FROM RESEARCH TO INDUSTRY

cea

Irfu
Institut de recherche
sur les lois fondamentales
de l'Univers

www.cea.fr

GET AND ITS UTILISATION

GET – GENERIC ELECTRONICS FOR TPCS

Emanuel Pollacco for the GET Collaboration
IRFU/SPhN

10 septembre 2014

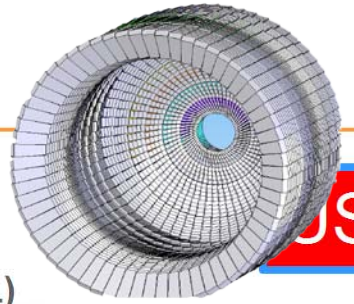
Preview

- Picture Gallery
  - Instruments Now & Tomorrow
  - VAMOS & MUST2 & MUSETTE
- The GET project
  - Glossary
  - GET System
- Projects Employing GET
  - A Catalogue
- Valorisation
  - Instruments Now & Tomorrow
  - How can we do it better next-time

Preview

- Picture Gallery
  - Instruments Now & Tomorrow
  - VAMOS & MAYA & MUST2 & MUSETTE Our first attempts in ASIC driven Systems
- The GET project
  - Glossary
  - GET System
- Projects Employing GET
  - A Catalogue
- Valorisation
  - Instruments Now & Tomorrow
  - How can we do it better next-time

Charged-particle detection

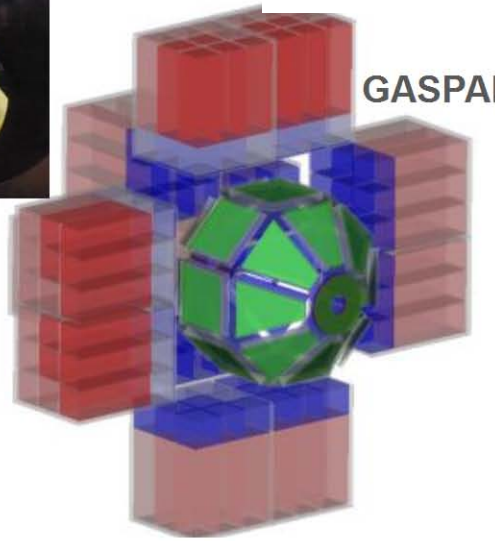


US

CHyMENE (IRFU)

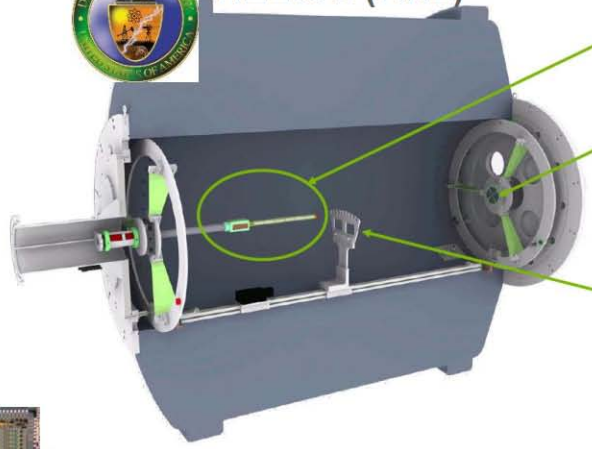
ANR

GASPARD (IPN)

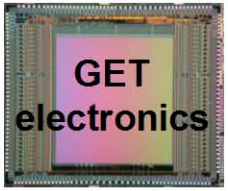


EU

HELIOS (ANL)

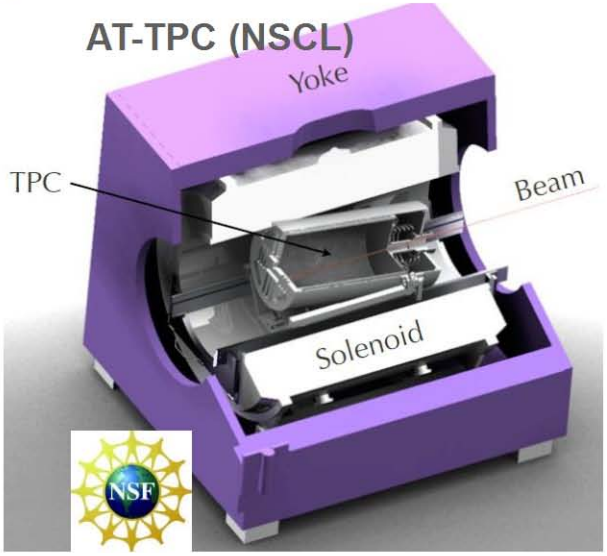


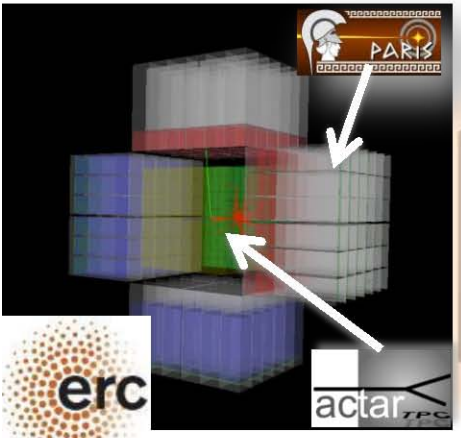
GET electronics



ANR

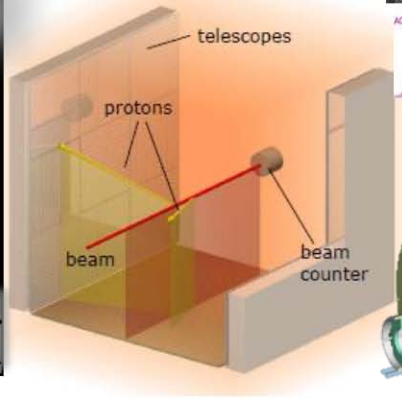
AT-TPC (NSCL)

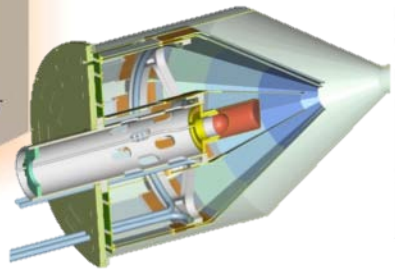




erc

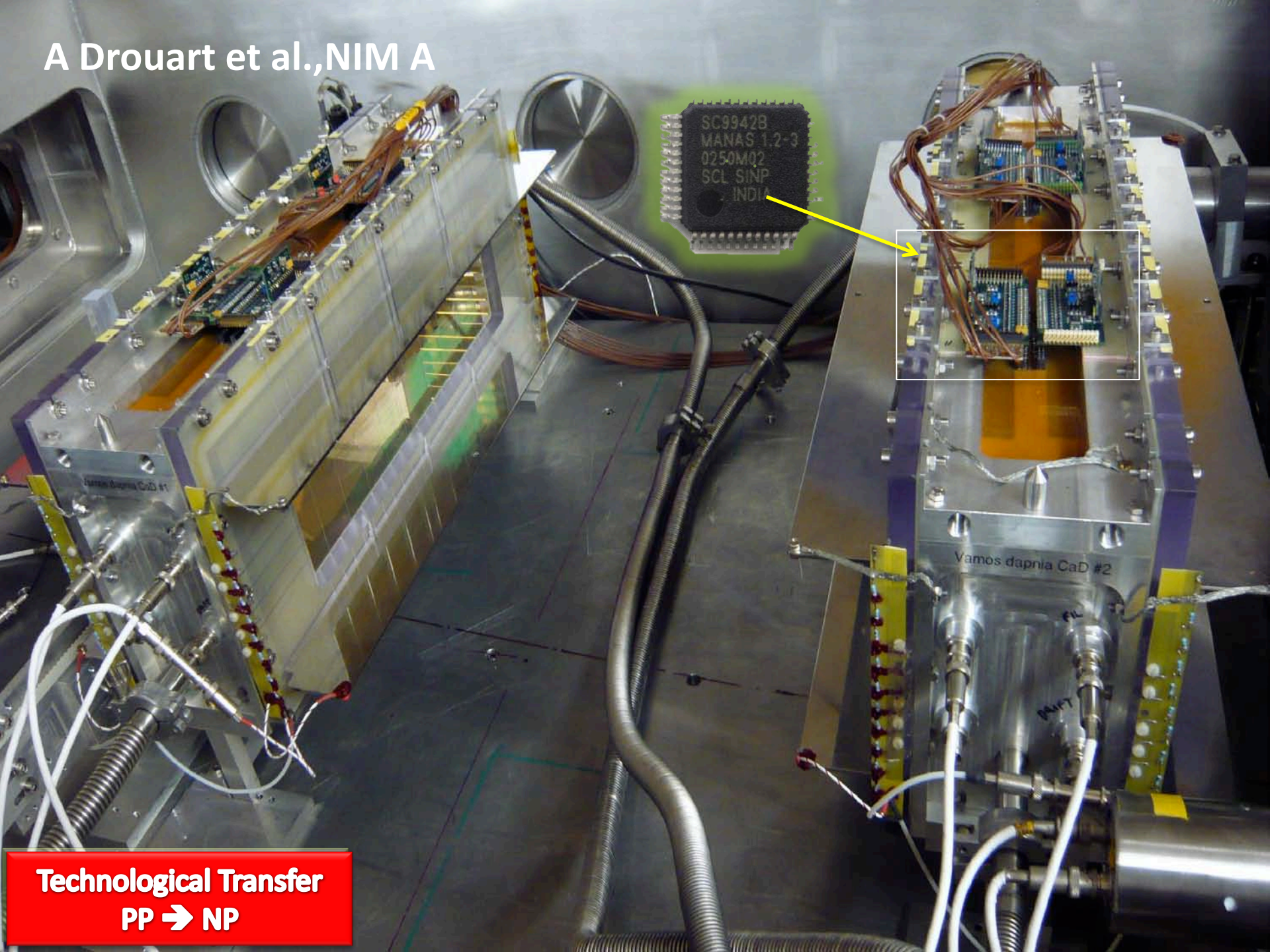
ACTAR TPC (GANIL)





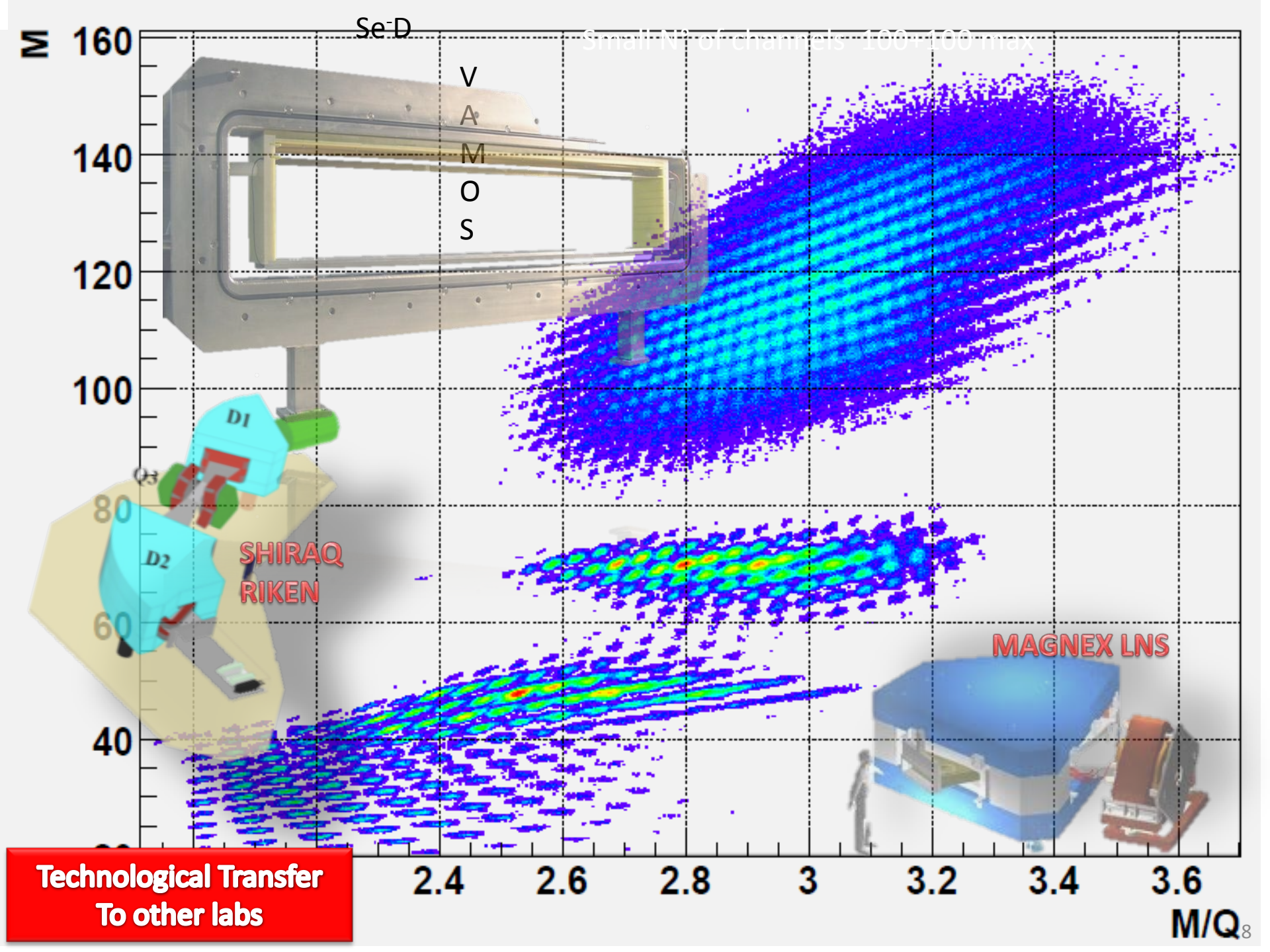
The first attempts in ASIC driven Systems

Borrowed from Part. Phys.


A Drouart et al.,NIM A
SC9942B
MANAS 1.2-3
0250M02
SCL SINP
INDIA
Vamos dapnia CaD #2
Technological Transfer
PP → NP

A Drouart et al.,NIM A

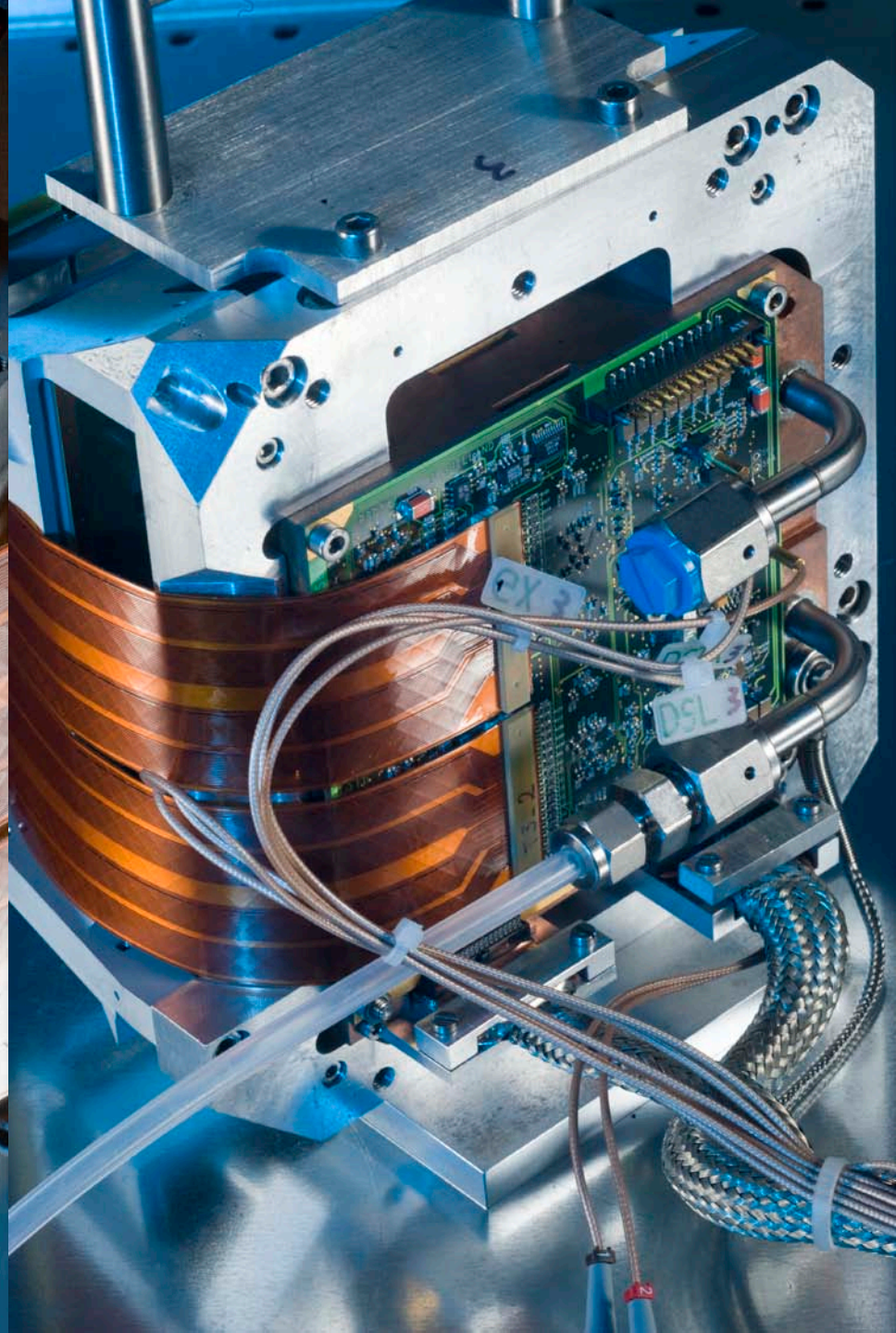
Technological Transfer
PP → NP



Technological Transfer To other labs

Attempting an α to ω ASIC driven system


MUST

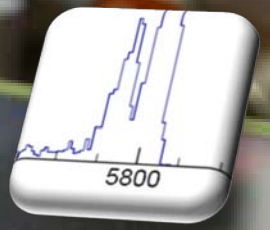

PX 3
DSL 3

10X10cm2, Compact
DSSD (0.7mm), Si(Li), CsI
Energy – 18Kev (30KeV Si)
Time – 300ps / Low EM
In Vacuum
20 experiments

MUST2 → MUSETTE → S^3

AGENCE NATIONALE DE LA RECHERCHE ANR

- Array for the focal plane of VAMOS
- (17keV FWHM α)



Technological Transfer
To our own labs

Irfu
Institut de recherche sur les lois fondamentales de l'Univers

GANIL
Laboratoire commun CEA/DSM
spiral2
CNRS/IN2P3

IPN

MATE Asic chips HIRFL-CSR (Lanzhou).

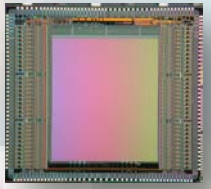
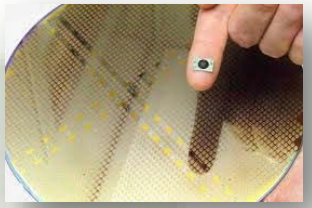
Technological Transfer
To other
far away labs

Preview

- Picture Gallery
  - Instruments Now & Tomorrow
  - VAMOS & MUST2 & MUSETTE
- The GET project (A System ➔ Several Instruments)
  - Glossary
  - GET System **(R-GET, FEMINOS, GET)**
- Projects Employing GET
  - A Catalogue
- Valorisation
  - Instruments Now & Tomorrow
  - How can we do it better next-time

GET – Glossary *(Industry Standards Hard)*

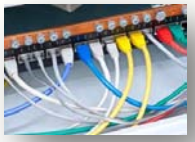
- **Sensors**
- **ASIC – *Application-Specific Integrated Circuit***

- **FPGA – *Field-Programmable Gate Array***


- **PCB – *Printed Circuit Board***

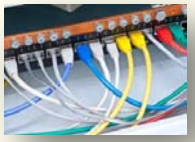

- **Inter-Connection Fabric/Chassis**



Current Telecommunication Standards
➔ Reliable, Inexpensive
➔ Now a CERN standard

GET – Glossary *(Industry Standards Soft)*

- Sensors – *Time Projection Chamber, DSSSDs, CsI, …*
- ASIC – *Application-Specific Integrated Circuit*
- FPGA – *Field-Programmable Gate Array (Firm/Software)*
- PCB – *Printed Circuit Board*
- Inter-Connection Fabric/Chassis

SENSORS

- **Active targets** – *Gas is Target*
- TPC+ Si or TPC+CsI
- TPC in Solenoid/Dipole
- DSSSD & CsI

- **TPC** (*1p & 2p decay, EoS, …*)
- **Beam Trackers** (*Beam, Focal Plane*)
- Special needs:

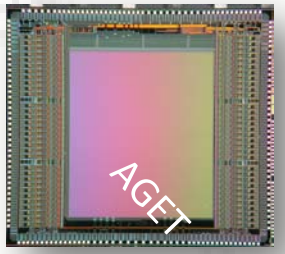
➔ Dyn. Rnge., Trigger, …, Nucl. Phys. Lab computing environments.

- Variable geometries, gain, gases, ions species

➔ Large variability in the functional electronics.

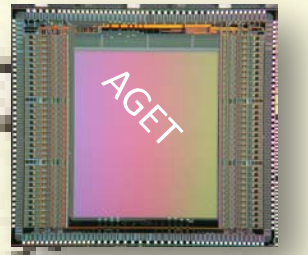
- Nucl. Phys. Community have today high activity in this instrumentation.

- **ASIC** ***(500 for 30k system)***
  - Micro Electronics – Analog & Numeric
  - 10^6 components
  - Reconfiguration Parameters (15) – … ← GENERIC



- **FPGA & Firm/Soft-ware** ***(Embedded Distributed Systems – 300 CPUs for 30k system)***
  - Field-Programmable Gate Array
  - FPGAs are integrated circuits *designed to be <u>reprogrammed</u> an unlimited amount of times* ← GENERIC

- **ASIC** ***(500 for 30k system)***
  - Micro Electronics – Analogical & Numeric Mix
  - 10^6 components
  - Reconfiguration Controlled – … ← GENERIC
  - 1-2 years to Conceive & Test
  - Approx. 100k€ in manufacturing processes



- **FPGA & Firm/Soft-ware** ***(Embedded Distributed Systems – 150 for 30k system)***
  - Field-Programmable Gate Array
  - FPGAs are integrated circuits *designed to be reconfigured and reprogrammed an unlimited amount of times after the manufacturing process* ← GENERIC
  - Fast moving Domain – to use latest version
  - Difficult to find/employ expertise
  - 2-3y to implement (Firmware & Software)
  - 1-2k€/each -> PCB 10k€/each R&D costs


AGENCE NATIONALE DE LA RECHERCHE
ANR


NSF


Eurotalents

GET


RIKEN
NiSHiNA
CENTER


CENBG


Irfu
cea


GANIL
spiral2
laboratoire commun CEA/DSM
CNRS/IN2P3

GET

- Who is doing the WORKs?
- How GET works?
- What it GETs?

Charge Signal, Q as a fn of time, T for a trigger condition

- For many channels (64-30,000channels)
- $\Delta Q/Q$ & $\Delta T/T$
- Evolved 4-Level Trigger
- Rates 1KHz to 10KHz.

GET Collaboration

- Faisal Abu-Nimeh[4], Shebli Anvar[1], H. Baba[5], Pascal Baron[1], Daniel Bazin[4], Chiheb Belkhiria[2], Bertram Blank[2], Joël Chavas[1], Patricia Chomaz[1], Eric Delagnes[1], Frederic Druillole[1], Patrick Hellmuth[2], Cedric Huss[2] , Eugene Galyaev[4], Bill Lynch[4], Wolfgang Mittig[4], Tetsuya Murakami[5], Laurent Nalpas[1], Jean-Louis Pedroza[2], Emanuel Pollacco[1],Riccardo Raabe[3], Jérôme Pibernat[2], Bruno Raine[3], Abdel Rebii[2], Atsushi Taketani[5], Frederic Saillant[3], Patrick Sizun[1], Daisuke Suzuki[4], Nathan Usher[4] and Gilles Wittwer[3].

- *[1] IRFU/SPhN, CEA-Saclay, Cedex 91191 Gif-sur-Yvette, France*
- *[2] CENBG, Chemin du Solarium, 33175 Gradignan Cedex, France*
- *[3] GANIL, Bd Henri Becquerel. BP 55027, 14076 Caen Cedex 05. France*
- *[4] NSCL, MSU, 1 Cyclotron, East Lansing, Michigan 48824-1321, US*
- *[5] RIKEN, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan*

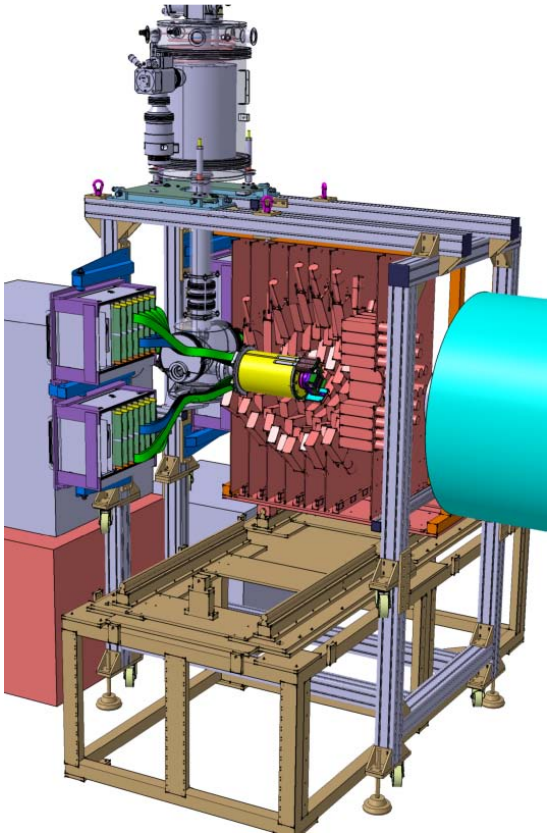
RIKEN NiSHiNA CENTER

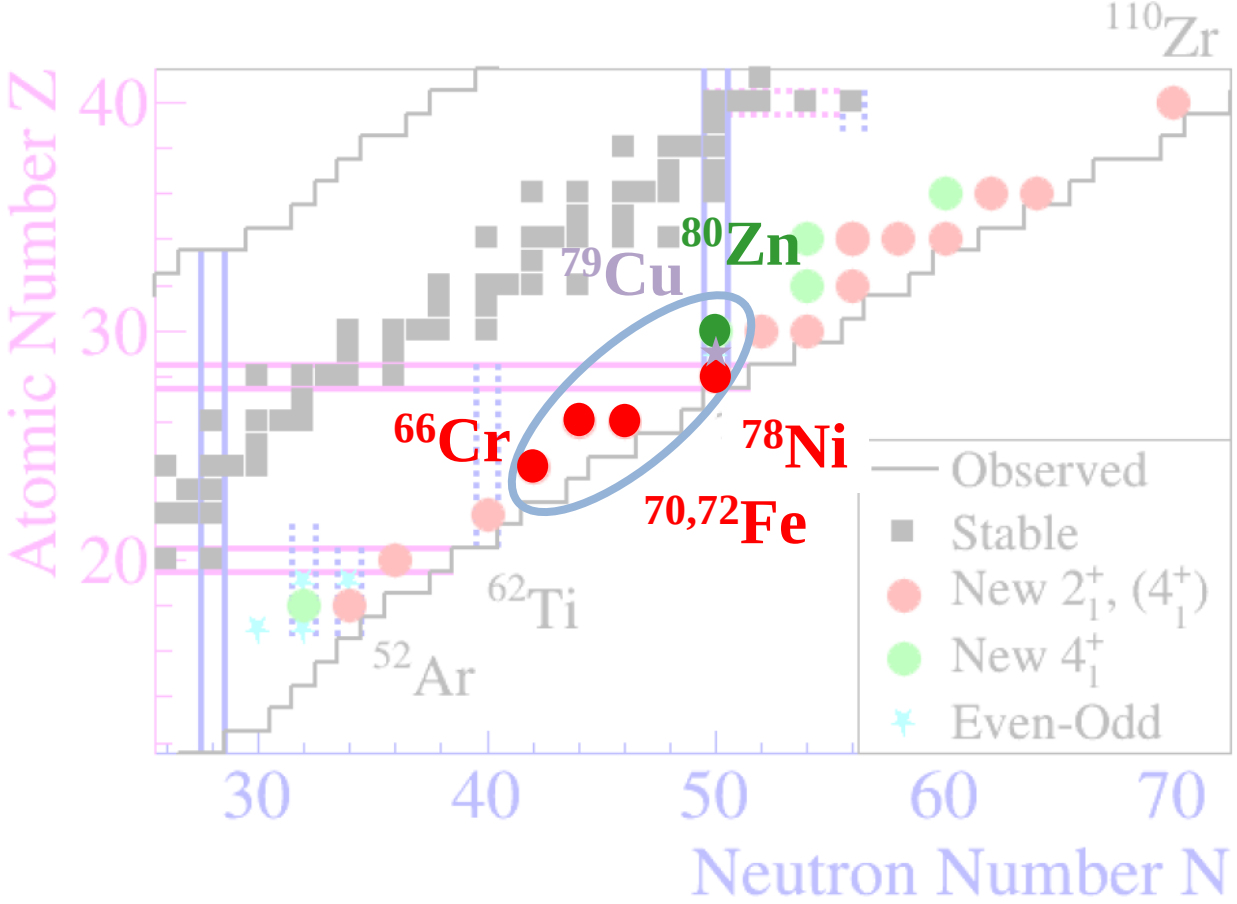
Irfu
Institut de recherche sur les lois fondamentales de l'Univers

GANIL spiral2
laboratoire commun CEA/DSM CNRS/IN2P3

CENBG

Spokespersons: P. Doornenbal (RIKEN), A. Obertelli (CEA, RIKEN)





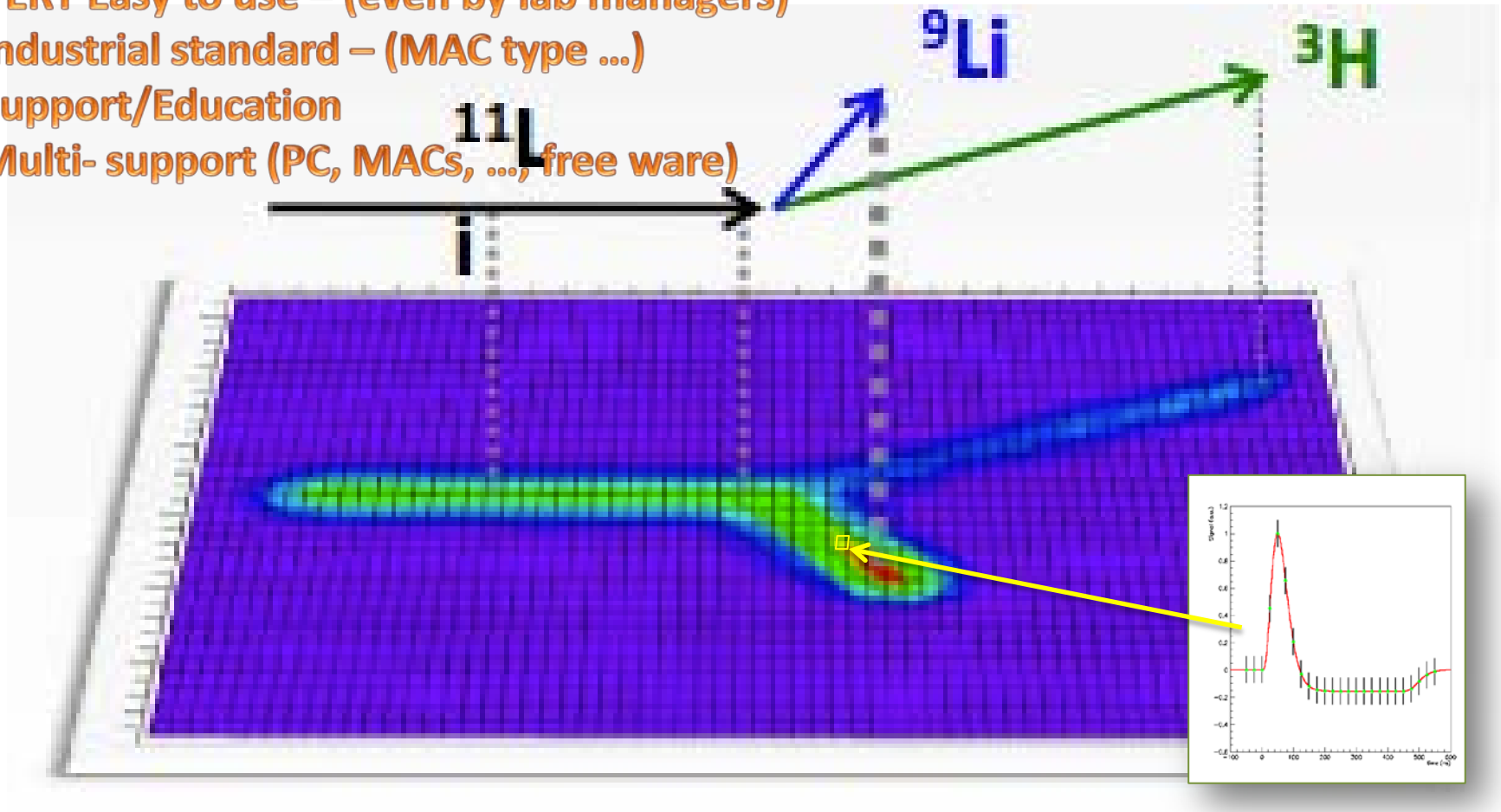
PSP framework promoted by **H. Sakurai** (RIKEN, Univ. of Tokyo)

You are welcome to the SEASTAR collaboration!

http://www.nishina.riken.jp/collaboration/SUNFLOWER/experiment/seastar/index.html

What we want:

- Charge (σ_Q =10^3e^-) as a f^n of time (σ_t =30psec)/channel
- On 1 – 32K Channels
- At >1KHz rate
- Generic – different systems – 20 today
- α to ω Package – from det. to disc (DAQ & Control & Security)
- VERY Easy to use – (even by lab managers)
- Industrial standard – (MAC type …)
- Support/Education
- Multi- support (PC, MACs, …, free ware)



Master Trigger

New concepts for NP.

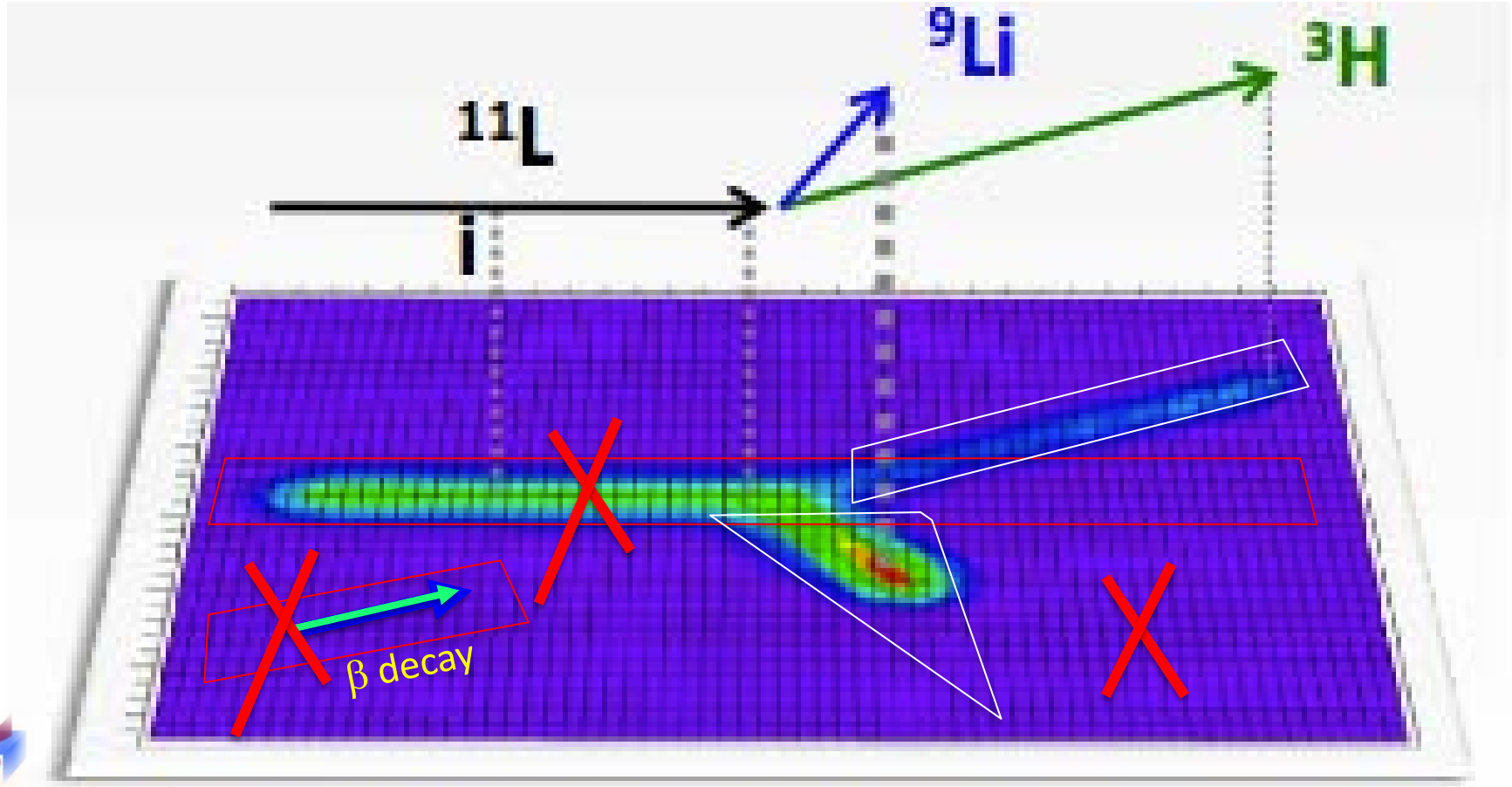
Numeric Trigger

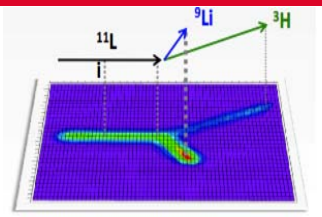
Multi-Level L_0, L_1, L_2 & L_3

Self Trigger

Selective read-out

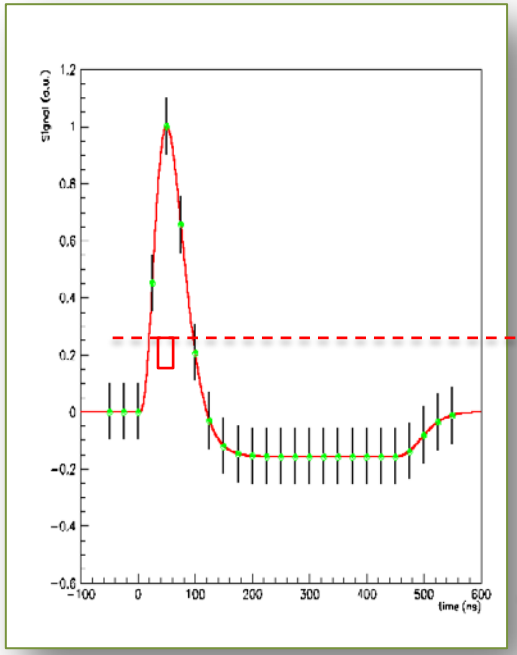
Pattern recognition

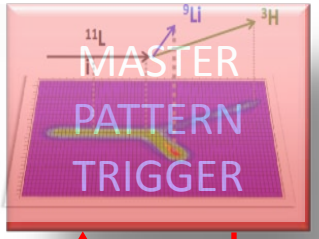




Analogic Memory
Sampled Signal
Analogic-Memory

32 000 Channels





FAST

L.E. Disc

TRIGGER
Which pad?
When?

Trigger

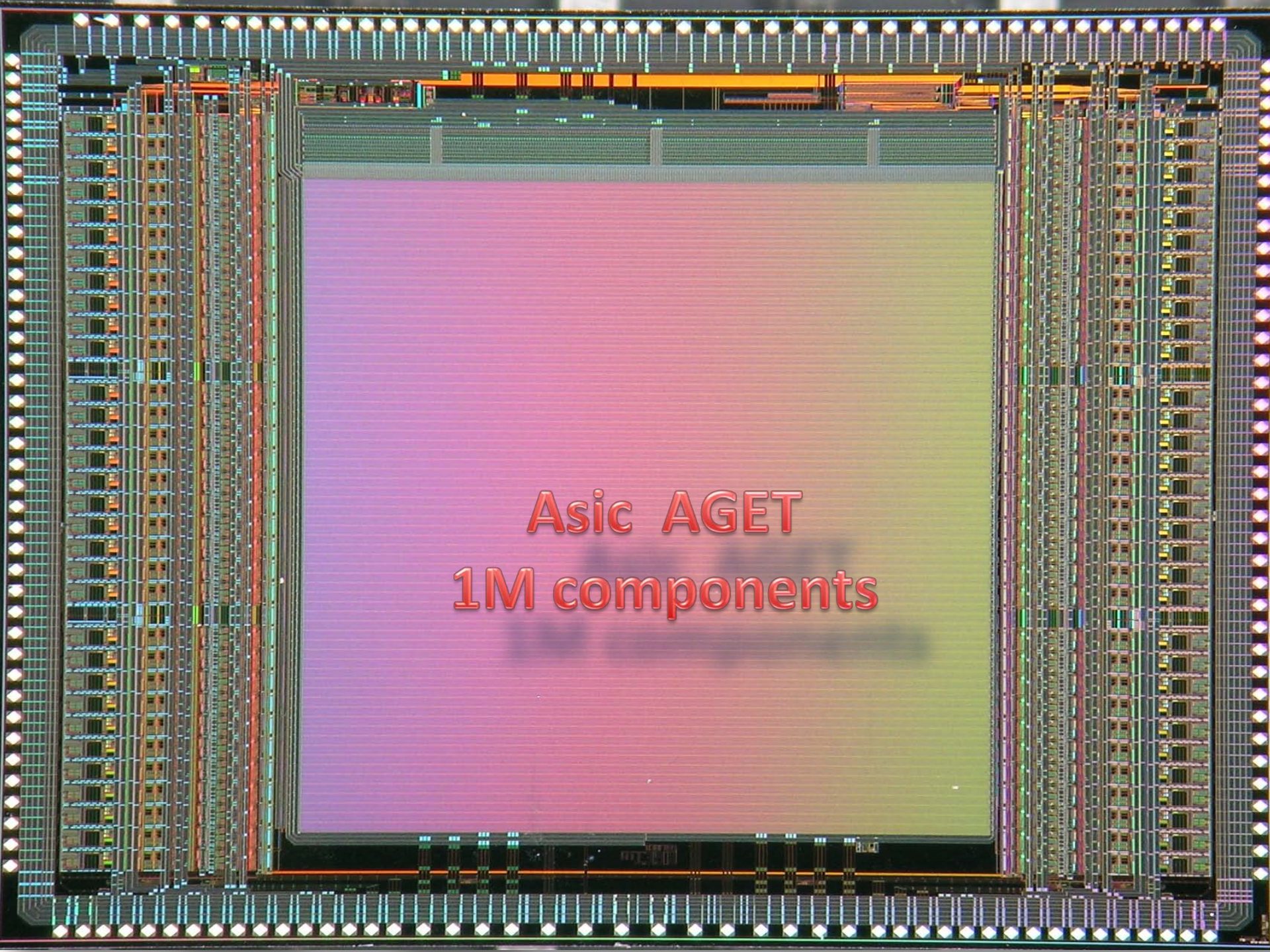
Pattern

SLOW

Conversion
To Numerics

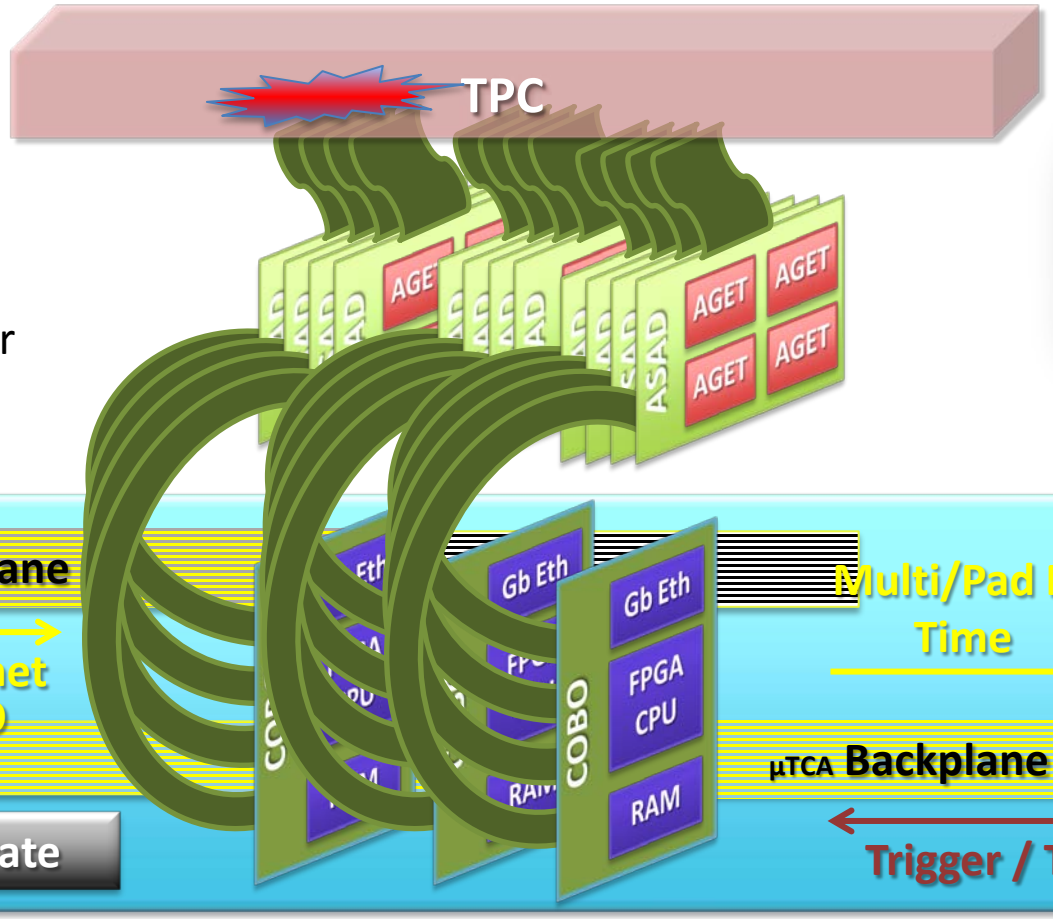
Useful
Data

GET

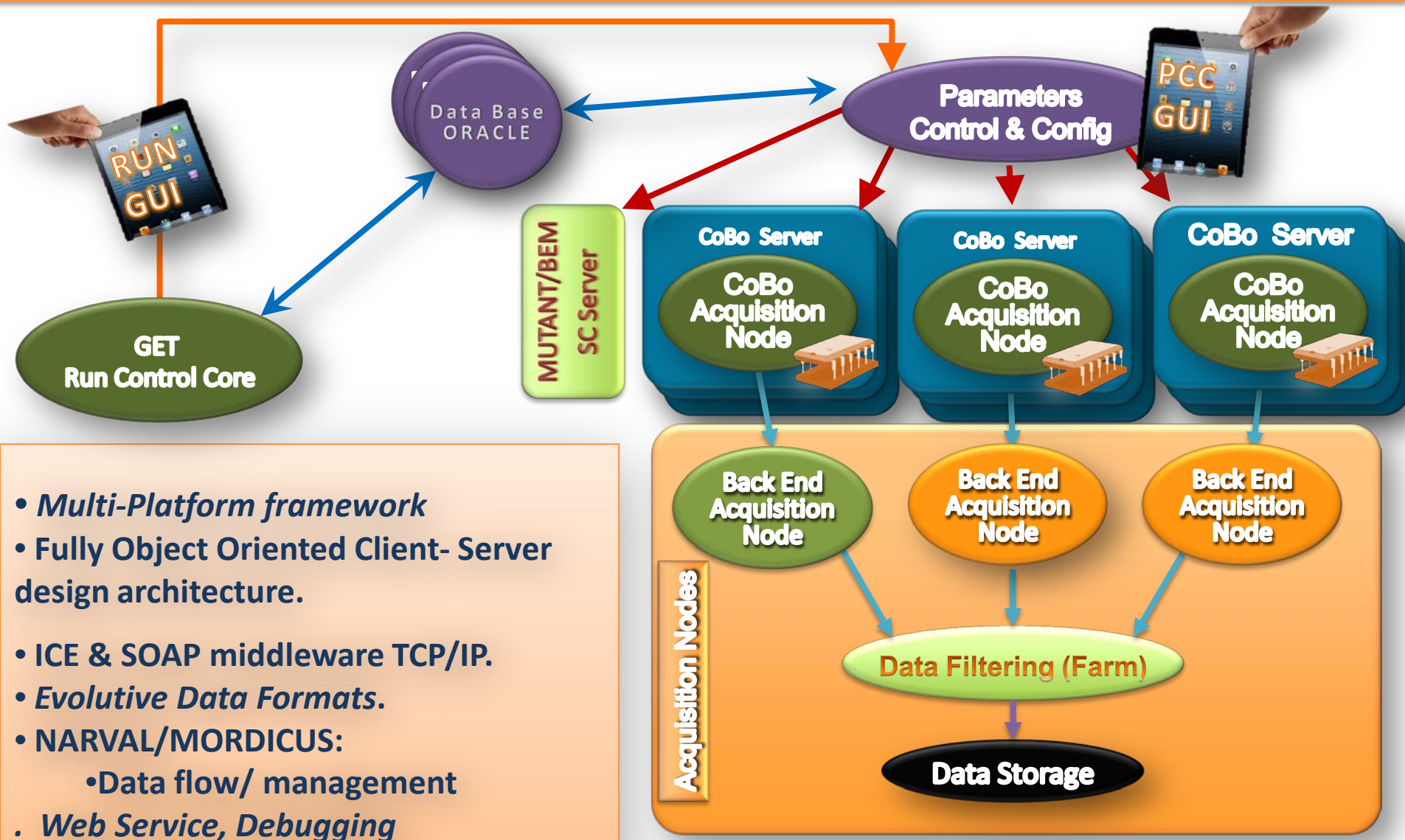

Asic AGET
1M components

Hardware Architecture/Sequence

AGET:-
Circular Memory
Capacitive Array
Disc/Channel=>Trigger

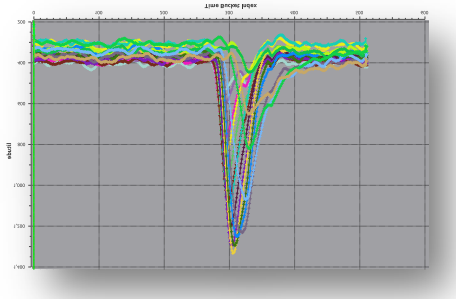


Software/Firmware Distributed System



- *Multi-Platform framework*
- Fully Object Oriented Client- Server design architecture.
- ICE & SOAP middleware TCP/IP.
- *Evolutive Data Formats*.
- NARVAL/MORDICUS:
  - Data flow/ management
- *Web Service, Debugging*
- *Generic Software design*

S. Anvar, GET coll.



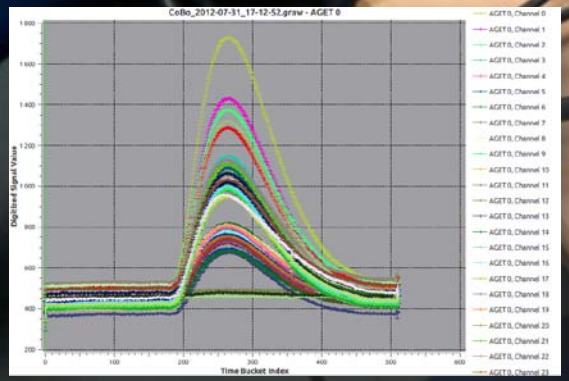
- Who did the WORKs?
- How does GET work?
- **What it GETs?**

Charge Signal, Q as a fn of time, T for a trigger condition

- For many channels (64-32K channels)
- $\Delta Q/Q$ – 10.5bits ($700e^-$) in 120fC
- Evolved 4-Level Trigger
- Rates 1KHz to ? Hz.
- **3 – system available: R-GET(0.064K), FEMINOS(0.2-5K) & GET(0.2-32K)**
- **Production in progress for approx 100Kchannels**

- *Confirmation Tests have been done at several labs on different instruments.*
- *ACTAR-TPC, SPIRIT, AT-TPC, FARCOS, … fn, resoln etc.*
- *High data rates AsAd ➔CoBo ➔Switch ➔PC confirm 800Mb/s/CoBo*

GET Test Bench



Preview

- Picture Gallery
  - Instruments Now & Tomorrow
  - VAMOS & MUST2 & MUSETTE
- The GET project
  - Glossary
  - GET System
-
- Projects Employing GET
  - A Catalogue
- Valorisation
  - Instruments Now & Tomorrow
  - How can we do it better next-time

GET VALORISATION- I

- A DAQ system needs to used by **as many users as possible**.

➢ **Forum** of users allow ease of obtaining solutions

  ➢ **Shared** developments Hardware, Firmware & Software

➢ Allows **Schools** & Workshops on applications to be organized.

  ➢ Nucl. Phys. Exposed to nouvelle techniques & standards (EDUCATION) – see below

- It allows the work accomplished in GET to be **widely publicised**. A positive return to the eng/phys/labs/country who build the system.

- It allows part of the engineering expenses by the participant labs or institutes to be covered. Allow for **HOT** line services, licenses to be covered.

- Well **documented** hardware & software will emerge (I hope!)

- EU and US **industry** profit from the building of the units.

GET VALORISATION- II

- The labs that procure the system profit from obtaining a performing system at a strongly **reduced development costs.**

- Labs sharing common electronics & DAQ systems will have **growth of ties** within the Nucl. Phys community and (Particle, Neutron, Astro-Physics …) in a domain which in the past was individualised efforts.

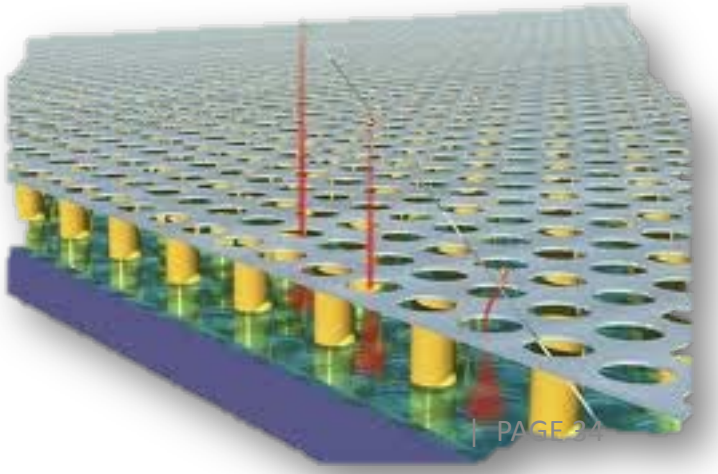
- Facilitates **the introduction** of nouvelle **telecommunication** standards in the community. Open means for **modernisation** of the instrumentation parks.

- Opens access to the Nucl. Phys. community to integrate

❑ Part. Phys./AstroPhys. Work Method

❑ Technical developments in

- ➢ Electronics
- ➢ DAQ
- ➢ Gas amplifiers (Micro-Pattern)
- ➢ Solid-State



Preview

- Picture Gallery
  - Instruments Now & Tomorrow
  - VAMOS & MUST2 & MUSETTE
- The GET project
  - Glossary
  - GET System
- Projects Employing GET
  - A Catalogue – MINOS/AT-TPC/SPIRIT-TPC/n_TOF/J-PARC
- Valorisation
  - Instruments Now & Tomorrow
  - How can we do it better next-time

21 Users Testing/Implem ting

- TPC – NucL. Phys.
- Tracker
- Part Phys
- AT-TPC
- Magnet+TPC

GET Implementation/Testing

PROJECTS DEPLOYING GET

- ***TPC in Magnets***
- *IRIT(RIKEN, MSU)*,#*
- E52 (J-PARC, Jp)#
- *AT-TPC (FRIB, US)*#*
- IBS-TPC (IBS, Kr)
- Pusan National Univ (Kr)
- IKS-T Louven (Be)

- ***Solid-State Devices***
- FARCOS (INFN-Catania, IT)
- TRACE/GASPARD (IRFU-IPNO, INFN-Padova, IT)
- FAZIA (GANIL, Fr)

* - System Developers
\# - System Building
- Funding
22 systems in 6 countries
80k channels built to date

- ***Beam Trackers***
- CAST (IRFU, Fr)
- n_ToF (IRFU,CERN)#
- S^3 (SPIRAL2, Fr)#
- Spectro (IPN-Orsay,Fr)#
- Spectrometer (IRFU, TAMU)
- FALSTAFF (IRFU)

- ***TPC***
- *MINOS (IRFU)*,#*
- AstroBox (IRFU, TAMU, IFIN)#
- *2p-TPC (CENBG, GANIL, Fr)*#*

- ***Active-Targets***
- TexAT-P (TAMU,US)#
- *ACTAR-TPC(SPIRA2, Fr)*,#*
- Lanzhou-TPC (IMP,Cn)
- Tokyo-TPC (Jp)#
- iTPC (SINAP, Cn)

FEMINOS

Deployment of AGET & GET Software


First SEASTAR campaign, may 2014

MINOS development and local teams

S. Anvar, L. Audirac, G. Authelet, H. Baba, B. Bruyneel, D. Calvet, F. Chateau, A. Corsi, A. Delbart**, P. Doornenbal**, J.-M. Gheller, A. Giganon, T. Isobe, Y. Kubota, C. Lahonde-Hamdoun, D. Leboeuf, D. Loiseau, M. Matsushita, A. Mohamed, J.-Ph. Mols, T. Motobayashi, M. Nishimura, S. Ota, H. Otsu**, A. Obertelli**, C. Péron, A. Peyaud, E.C. Pollacco, G. Prono, J.-Y. Rousse, H. Sakurai, C. Santamaria, M. Sasano, R. Taniuchi, S. Takeuchi, T. Uesaka, Y. Yanagisawa, K. Yoneda

Physics collaborations

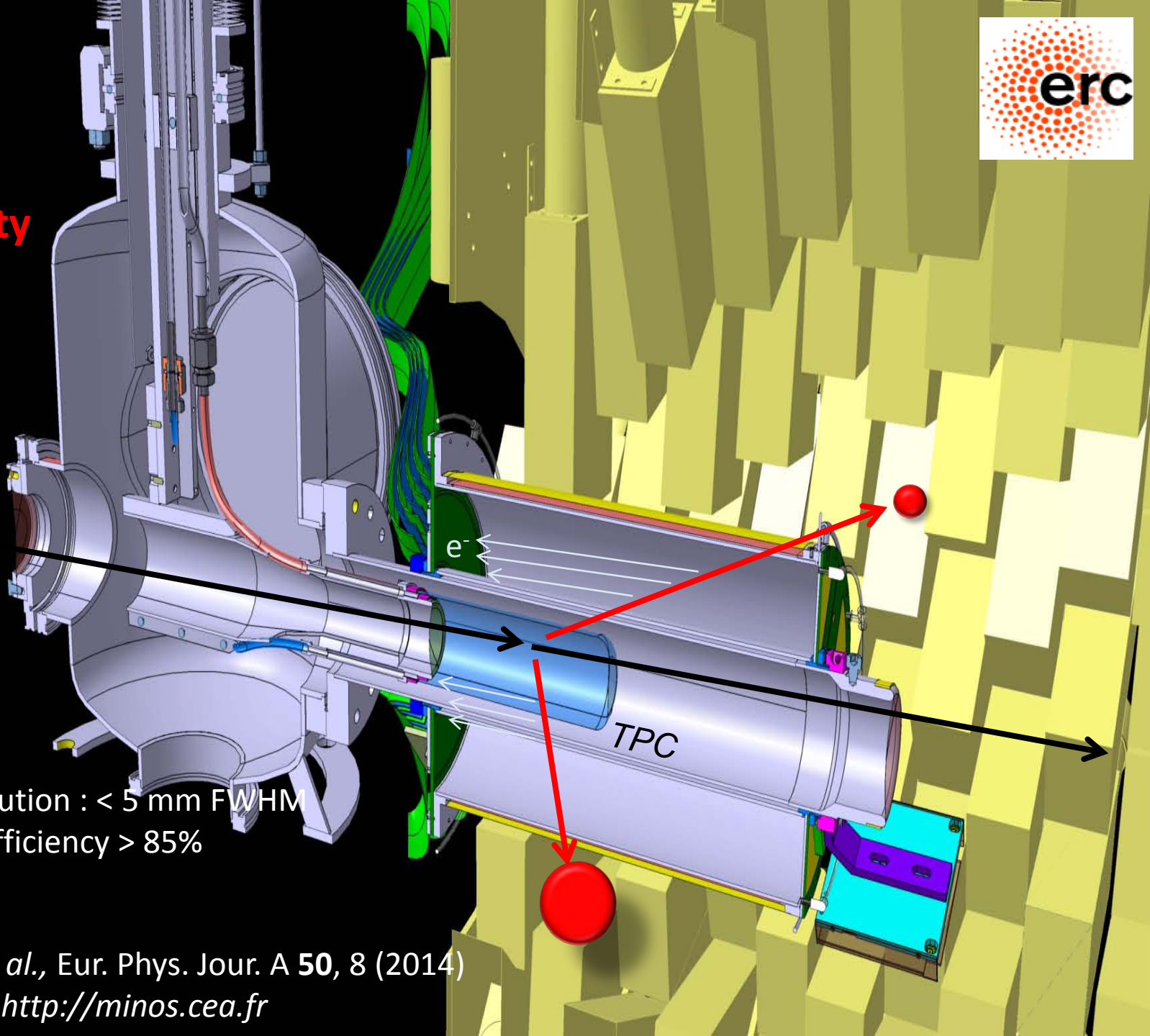
Di-neutron correlations H. Baba, D. Beaumel, P. Doornenbal, M. Dozono, T. Isobe, Y. Kikuchi, T. Motobayashi, H. Otsu, M. Sasano, H. Sato, Y. Shimizu, S. Takeuchi, T. Uesaka, K. Yoneda, J. Zenihiro (*RIKEN Nishina Center)*, **A. Corsi**, A. Gillibert, A. Obertelli, E. C. Pollacco, C. Santamaria (*CEA Saclay),* S. Kawase, M. Kobayashi, M. Matsushita, S. Ota, M. Takaki, T. L. Tang, H. Tokieda, K. Yako *(CNS),* K. Kisamori, **Y. Kubota**, C. S. Lee (*CNS and RIKEN Nishina Center),* K. Kobayashi (*Rikkyo University),* T. Kobayashi (*Tohoku University),* Y. Kondo, T. Nakamura, Y. Togano (*Tokyo Institute of Technology),* K. Ogata (RCNP)

Oxygen isotopes Y. Kondo, T. Nakamura, Y. Togano, M. Shikata, J. Tsubota (Tokyo Tech), H. Baba, H. Sato, K. Yoneda, H. Otsu, T. Isobe, M. Sasano, Y. Shimizu, T. Uesaka (RIKEN Nishina Center), T. Kobayashi (Tohoku University), F. Château, D. Calvet, A. Gillibert, J.-M. Gheller, V. Lapoux, A. Peyaud, A. Obertelli, A. Corsi, E.C. Pollacco, C. Santamaria (CEA Saclay), T. Aumann, H. Scheit (TU Darmstadt), N. Orr, J. Gibelin, F.M. Marques, S. Leblond, N.L. Achouri, F. Delaunay (LPC Caen), Y. Satou, S. Kim, J. Hwang (Seoul National University), T. Murakami, N. Nakatsuka (Kyoto University), C.R. Hoffman (Argonne National Laboratory), A. Navin, M. Rejmund, A. Lemasson (GANIL), S. Stephenson (Gettysburg college), H. Simmon (GSI)

SEASTAR N. Alamanos, G. de Angelis, N. Aoi, H. Baba, C. Barbieri, C. Bertulani, A. Corsi, F. Delaunay, Z. Dombradi, **P. Doornenbal**, T. Duguet, S. Franchoo, J. Gibelin, A. Gillibert, S. Go, M. Gorska, A. Gottardo, S. Grévy, J.D. Holt, E. Ideguchi, T. Isobe, A. Jungclaus, N. Kobayashi, T. Kobayashi, Y. Kondo, W. Korten, Y. Kubota, I. Kuti, V. Lapoux, S. Leblond, J. Lee, S. Lenzi, H. Liu, G. Lorusso, C. Louchart, R. Lozeva, F.M. Marques, I. Matea, K. Matsui, Y. Matsuda, M. Matsushita, J. Menendez, D. Mengoni, S. Michimasa, T. Miyazaki, S. Momiyama, P. Morfouace, T. Motobayashi, T. nakamura, D. Napoli, F. Naqvi, M. Niikura, A. Obertelli, N. Orr, S. Ota, H. Otsu, T. Otsuka, N. Pietralla, Z. Podolyak, E.C. Pollacco, G. Potel, G. Randisi, F. Recchia, E. Sahin, H. Sakurai, C. Santamaria, M. Sasano, A. Schwenk, Y. Shiga, Y. Shimuzu, S. Shimoura, J. Simonis, P.A. Soderstrom, S. Sohler, V. Soma, I. Stefan, D. Steppenbeck, T. Sumikama, H. Suzuki, M. Tanaka, R. Taniuchi, K.N. Tuan, T. Uesaka, J. Valiente Dobon, Zs. Vajta, D. Verney, H. Wang, V. Werner, Zh. Xu, R. Yokoyama, K. Yoneda

MINOS : Magic Numbers Off Stability

In-beam knockout experiments

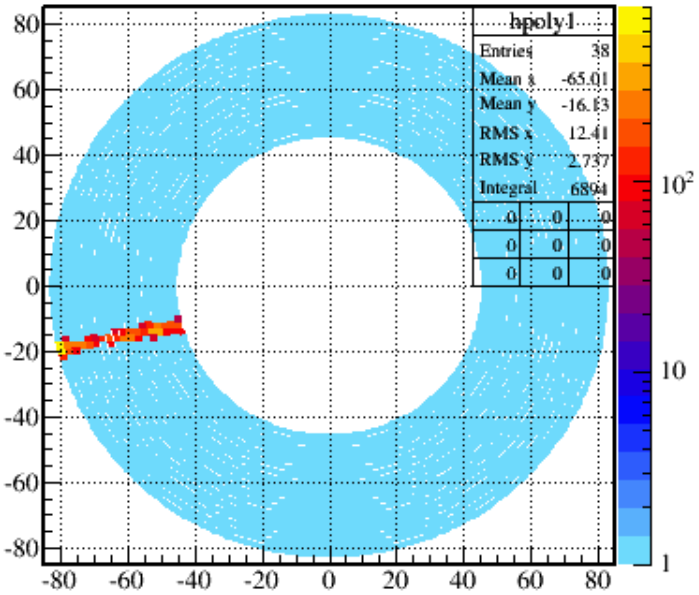


Vertex resolution : < 5 mm FWHM
Detection efficiency > 85%

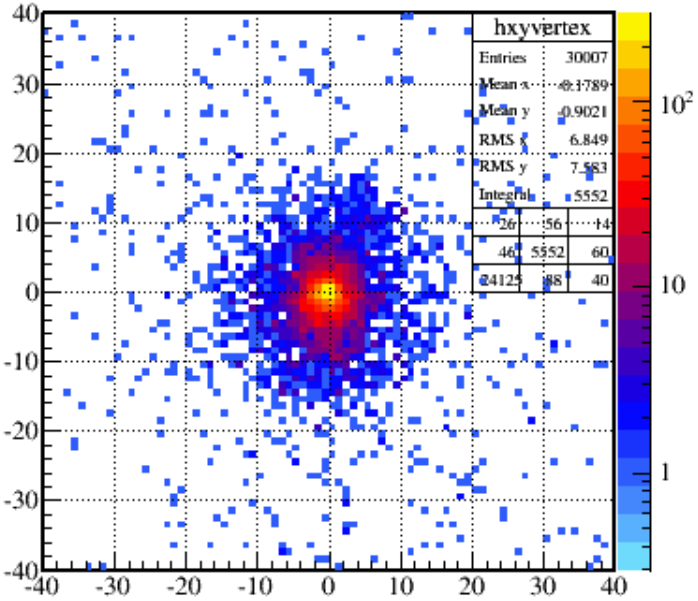
A. Obertelli *et al.,* Eur. Phys. Jour. A **50**, 8 (2014)
http://minos.cea.fr

MINOS: T

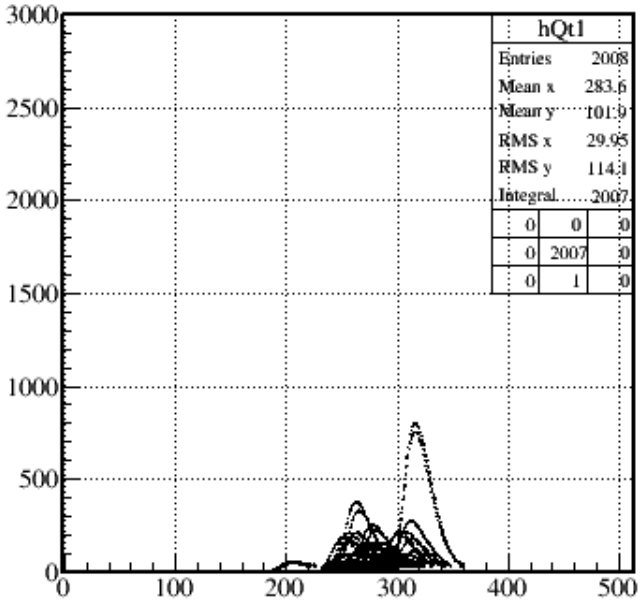
XY view - 1 event



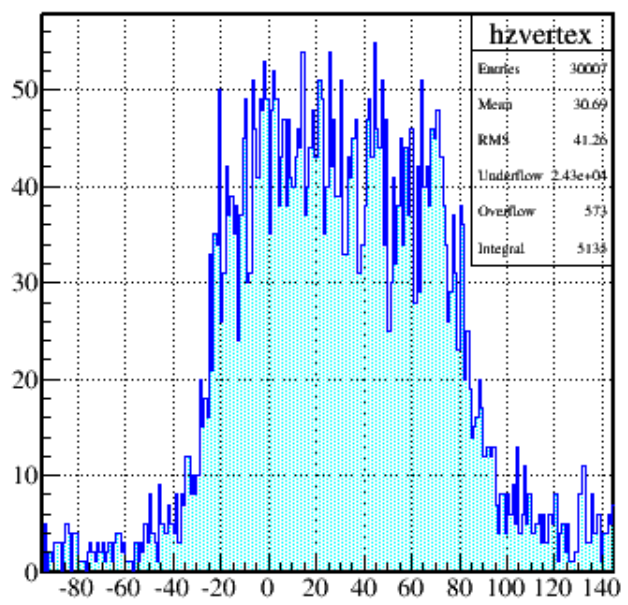
Vertex reconstruction xy



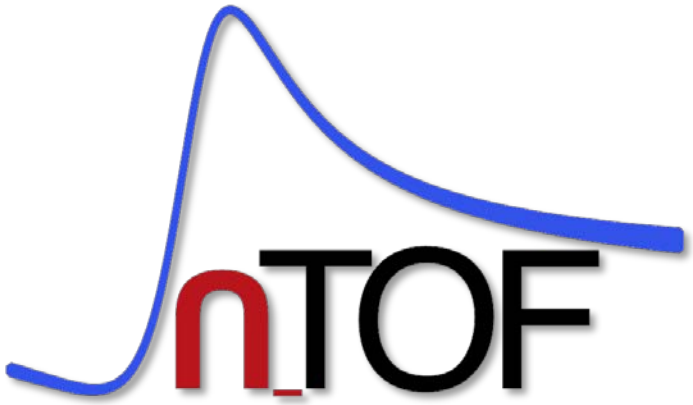
Q(t) signal - 1 event



Vertex reconstruction along beam



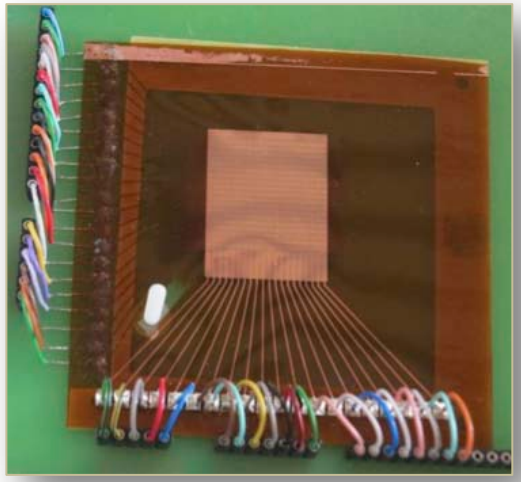
DAQ – Sys

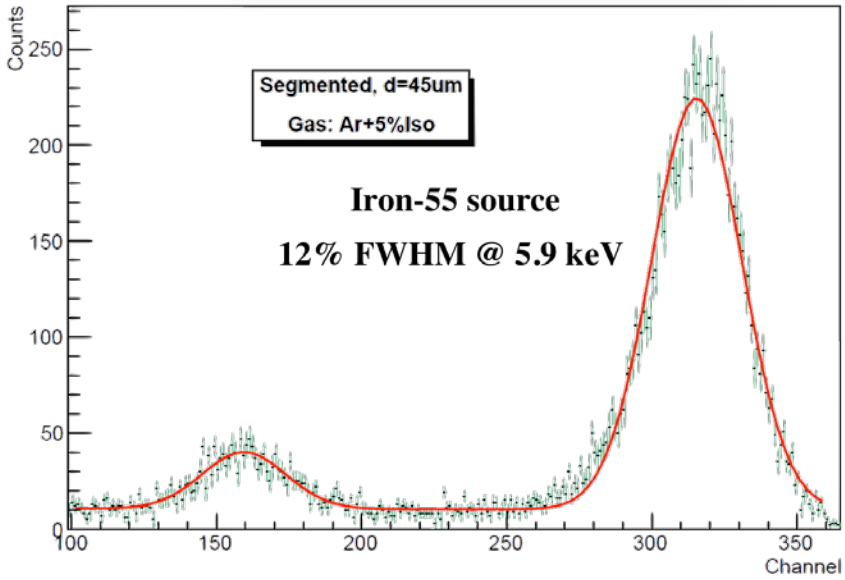

nTOF

Segmented mesh – New Gas Amplifiers

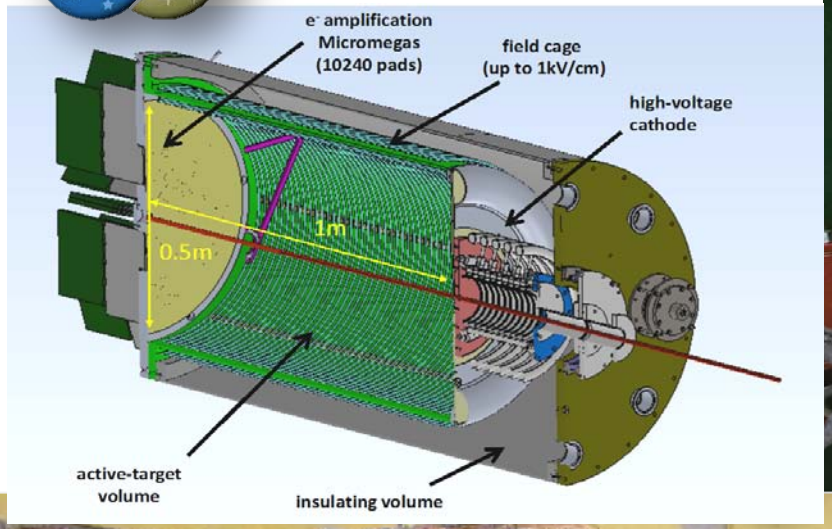
- A real X-Y scheme.
  - Detector prototype (tested succesfully)
    - Mesh & anode subdived into 20 strips
    - Mesh hole ø: 60 µm pitch: 100 µm
    - Strip: 1 mm wide spaced by 40 µm
  - Final detector (end of june)
    - 60 x 60 strips on a 6x6 cm^2 area
    - Similar to proto design
  - Front end electronic (end of june)
    - To distribute HV on each strip and send signal to acquisition card
  - AGET + reduced Cobo
    - Allow to work in self trigger mode
    - Retrieve timing information between strip

Experiment will start mid-july





AT-TPC (FRIB)


e⁻ amplification
Micromegas
(10240 pads)
field cage
(up to 1kV/cm)
high-voltage
cathode
1m
0.5m
active-target
volume
insulating volume

ERC: ACTAR TPC

From G.F. Griny

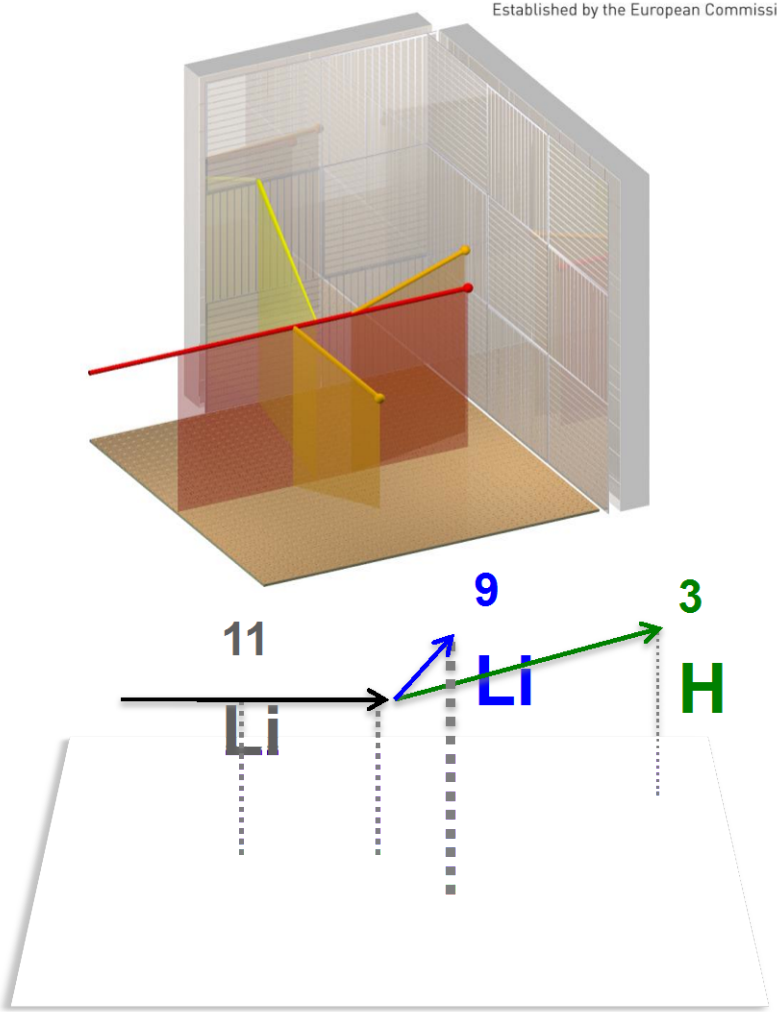
European Research Council
Established by the European Commission

All of the advantages of an active target plus …

- Overcomes many of the limitations with present devices
- Funded via an ERC Starting grant (2014-2019)

Physics cases

- One and two nucleon transfer reactions
- Rare and exotic nuclear decay (2p, β2p, …)
- Transfer-induced fission
- Inelastic scattering and giant resonances
- Resonant scattering and astrophysics



Detector Design

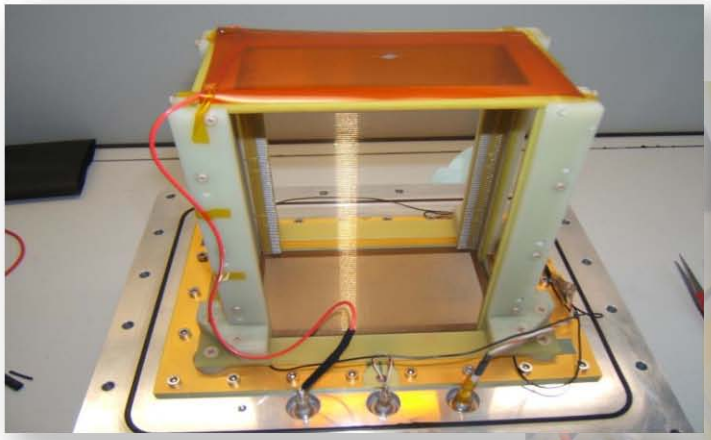
- Amplification = MICROMEGAS* (+ GEMs)
- Pad sizes of 2x2 mm^2 = 16384 channels
- **ANR General Electronics for TC's (GET)**
- Improved data throughput + internal trigger

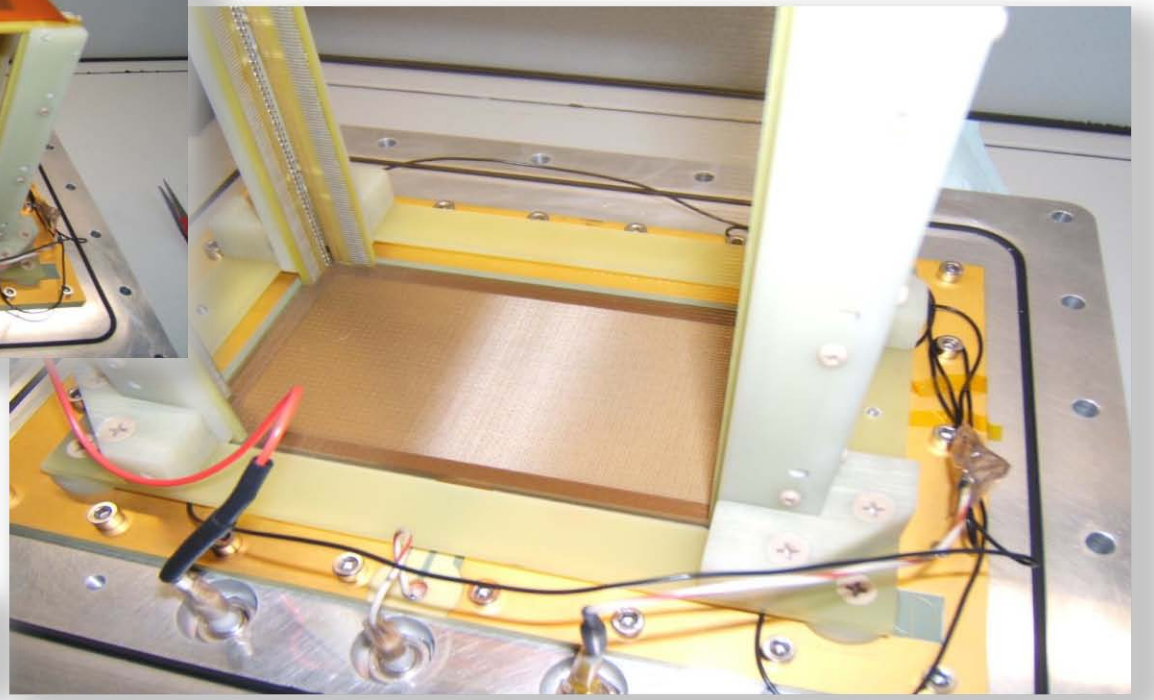
Physics program at SPIRAL1&2, HIE-ISOLDE

ACTAR TPC Demonstrator

From G.F. Grinyer, GANIL

Personal comment : need for benchmark experiment to demonstrate performances





Wire Field Cage (1 mm pitch)
Active area: 6×12 cm²
2048 channels

GANIL spiral2
laboratoire commun CEA/DSM — CNRS/IN2P3

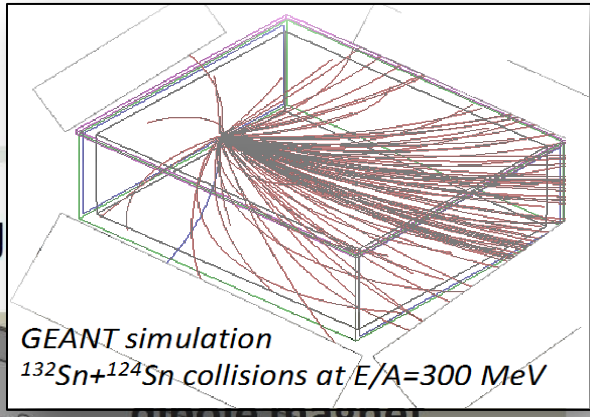
*Prototype detector tests: J.Pancin *et al*. NIMA 735, 532 (2014)

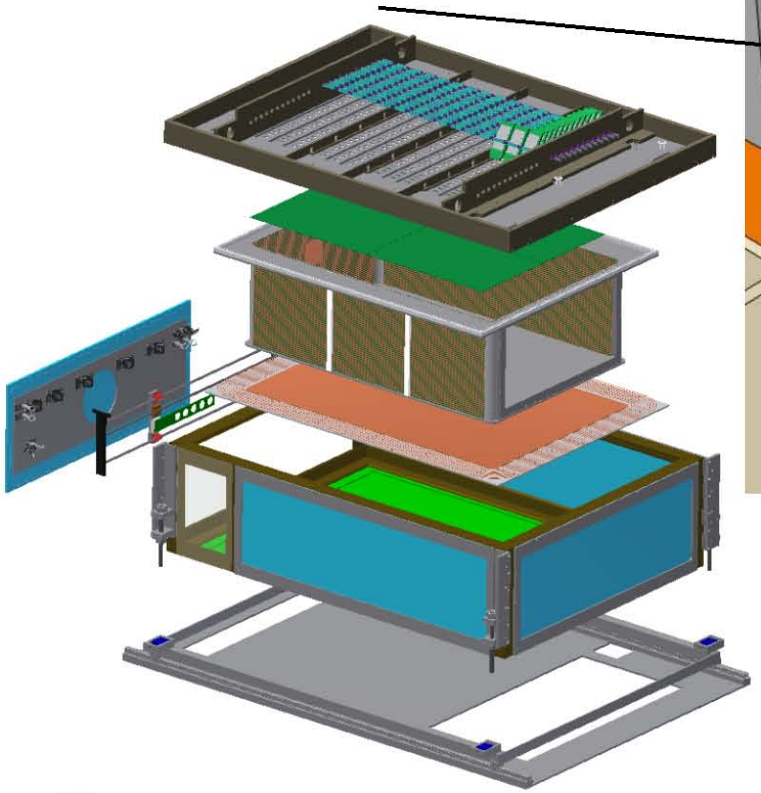
SPIRIT-TPC

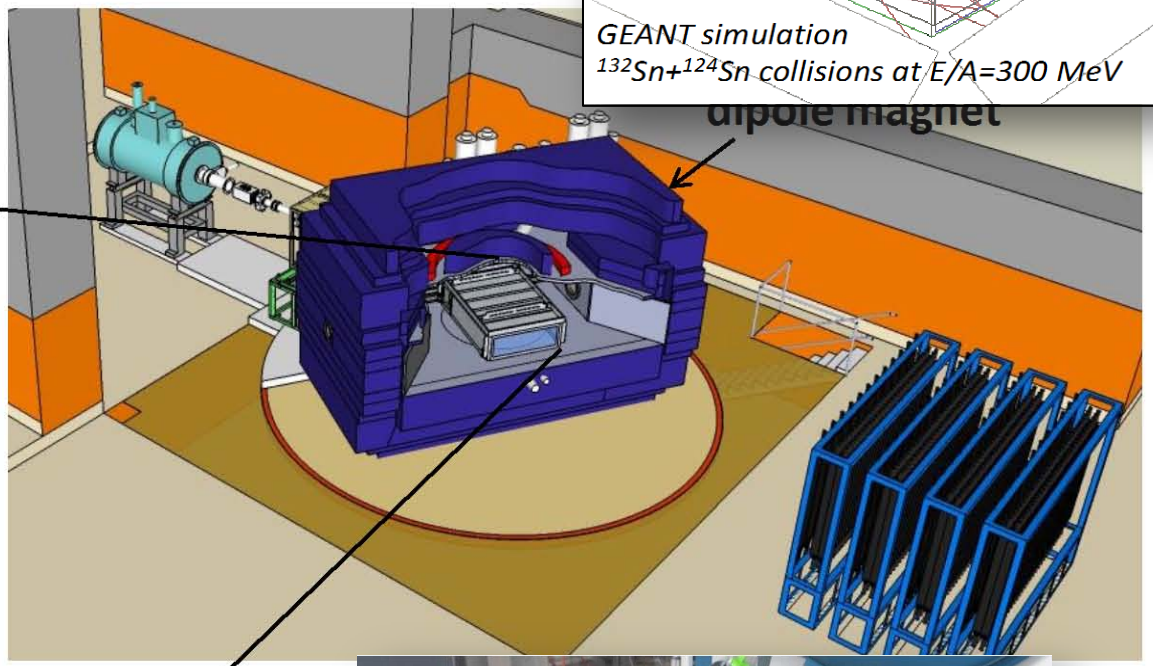
Photo courtesy of T. Isobe

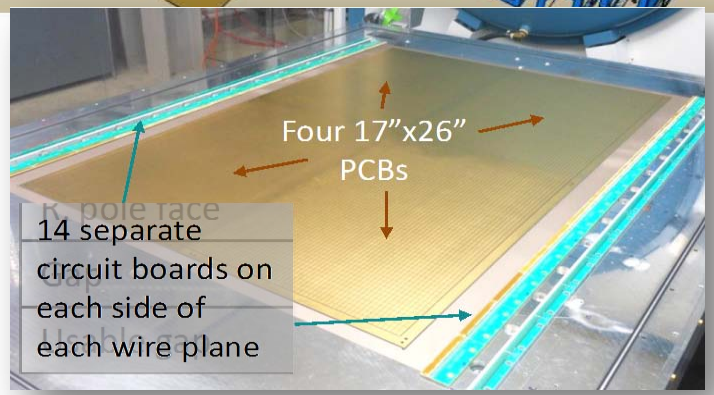
S-TPC: *SAMURAI Spectrometer*

- SAMURAI: high-resolution spectrometer at RIKEN, J







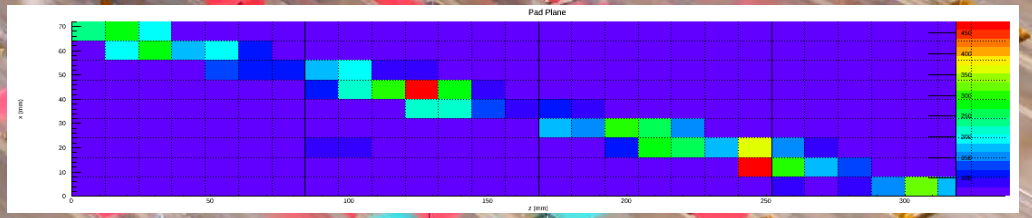


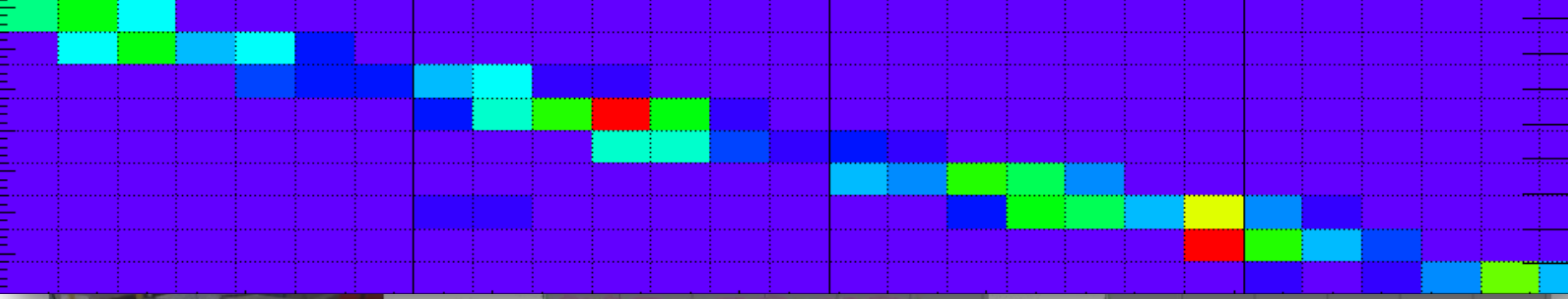
Plots courtesy of T. Isobe

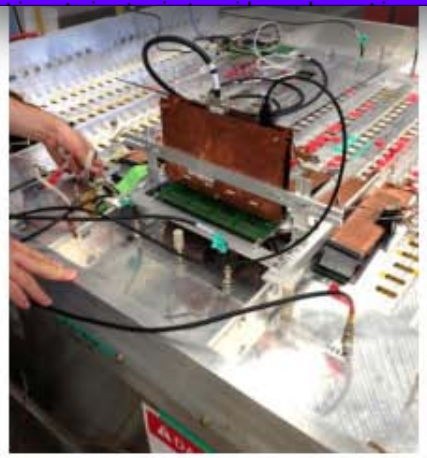
SPIRIT-TPC with GET system

10 240 ch
160 AGET
On 40 AsAd
To 10 CoBo (10X0.8GHz)
With 1 Trigger
With 1 Switch (10GHz)

Cosmic Event on: *July 24th, 2013 @NSCL*



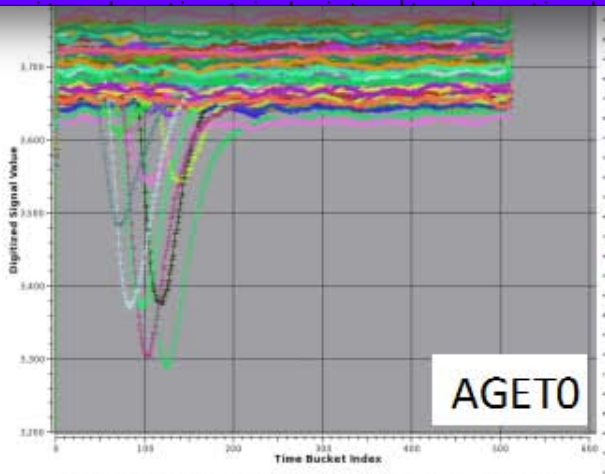


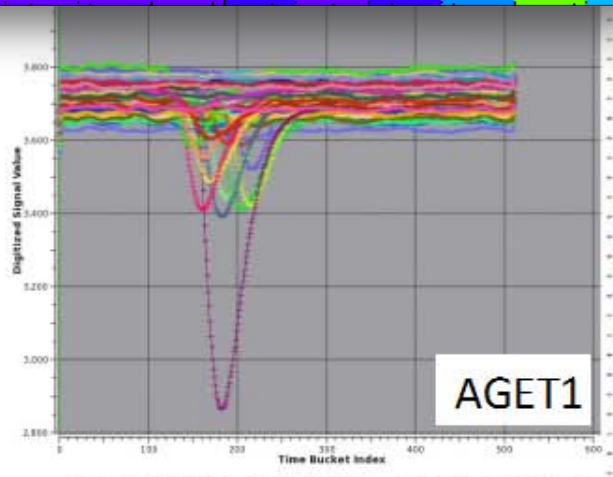


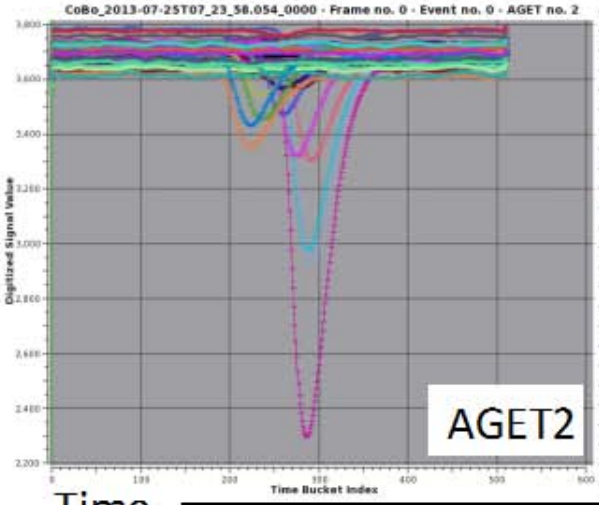
Cosmic Event 0:
July 24th, 2013
@NSCL

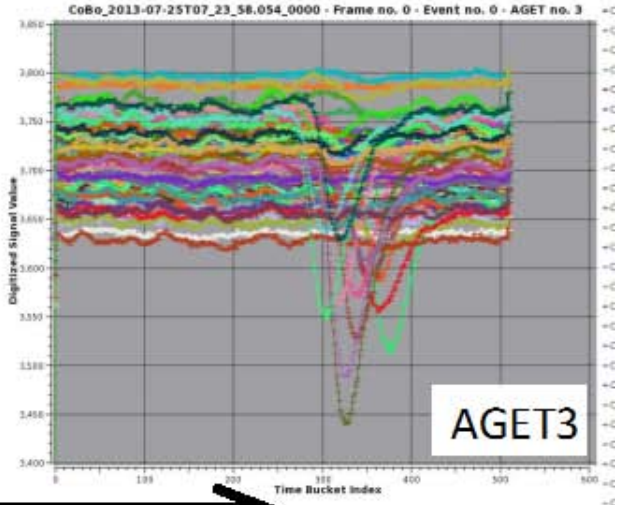
>500 cosmic events so far

Pulse height









Time

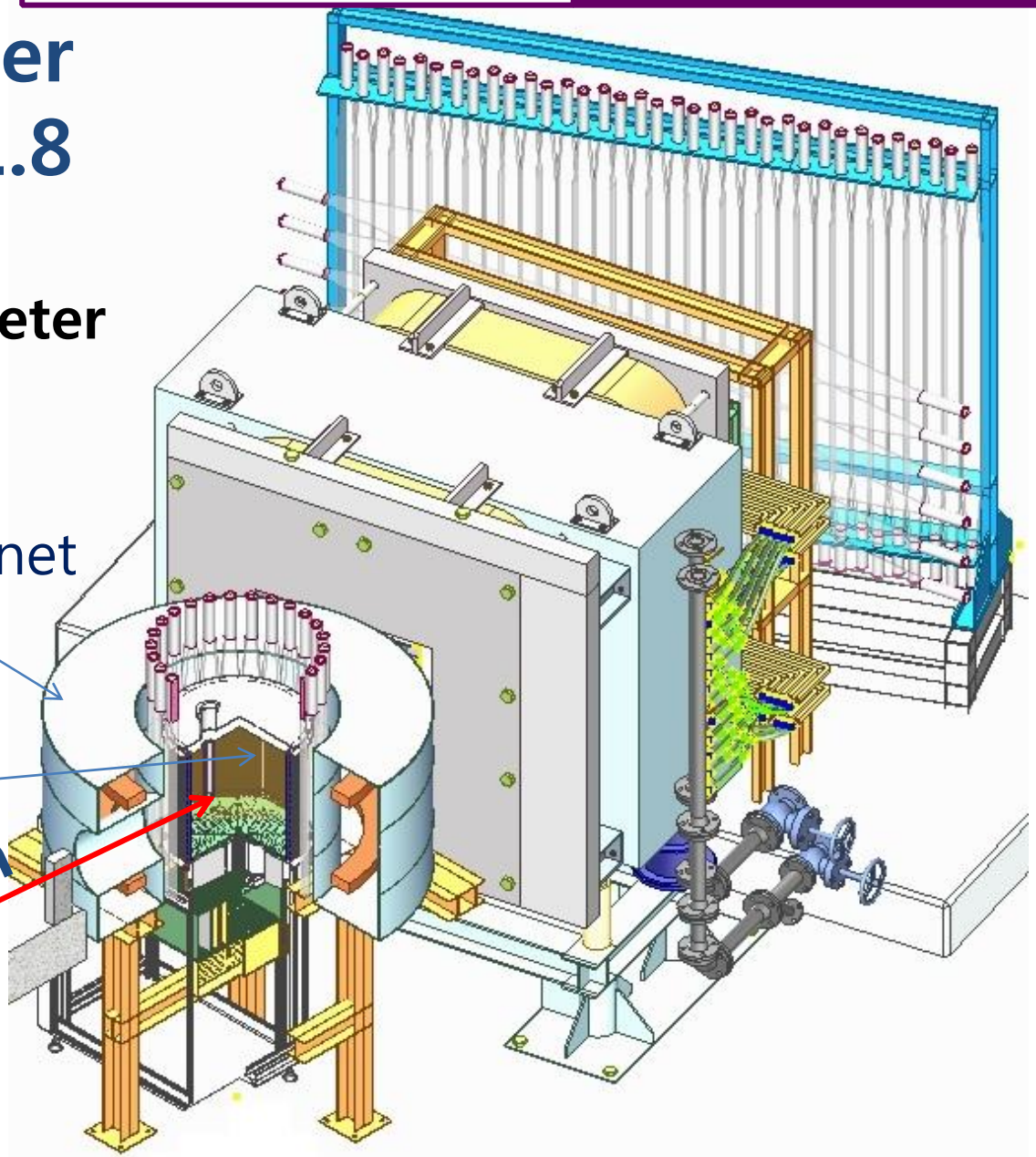
Plots courtesy of T. Isobe

E42 Spectrometer @ J-PARC K1.8

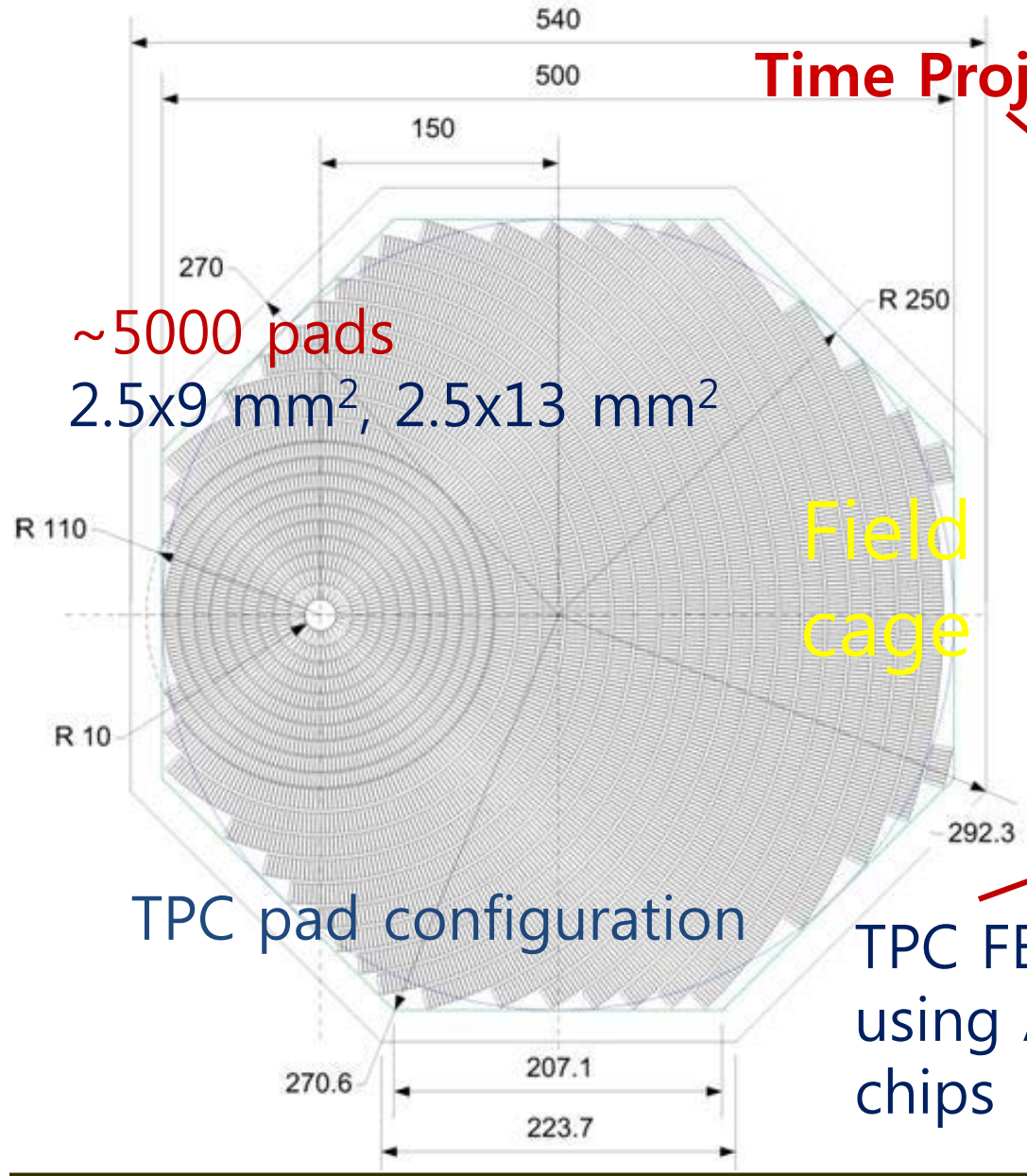
- **Hyperon Spectrometer + K^+ Spectrometer**

Superconducting Helmholtz-type magnet

Time Projection Chamber



ahnjk@pusan.ac.kr



~5000 pads
2.5x9 mm^2, 2.5x13 mm^2

TPC pad configuration

Time Projection Chamber

Field cage

TPC FEEs using A-GET chips

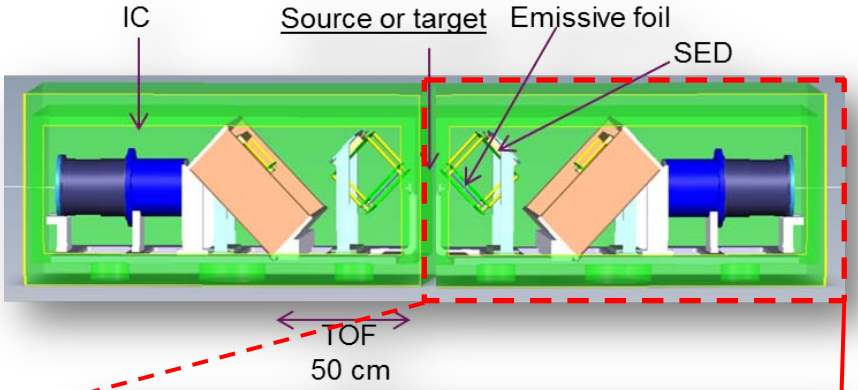
ahnjk@pusan.ac.kr

FALSTAFF: Four Arm cLover for the STudy of Actinide Fission Fragments

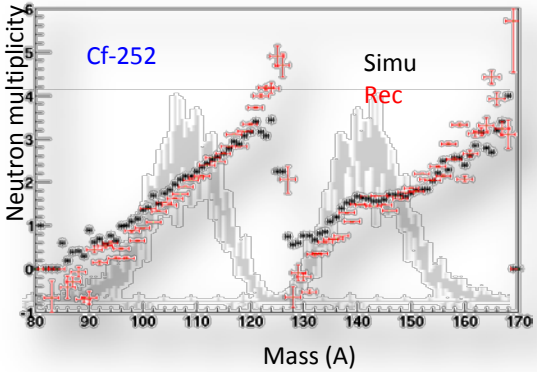
Fragments in coincidence
- Charges
- Kinetic energies
- Final masses (after n evaporation)
- Initial masses (before n evaporation)

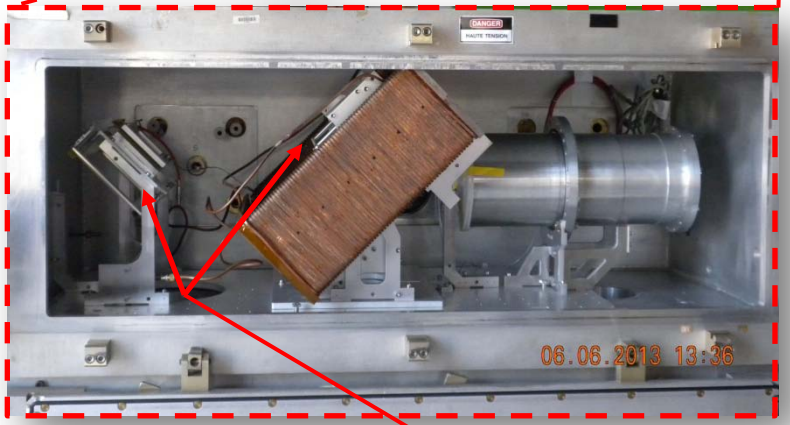
} Neutron mult.

Fragments + gamma
Fragments + neutrons



Actinides to study:
$^{238,235}U$, ^{239}Pu, ^{237}Np,
^{232}Th, ^{233}U, ...





TOF detectors (emissive foil + SeD)

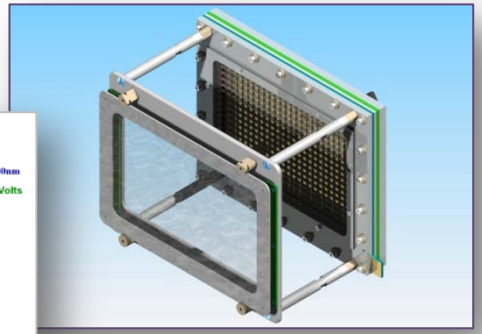
Time signal from anodes at mid-distance (1.6 mm) between the detector window and the cathode.

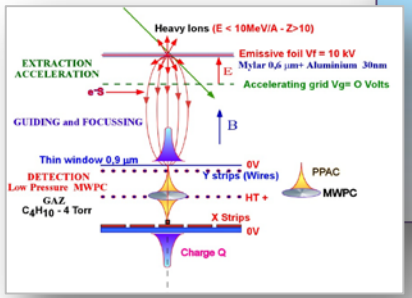
Time resolution σ< 150 ps

Position reconstructed from a (68x48) pixelized cathode.

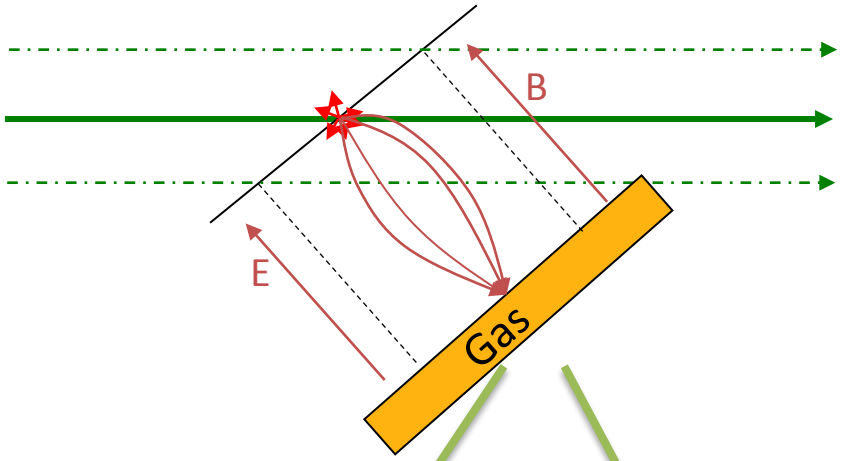
Position resol^{n} < 3 mm without a magnetic field
< 1 mm with a magnetic field

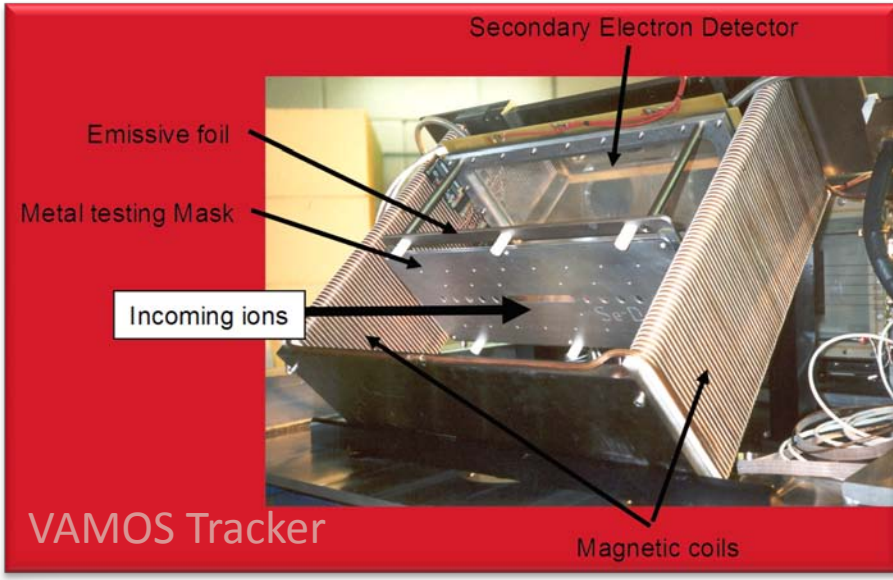
Secondary electrons detector

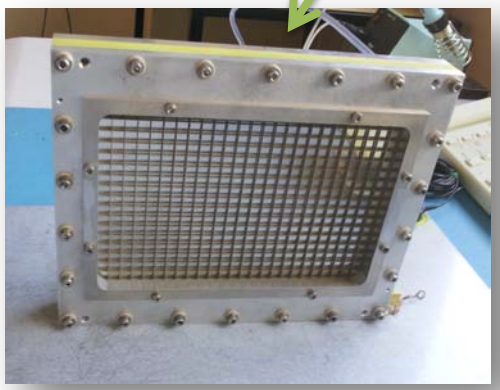


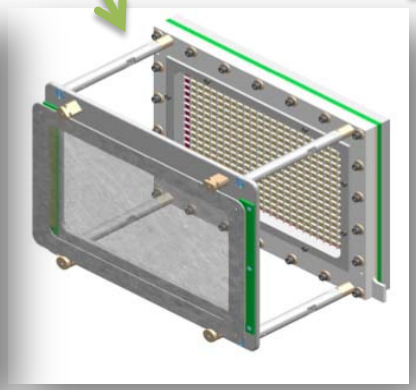


SLOW Heavy Beams in S3





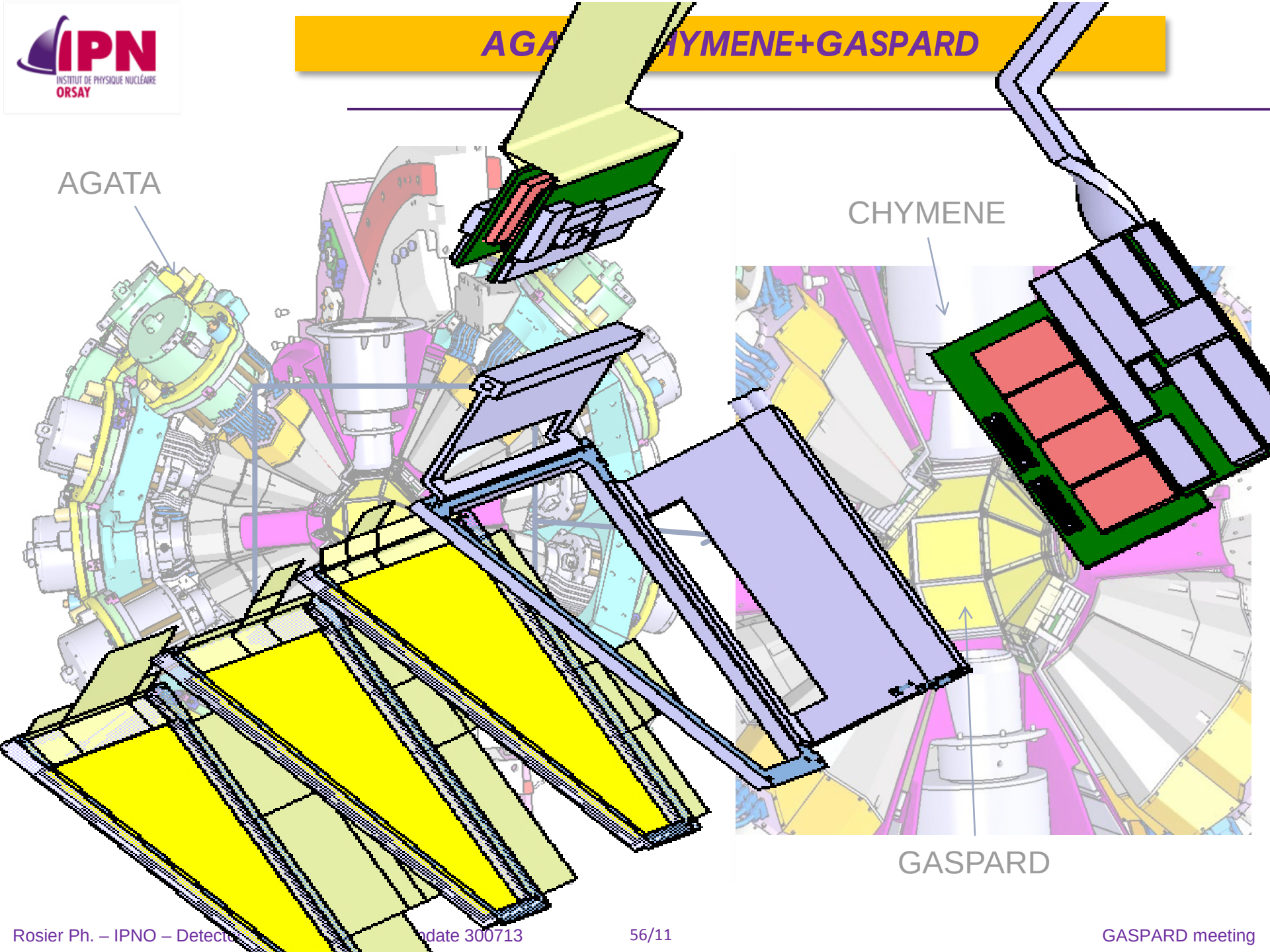




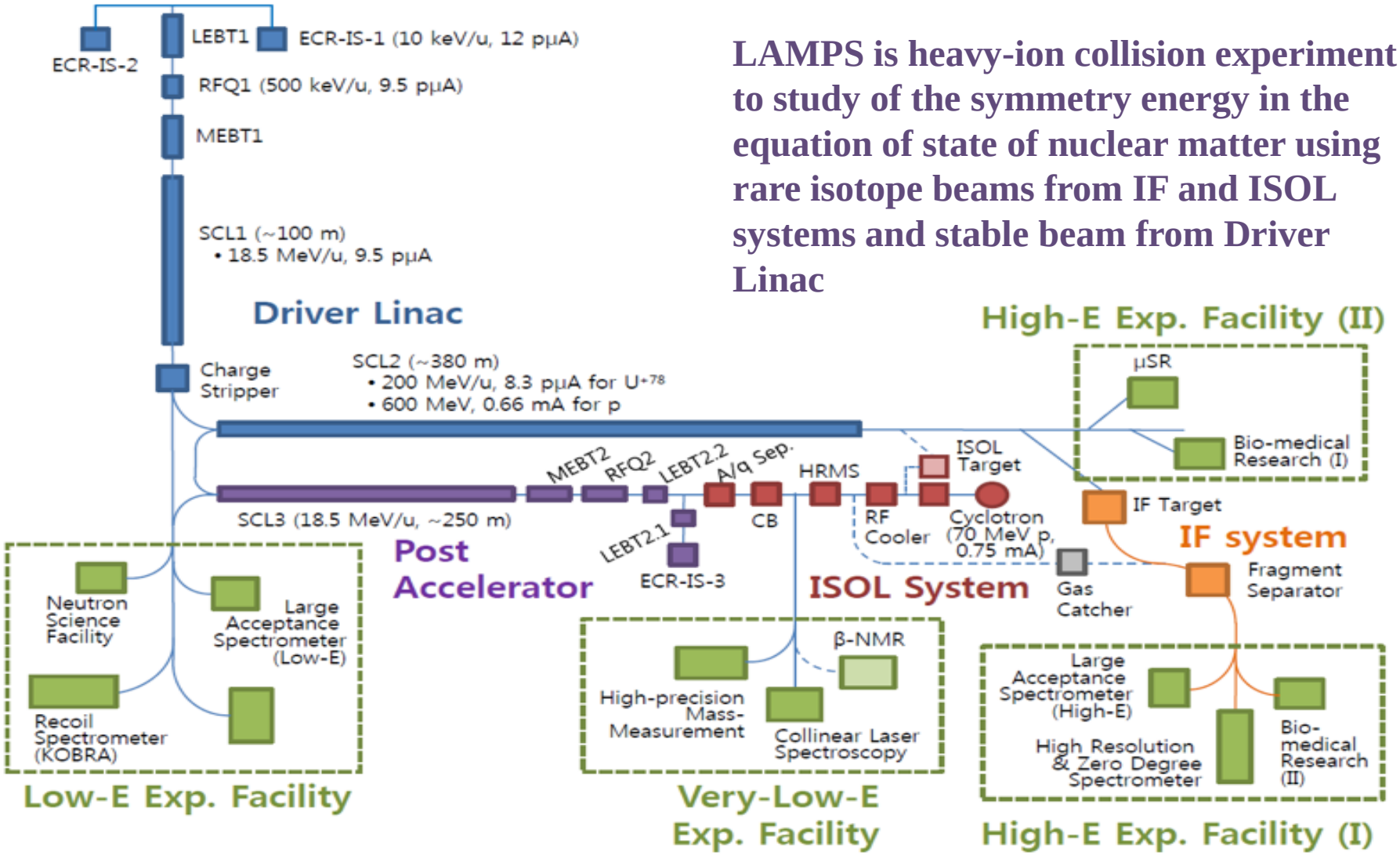
S3,

Micromegas – Gas Amp
GET Based Electronics
Good Counting Rates 10^6
ΔT= 300psec (FWHM)
Δx & Δy = 2-3mm (FWHM)

AGA[illegible]HYMENE+GASPARD

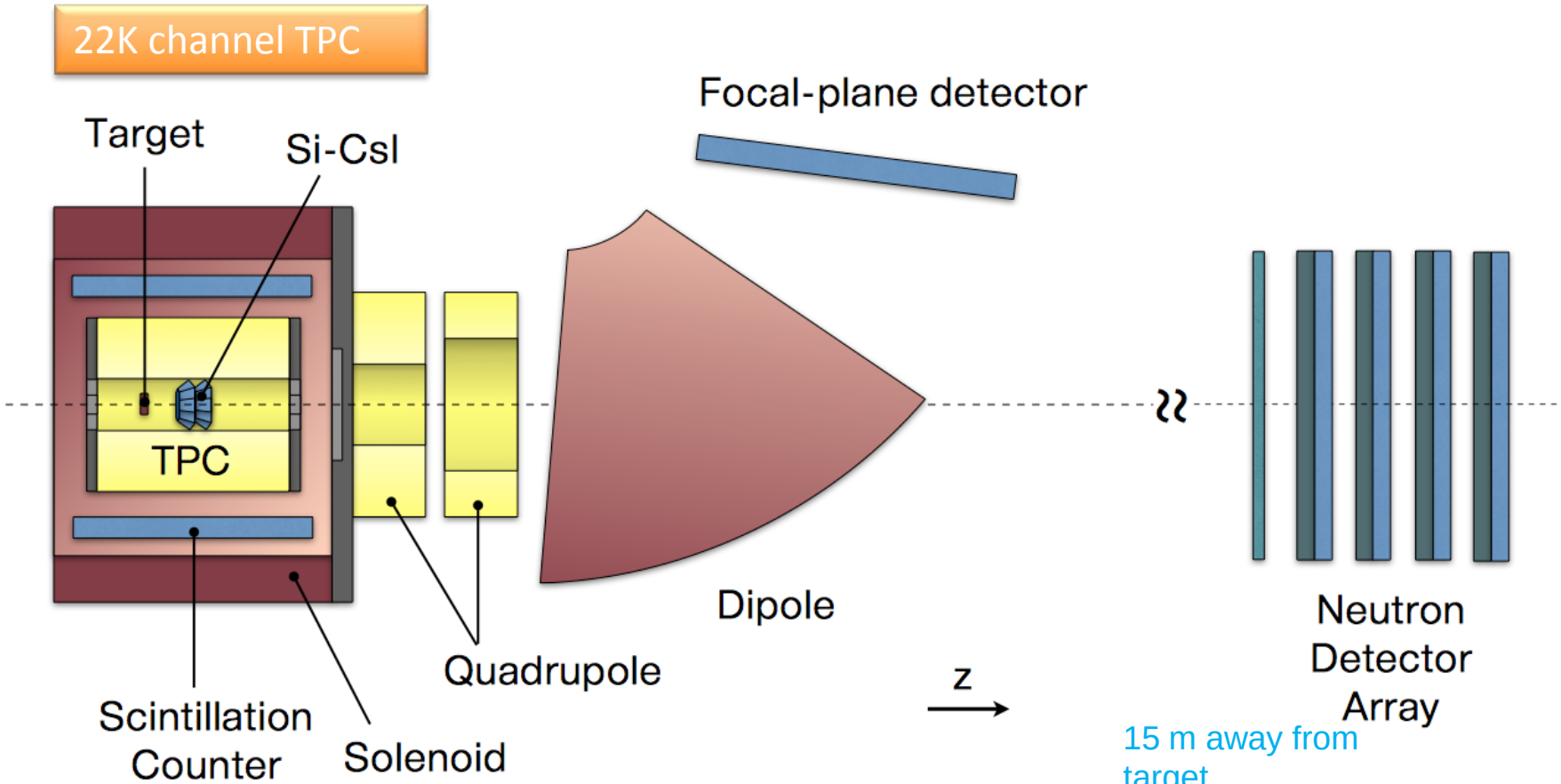


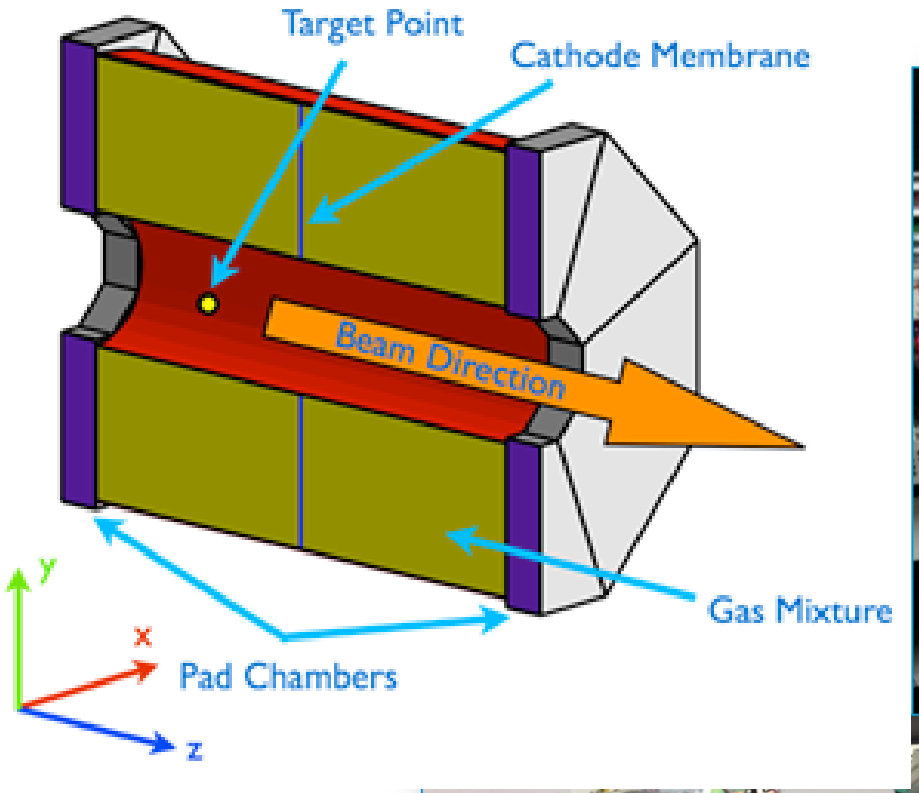
LAMPS Experimental Facilities

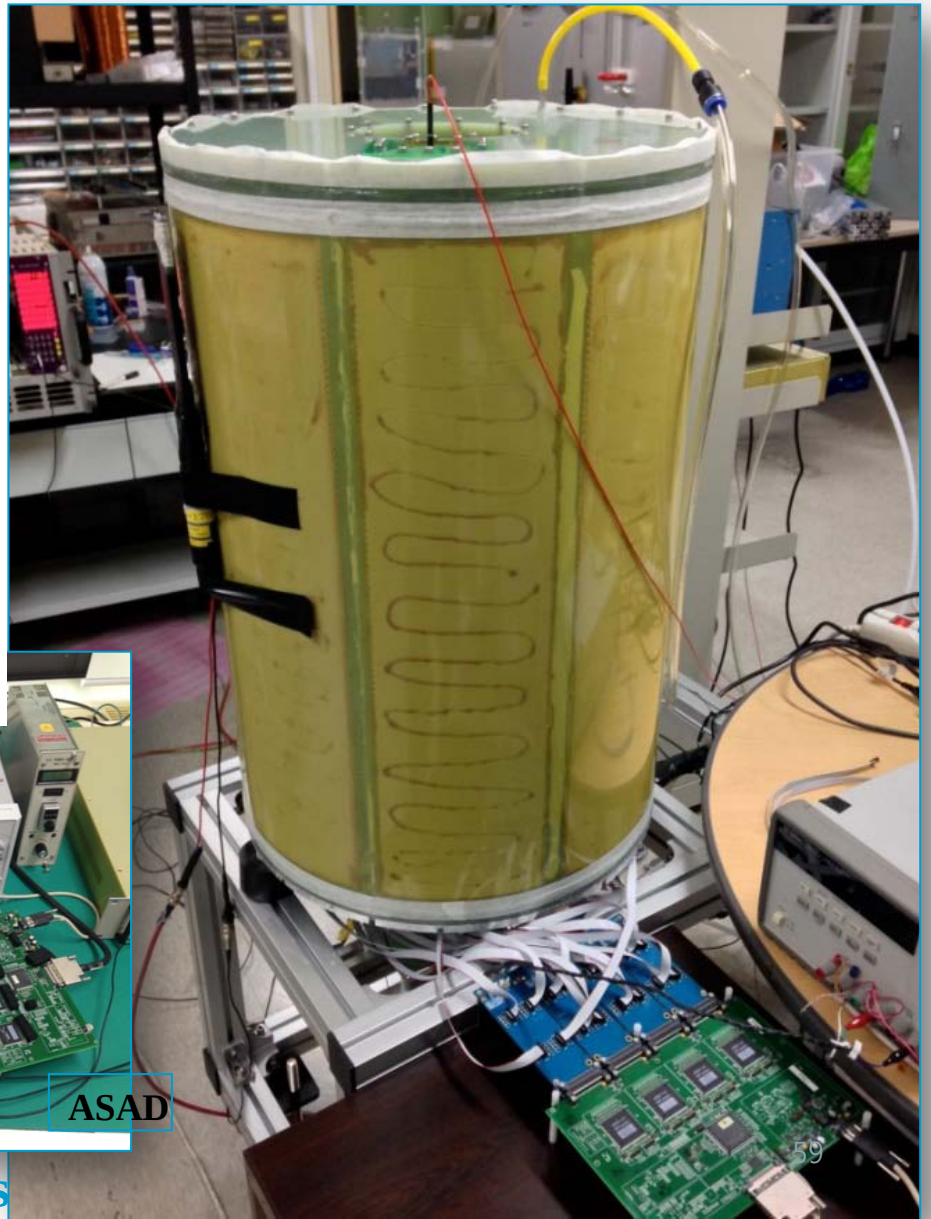


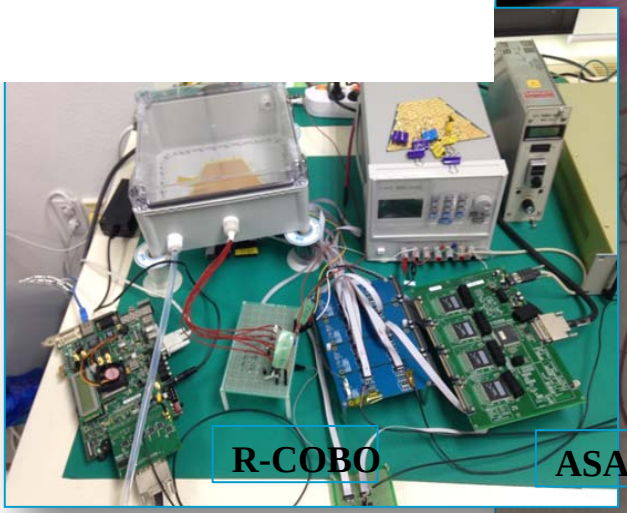
LAMPS is heavy-ion collision experiment to study of the symmetry energy in the equation of state of nuclear matter using rare isotope beams from IF and ISOL systems and stable beam from Driver Linac

High Energy LAMPS Experimental Setup









R-GET System Tests

The iTPC project in SINAP

- The SINAP nuclear physics group proposed to carry out an GEM foil based TPC R&D in RHIC-STAR exp. We are now building a small prototype in our lab.

- The project is agreed by the National Science & Tech. Division, the people involved in the project are: Dr. Jinhui Chen, Fei Lu, Yugang Ma, Song Zhang and Chen Zhong

- Our physics focus in this RHIC-STAR inner TPC upgrades include:

  - high pT Kaon identification to probe the strange quark dynamics
  - Clean pion to probe the transverse interference fragmentation functions
  - extend eta coverage to carry out the v(n) flow analysis

Features

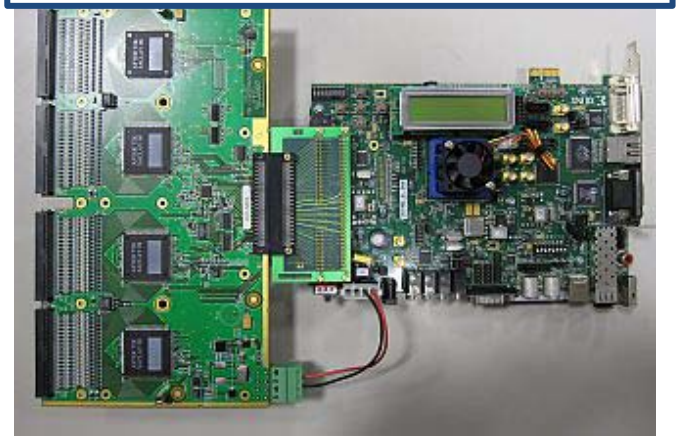
- 30 cm long / 15 cm diameter
- very low material budget
- Ar(85%)CF4(12%)iso(3%) gas:
  drift velocity: 4.5 cm/μs
  dispersion: 200 μm × √cm
- AGET: digital, 512 time bin, 100 MHz
  individual discriminator / channel
  typical dead time of 150 μs / event

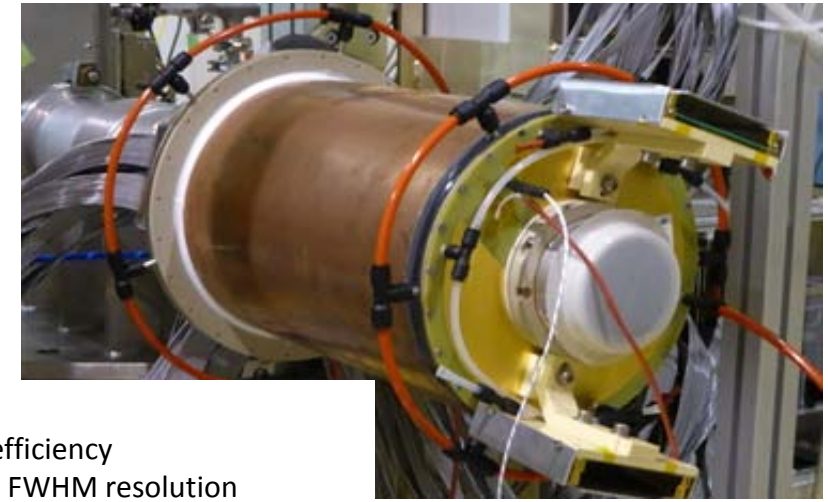
High granularity detector (TPC)

> 4000 pads, size ~4 mm^2

MicroMegas (IRFU)

NEW Electronics and Soft



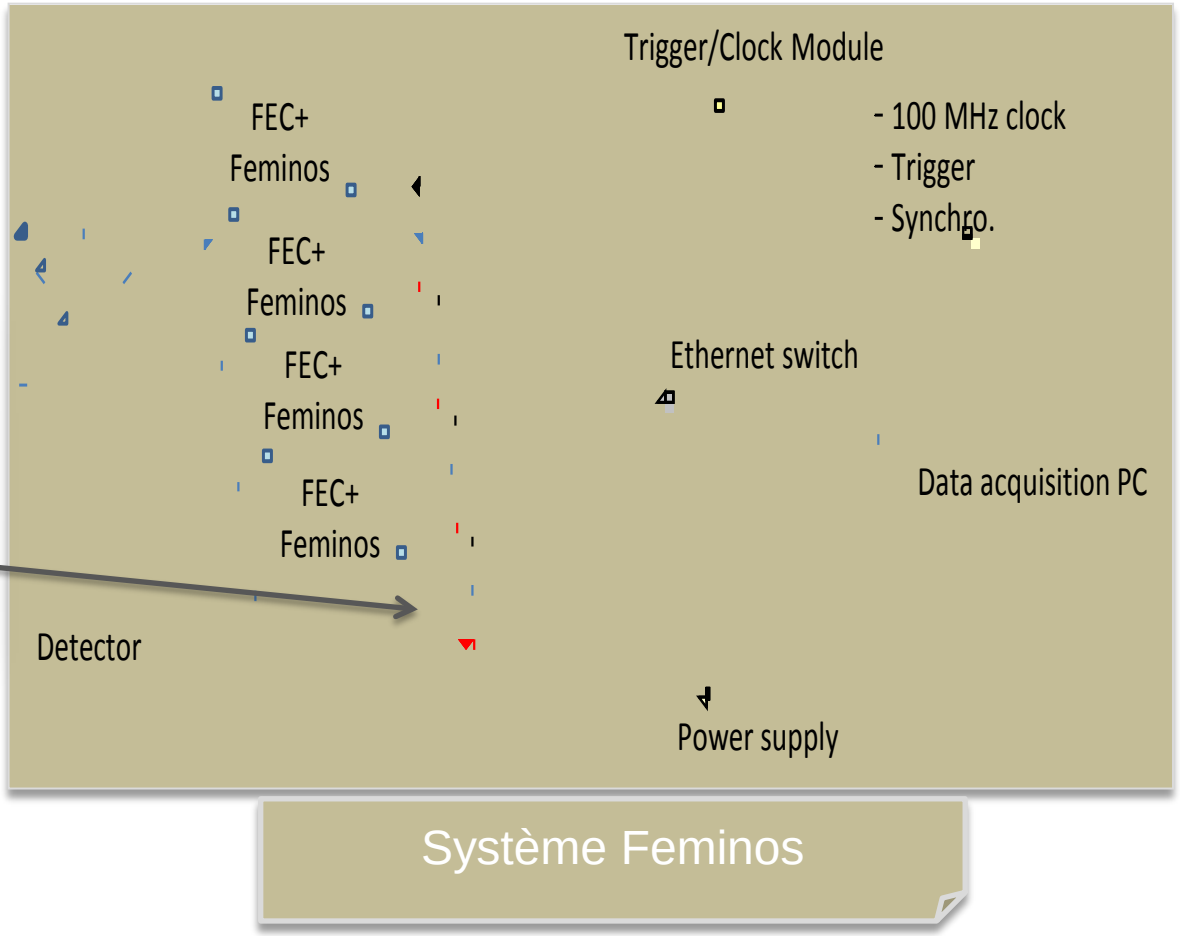


TPC
> 85% efficiency
< 5 mm FWHM resolution

First use of **AGET chip** in a physics experiment (GET project: CEA, IN2P3, NSCL collaboration)

MINOS – A GET Hybrid

CoBo Hybride



Système Feminos

denis.calvet@cea.fr
Frederic.Chateau@CEA.fr

GET VALORISATION- III

- **What would be of Interest to the Nucl. Phys. Community at large?**

- Fund **HOT LINE** services for more than one year
- Fund continuous update of the system
  - *e.g. Convert the FIRMWARE to GENERIC FIRMWARE*
  - *Improve on the Dyn. Rnge. of front-end & Fast tracking of beams*
  - *Solid-State Application for PID. Vacuum compatibility of front-end*
  - *Advanced GENERIC approach for future Hardware Developments (Fast moving domain)*

- Study of GENERIC approaches:

e.g. *Expertise the characteristics of the **generic** qualitative **method**.*

- Simplify the valorisation for the Providers & Clients

e.g. A company that provides sale services etc.

- Standardized/Simpified MoU are needed for IP and Valorisation efforts within a EU context.

- Attract “small” users for bench & educational & industry

e.g. Organise “schools”, (attract students in high-tech instrumentation)
Provide additional “turn-key” documentation and software
Use in industrial applications