



Silicon Arrays

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- Silicon detectors are crucial for charged particle detection
 - Energy resolution (up to 25 keV)
 - Good timing characteristics (~1 ns resolution.)
 - Position sensitivity (1 mm and better)
 - Pulse shape analysis for particle ID
 - Compact

- There is no single multipurpose, universal, one size fits all Silicon Array.
- Silicon Arrays are rarely stand alone and usually combined with other detectors.
 - Silicon Array + Gamma Array + Spectrometer
 - Silicon Arrays + CsI(Tl) for Fast Beams.
 - Silicon Array + Active target / gas counter.
 - Other

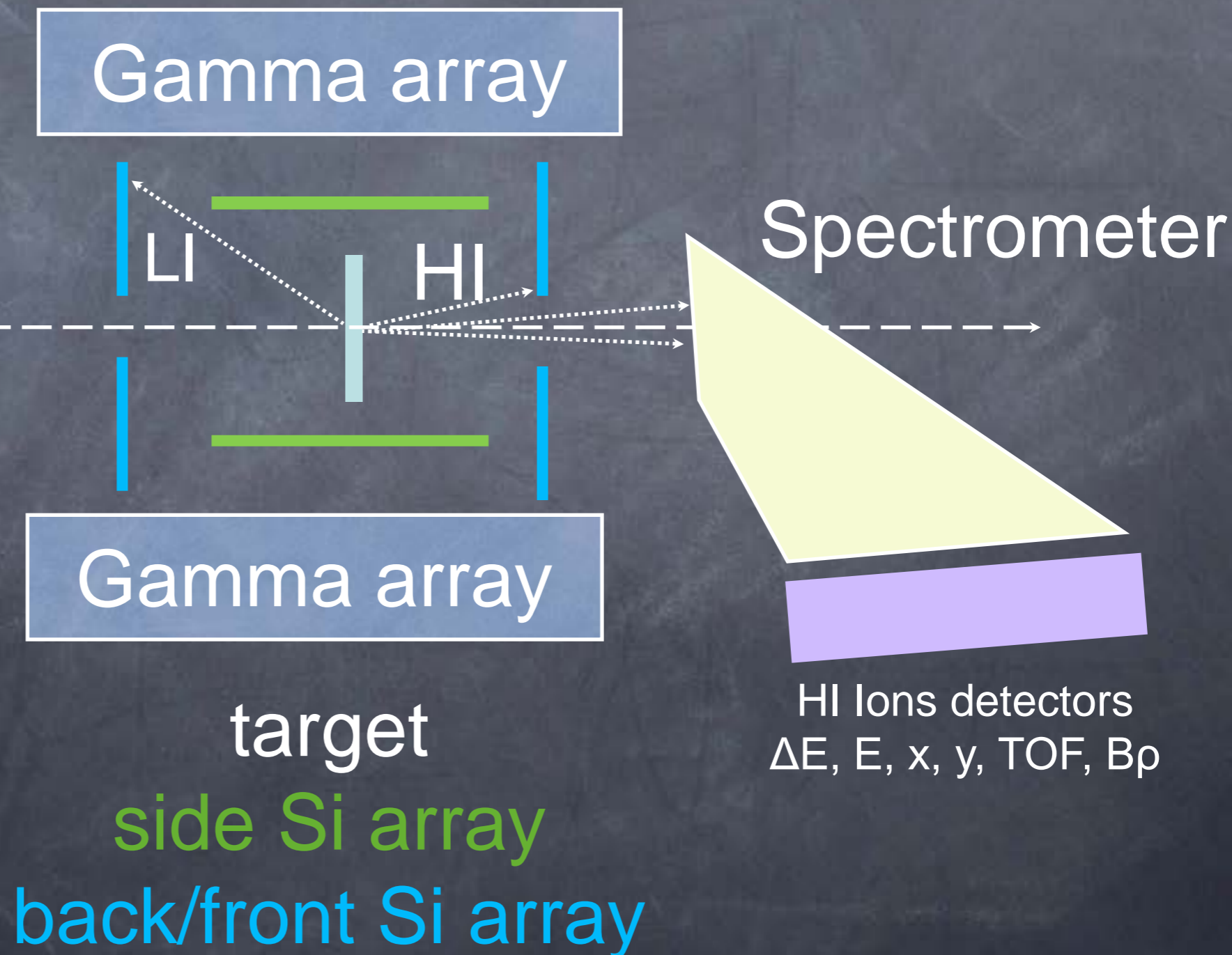
Si array + Gamma array + spectrometer

Gamma detection improves resolution, but reduces efficiency

RIB

Coincidence between light recoil and γ -ray can be measured with RIBs $>10^5$ pps

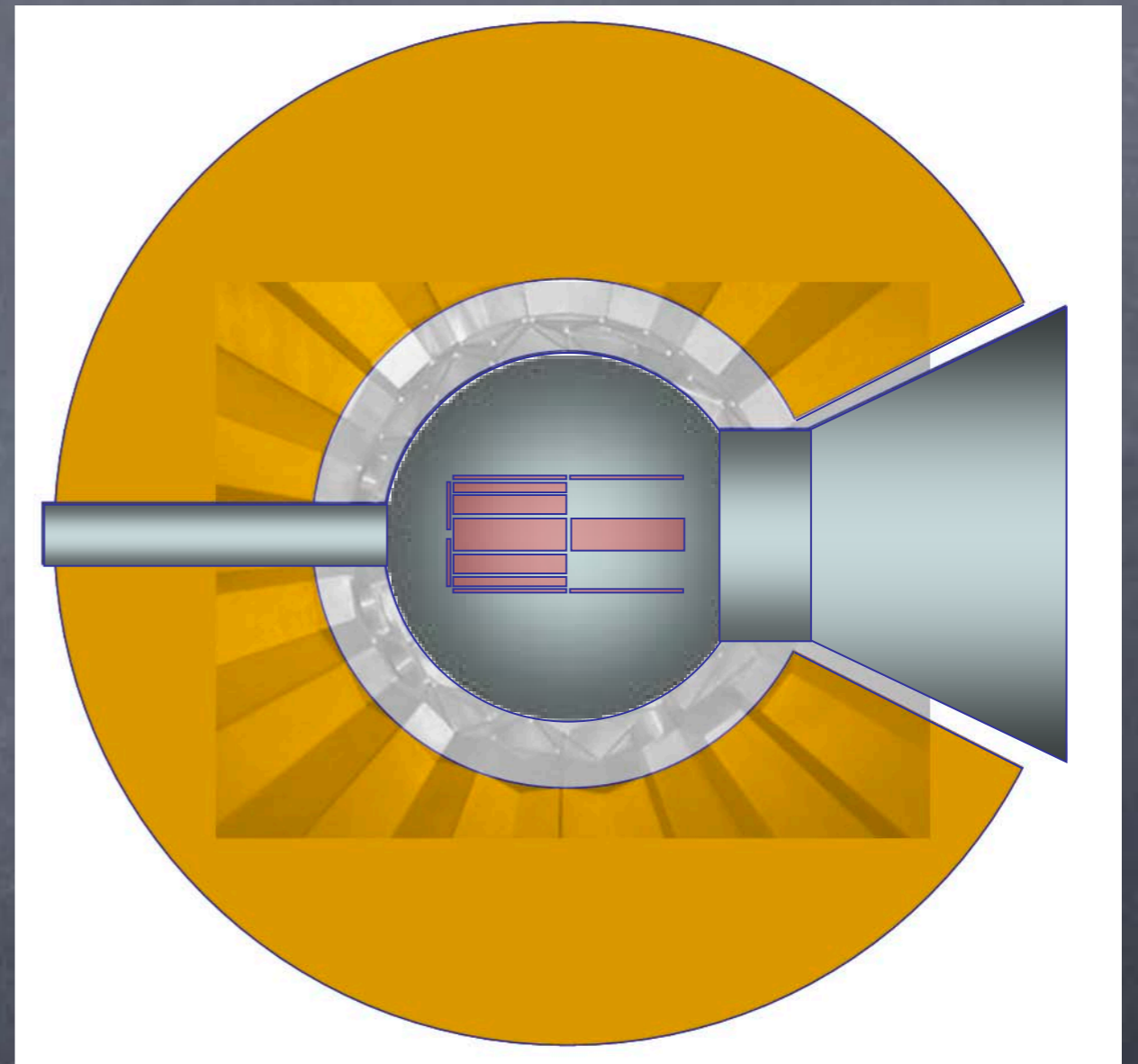
Thick target allows to perform measurements with beams $>10^3$ pps (no light recoil is measured)



Coupling Silicon Arrays to Gamma Arrays

Physics: direct reactions + good energy resolution of gamma detectors.

- ORRUBA + GAMMASPHERE
Steve Pain, Univ of W of Scotland
Dan Bardayan, Michael Smith,
ORNL J. Cizewski, Rutgers
- HYBALL at ORNL, A. Galindo-Uribarri
- SHARC (Collaboration of
U of York, U of Manchester, U of
Surrey, U of Birmingham, U of
Liverpool, Daresbury L, Louisiana S
U, TRIUMF, McMaster U, St.
Marry's U, Simon Frazer U, U de
Motreal)



**Objective: compactness
and high segmentation**

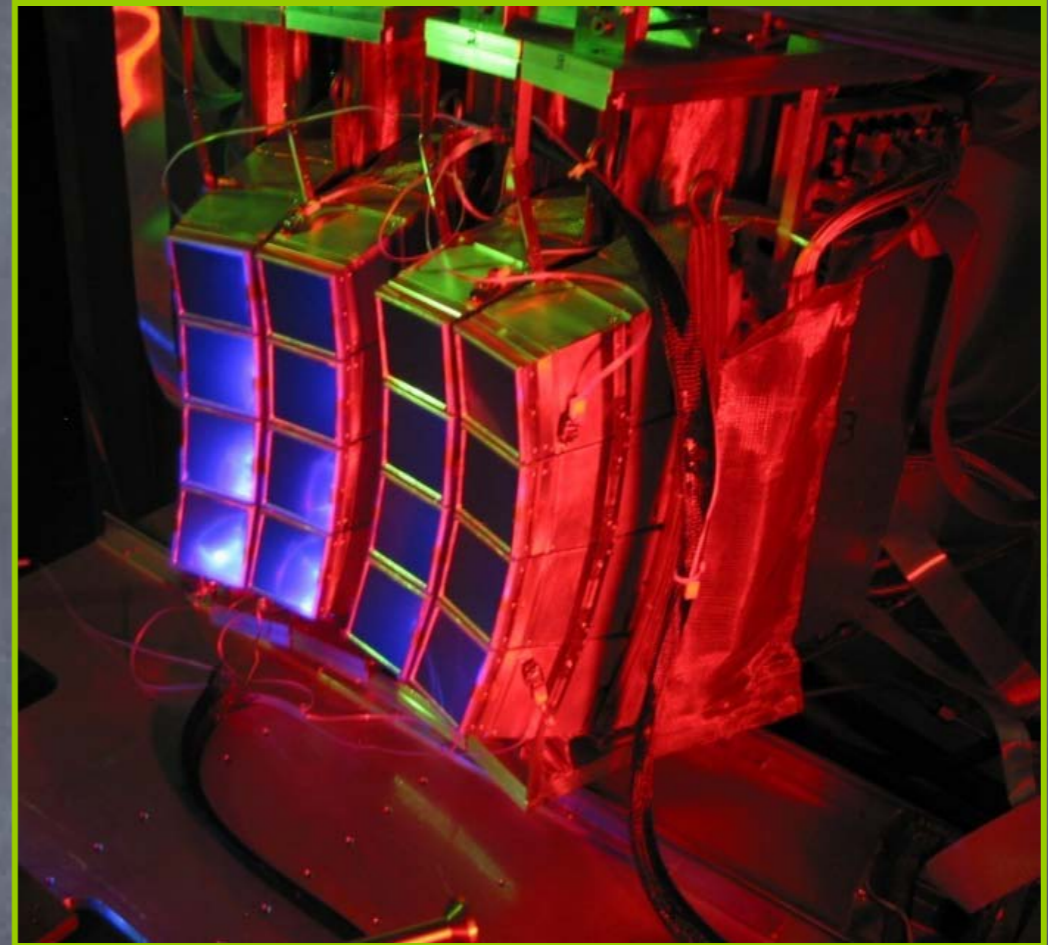
FAST beams: HiRA upgrade

Physics: Direct Reactions,
Breakup and Coulomb disassociation,
Resonance Spectroscopy,
Correlation functions,
Fragmentation.

It is possible to increase the efficiency presently available with HiRA by a factor of two or more.

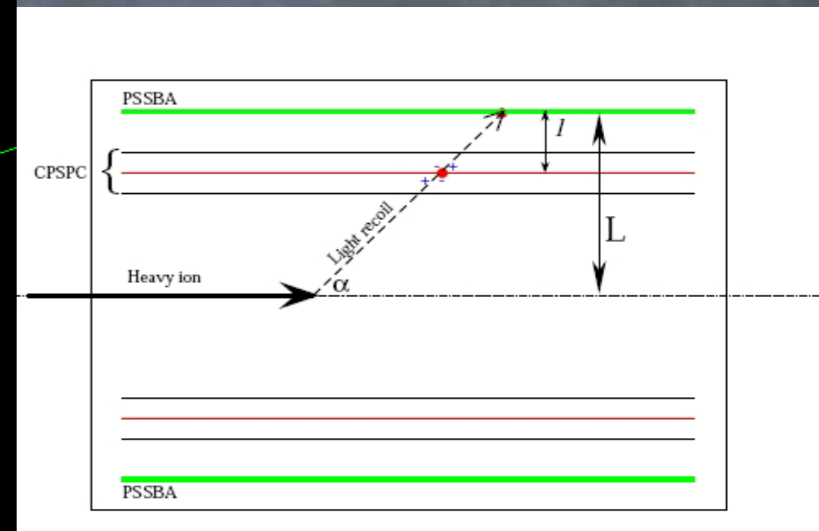
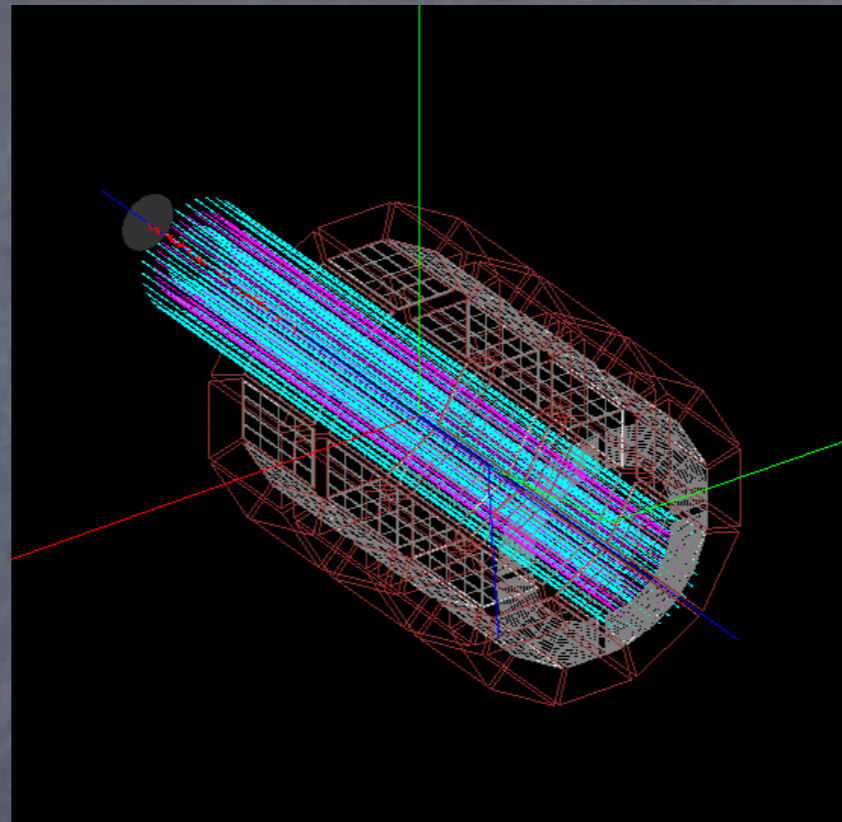
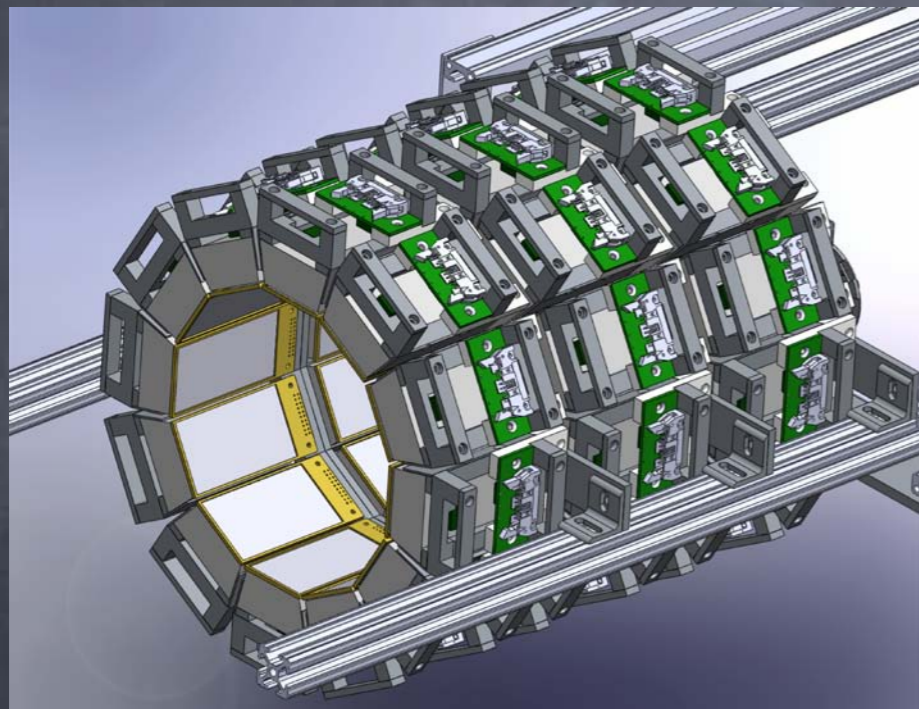
- Requires an increase in the number of telescopes.
- Requires increased granularity of the CsI(Tl) detectors

Collaboration of Michigan State University, Indiana University, Washington University in St. Louis, SIU at Edwardsville, INFN Milano, and Western Michigan University.



Coupling Silicon Arrays with Active Target.

Physics: thick target with tracking capability - resonance reactions (measuring excitation functions), direct reactions.



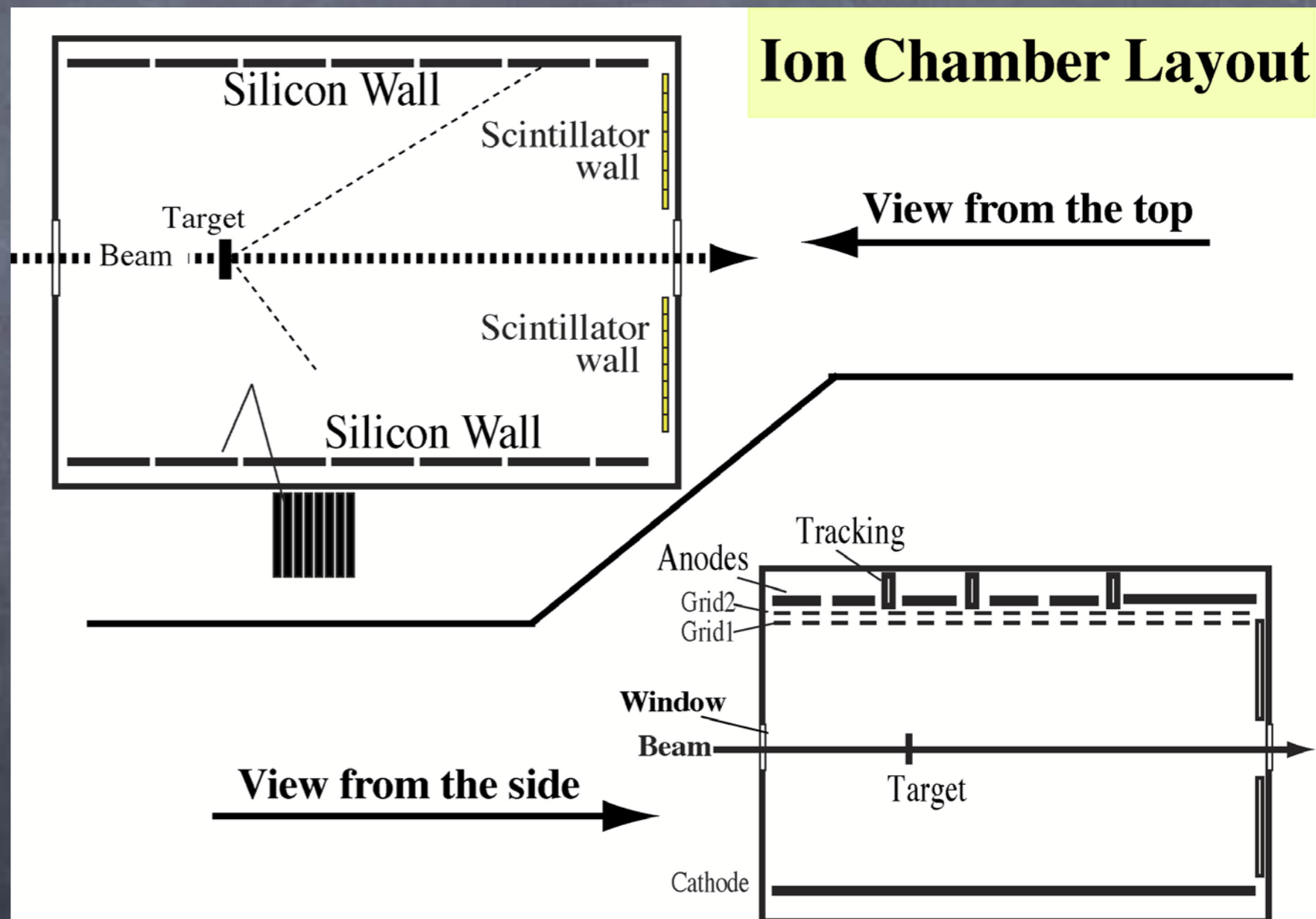
ANASEN (Array for Nuclear Astrophysics Studies with Exotic Beams)

Collaboration of Louisiana S U, Florida S U, ORNL, Michigan S U

Coupling Silicon Arrays with gas counters for tracking.

Physics: Fusion-fission, fusion evaporation, deep inelastic, quasi-elastic.

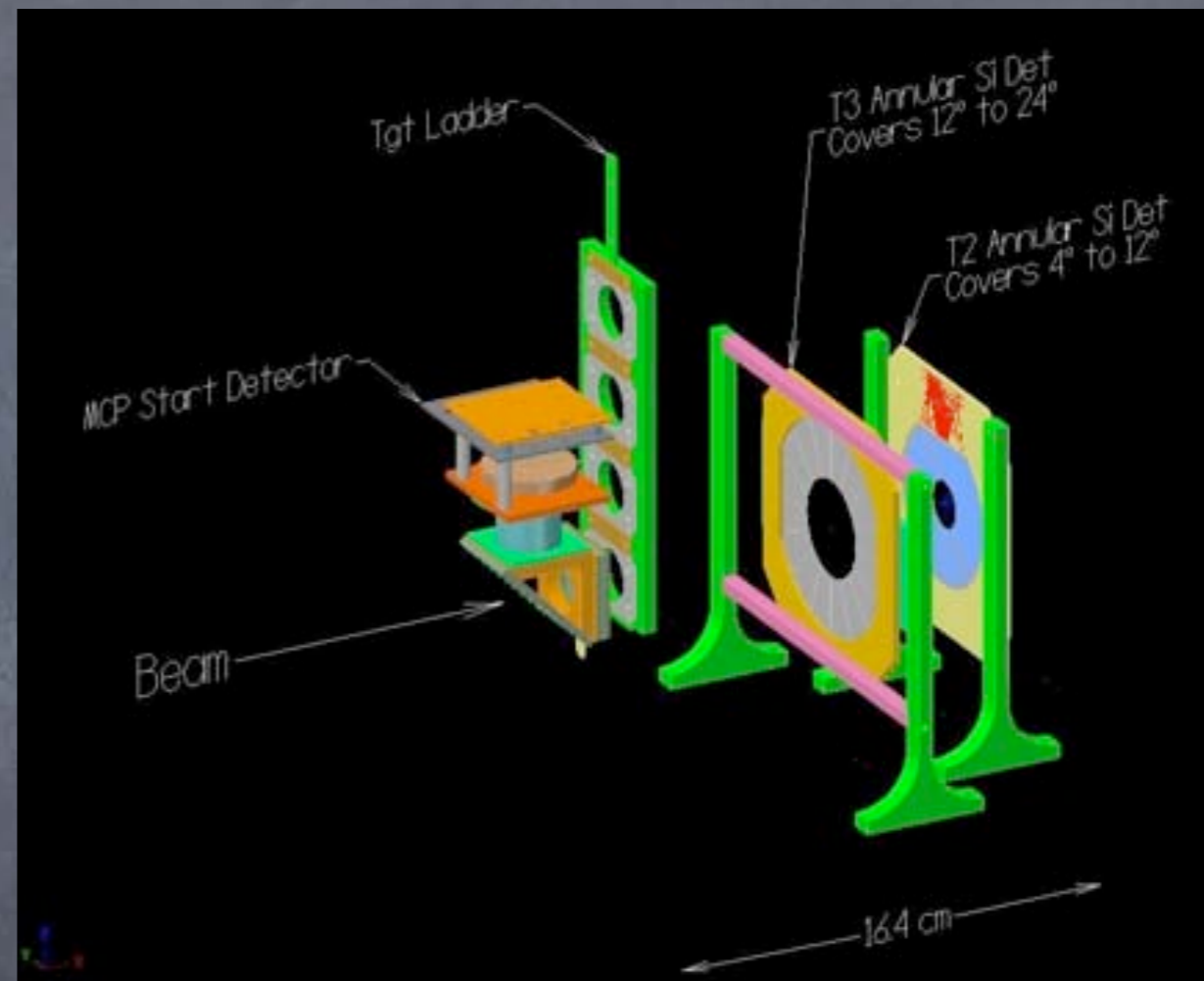
Collaboration of
ORNL, UNAM (Mexico),
Oregon S U, U of Notre
Dame



Fast timing Si arrays: SiEFUS

Physics: Elastic scattering, near/sub-barrier fusion

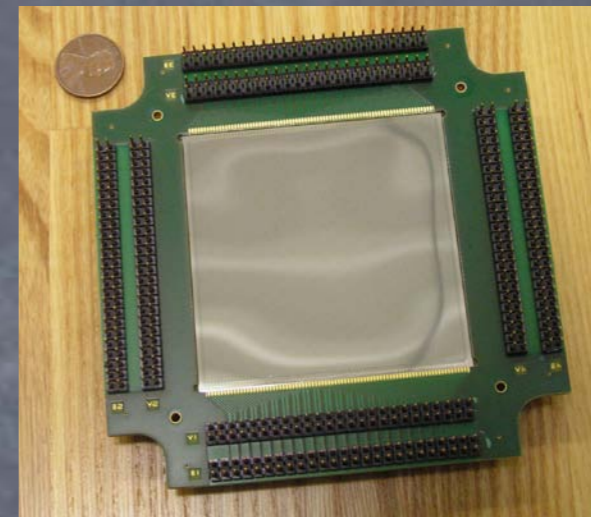
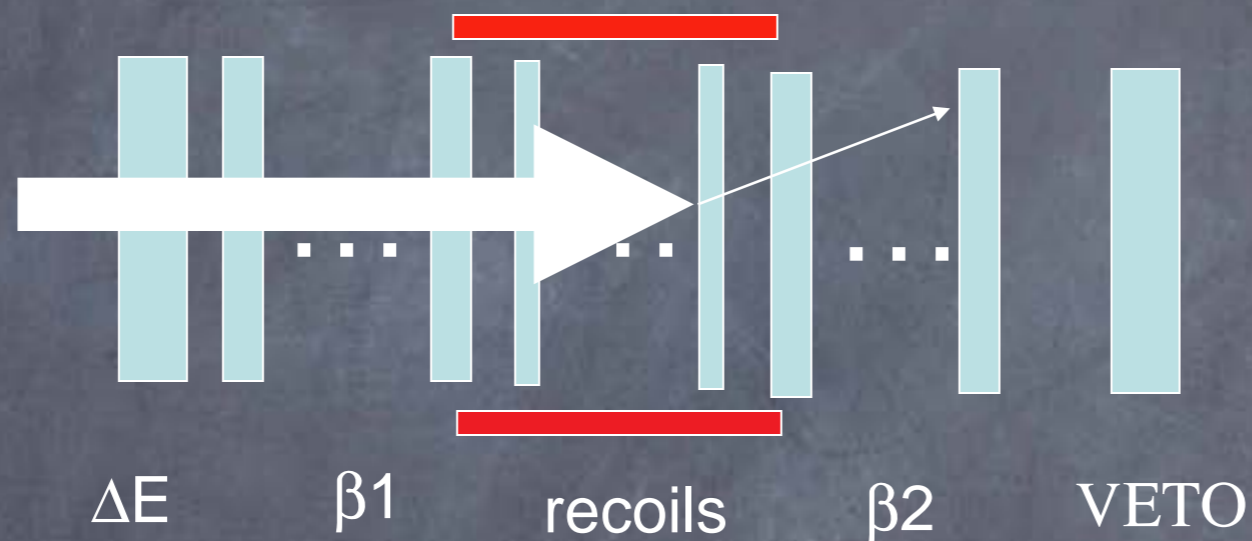
Collaboration of Indiana U,
ORNL, U of Rochester,
Western Michigan U, GANIL



nTD (*neutron Transmutation Doped*) Si detectors utilizing TOF and pulse shape discrimination. The time resolution for the device (based on prototype measurements) will be ≤ 200 ps.

FRIDA – FRIB Implantation Decay Arrays

Physics case: **decay, tagging**



160x160 strips

U of Chicago, Argonne

- Silicon detectors are crucial for charged particle detection
 - Energy resolution (up to 25 keV)
 - Good timing characteristics (~1 ns resolution.)
 - Position sensitivity (1 mm and better)
 - Pulse shape analysis for particle ID
 - Compact

HOWEVER

SEVERAL general problem areas have been discussed

- Problem Area #1: **thickness**
 - Double sided strip detectors limited to 1-2 mm (range of 13 – 18 MeV protons)
 - The thickest Si(Li) detectors are 5-8 mm (range of 30 – 40 MeV protons). Very expensive and delicate.
 - Other semiconductor detector technology? CZT?
- Problem Area #2: **timing resolution**
 - Can we improve timing properties of large area Si detectors (**100 ps ?**). Neutron Transmutation Doped (nTD) detectors.

- Problem Area #3: **Si at ultra low T high B.**
 - Needed for use with polarized target.
- Problem Area #4: **Lack of manufacturers**
 - There is only **one** company which offers custom designed segmented detectors.
- Problem Area #5: **readout**
 - Large Si arrays with position sensitivity require large number of readout channels (**1000+**). ASICs / Digital Signal Proc.

- Problem Area #6: **radiation damage**
 - How to make detectors less susceptible to radiation damage?

- Problem Area #7: **New materials**
 - Diamond detectors? CZT?

How to proceed?


Working workshop to bring together community to advance charged particle detector technology and instrumentation with goal of generating proposal to support R&D activity.

Join US!!

<http://sawg.physics.fsu.edu>

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FRIB SILICON ARRAYS WORKGROUP



WELCOME TO FRIB SILICON ARRAYS WORKGROUP

This is the website of FRIB Silicon Arrays workgroup (SA-WG)

Scope of the workgroup:

Silicon detector technology is a key aspect of current Rare Isotope Beam science and silicon detector arrays will be critical to many of the science programs at FRIB. The SA-WG is focused on significantly advancing the fundamental characteristics of silicon technology as well as developing arrays for specific purposes at FRIB. As silicon arrays are often no longer stand alone devices, it is essential that the SA-WG coordinate with other FRIB workgroups in order to achieve optimal design and integration of specific silicon detector arrays.

NSAC 2007 Long Range Plan Recommendation: We recommend construction of the Facility for Rare Isotope Beams (FRIB), a world-leading facility for the study of nuclear structure, reactions, and astrophysics. Experiments with the new isotopes produced at FRIB will lead to a comprehensive description of nuclei, elucidate the origin of the elements in the cosmos, provide an understanding of matter in the crust of neutron stars, and establish the scientific foundation for innovative applications of nuclear science to society

WELCOME JOIN NEWS MATERIALS RESTRICTED AREA CONTACT

JOIN THE FRIB SILICON ARRAYS WORK GROUP

TO JOIN THE WORK GROUP FILL OUT THIS REGISTRATION FORM

Registration form

Name:

Institution:

Email Address:

FRIB Silicon Array Work Group

Welcome back Grigory Rogachev (Logout), Account Projects Administration

Overview Messages Tasks Milestones Files Tags Forms People

Dashboard > FRIB Silicon Array Work Group > Overview

Overview

Add message Add task list Add milestone Add file

Recent activities

Details	Taken on, by
FILE '2pager_FusionFission1.doc' uploaded	Today 19:00, Grigory Rogachev
FILE '2pager_FusionFission1.doc' deleted	Yesterday, Grigory Rogachev
FILE 2pager_FusionFission1.doc revision #2 deleted	Yesterday, Grigory Rogachev
MESSAGE 'Breakout session presentations' added	Yesterday, Grigory Rogachev
FILE 'FRIB10_ANASEN.ppt' uploaded	Yesterday, Grigory Rogachev
FOLDER 'presentations' added	Yesterday, Grigory Rogachev
MESSAGE 'FRIB SAWG tentative agenda for Feb 20' added	Feb 17, 2010, Jolie Cizewski
FILE 'SAWG-breakout-tentative-agenda.pdf' uploaded	Feb 17, 2010, Jolie Cizewski
FILE '2pager_ACTAR.doc' updated	Feb 17, 2010, Grigory Rogachev
FILE '2pager_Super ORRUBA.doc' updated	Feb 17, 2010, Grigory Rogachev

Project status: Active

- Edit project details
- Mark project as finished

Involved companies

- Department of Physics @ FSU
- University of Tennessee
- Rutgers University
- Indiana University
- CEA Saclay
- Argonne National Laboratory
- Oak Ridge National Laboratory
- Oregon State University
- Cyclotron Institute, TAMU
- Pacific Northwest National Laboratory
- Western Michigan University
- Tennessee Technological University
- GSI Darmstadt
- Lawrence Livermore National Lab
- University of Rochester
- Colorado School of Mines
- Michigan State University

RSS feeds

Recent activities

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Summary

- Silicon detector arrays will be critical to many of the science programs at FRIB.
- The SA-WG is focused on advancing the fundamental characteristics of silicon technology as well as developing arrays for specific purposes at FRIB.
- The workshop on the semiconductor detectors for nuclear physics technology development with the goal to coordinate and centralize R&D was suggested.