

# SAMURAI-TPC

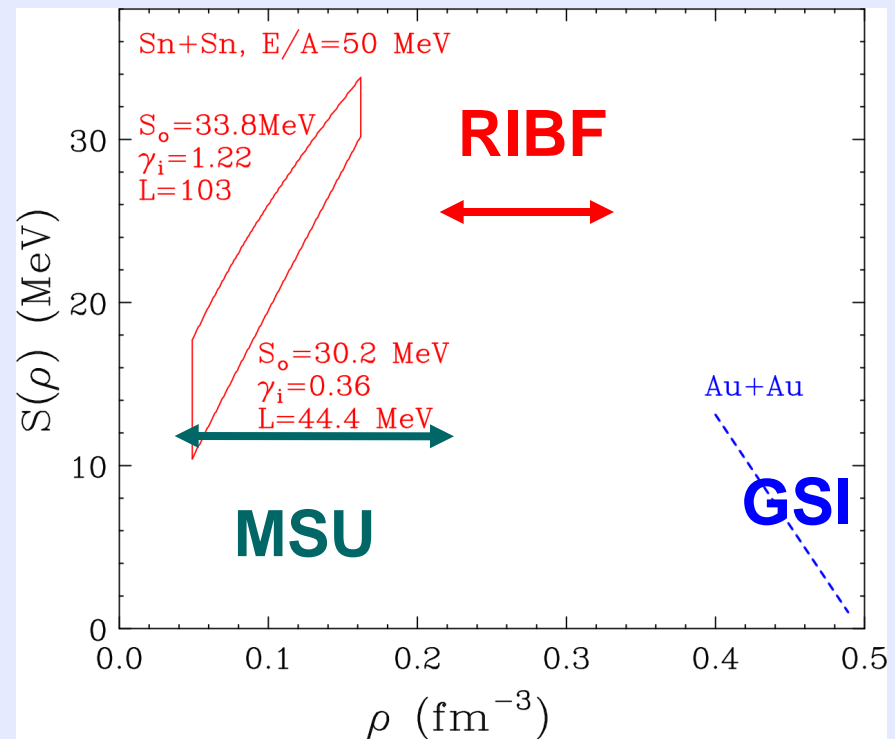
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Tetsuya MURAKAMI

For SAMURAI-TPC Collaboration

# Motivation

- ◆ Put a constraint on density dependence of Symmetry energy.



Details I will talk tomorrow.

# Brief History

- ◆ Bill Lynch and T.M. agreed to study a symmetry energy at RIBF in 2003. T.M. joined the DAIMAJIN Project and propose to construct a TPC in 2004.
- ◆ A construction of TPC was included in the TAC Report of SAMURAI Project in 2005.
- ◆ Because of nature of the SAMURAI Budget (1.5B yen) approved at the end of 2007 we abandoned to construct TPC using the approved budget in 2008.
- ◆ In 2009, formed an international collaboration to determine the symmetry energy over a range of density. Submitted a construction proposal of SAMURAI-TPC to RIBF-PAC and a money request to US/DOE.

# SAMURAI-TPC Collaboration

## Determination of the Equation of State of Asymmetric Nuclear Matter

NSCL/MSU: *M.B. Tsang, W.G. Lynch, Z.Chajecski, G. Westfall, P. Danielewicz, E. Brown, A. Steiner*

Texas A&M Univ.: *S. Yennello, A. McIntosh*

Western Michigan Univ.: *Michael Famiano*

Univ. Notre Dame: *U. Garg*

GSI: *W. Trautmann, Y. Leifels*

Daresbury Lab.: *R. Lemmon*

INFN/LNS: *G. Verde, A. Pagano, P. Russotto, M. di Toro, M. Colonna, A. Bonasera, V. Greco*

Univ. Budapest : *V. Baran*

SUBATECH: *C. Hartnack*

GANIL: *A. Chbihi, J. Frankland, J.-P. Wieleczko*

China IAE: *Y. Zhang, Z. Li, F. Lu (Peking Univ.), W. Tian (Chinese SAS)*

Brazil: *S. Souza, R. Donangelo, B. Carlson*

RIKEN: *H. Sakurai, S.Nishimura, Y. Nakai, A. Taketani, T. Isobe, H. Baba*

Rikkyo Univ.: *J. Murata, K. Ieki*

Tohoku Univ.: *A. Ono*

Kyoto Univ.: *T. Murakami*

# Time table for construction

As indicated in DOE Project Management Plan

*US collaboration: To design, build and test the SAMURAI-TPC detector*

*Proposal submitted: December, 2008 -- \$1.2M*

*Approved: November, 2009*

*Proposal management plan submitted: December, 2009*

*proposed completion dates in Jan, 2010:*

*Completion date : March 31, 2013*

*Shipping date to RIKEN: April 30, 2013*

*Projects put on hold: March, 2010*

*Revised budget submitted: April, 2010*

*Revised budget approved: May, 2010*

*New proposed start date: Sept 1, 2010*

*Funding profile in 3 years but project finishes in 5 years*

*This allows flexibility regarding the completion of TPC*

# Original Milestones

## Need a revised detailed plan.

The project management and control milestones

Milestone		location	Milestone date	
			(FY and quarter)	
Design	Chamber	NSCL	Q4	2010
Design	Detector	NSCL	Q4	2010
Procure	Chamber	NSCL	Q3	2011
Procure	Detector	NSCL	Q3	2011
Construct & Test	Chamber	NSCL	Q4	2011
Construct, Install & Test	Detector	NSCL	Q3	2012
Contingency	TPC	RIKEN	Q1	2013
Ship	TPC	NSCL	Q2	2013
Install & Test	TPC	RIKEN	Q3	2013
Commissioning	TPC	RIKEN	Q1	2014
Reconfigure new electronics		RIKEN	Q2	2015
$\pi^+/\pi^-$ experiment		RIKEN	Q2	2014
n/p experiment		GSI	Q2	2011

# “Mutual” Understandings

- ◆ Designed based on EOS TPC. Expected weight is 150kg for TPC itself and 200kg for FEE (preamp~ADC) near TPC.
- ◆ RIKEN have the responsibility for the coordination of the all activities in installation, commission and experimental activities in RIKEN Mentioned in the project management plan to DOE.
- ◆ RIKEN will be responsible to procure the components such as the laser calibration system, gas-handling systems and GET electronics



## Symmetry Energy

SAMURAI-TPC

### Events in this category:

▼ 2010

#### December 2010

21  [SAMURAI-TPC meeting](#) (protected) 

#### November 2010

16  [SAMURAI-TPC meeting](#) (protected) 

#### October 2010

27  [SAMURAI-TPC meeting](#) (protected) 

#### September 2010

15  [SAMURAI-TPC meeting](#) (protected) 

#### August 2010

17  [SAMURAI-TPC meeting](#) (protected) 

#### July 2010

29  [SAMURAI-TPC Collaboration meeting](#) (protected) 

#### June 2010

24  [SAMURAI-TPC meeting](#) (protected) 

#### May 2010

27  [SAMURAI-TPC meeting](#) (protected) 

13  [SAMURAI-TPC meeting](#) (protected) 

#### April 2010

29  [SAMURAI-TPC meeting](#) (protected) 

15  [SAMURAI-TPC meeting](#) (protected) 

01  [SAMURAI-TPC meeting](#) (protected) 

#### March 2010

08  [SAMURAI-TPC meeting](#) (protected) 

#### February 2010

19  [SAMURAI-TPC Collaboration meeting](#) (protected) 

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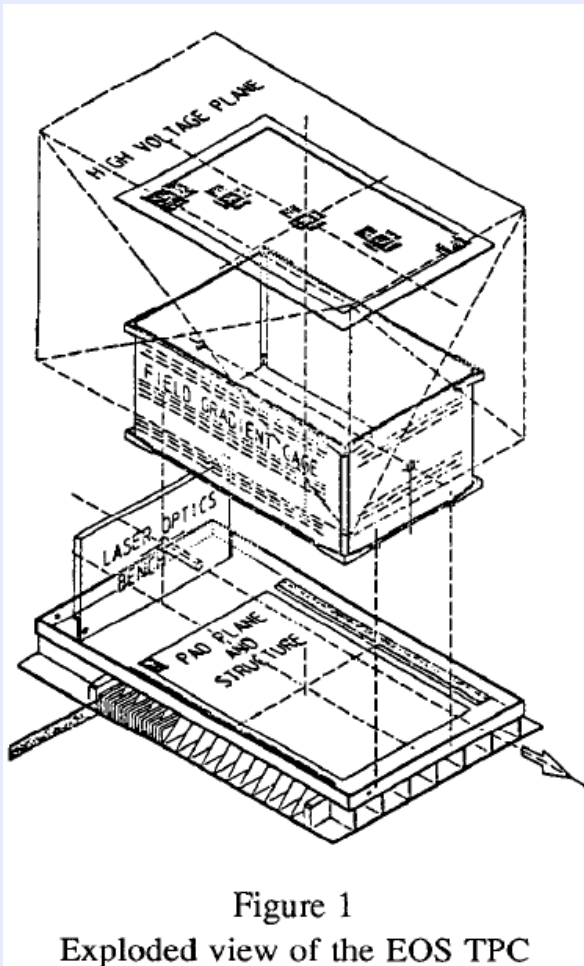
[Conference](#)



# Design of New TPC chamber

Alan McIntosh (*Texas A&M University*)

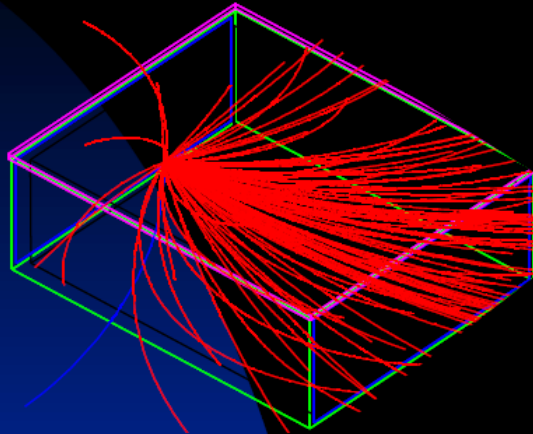
## ◆ Based on EOS TPC



At FNAL in Aug 2010

Obtain available drawings >> make reduced size drawings

# TPC properties



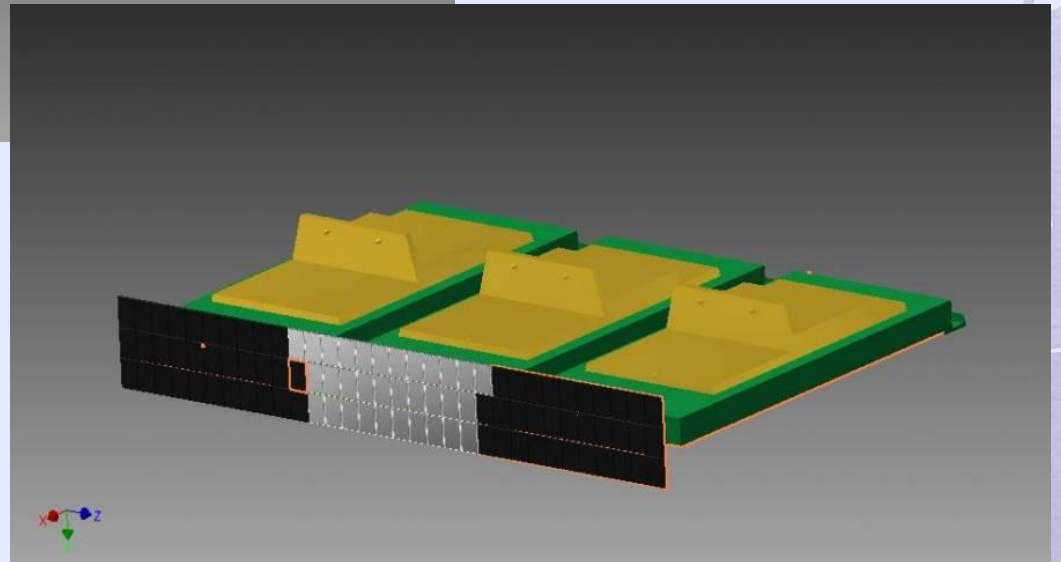
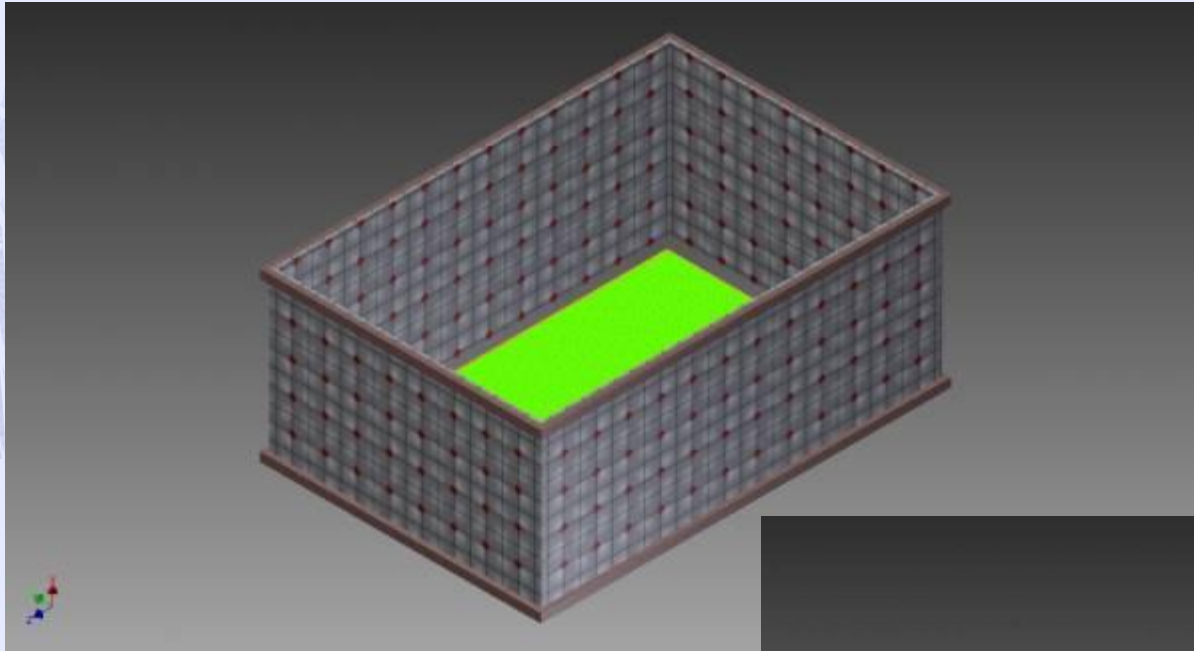
**GEANT simulation**  
 **$^{132}\text{Sn}+^{124}\text{Sn}$  collisions at  $E/A=300$  MeV**

- **Good efficiency for pion track reconstruction is essential.**
- **Initial design is based upon EOS TPC, whose properties are well documented.**

<b>SAMURAI TPC parameters</b>	
Pad plane area	1.3m x 0.9 m
Number of pads	11664 (108 x 108)
Pad size	12 mm x 8 mm
Drift distance	55 cm
Pressure	1 atmosphere
dE/dx range	Z=1-3 (Star El.), 1-8 (Get El.)
Two track resolution	2.5 cm
Multiplicity limit	200 (large systems absolute pion eff.)

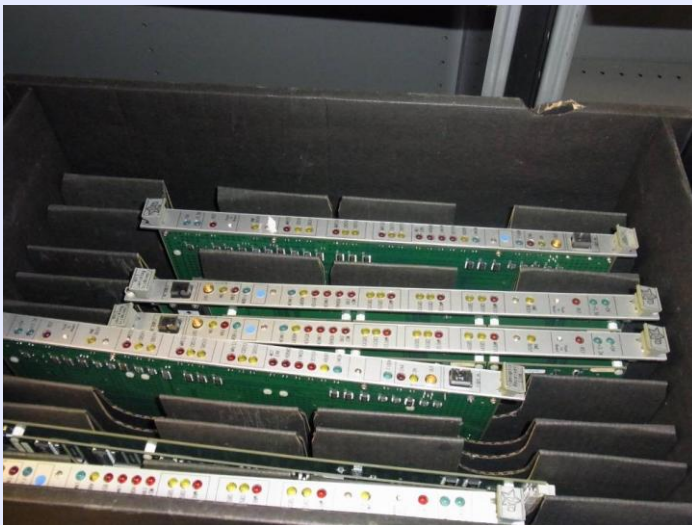
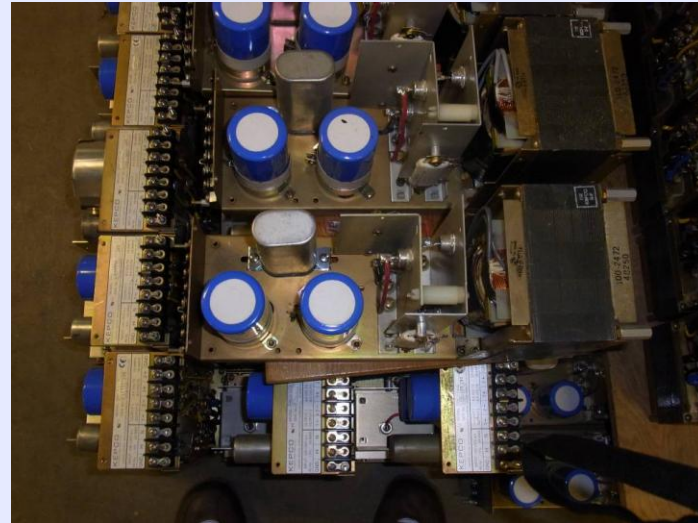
# Design of Field Cage

Jimmy Dunn (NSCL/MSU)





# Finally obtain STAR Electronics but still at BNL



# Status of Japanese collaboration

# Read-out electronics

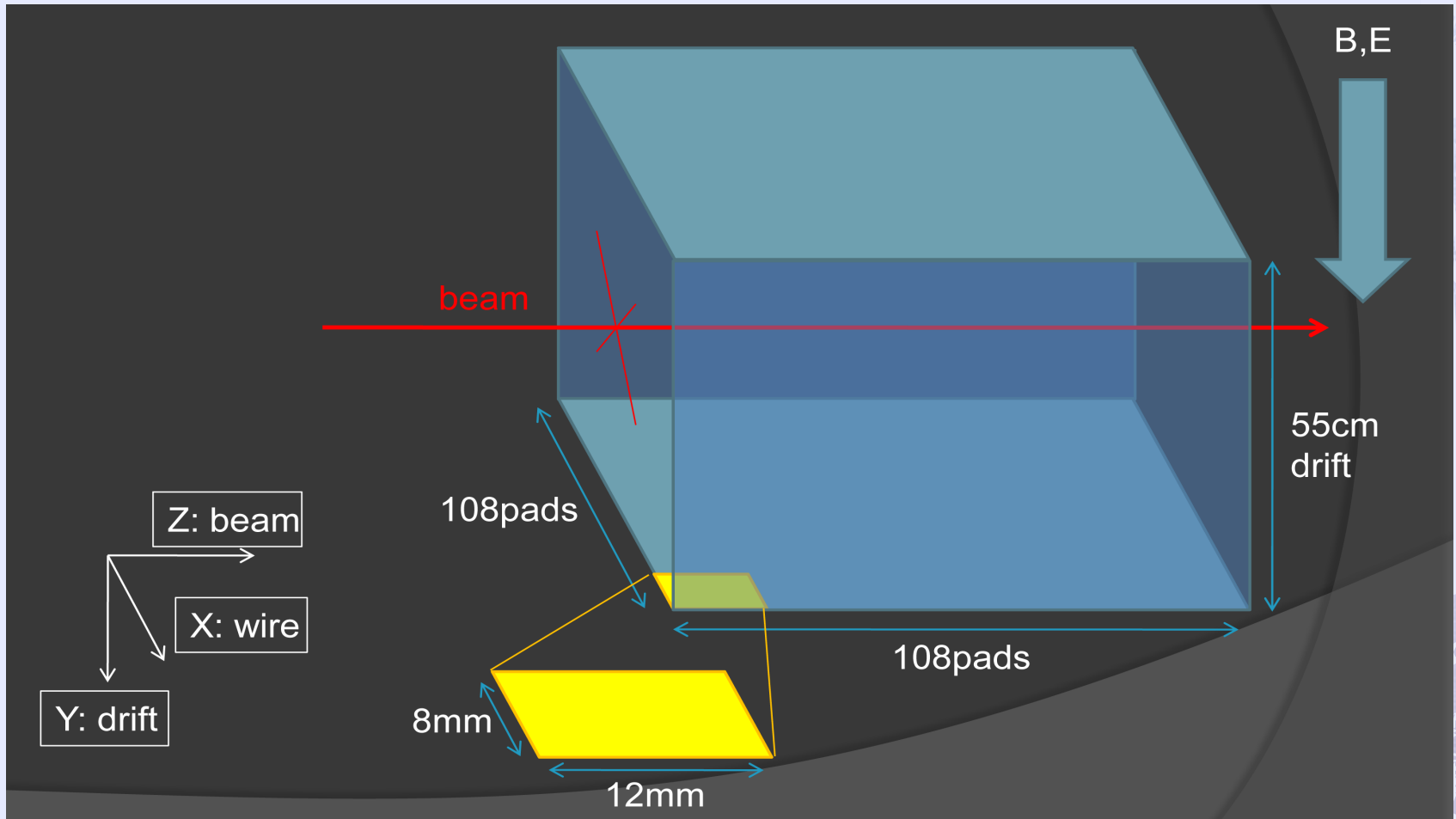
- ◆ For test
  - Purchased T2K electronics
  - one FEC and FEM
- ◆ For short term
  - STAR-FEE will be used as the readout electronics.
- ◆ For future
  - After GET electronics is ready, we intend to migrate our readout system to new one

# GAS Handling system

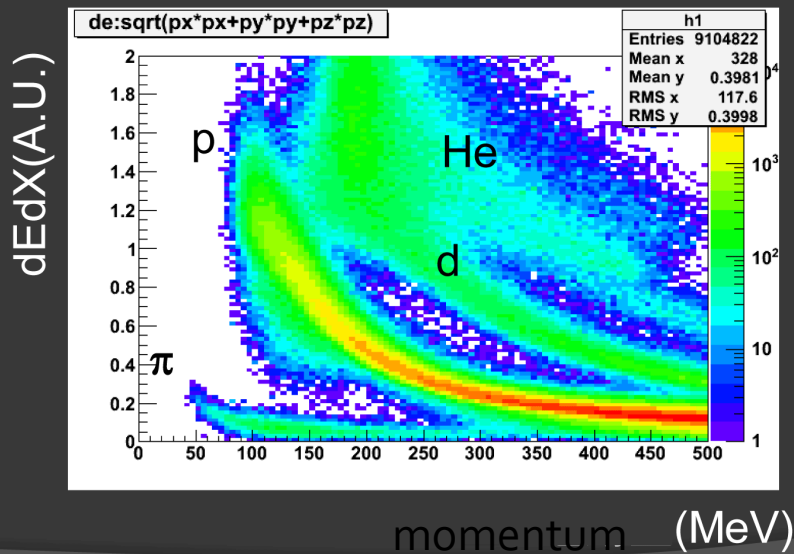
- ◆ A dedicated gas system will be necessary for the operation of TPC at SAMURAI.
- ◆ P-10 (Ar90% -CH<sub>4</sub>10%) gas will be used.
- ◆ A few liter per minutes flow is expected.
- ◆ Less than 100ppm O<sub>2</sub> and H<sub>2</sub>O contamination. RHIC-STAR: 25ppm-O<sub>2</sub>, 20ppm H<sub>2</sub>O  
(Pure gas condition is required for a good efficiency.) >>Need investigation!!!
- ◆ We would like to share the part of our gas system with other SAMURAI experiments.



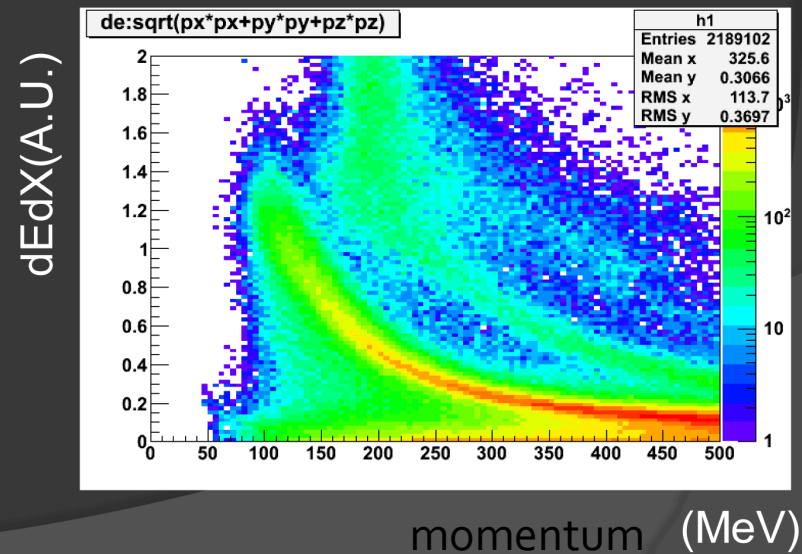
# Schematic View of TPC



# Geant4 simulation by Isobe-san



Single Track

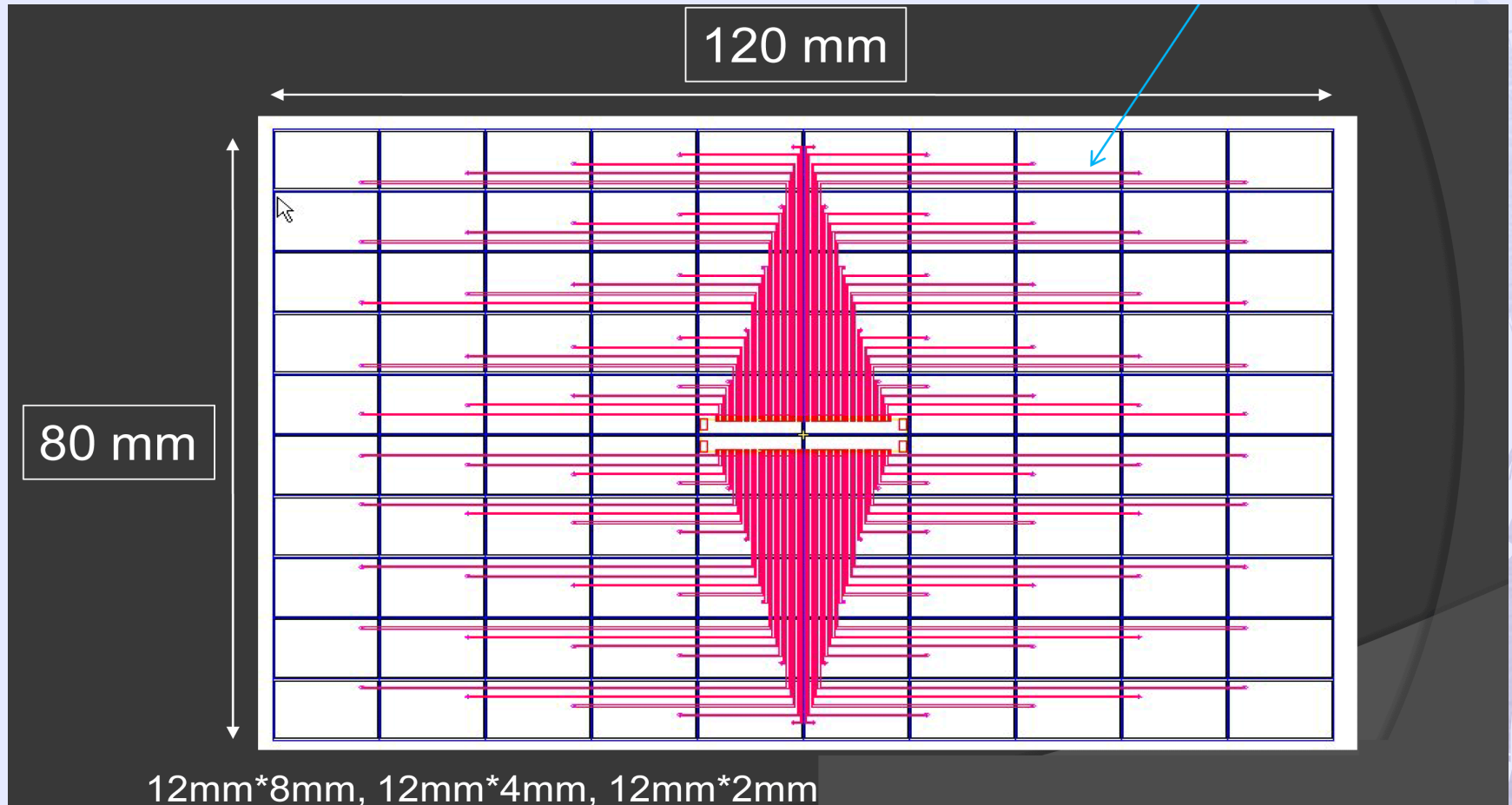


Sn+Sn minimum bias

# Construction of Test TPC

- ◆ Sensitive area of 10 cm × 10cm
- ◆ Design a connector for Pads
- ◆ Test laser calibration system
  - >> correct distortion of electric field
- ◆ R&D of GET electronics
- ◆ Select how to amplify signals
  - MWDC vs Micro MEGAS (vs GEM)
- ◆ Investigate influence of high density ions at HIMAC?

# Basic design of Pad plane



Investigate cross talk problem by Taketani et al.

# Laser system

- ◆ Borrow existing laser for a short time period.  
[Tempest 10]  
repetition 10Hz  
266 nm 30mJ  
pulse width 3-5 ns
- ◆ Obtain dedicated system next year?  
Need ~ ¥5,000k  
for example spectra-physic INDI-40 10  
266 nm 55mJ

# Summary

- ◆ We are working hard to finalize the design of TPC now.