

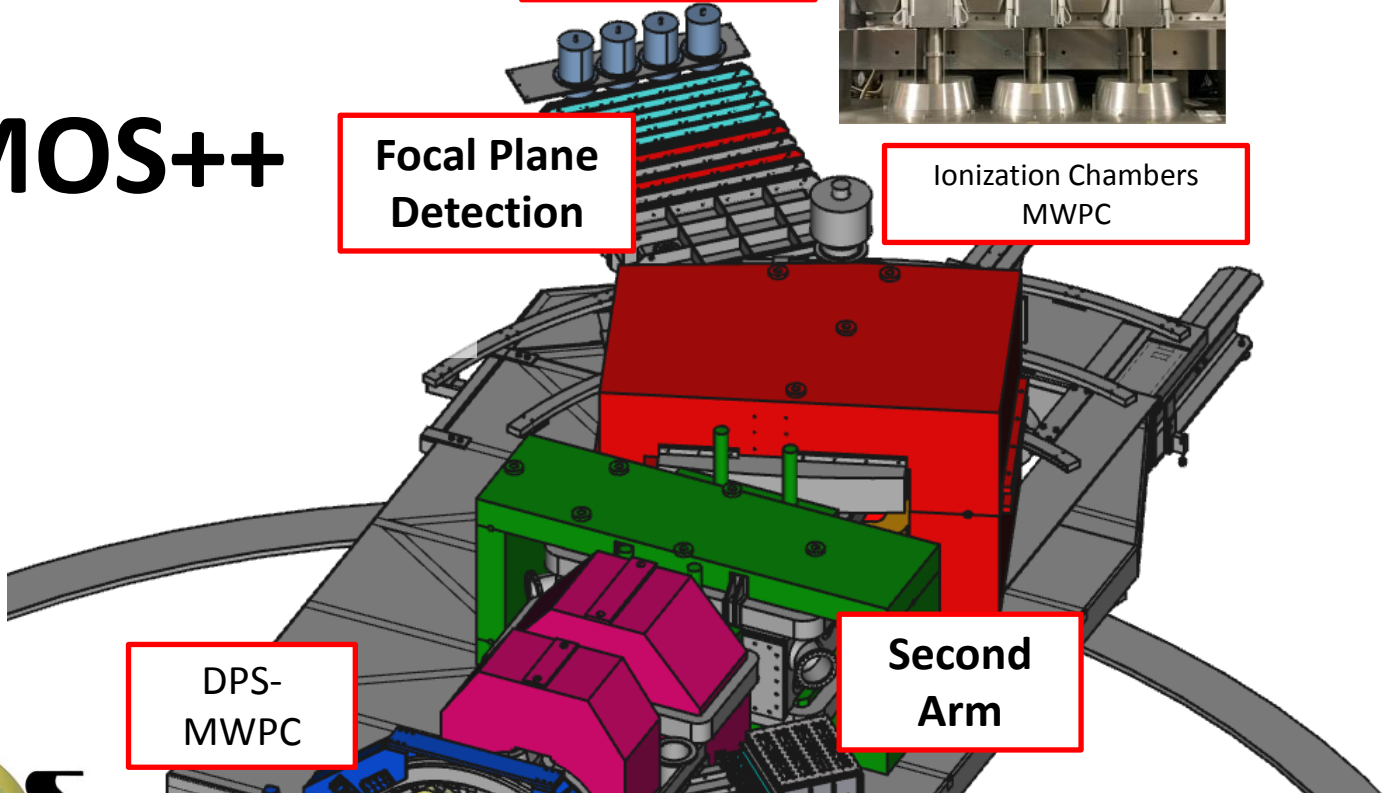
# VAMOS++

EXOGRAM at  
Focal Plane



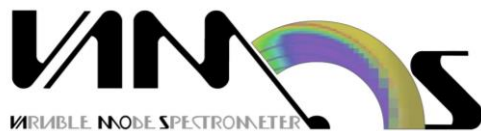
Focal Plane  
Detection

Ionization Chambers  
MWPC

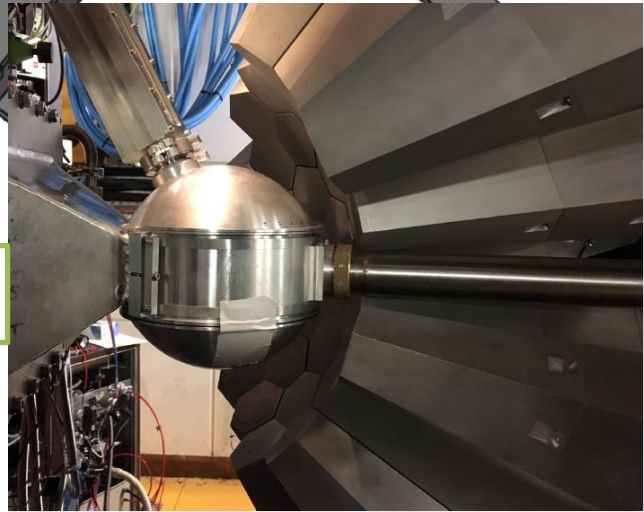
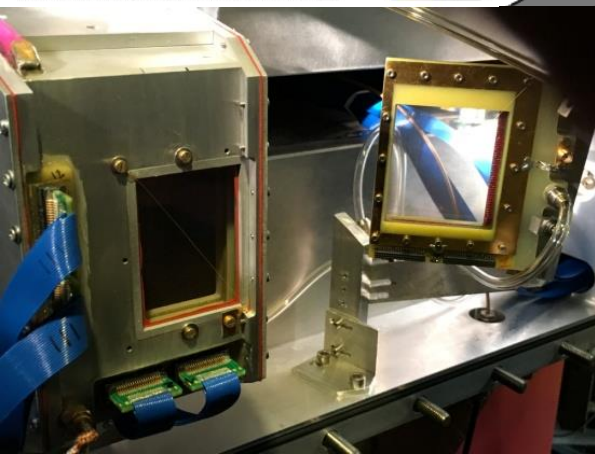


DPS-  
MWPC

Second  
Arm



AGATA



# Short summary of VAMOS VARIABLE MODe Spectrometer

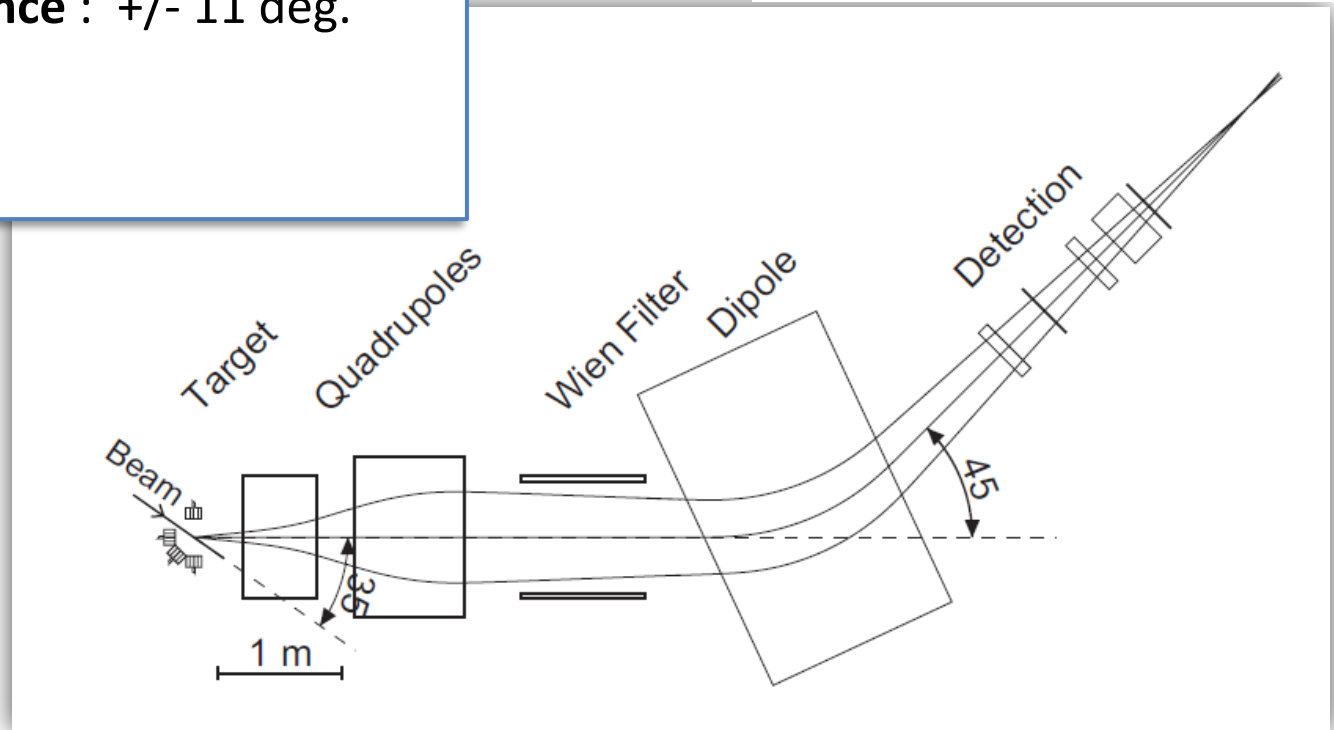
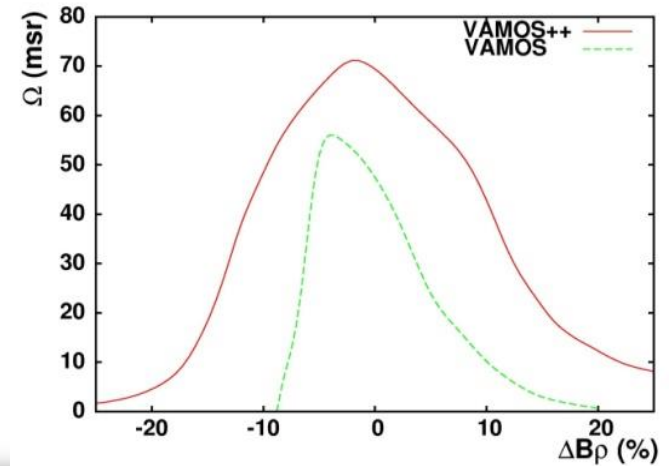
In operation since 2001

Horizontal acceptance : +/- 7 deg.

Vertical acceptance : +/- 11 deg.

Max  $B\rho$  : 1.6 Tm

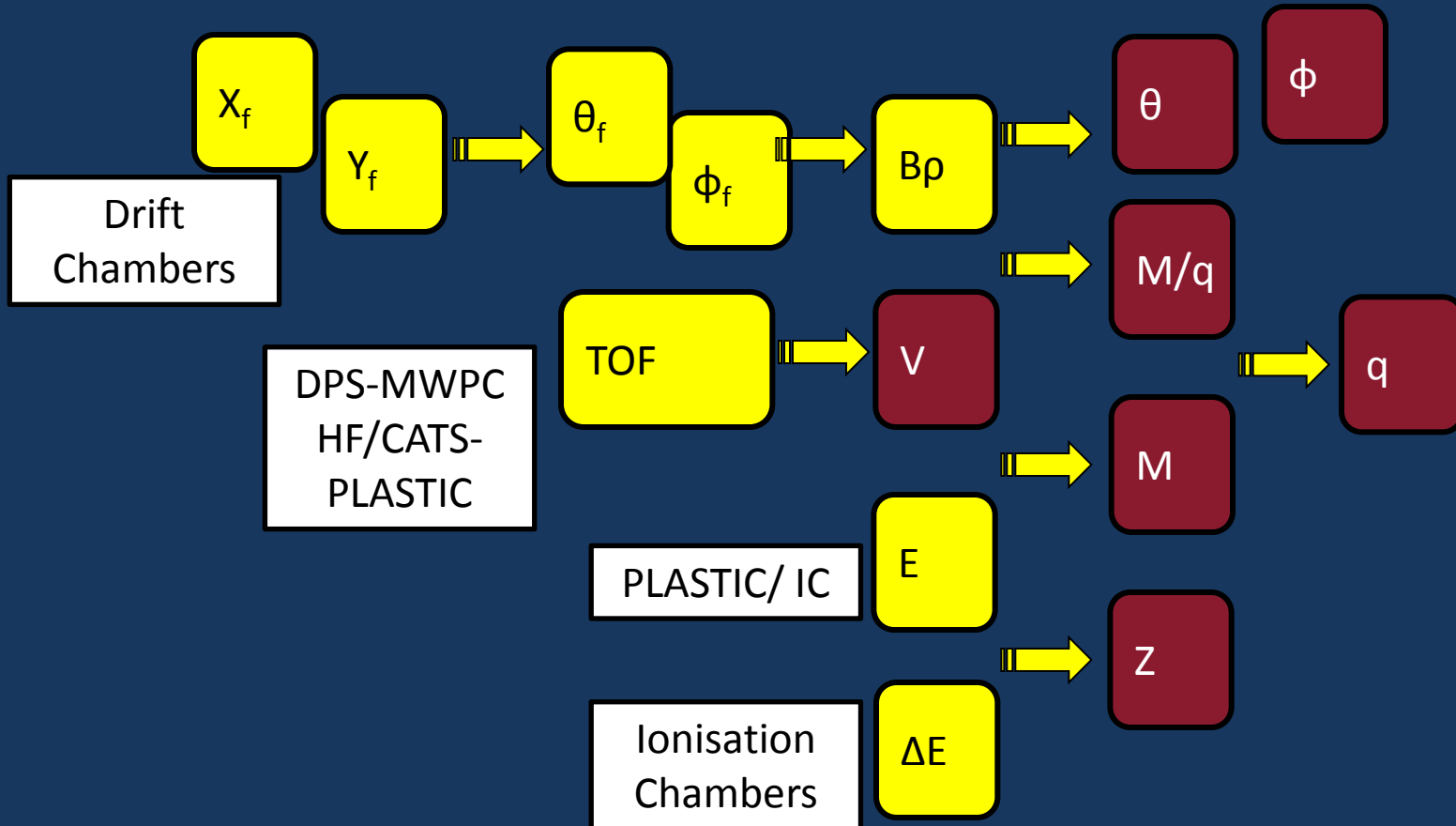
$\Delta M/M$  :  $2 \cdot 10^{-3}$



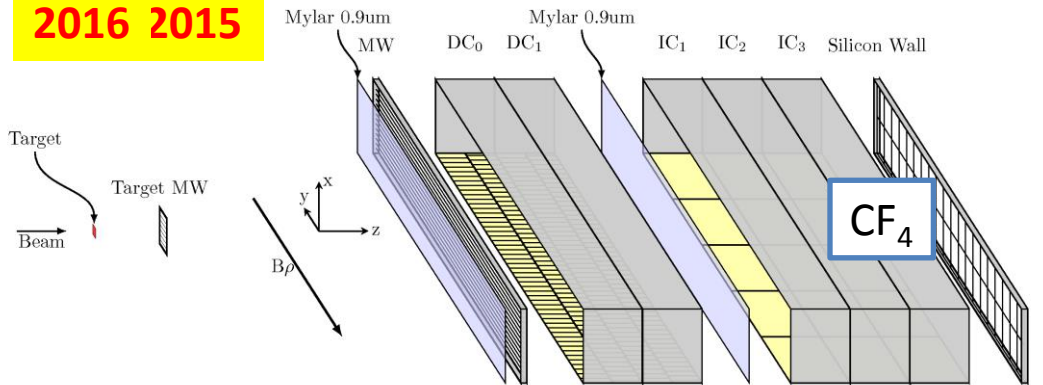
S. Pullanhiotan et al. , NIM A 593 (2008) 343

M. Rejmund et al., NIM A 646 (2011) 184

# VAMOS Measurement (Software Spectrometer)



2016 2015

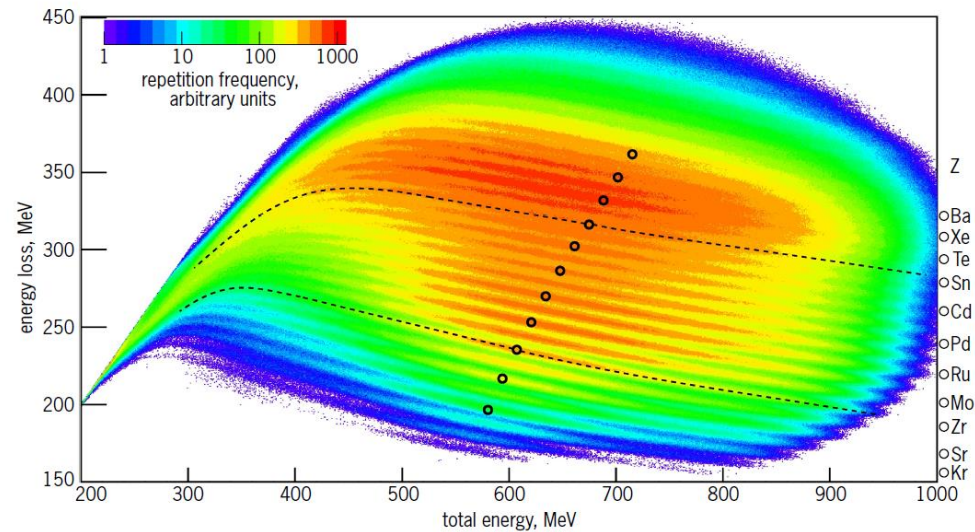


E585 – 30 mbar +Si Wall

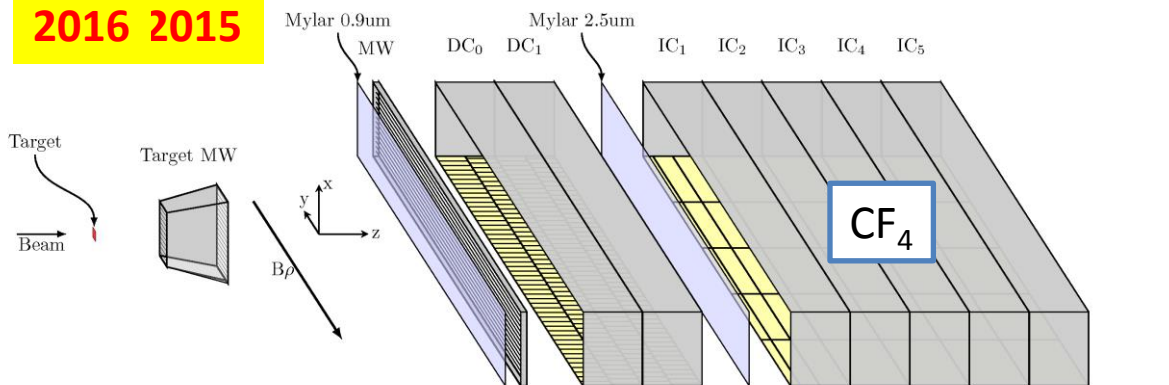
56 cm

35 cm

# Ionization Chambers



2016 2015



E585 – 30 mbar +Si Wall

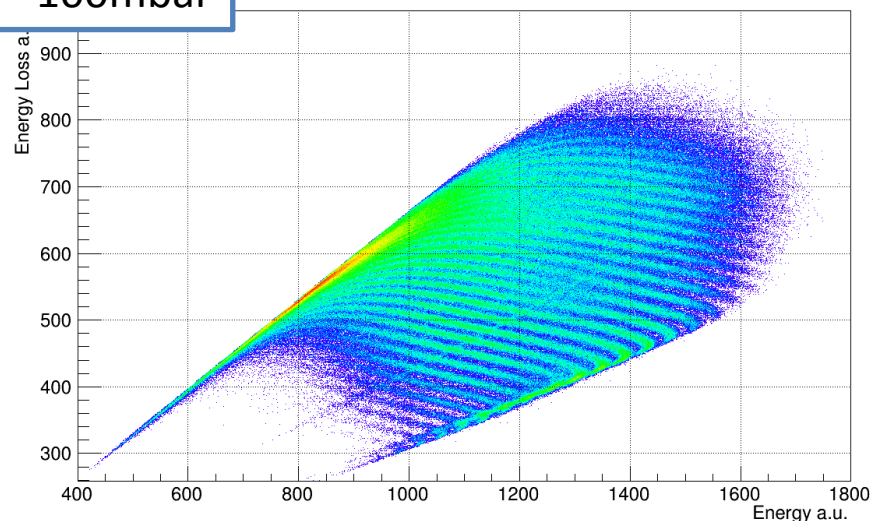
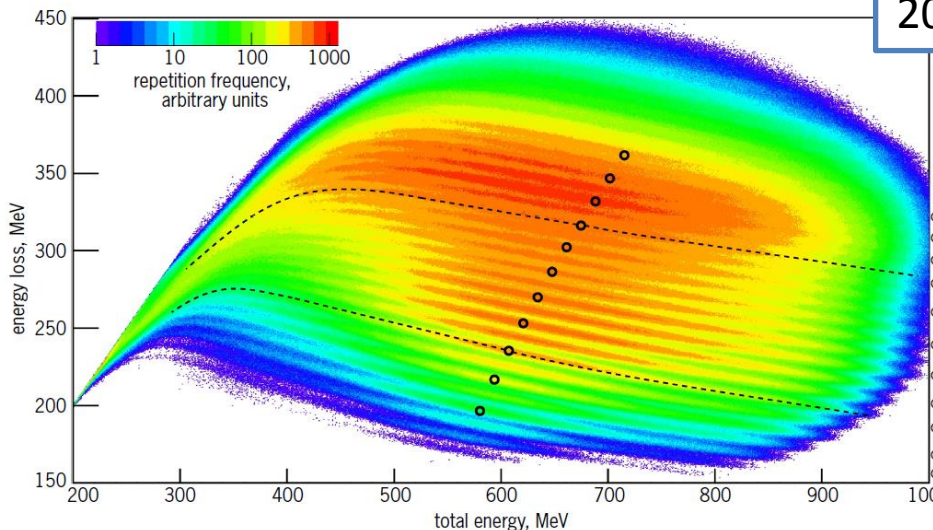
56 cm

60 cm

# Ionization Chambers

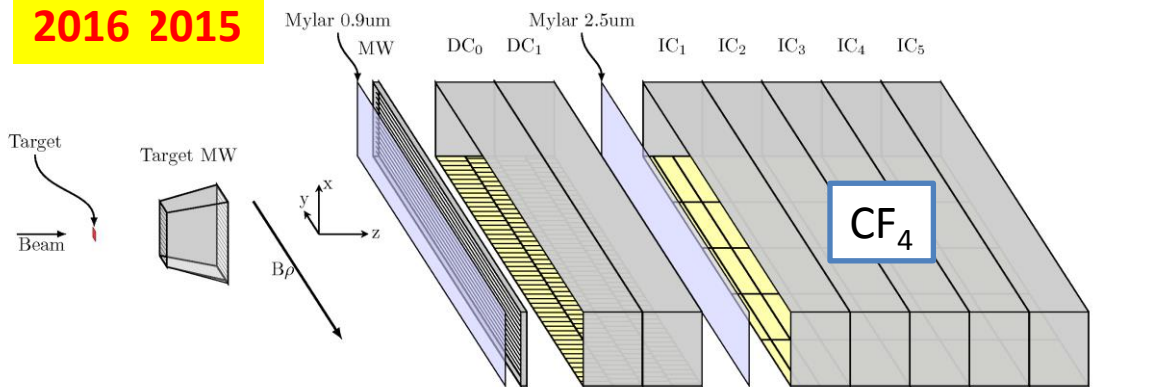
2015 - 100mbar

U(6.6 MeV/u)+Be



- 2014 - 2015 : Replaced Silicon Wall by IC
- 2016 : Additional IC Row : Increase dynamic range
- 2016 : Improved stability of gas regulation system

2016 2015

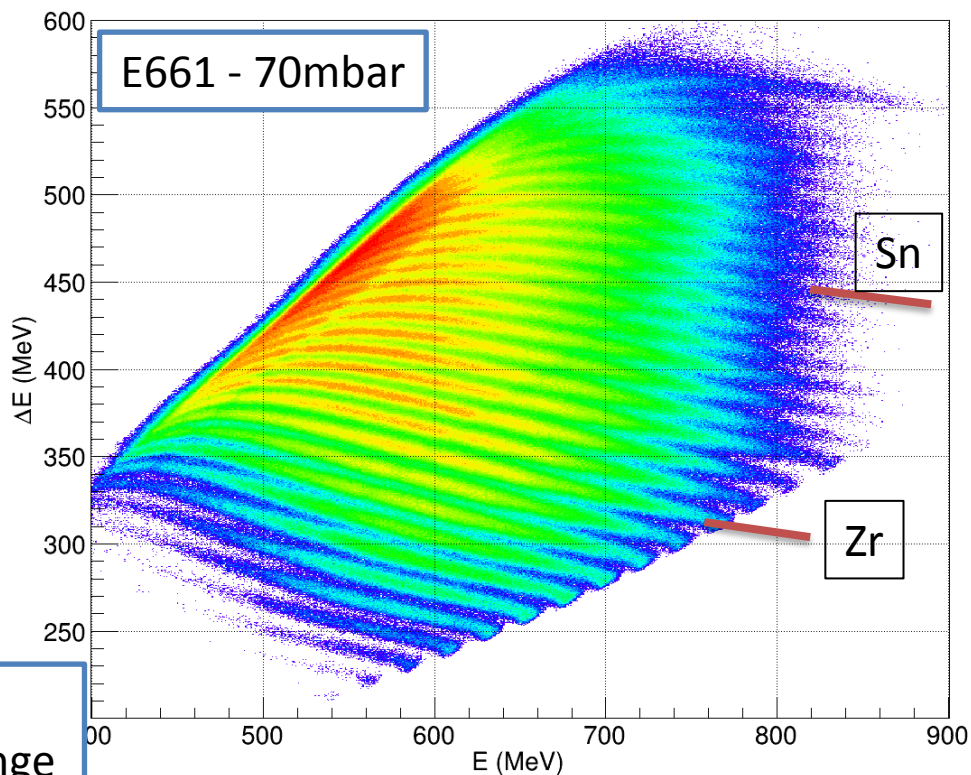
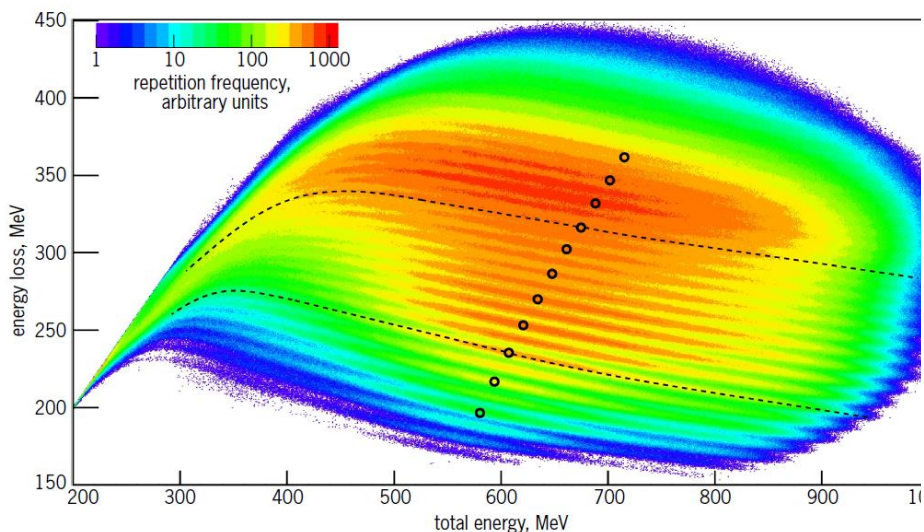


E585 – 30 mbar +Si Wall

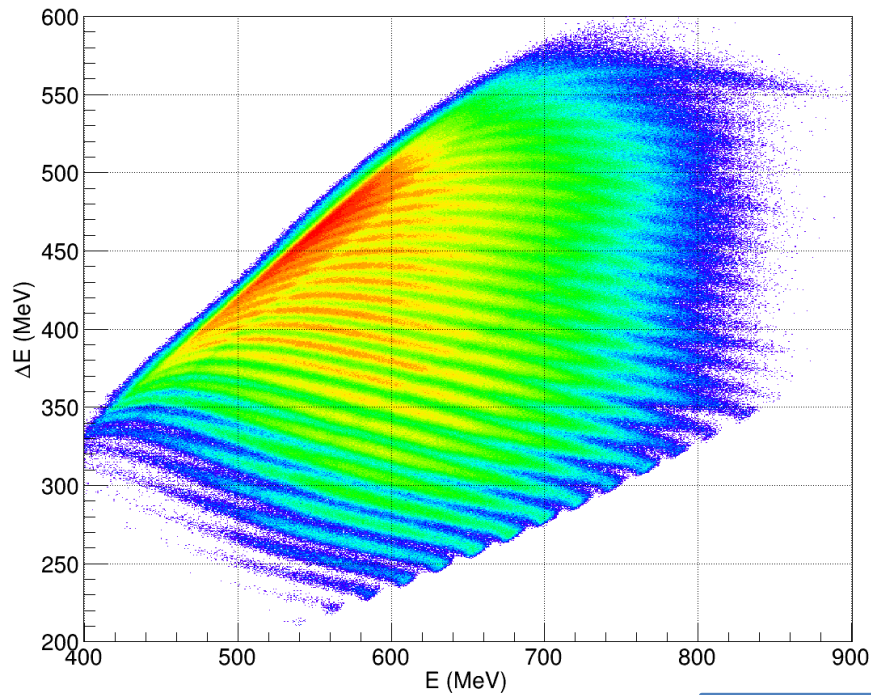
56 cm

60 cm

# Ionization Chambers

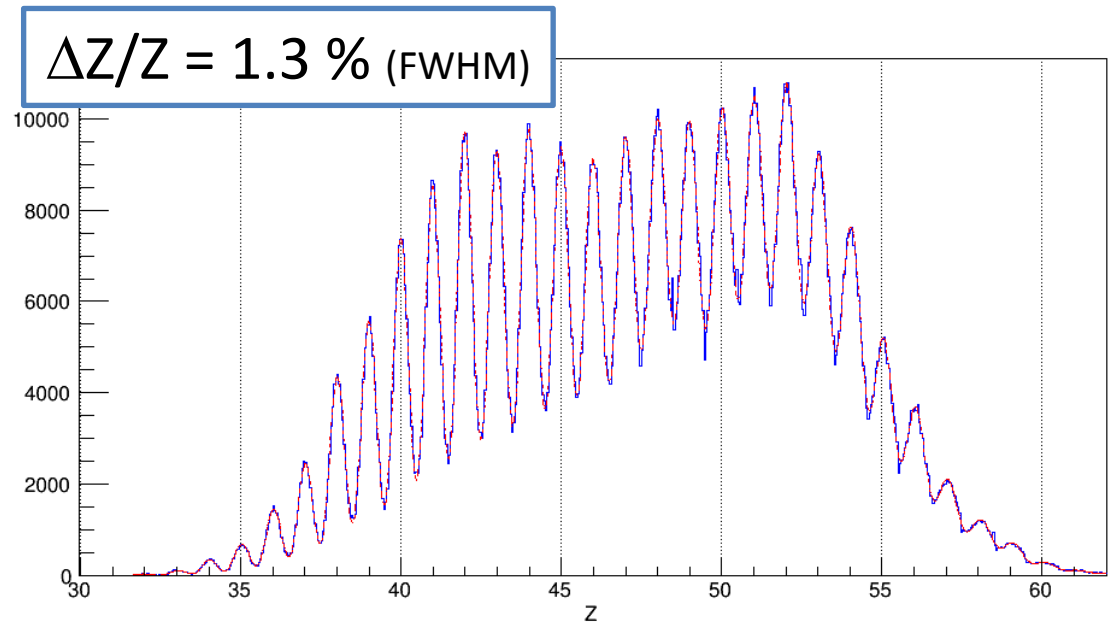


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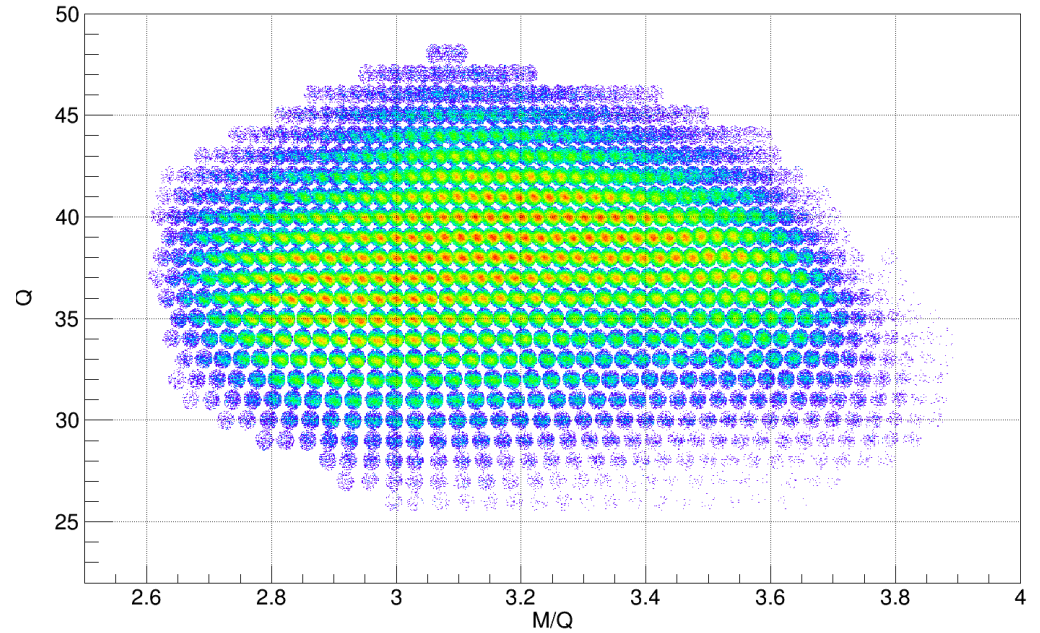
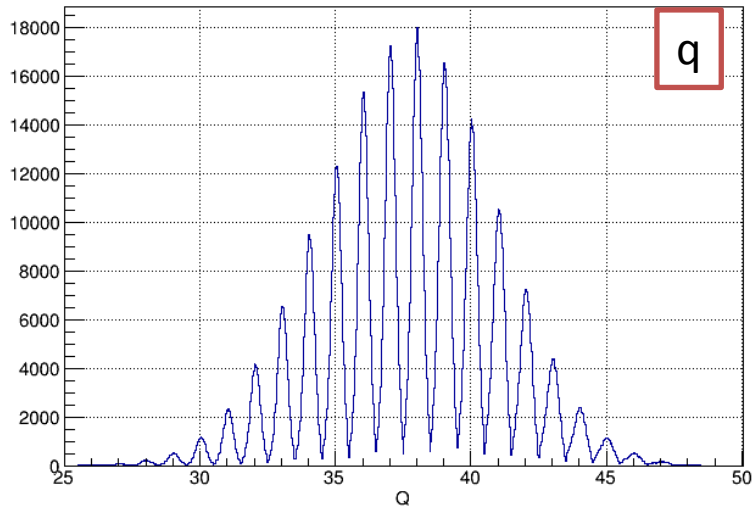


# Isotopic identification ( $Z, A, q$ )

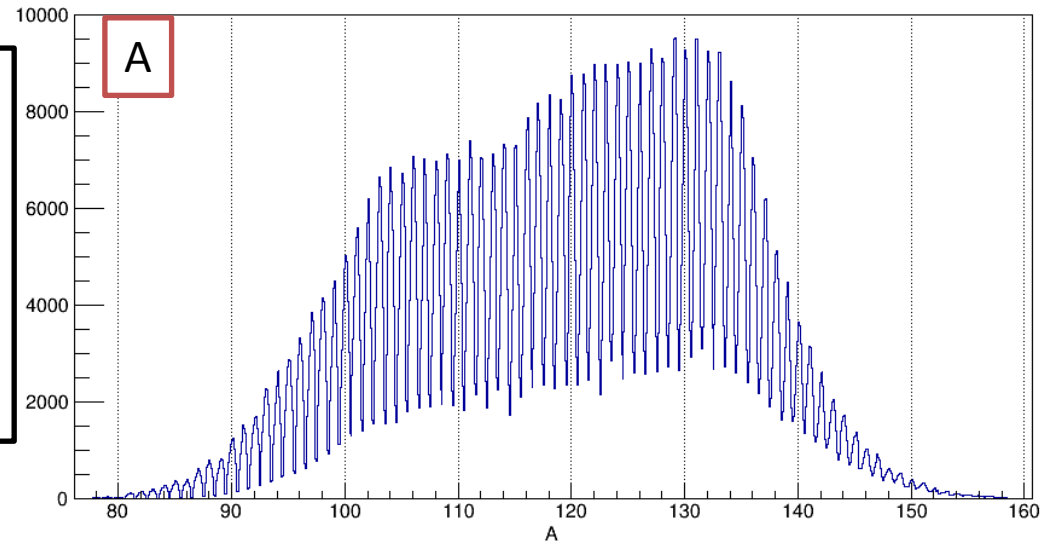
Energy range :  
4 to 8 MeV/A !



# Isotopic identification(Z,A,q)



- $\sigma_{\Delta E}/\Delta E \approx 2.2\%$  (FWHM)
- $\sigma_q/q \approx 1.3\%$  (FWHM)
- $\sigma_A/A \approx 3 \times 10^{-3}$  (FWHM)

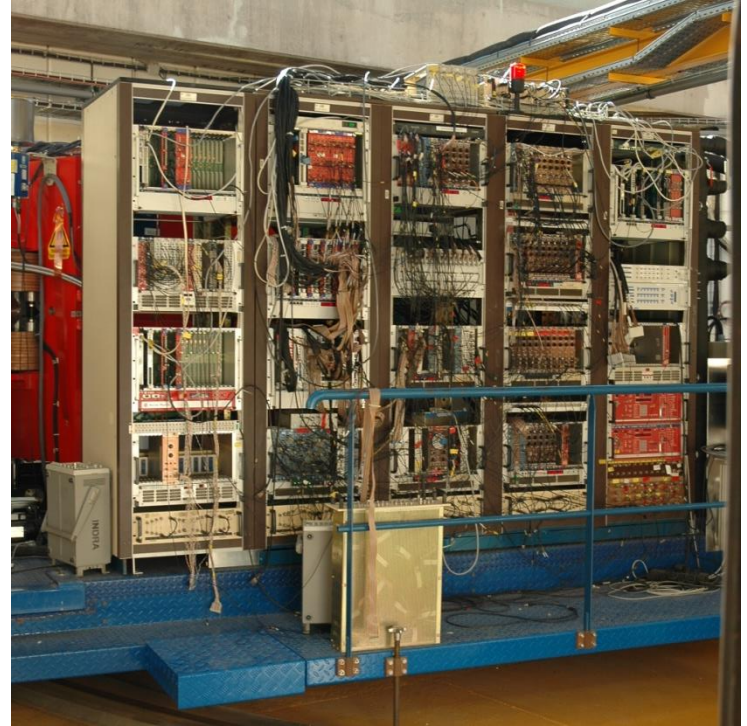




# Upgrade to Digital Electronics

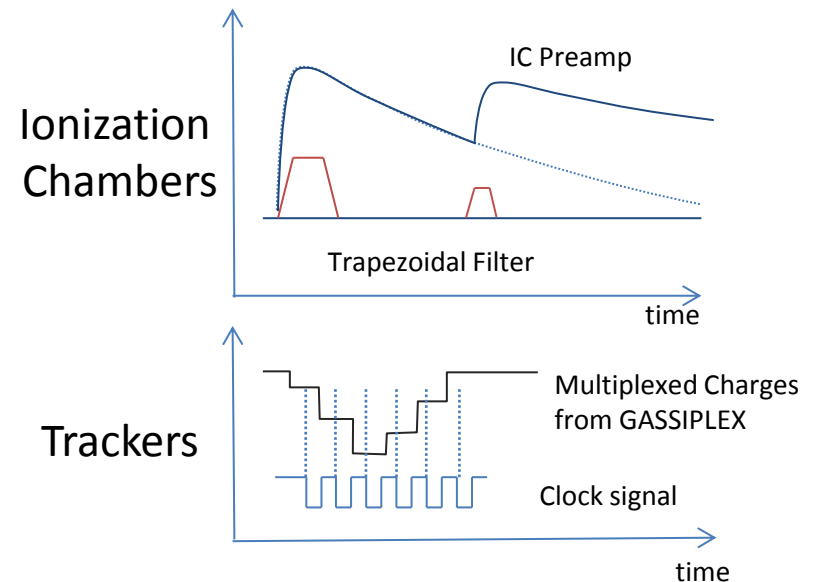
## Goals :

- 1) Improve counting rate capabilities for **Ionization Chambers and Tracking Detectors (DPS-MWPC, DC)**
  - Reduced dead time from 100 to 20 $\mu$ s
  - Pile up treatment in IC
- 2) Solve aging problems of existing electronics for tracking detectors



## Description:

- 1) **NUMEXO2** modules  
(same hardware as EXOGAM2)
- 2) **Firmware modification**
  - Handling 16 ch. per NUMEXO2 boards
  - Demultiplexing signal (GASSIPLEX chains)
- 3) 7 modules  
(4 for trackers, 2 for IC +1 spare)



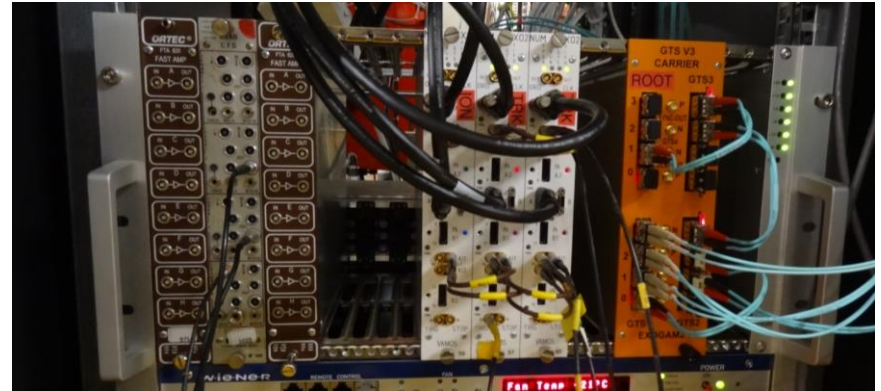
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## Status :

2016 :

- 7 motherboards ordered and received
- Adaptation of new firmware

2017 : using spare card from EXOGAM2

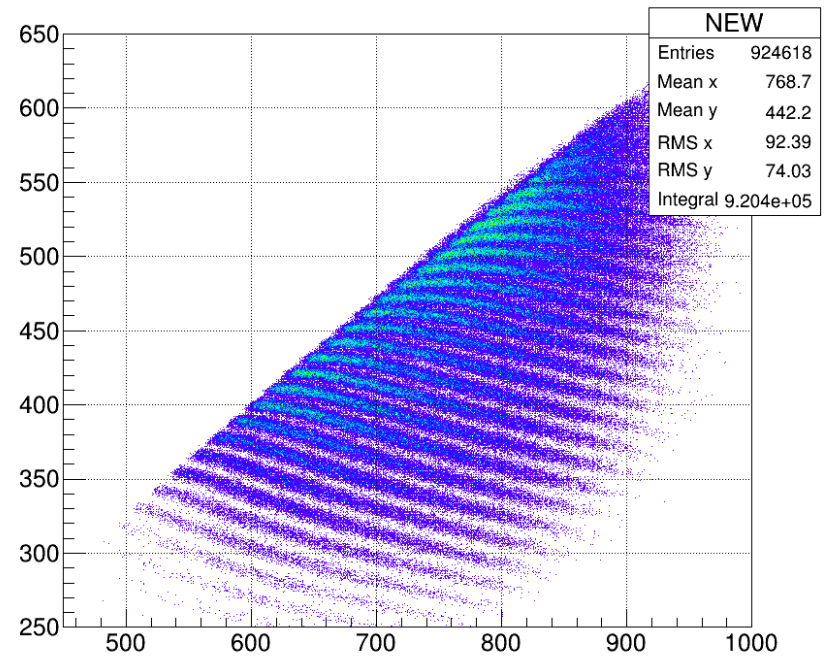
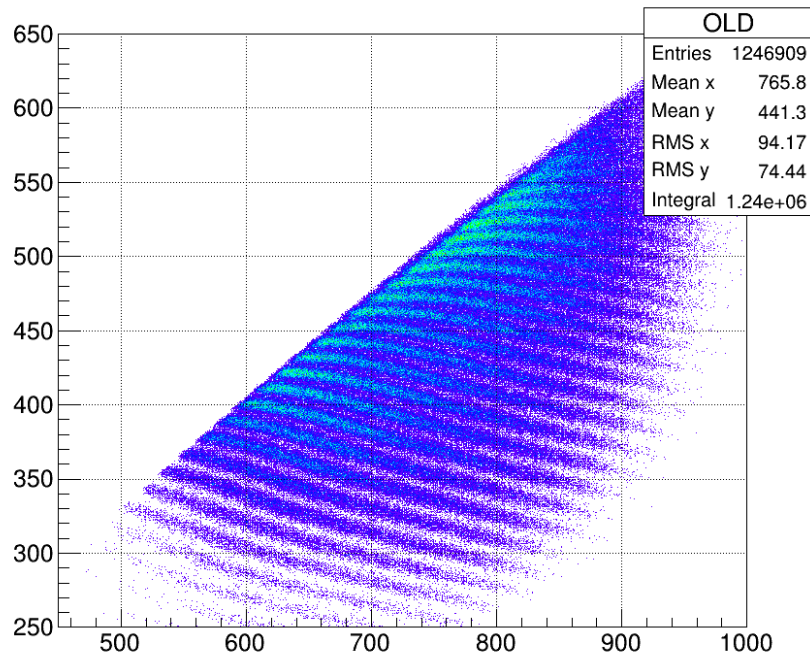
- S1 : New firmware
- Fall 2017 : Parallel operation  
In Beam : **IC and DPS MWPC**

2018 :

- Upgrade of firmware for IC  
( LE discriminators)
- Reception of VAMOS FADC
- Reception of VAMOS GTS parts
- Replacement of the « old » electronics <sup>10</sup>

# NUMEXO 2 : $\Delta E-E$

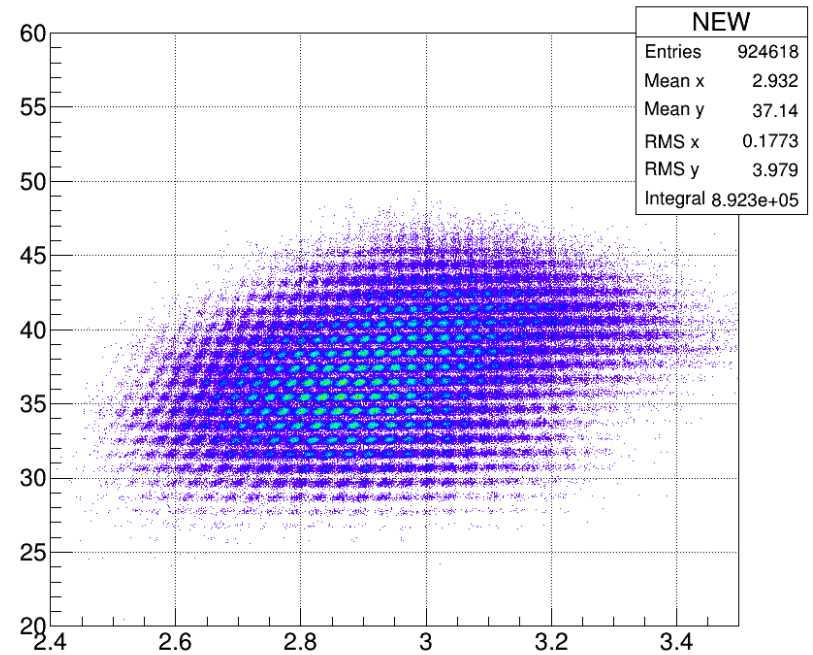
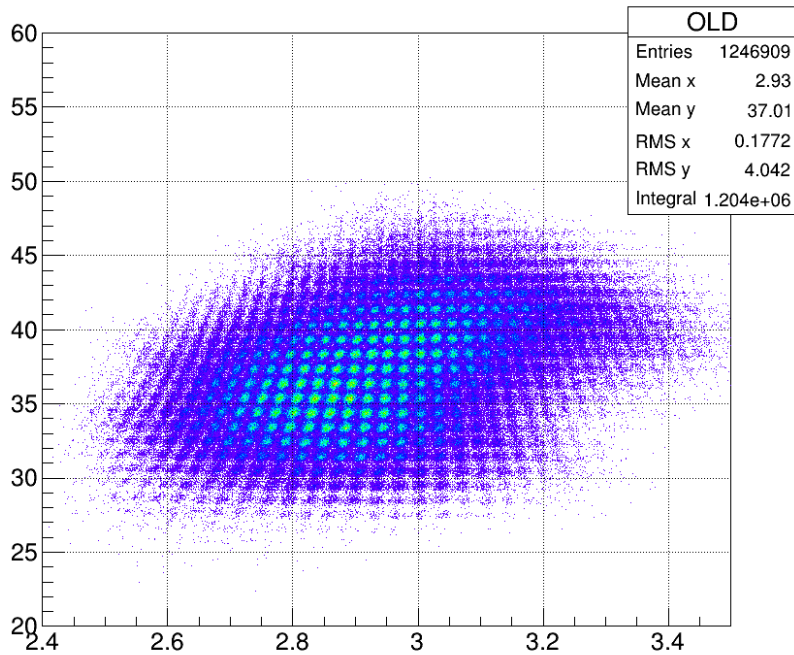
$^{238}\text{U} + ^{24}\text{Mg}$  – Nov 2017



Improving Energy resolution !  
Low counting rate => Basically from a Fluctuating Baseline

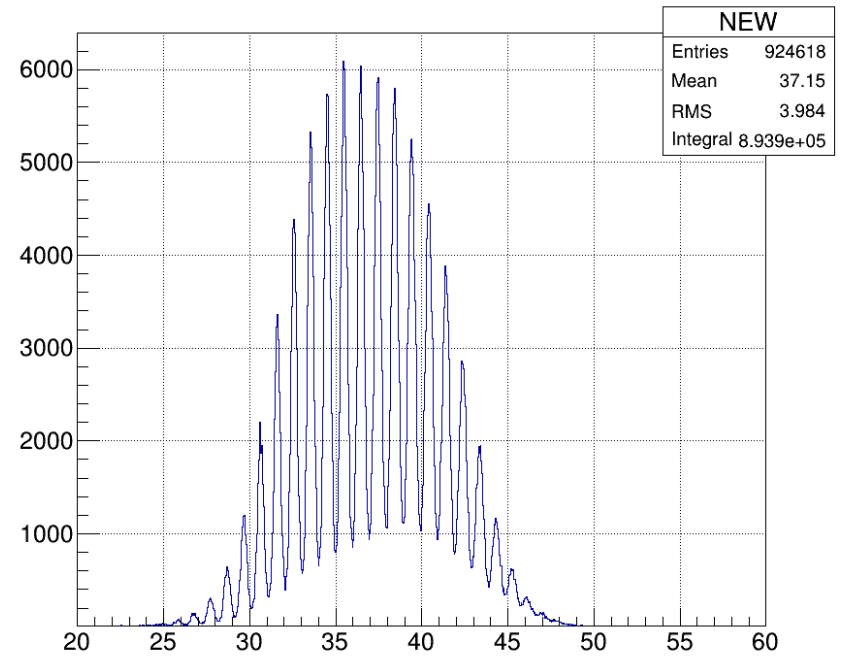
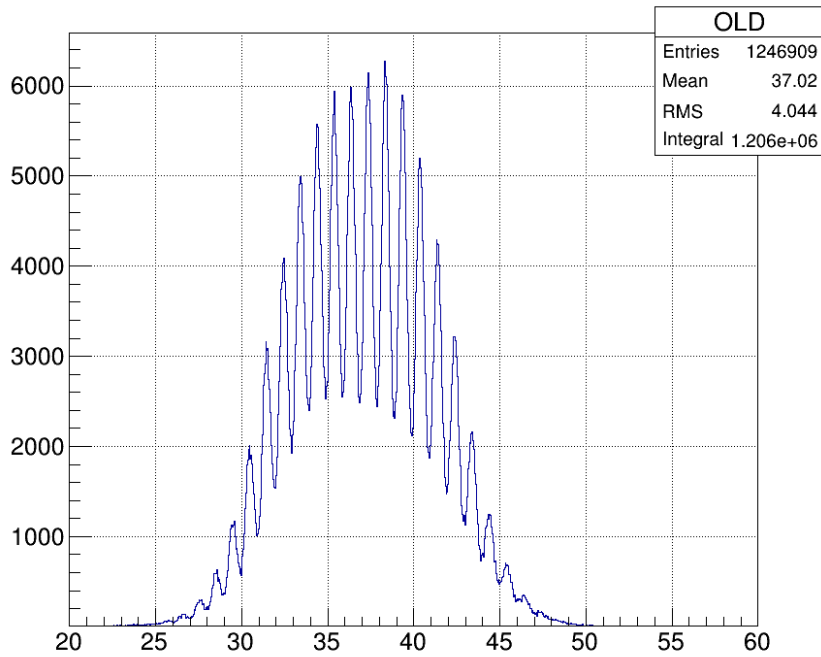
# NUMEXO 2 : Q vs M/Q

$^{238}\text{U} + ^{24}\text{Mg}$  – Nov 2017



# NUMEXO 2 : Q

$^{238}\text{U} + ^{24}\text{Mg}$  – Nov 2017



# Large size DPS-MWPC at the focal plane

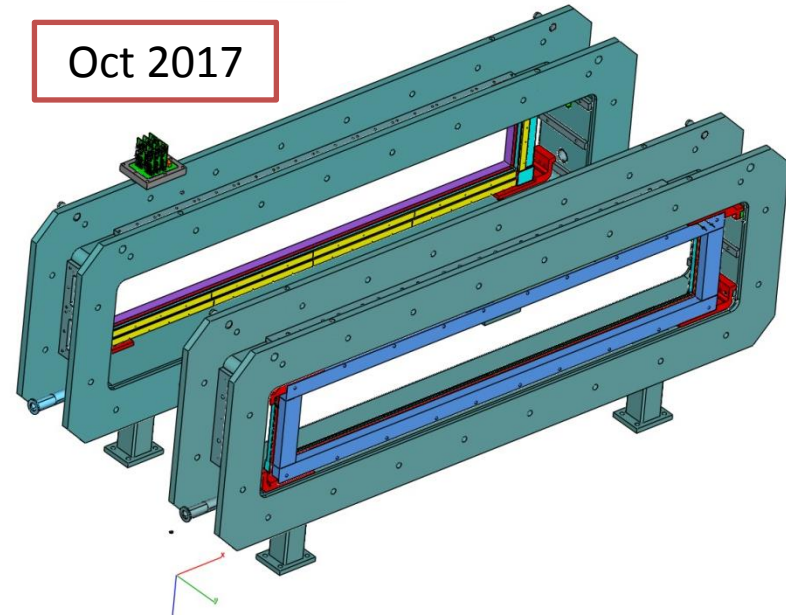
## Goals :

- 1) Improve time resolution and efficiency
- 2) Reduce material to measure lower energy and/or heavier ions
- 3) Improve counting rate capabilities compared to Drift Chambers
- 4) Handle multiple trajectories

## Description:

- 1) Pair of Dual Position Sensitive (DPS) MWPC to replace the pair of Drift Chambers and existing MWPC (time)
- 2) Individual readout of charges using Gassiplex
- 3) Active area  $1000 \times 150 \text{ mm}^2 \Rightarrow 1150 \times 2$  position wires

Oct 2017



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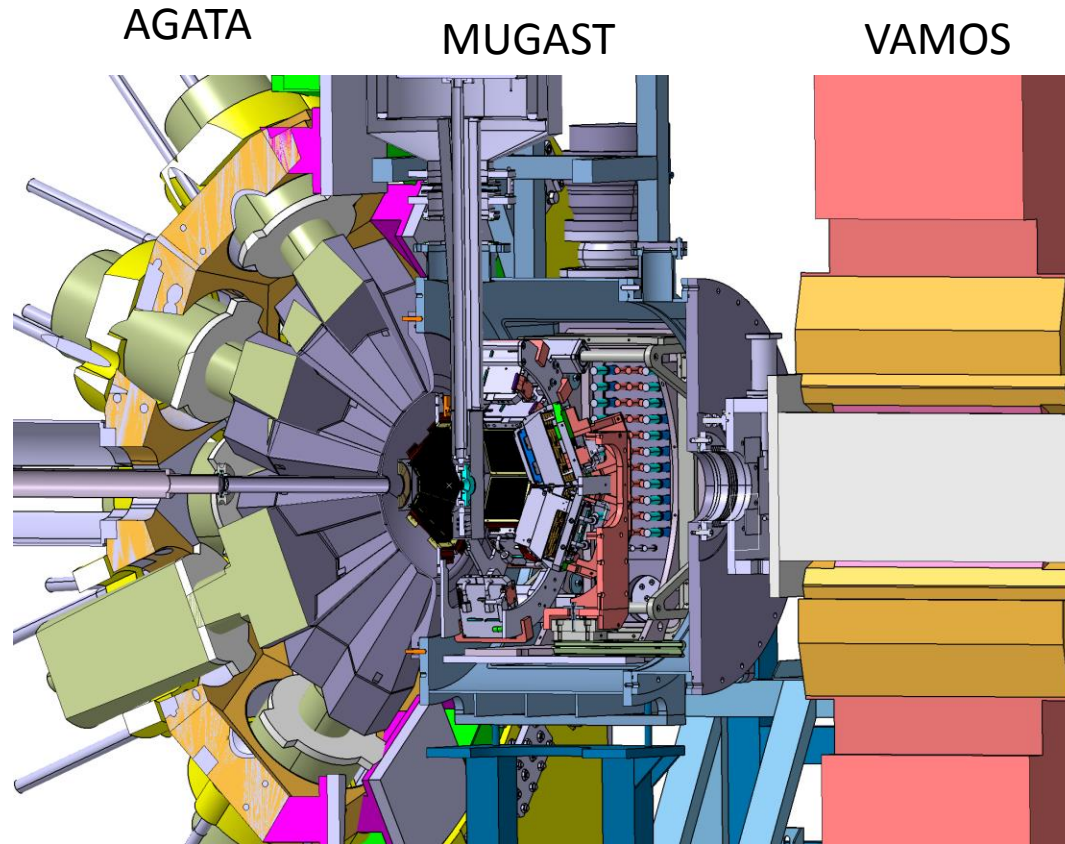
Oct 2017



## Status

- 1) First Chamber : In beam in Fall 2017  
Used in parallel for e753  
Replace old MWPPAC in e667  
 $\Rightarrow$  better resolution and efficiency on the entire active area
- 2) Second Chamber being build

# Anticipating MUGAST needs



## Transfer in inverse kinematics

**Triple coincidences :**

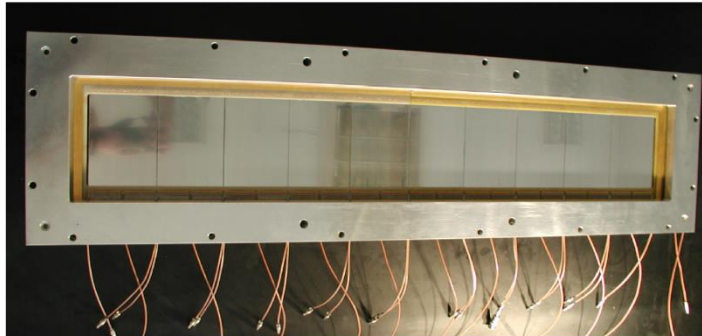
MUGAST (p,d,t,<sup>3</sup>H) – AGATA (γ)– VAMOS

- faster ions
- lighter ions
- vamos at 0° : direct beam



# Anticipating MUGAST needs

- change the strategy of the Focal Plane for transfer reaction
  - Get rid of the plastic previously used
  - **New** TOF Stop : PPAC at Focal Plane

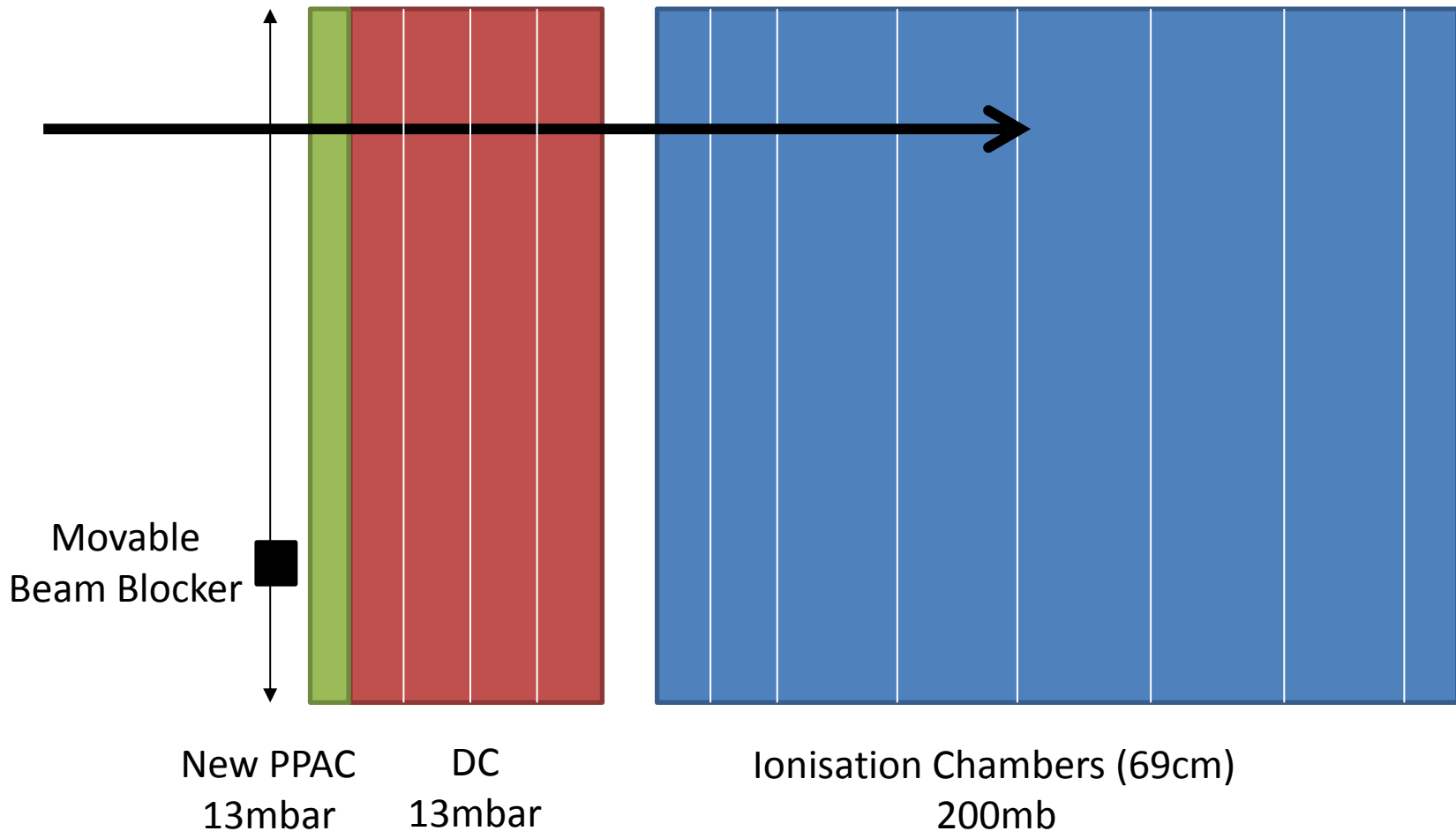


*Fig. 1. The mylar cathode prototype of MWPPAC.*

Done at Prisma

- IC at higher pressure (today 100mb, 200mb in 2019)
  - **New** Increase IC depth (today 57cm , +12 cm 2019)
- To be ready for 2019

# Upgraded focal plane for MUGAST



# Summary

## Ongoing developments

- Digital Electronics
- Large Size DPS MWPC
- Extended Ionization Chambers
- Large Size PPAC for fast/light ions
- Improved reconstruction procedures

