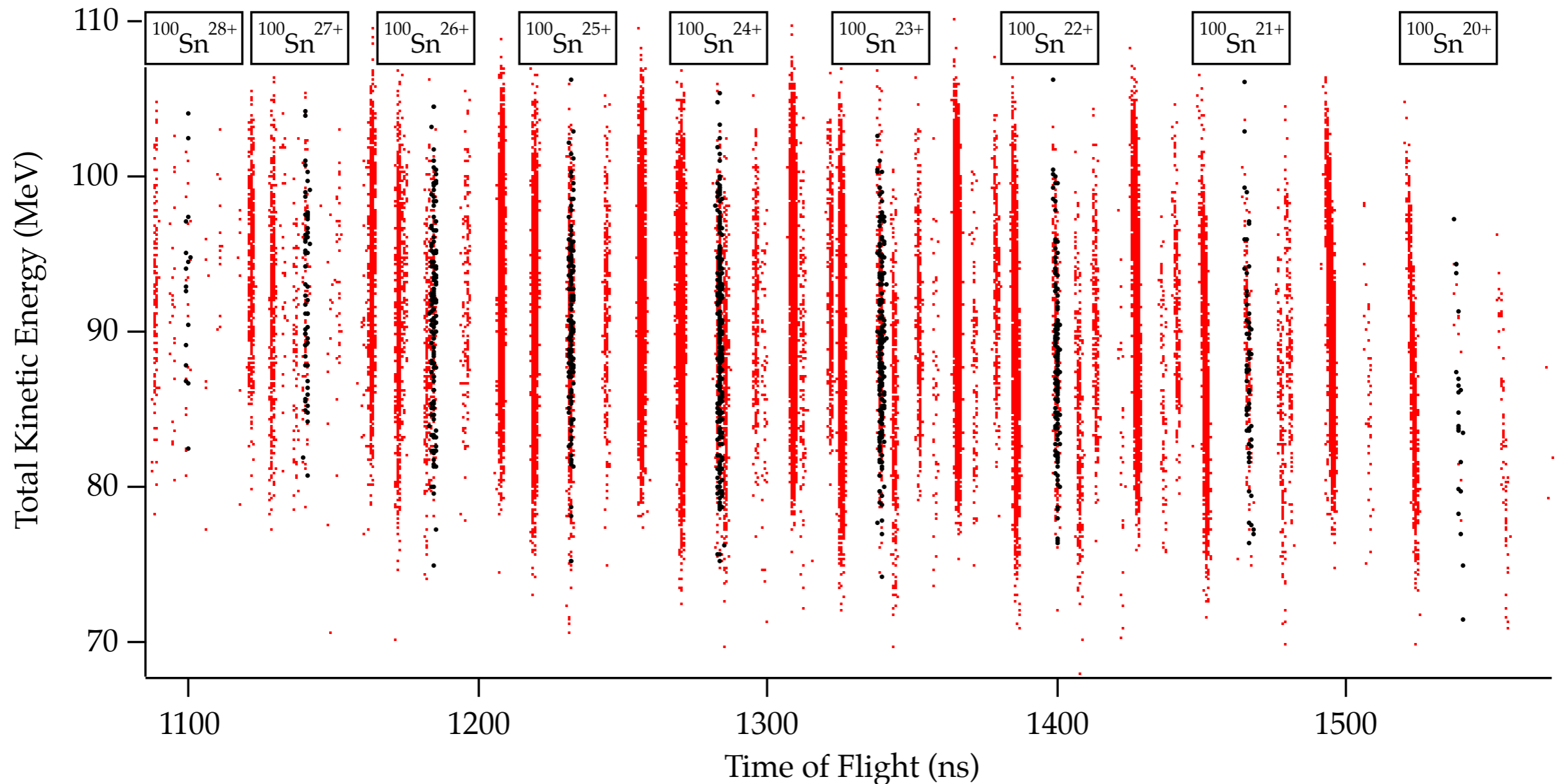


ISLA performance

- Acceptances
 - 64 msr (± 200 mrad dispersif, ± 80 mrad non-dispersif)
 - 10% $\Delta P/P$ (and M/Q) @ 64 msr, 16% @ 32 msr
- Optical properties
 - M/Q : $\sim 1/2000$ intrinsic at full acceptance and without corrections, depends also on RF bunch size
 - Dispersion at dispersive focal plane: 5.4 cm/% $\Delta P/P$
 - Point-to-point imaging at isochronous focal plane
 - Maximum rigidity: 3.2 T.m.

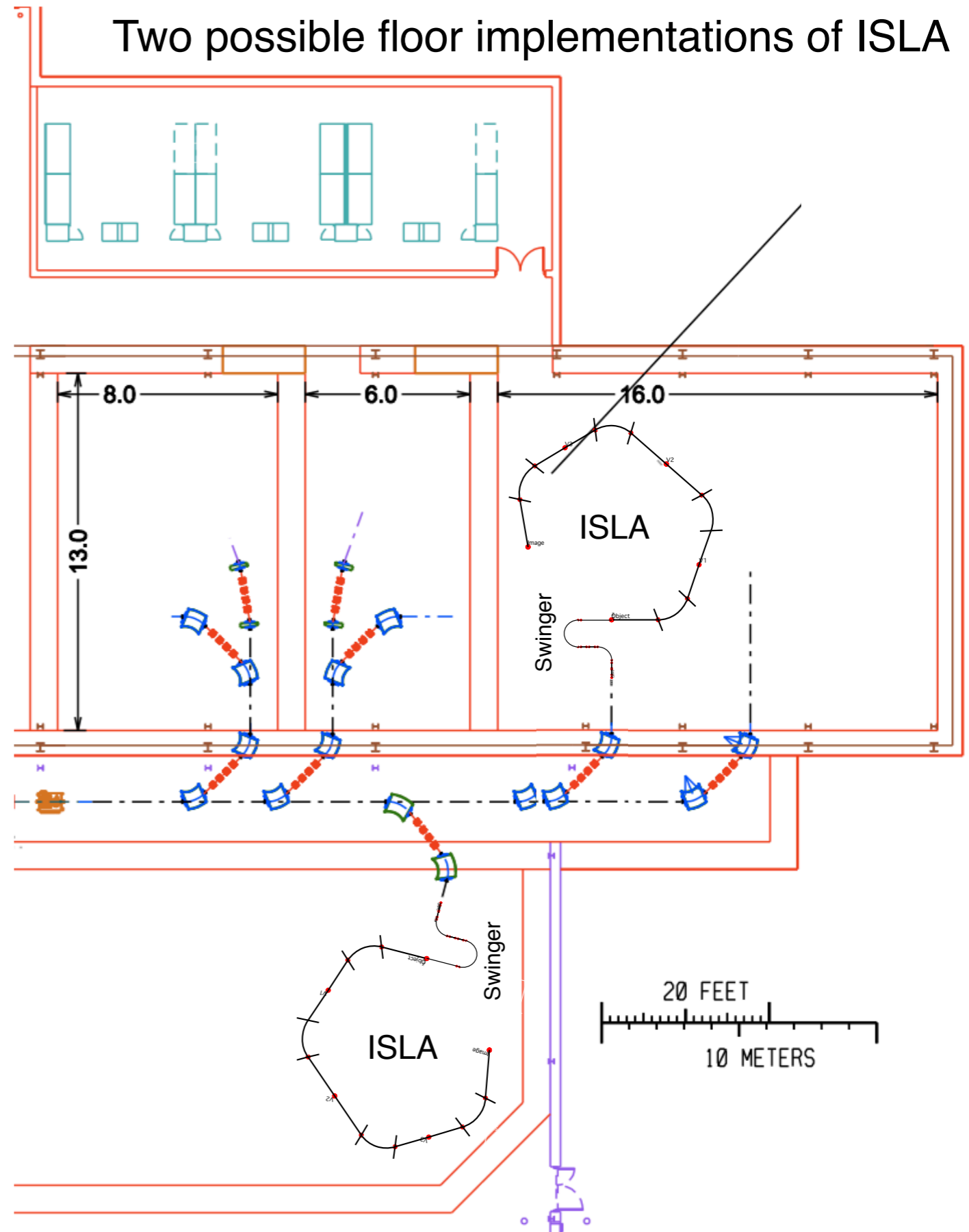
Monte-Carlo simulation

- Symmetric fusion-evaporation $^{56}\text{Ni}+^{50}\text{Cr}: ^{100}\text{Sn}$
- Time of Flight resolution: 1 ns from RF bunch



Possible vault implementations

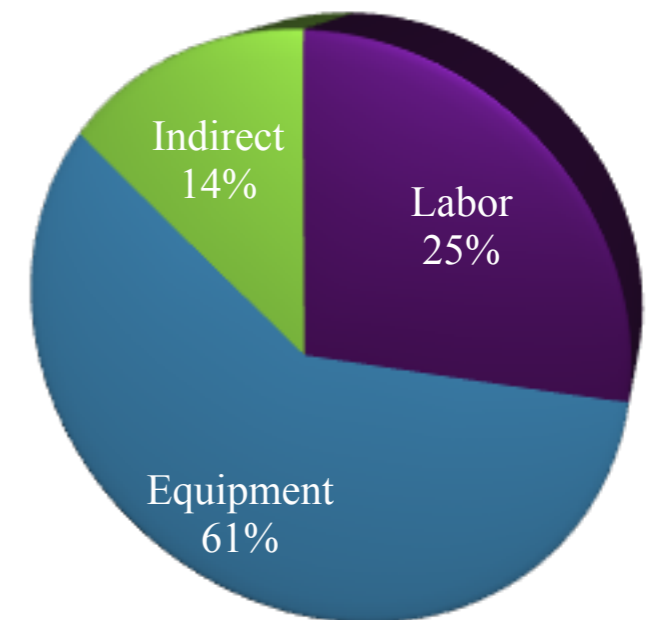
- ISLA and its beam swinger drawn to scale
- Two possible locations in ReA12 experimental areas



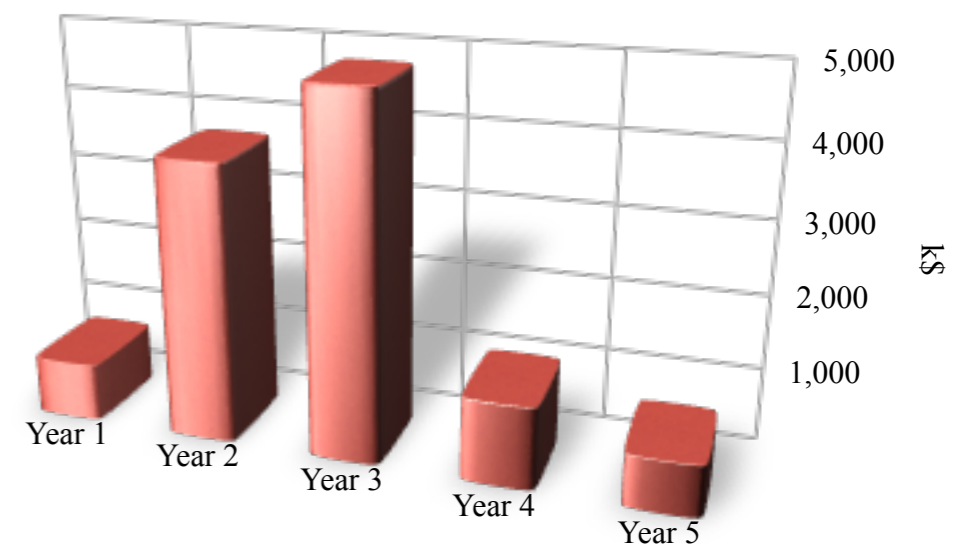
Preliminary budget

Items	Cost in M\$ (25% cont.)
Dipoles	5.5
Swinger & others	0.6
Infrastructure	0.4
Detectors	0.3
Indirect	1.5
Labor	2.8
Total	11.1

Cost repartition by categories



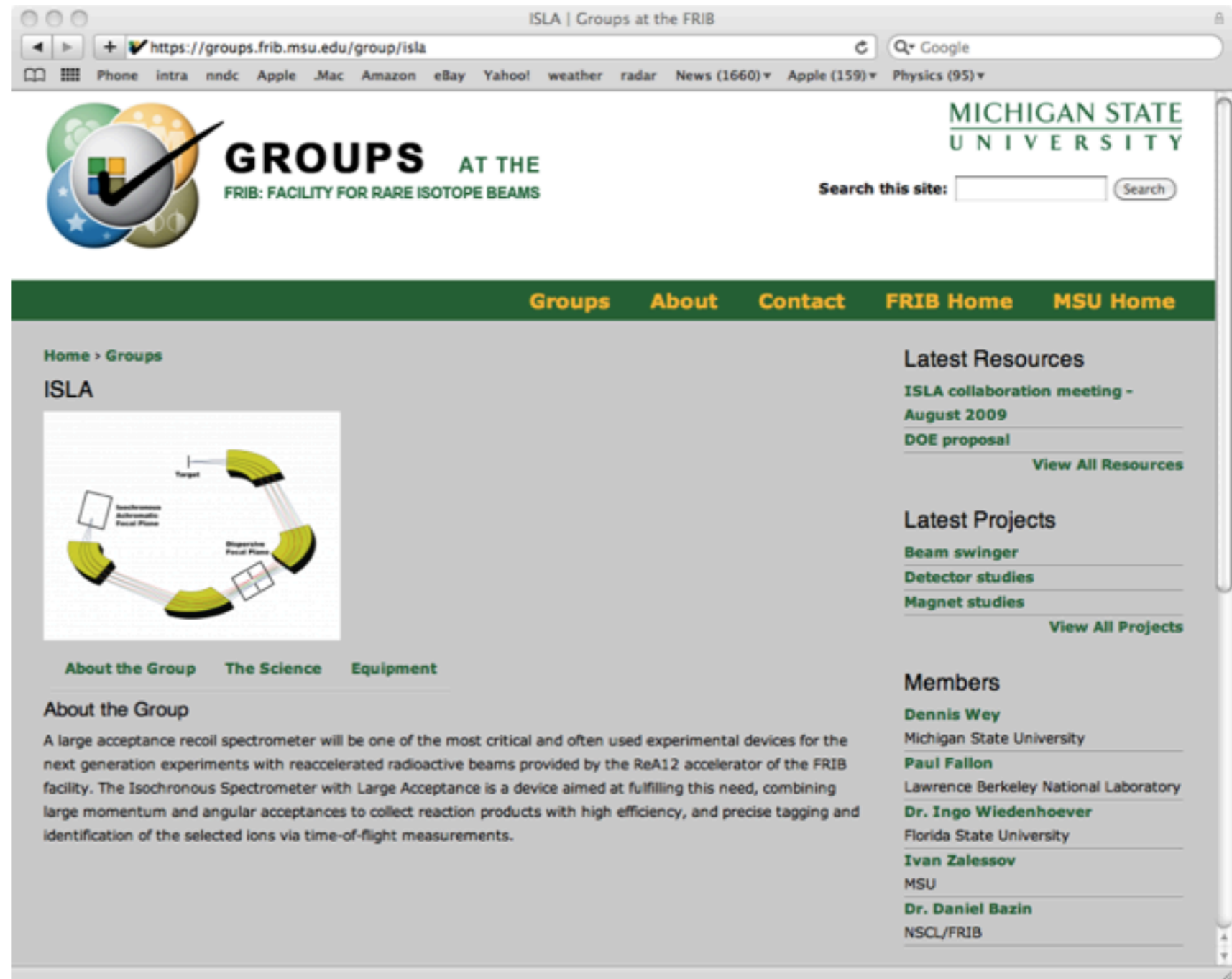
Yearly appropriations



Workgroup and web site

- 29 members from 7 institutions
- Web site main communication channel
- Contacts:
 - bazin@nscl.msu.edu
 - mittig@nscl.msu.edu

<https://groups.frib.msu.edu/group/isla>



The screenshot shows a web browser window displaying the ISLA web site. The browser's address bar shows the URL <https://groups.frib.msu.edu/group/isla>. The page header includes the Michigan State University logo and a search bar. The main navigation menu contains links for [Groups](#), [About](#), [Contact](#), [FRIB Home](#), and [MSU Home](#). The page content is titled "ISLA" and features a diagram of the Isochronous Spectrometer with Large Acceptance (ISLA) setup, showing a target, a dispersive focal plane, and a beam swinger. Below the diagram are links for [About the Group](#), [The Science](#), and [Equipment](#). The "About the Group" section describes the ISLA as a large acceptance recoil spectrometer used for next-generation experiments with reaccelerated radioactive beams. The right sidebar contains sections for "Latest Resources" (including ISLA collaboration meeting - August 2009 and DOE proposal), "Latest Projects" (including Beam swinger, Detector studies, and Magnet studies), and "Members" (listing Dennis Wey, Paul Fallon, Dr. Ingo Wiedenhoever, Ivan Zalessov, and Dr. Daniel Bazin).