

The AT-TPC at MSU

present and next future

Wolfgang Mittig

February-2010

FRIB User Meeting

AT-TPC Collaboration

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I-Yang Lee, Larry Phair

Lawrence Livermore National Laboratory

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University Notre Dame

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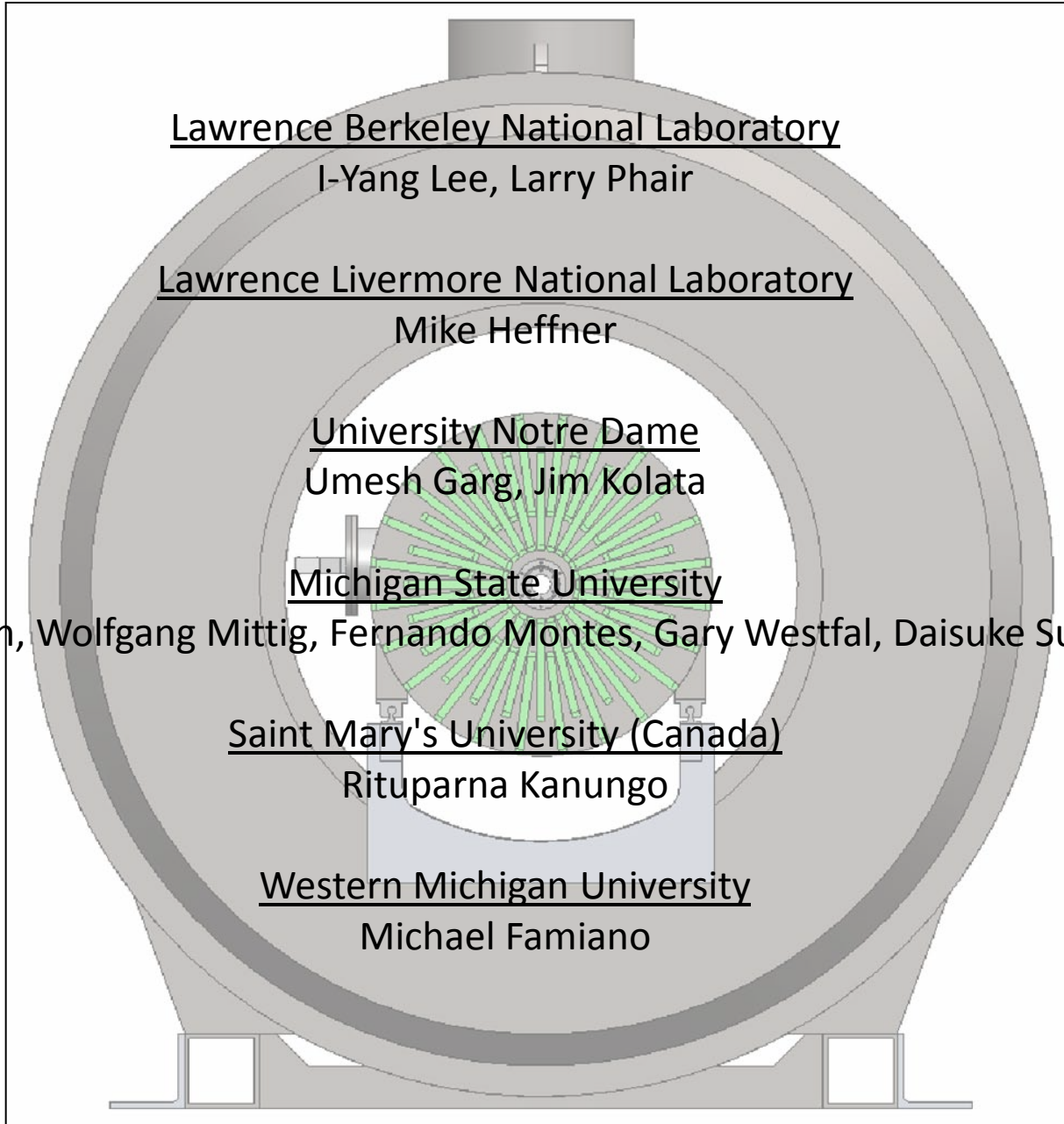
Bill Lynch, Wolfgang Mittig, Fernando Montes, Gary Westfal, Daisuke Suzukil

Saint Mary's University (Canada)

Rituparna Kanungo

Western Michigan University

Michael Famiano



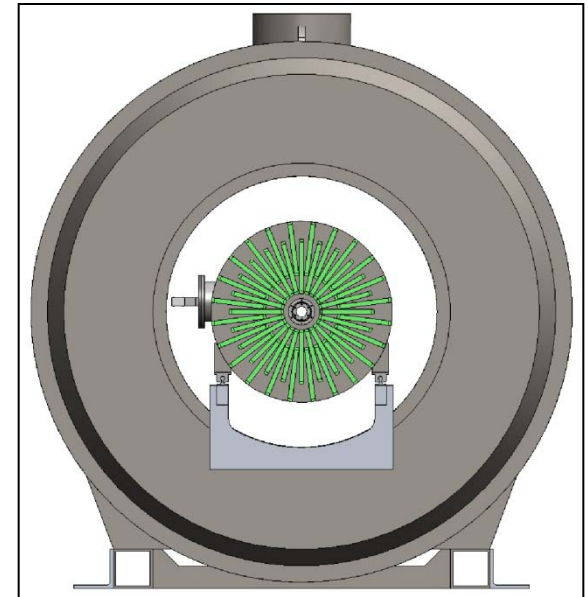
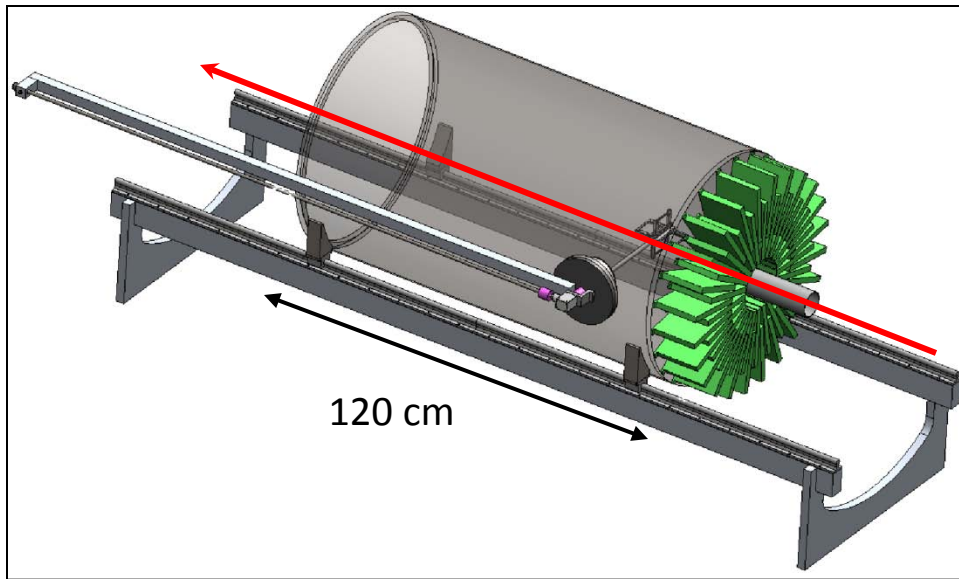
AT-TPC Scientific Program

Table 1: Overview of the AT-TPC scientific program.

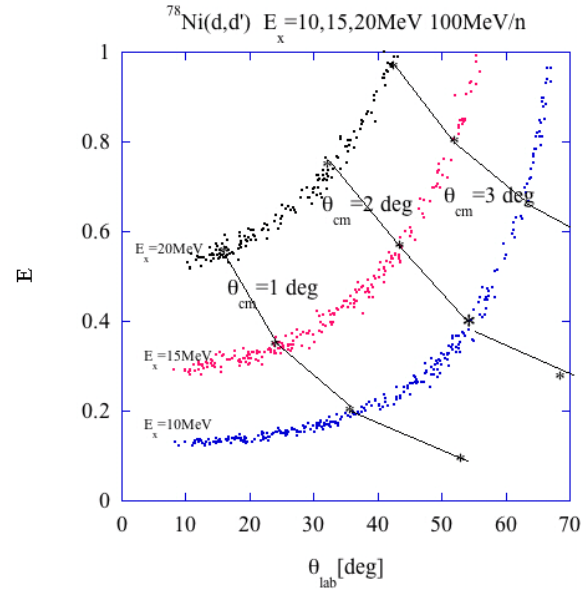
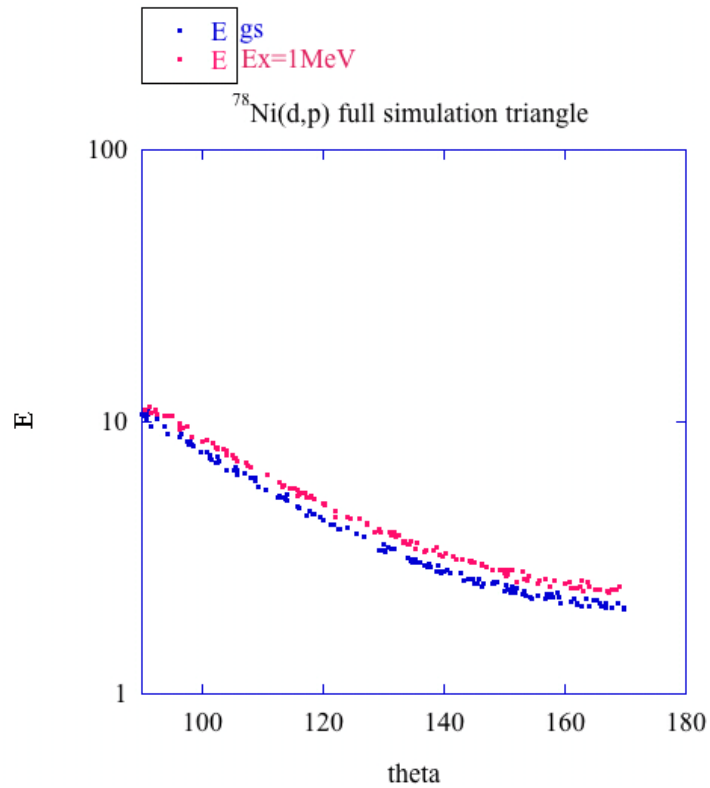
Measurement	Physics	Beam Examples	Beam Energy (A MeV)	Min Beam (pps)	Scientific Leader
Transfer & Resonant Reactions	Nuclear Structure	$^{32}\text{Mg}(d,p)^{33}\text{Mg}$ $^{26}\text{Ne}(p,p)^{26}\text{Ne}$ $^{66,\dots,70}\text{Ni}(p,p)$	3	100	Kanungo
Astrophysical Reactions	Nucleosynthesis	$^{25}\text{Al}(^3\text{He},d)^{26}\text{Si}$	3	100	Famiano, Montes
Fusion and Breakup	Nuclear Structure	$^8\text{B}+^{40}\text{Ar}$	3	1000	Kolata
Transfer	Pairing	$^{56}\text{Ni}+^3\text{He}$	5-19	1000	Macchiavelli
Fission Barriers	Nuclear Structure	$^{199}\text{Tl}, ^{192}\text{Pt}$	20 - 60	10,000	Phair
Giant Resonances	Nuclear EOS, Nuclear Astro.	$^{54}\text{Ni}-^{70}\text{Ni},$ $^{106}\text{Sn}-^{127}\text{Sn}$	50 - 200	50,000	Garg
Heavy Ion Reactions	Nuclear EOS	$^{106}\text{Sn} - ^{126}\text{Sn},$ $^{37}\text{Ca} - ^{49}\text{Ca}$	50 - 200	50,000	Lynch

- Detector will make use of the full range of beam energies and intensities available at NSCL & FRIB
- Experiments with rare isotope beams continuously push the limits of low beam intensities and low cross sections
- AT-TPC will address these limitations by providing access to reactions at beam intensities as low as 100pps

AT-TPC Introduction

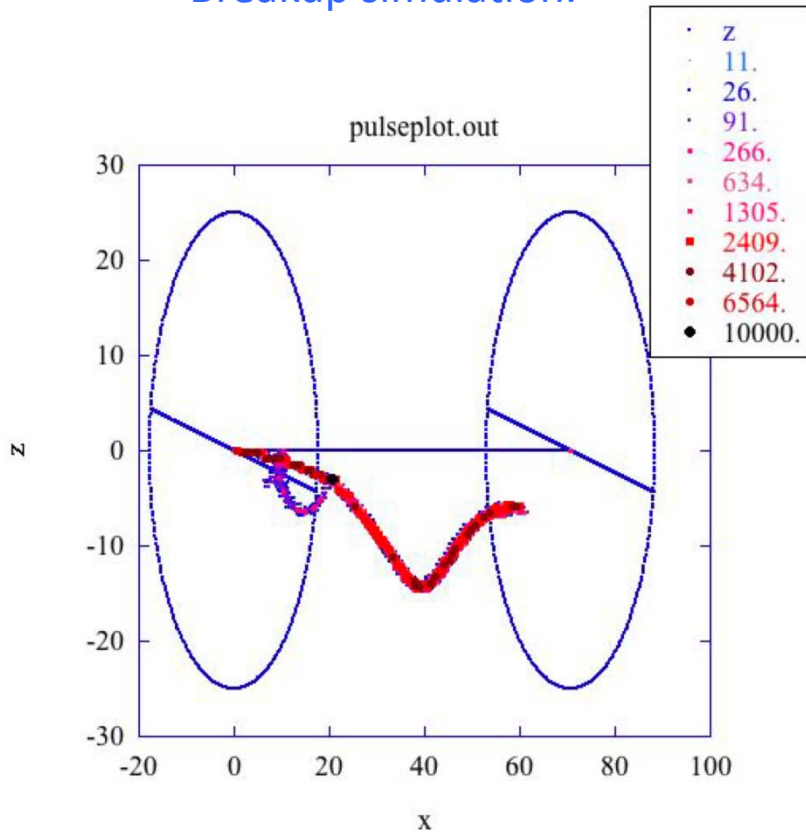


- Fixed Target Mode:
 - A target wheel will be installed within the chamber thus the gas will serve only as a detector
 - Configuration will reflect standard TPC conditions (ex: P10 @ 1atm)
- Active Target Mode:
 - The chamber gas will act as both detector and target
 - Gas identity and pressure chosen based on experimental requirements
 - Limitations imposed by low beam intensities will be addressed by providing a thick target while retaining high resolution and efficiency
 - H_2 , D_2 , ^3He , ^4He , Ne, Ar, Isobutane
 - Pressures ranging from 0.2-1.0 atm

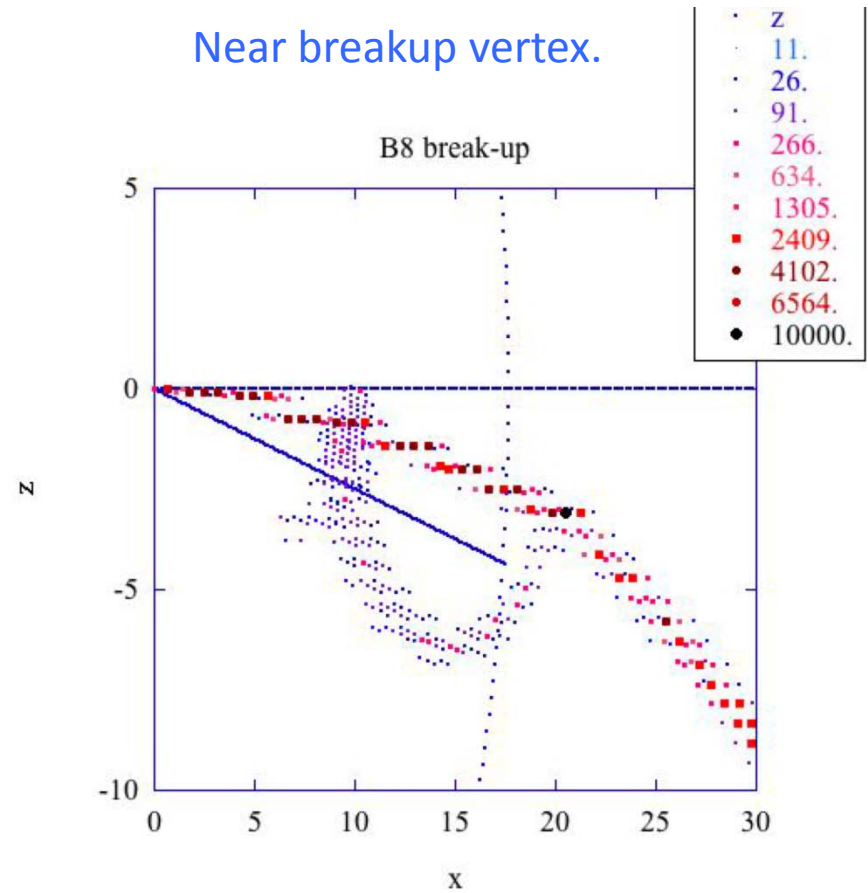


More generally, the aim is to develop a device that provides a resolution for nuclear structure studies in inverse kinematics with a resolution comparable to the one achieved in direct kinematics with high resolution spectrometers, together with highest efficiency and thick targets

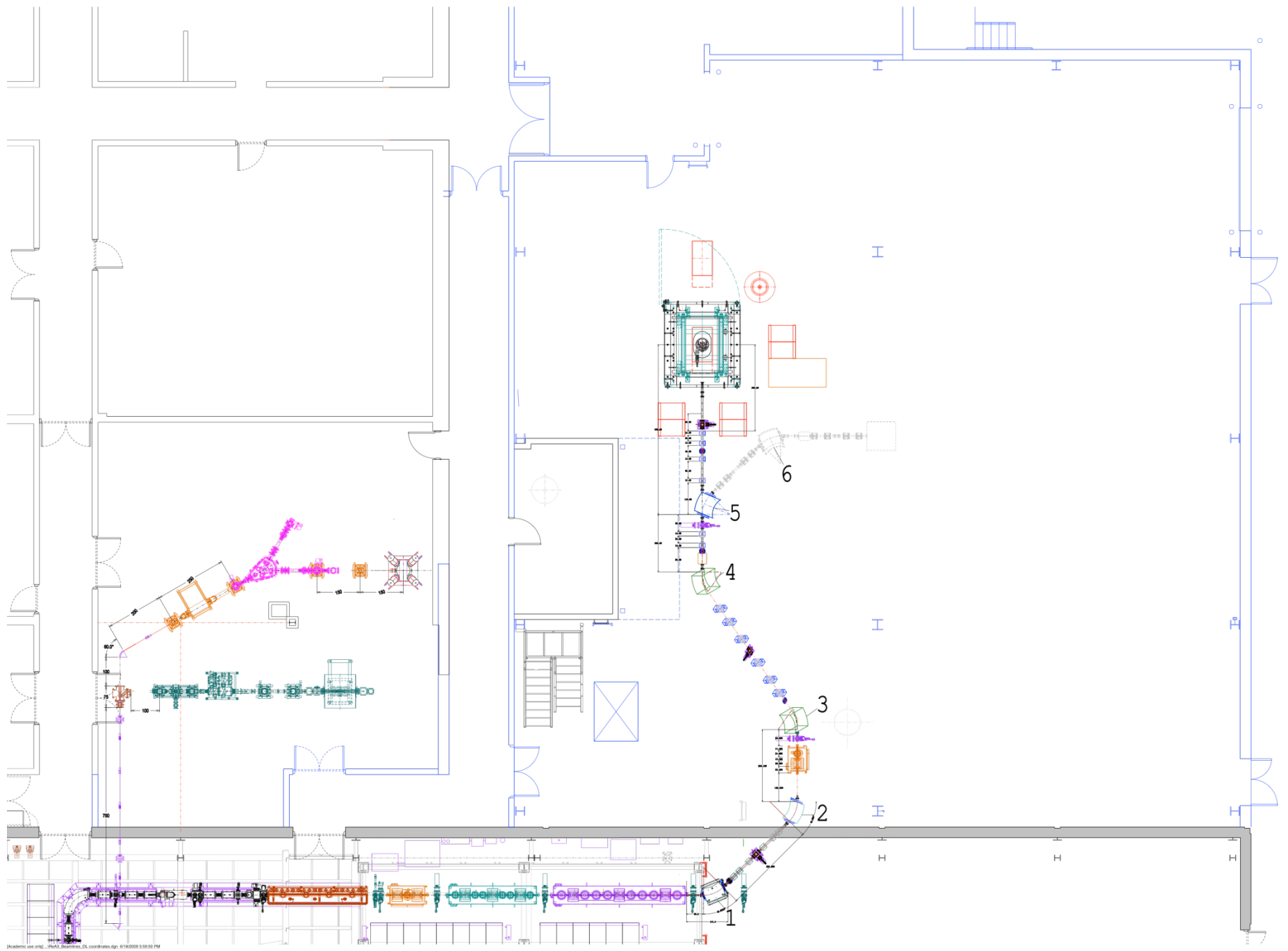
Breakup simulation.



Near breakup vertex.



- Resolution of the recoil energy $\sim 2\%$ as for fusion events.
- Proton track clearly visible and its properties can be measured.
- Care must be taken to prevent rejection as a “non-interacting” event.



General Electronics for TPCs: GET

**IRFU, GANIL, CENBG
MSU, RIKEN**

For different detectors

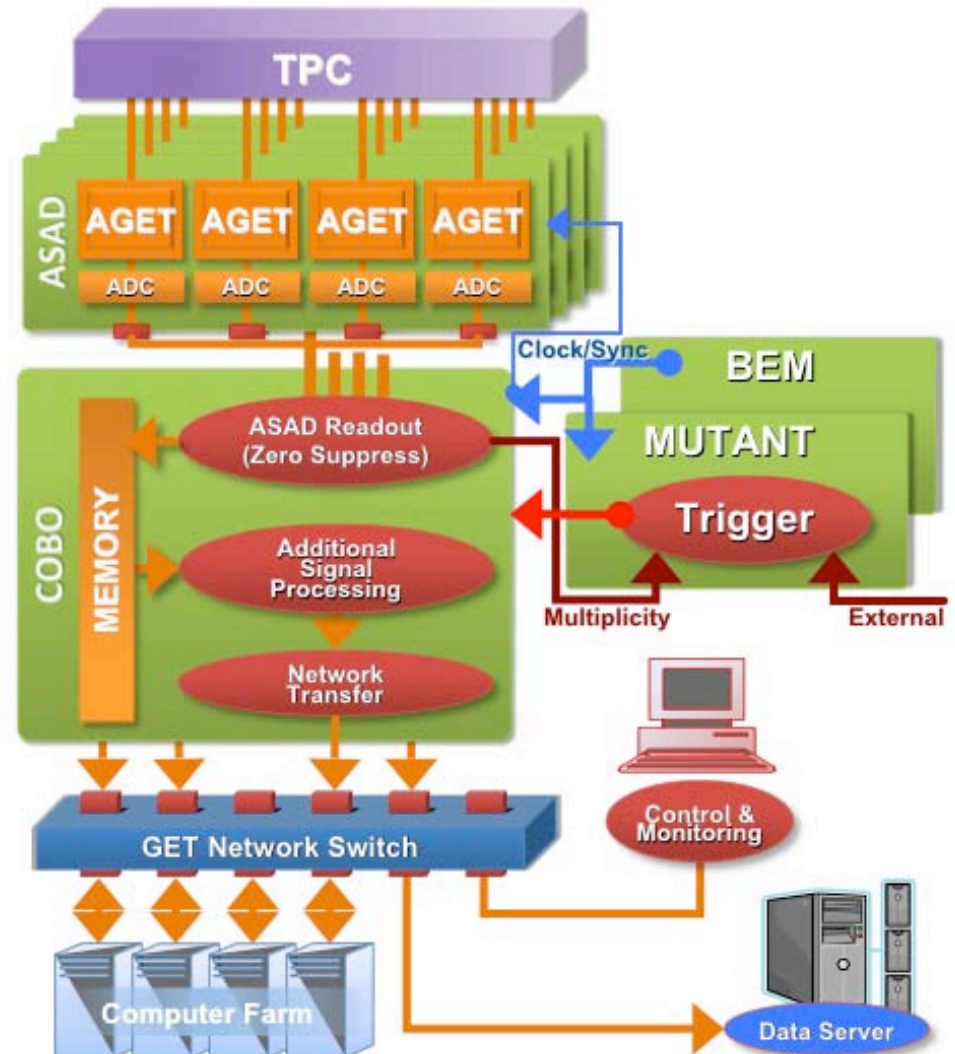
AT-TPC: ~10000channels

Technical Meeting

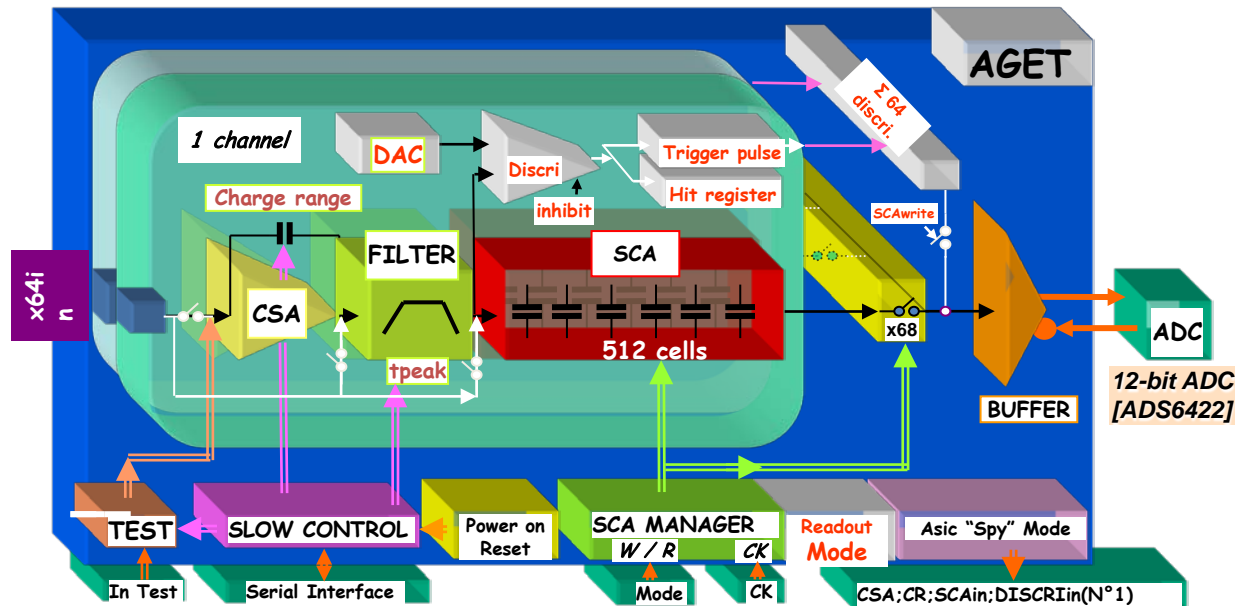
Bordeaux 18-19 Nov 09

General Meeting

Crepon, 11-15 Jan 10



AGET



AGET Main features

64 Analog Channels: Analog part + **S**ampling **C**apacitor **A**rray.

Channel

CSA + PZC + Filter (semi-Gaussian order 2).

SCA: 512 analog memory cells.

Auto Triggering: discriminator + threshold (DAC) + inhibition.

Trigger & Readout

Trigger [Analog sum of the 64 discri.].

Several SCA readout modes.

Address of the hit channel(s) [read & write].

2p acquisition mode

Slow Control.

Power on reset.

Test mode:

calibration or test

[channel/channel]

functional

[all channels on one shot]

Spy mode

Status report of the AT-TPC (February 2010)

1) Achieved: Funding and organisational framework

- a) MRI funding accepted, funds received
- b) French GET (General Electronics for TPC's) collaboration obtained funding ANR (700 kEuros)
- c) NSCL physics workgroup for the project meets weekly, with typically 6 participants
- d) national-international collaboration established, 4 letters of intend for ReA3
- e) international collaboration formed for electronics development

2) Achieved: Technical

- a) electronics (Asic, complete chain up to switch connecting to PC's) fully defined
- b) first submission of Asics scheduled for march 2010
- c) development of the Cobo prototype follows closely the schedule
- d) first complete prototype of electronics from Asic to PC-switch scheduled for end of 1st semester 2010
- e) testchamber at NSCL operational, test of GEMs and micromegas with gamma and alpha source were performed **for non-explosive gases**
- f) full TPC electronics running for 270 channels with data acquisition
- g) implantation in ReA3 area defined
- d) full simulations from track to track-analysis running, comparison of square pads and triangular pads done

3) Intermediate Steps

Test detector with 256 channels designed for beam experiment for autumn 2010

Conclusion/recommendations

- Conc. Design of the AT-TPC layout will be done in next 6 months, followed by a design review (sept-oct 2010); input from potential user needed (examples of experiments,...)
- Parallel session: consider decay studies (2p,...)
- Consider use without solenoid
- Consider share of solenoid of/with Helios