



UNIVERSITÀ
DEGLI STUDI
DI MILANO

"Ancillaries for AGATA@LNL "

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Milano, 11-15 September 2017

18th AGATA week and 2nd Position Sensitive Germanium
Detectors and Application Workshop



AGATA Beyond 2020

Towards 4π – AGATA WHITE Book

- Physics Cases
- Host Laboratories

AGATA @ LNL/SPES

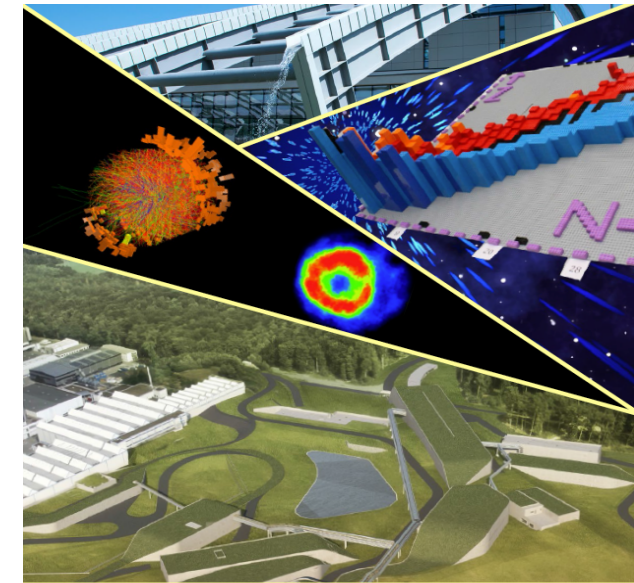
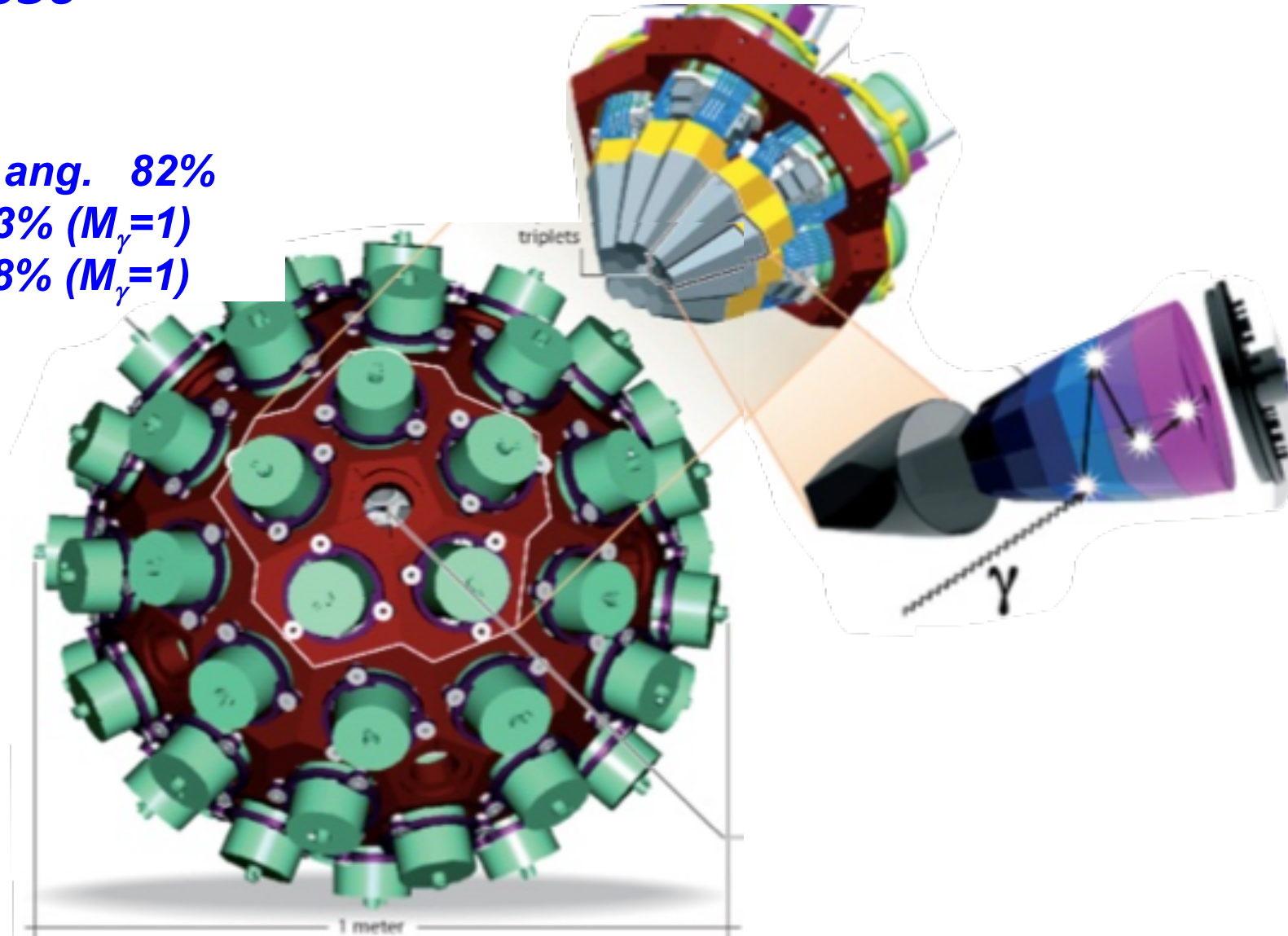
Possible installation after 2021

- AGATA @ SPES
- SPES LOI's
- Ancillaries

ASC Meeting – Milano 3-4 April 2017

Construction of AGATA – Phase II (Full 4π Detector) by 2030

Solid ang. 82%
Eff. 43% ($M_\gamma=1$)
P/T 58% ($M_\gamma=1$)



NuPECC



NuPECC
Long Range Plan 2017
Perspectives
in Nuclear Physics

A. Bracco, Chair

Support to the completion of AGATA in full geometry

AGATA represents the state-of-the-art in gamma-ray spectroscopy and is an essential precision tool underpinning a broad programme of studies in nuclear structure, nuclear astrophysics and nuclear reactions. AGATA will be exploited at all of the large-scale radioactive and stable beam facilities and in the long-term must be fully completed in full 60 detector unit geometry in order to realise the envisaged scientific programme. AGATA will be realised in phases with the goal of completing the first phase with 20 units by 2020.

To support funds applications for **AGATA 4π**
a “**WHITE Book**” will be produced

- **Physics Cases for AGATA in 2021 – 2030 period**
- **Focus on 5 possible Host Laboratories:**

CERN/ISOLDE – WG1 (*M. Zielińska (chair), P. Reiter (co-chair)*)

GANIL/SPIRAL1/SPIRAL2 – WG2 (*B. Cederwall (chair), E. Clément (co-chair)*)

GSI/FAIR – WG3 (*A. Jungclaus (chair), M. Górska (co-chair)*)

JYFL – WG4 (*D. Jenkins (chair), Paul Greenlees (co-chair)*)

LNL/SPES – WG5 (*S. Leoni (chair), J. Valiente-Dobon (co-chair)*)

+ Common WG – WG6 (*ACC chair (chair), ASC and AMB chairs (co-chairs)*)

Emphasis on the *particularities and uniqueness* of each of the host labs

→ Final version to be ready by the end of 2018

AGATA@LNL/SPES – WG5 (S. Leoni (chair), J. Valiente-Dobon (co-chair))

Didier Beaumel (IPN-Orsay)

Giovanna Benzoni (INFN-Milano)

Fabio Crespi (University of Milano and INFN)

Dominique Curien (Strasbourg)

Gilbert Duchene (Strasbourg)

Bogdan Fornal (IFJ-Krakow)

Kalin Gladnishki

Alain Goasduf

Amel Korichi

Roberto Menegazzo

Daniele Mengoni

Adriana Nannini

Daniel Napoli

Johan Nyberg

Georgi Rainovski

Francesco Recchia

John Smith

Magda Zielińska

STARTING POINT:

LOI's for SPES

presented at

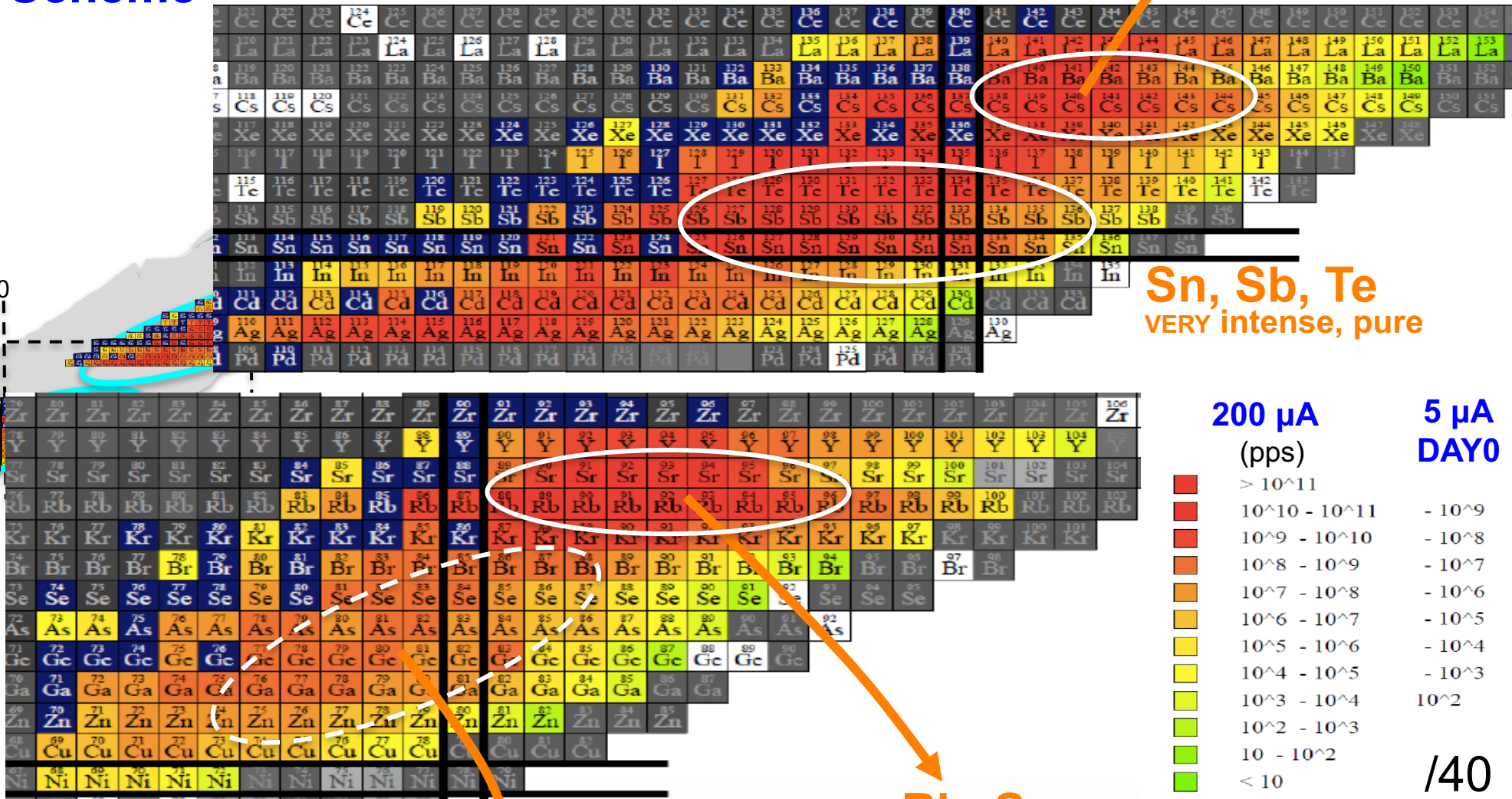
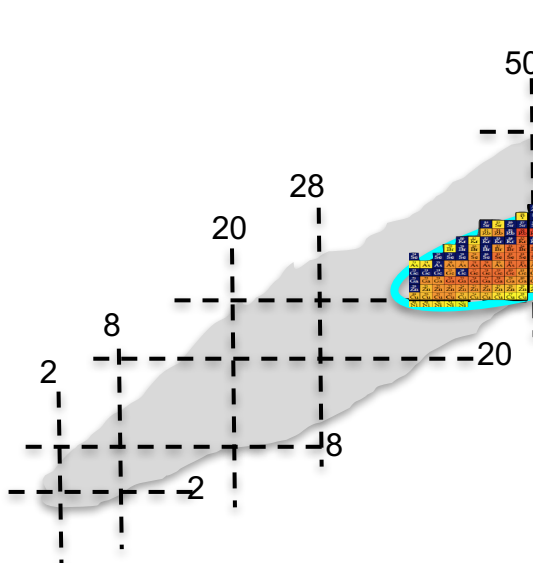
SPES WS 2014 and 2016

To be fully defined ...

SPES - BEAMS

ISOL production Scheme

p (40 MeV) + ^{238}U
 200 μA
fission



Cs, Ba, ...
 VERY intense, pure

Sn, Sb, Te
 VERY intense, pure

Ga, Ge ...
 intense, pure

Rb, Sr, ...
 VERY intense, pure

SPES – Intense Exotic Species

Sn, Sb, Te, ... } DAY0: up to 10^9 pps
Cs, Ba, ... } FULL: up to 10^{11} pps
Rb, Sr, ... } 1+
Ga, Ge, ... } 40 keV

**Ground State properties, ...
 β -decay spectroscopy**

coordinated by G. Benzoni, INFN-Milano

LNL – Accelerator

ALPI Superconductive LINAC

Reactions at 10 MeV/A

($\text{eff}_{\text{CB}} = 4\%$, $\text{Trans}_{\text{ALPI}} = 50\%$)

DAY0: up to 10^7 pps

FULL: up to 10^9 pps

- Coulex
- Transfer
- Multi-Nuc.Transfer
- Fusion

**In-Beam
Nuclear Structure**

LOI's for SPES – 2014 and 2016 Workshops

47 LOIs = 42 (Physics) + 5 (Instruments Installation)

22 LOIs requesting AGATA + Ancillaries

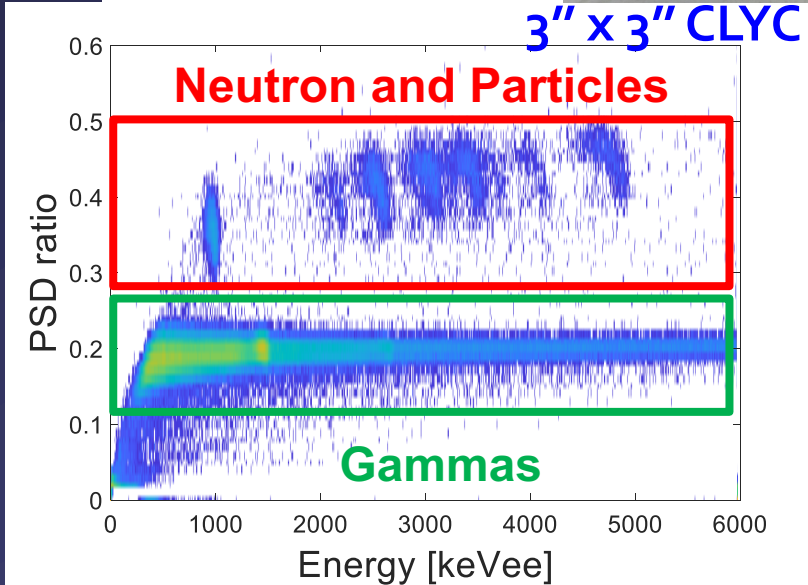
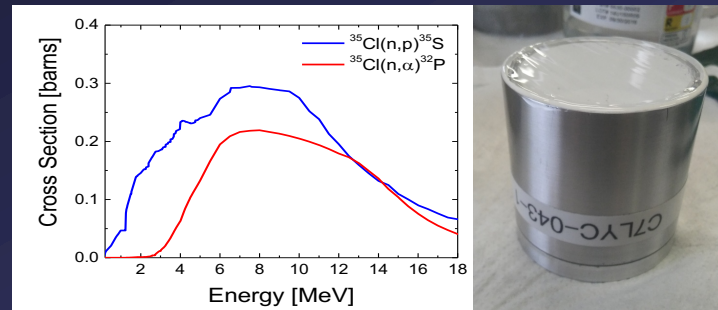
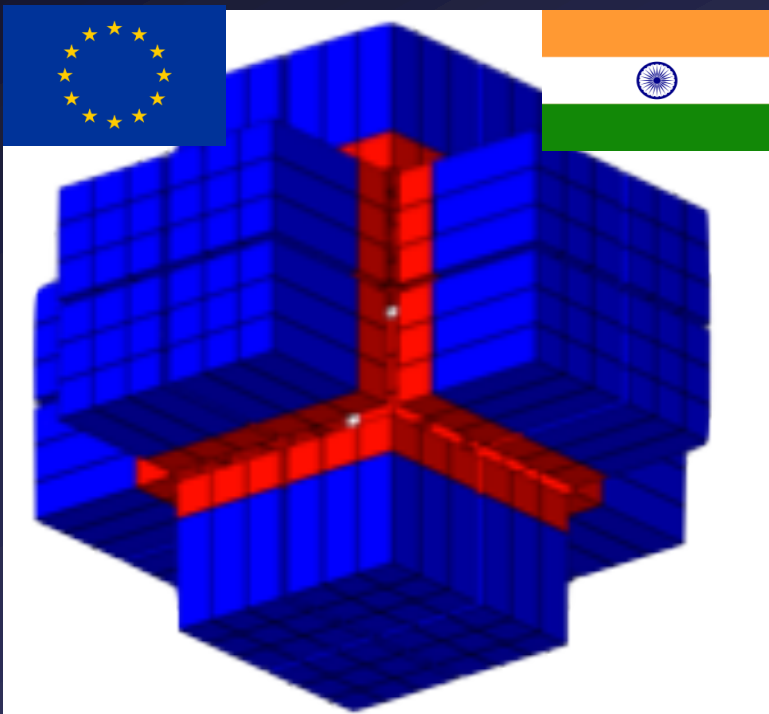
AGATA/GALILEO	22
+ Large Scintillators	3
+ Charged Particles (Coulex)	7
+ Charged Particles (Transfer)	10
+ Magnetic Spectrometer	4
+ Plunger	2
+ Neutron Detector	1
+ Recoil Filter	1

*Several experiments
each LOI ...*

ALL requested ANCILLARIES (some under development ...) will be available at LNL

Large Volume Scintillators

GALILEO – INFN
 $\epsilon \approx 8\%$



up to 10 LaBr_3 3"x3"
 $\epsilon \approx 1\%$ @ 16 MeV

(F. Camera et al., MILANO)

- in use with GALILEO -

PARIS

$\text{LaBr}_3 + \text{NaI}$ phoswitch

(A. Maj et al., KRAKOW)

- in use with AGATA@GANIL -

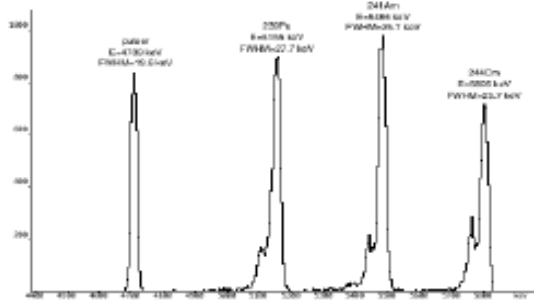
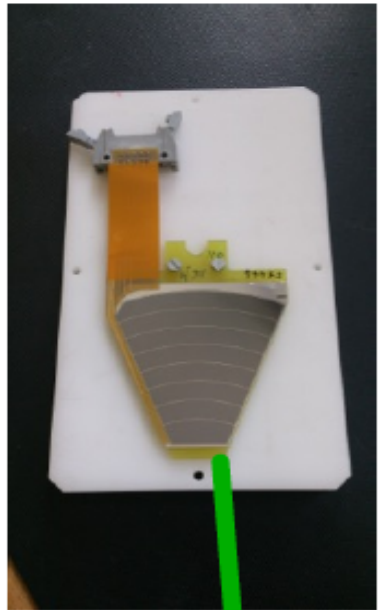
Possible **SMALL array** of elpasolite crystals (CLYC):

- excellent γ and n detection
 - n energy measurement
 - → close packed geometry (F. Camera et al., MILANO)
- Under investigation ...*

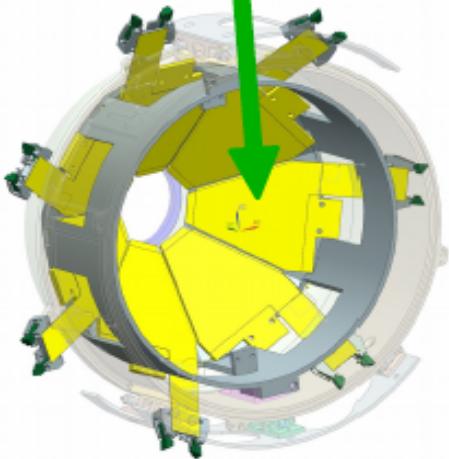


Charged Particle (Coulex): SPIDER

(A. Nannini – INFN-Florence)



- Energy resolution: ~ 25 keV for α -particles @ ~ 5.5 MeV
- Doppler correction (MC simul): FWHM $\sim 0.2\%$ @ 1.3 MeV, $\beta \sim 3\%$

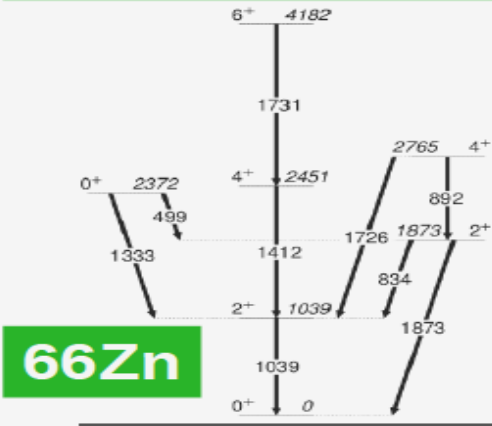


- Angle [8 independent strips, 8 sectors]
- Range: 133 – 168 deg
- Digital electronics

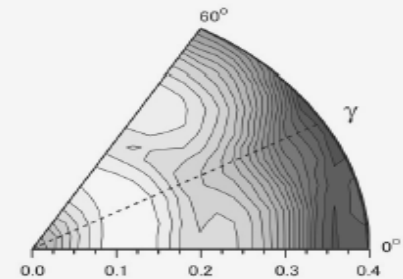
Strip thickness: 300 μ m

eight separate silicon strip detectors
(Silicon Ple DetectorR)

Commissioning case



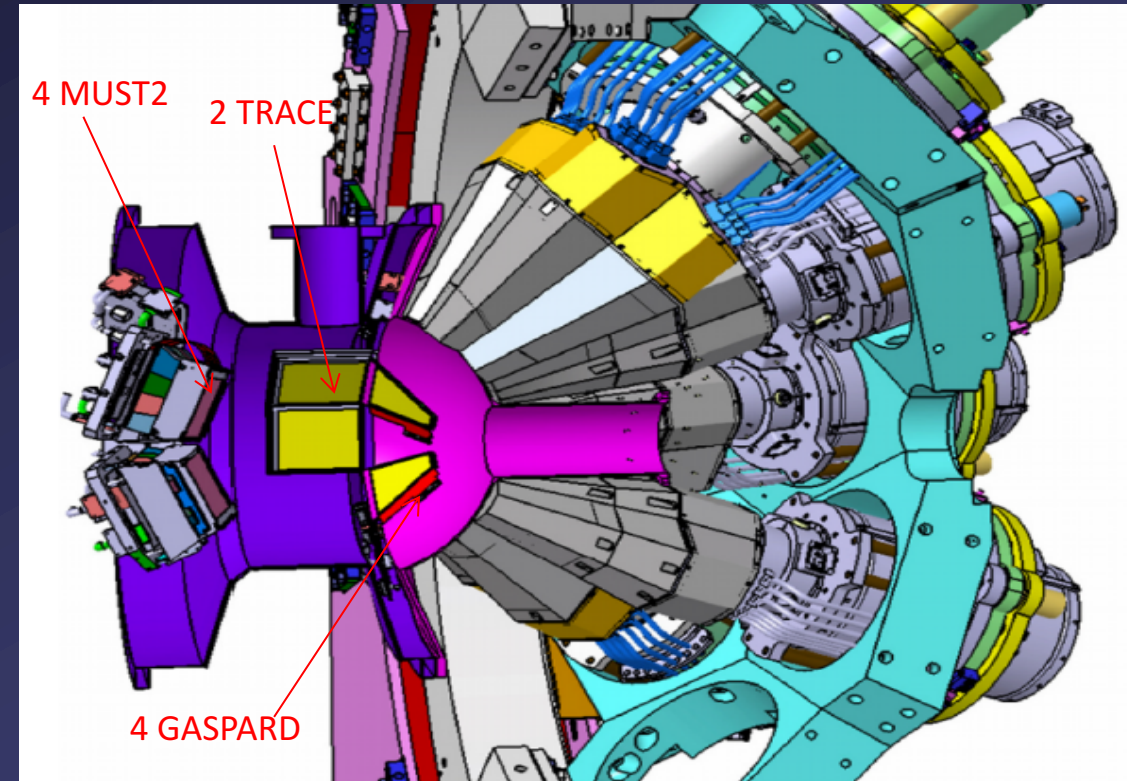
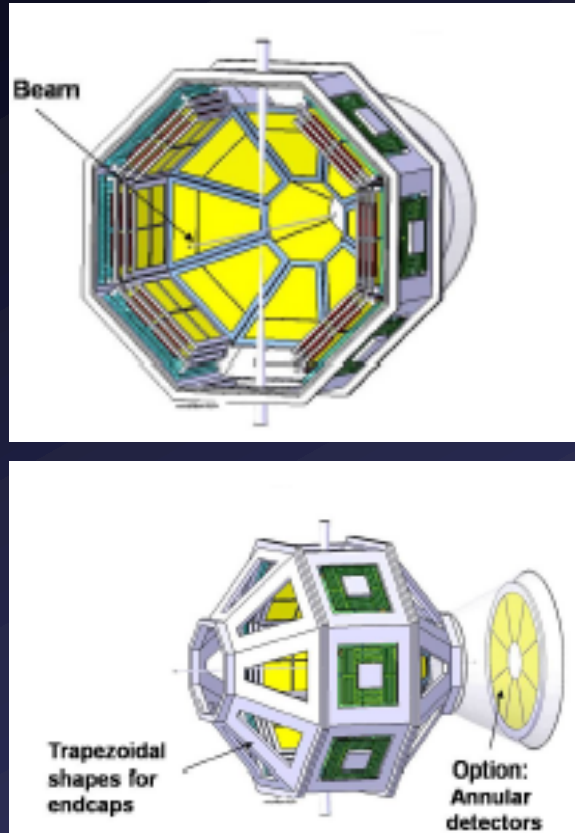
66Zn



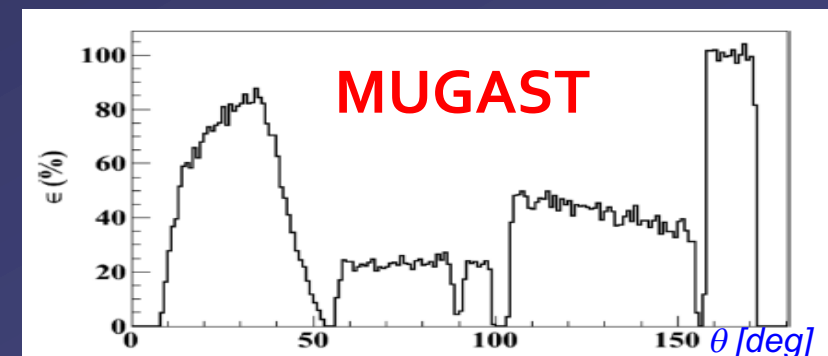
*Commissioned in 2016
- in use with GALILEO -*

Charged Particle (Transfer): MUST/GASPARD/TRACE (GRIT)

(D. Mengoni – Padova, D. Beaumel – IPN Orsay)

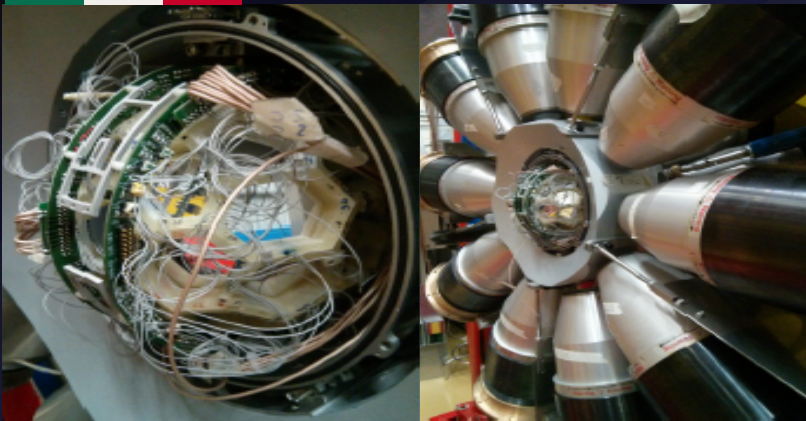


*Development on going
LOI @ GANIL, SPIRAL₁, LISE and SPES*



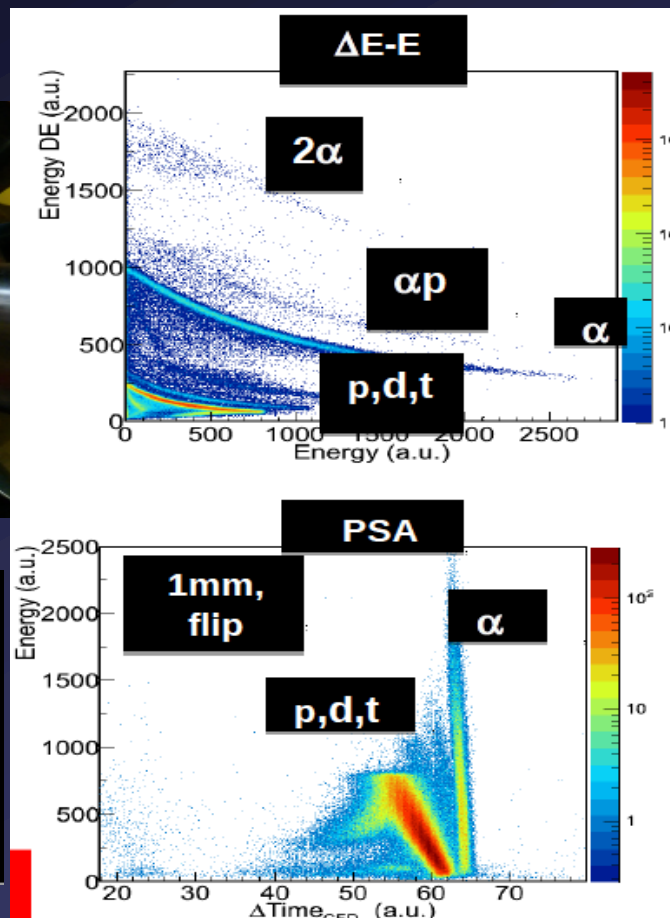
Charged Particle (tagging)

EUCLIDES



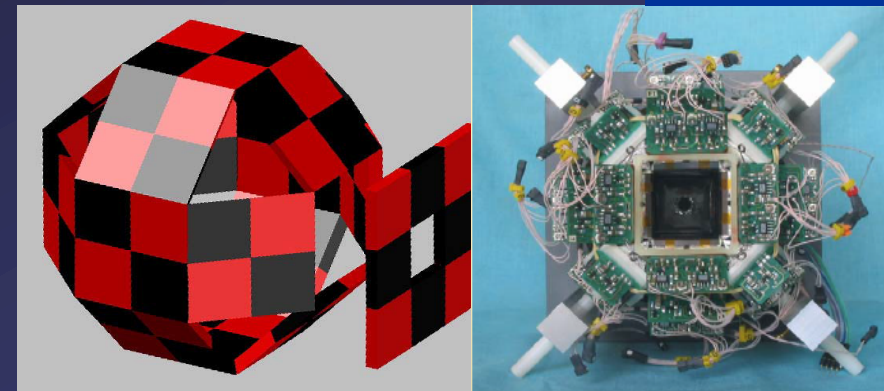
- 110 Silicon detectors (80%4 π)
- $\epsilon_{\alpha} \sim 30\%$; $\epsilon_p \sim 50\%$;
- $\sim 100\%$ working, $\sim 80\text{keV}$ FWHM
- New compact preamps
- Digital electronics
- Trigger-less mode

(D. Mengoni, Padova)
- in use with GALILEO -



GOOD particle-identification
by E- ΔE and PSA

DIAMANT



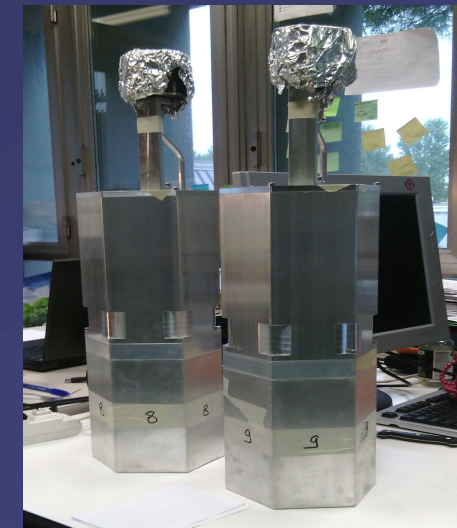
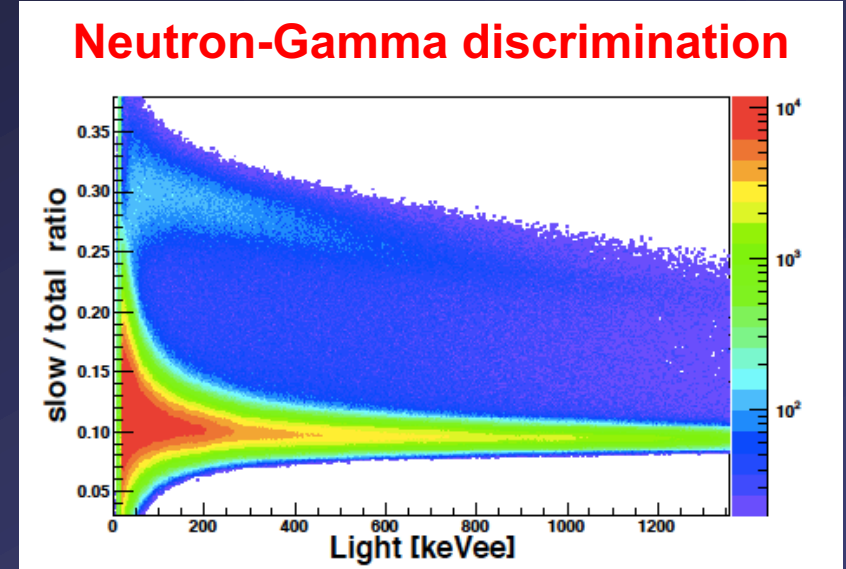
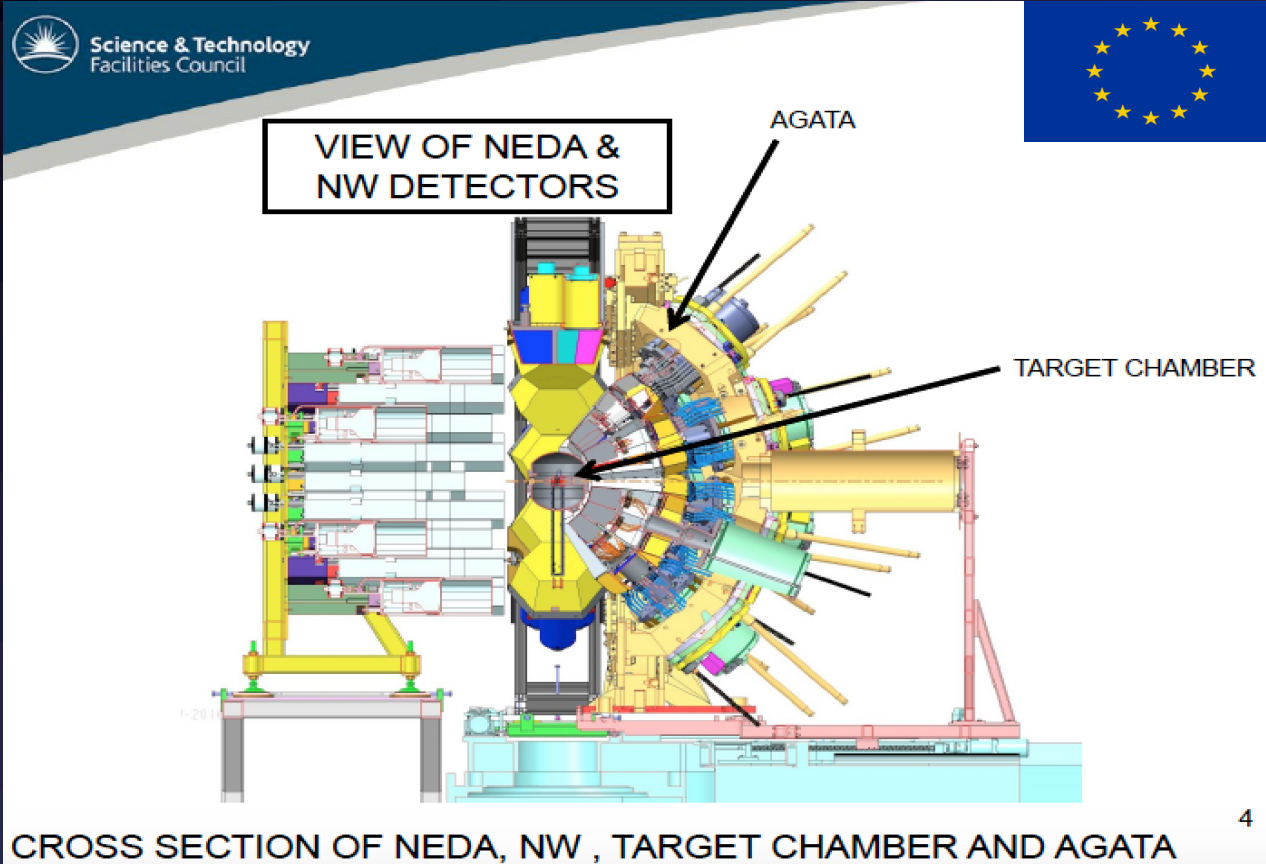
- 84 CsI(Tl) with PIN diode detectors
- $\sim 90\%$ of 4 π
- detection of protons: $> 70\%$
- detection of alphas: $\sim 50\%$

See talk of G. Jaworski and N. Redon

Electronics development on going
- In use in 2018
with AGATA@GANIL -


Neutron Detector: NEDA

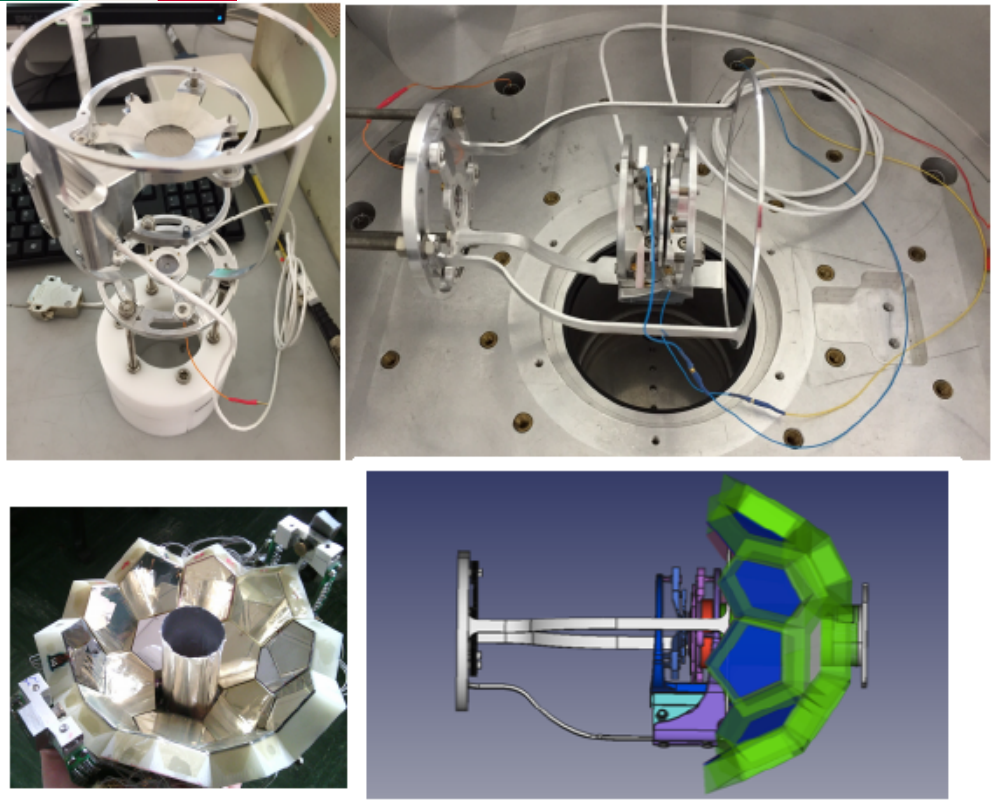
(J. Valiente-Dobon – LNL)



*Development on going
- In use in 2018 ... with AGATA@GANIL -*

PLUNGER

 LNL-Plunger
(Cologne collaboration)



- compact geometry
- possible use with EUCLIDES
- R&D for g-factor

(A. Goasduff, Padova)

- in use with *GALILEO* -

- *Already in use with AGATA@GANIL* -

Cologne Plunger
(K. Fransen, IKP Cologne)



Orsay Plunger
(J. Ljungvall, CSNSM-IN2P3-CNRS)



For lifetime measurements:

FATIMA array also...

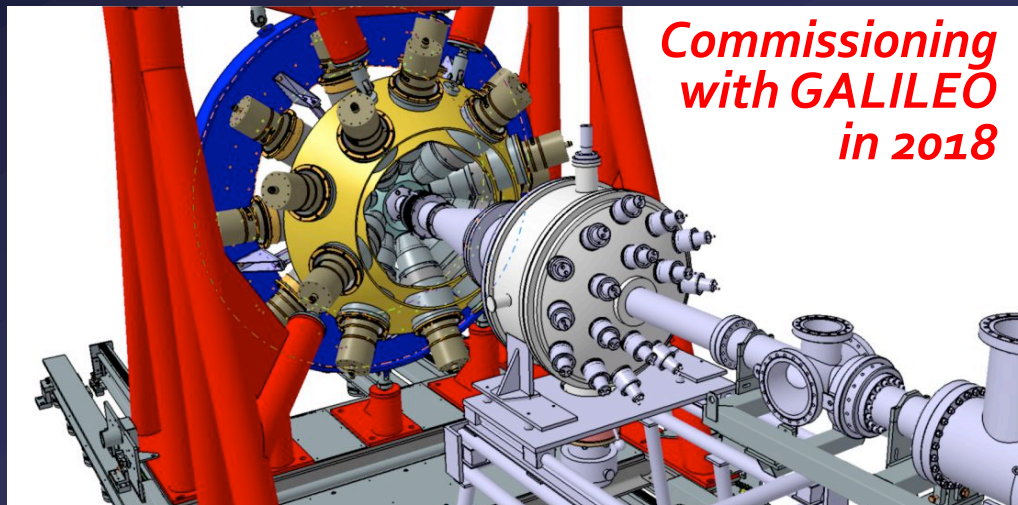
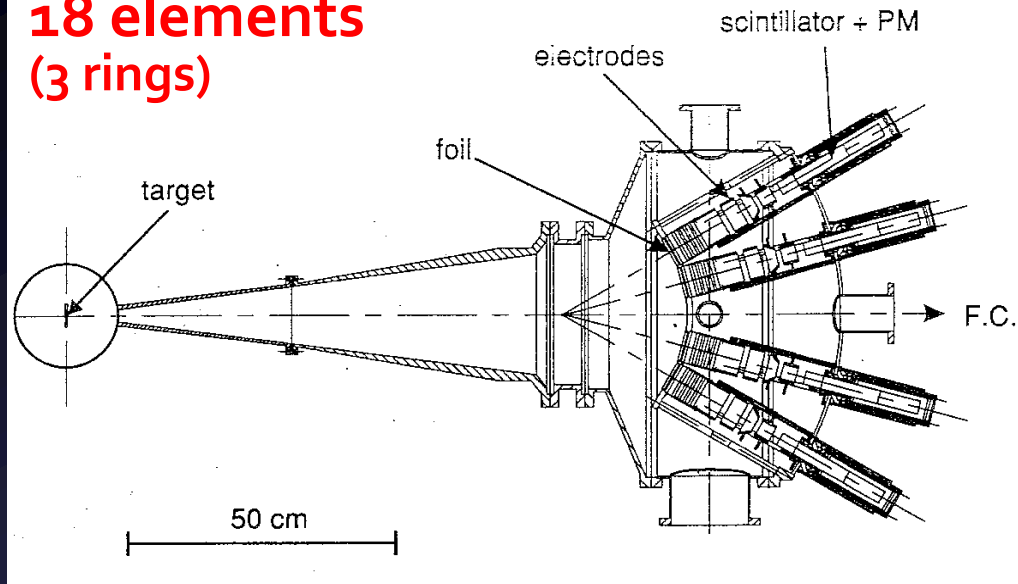
already in use with AGATA@GANIL

See talk of M. Rudigier

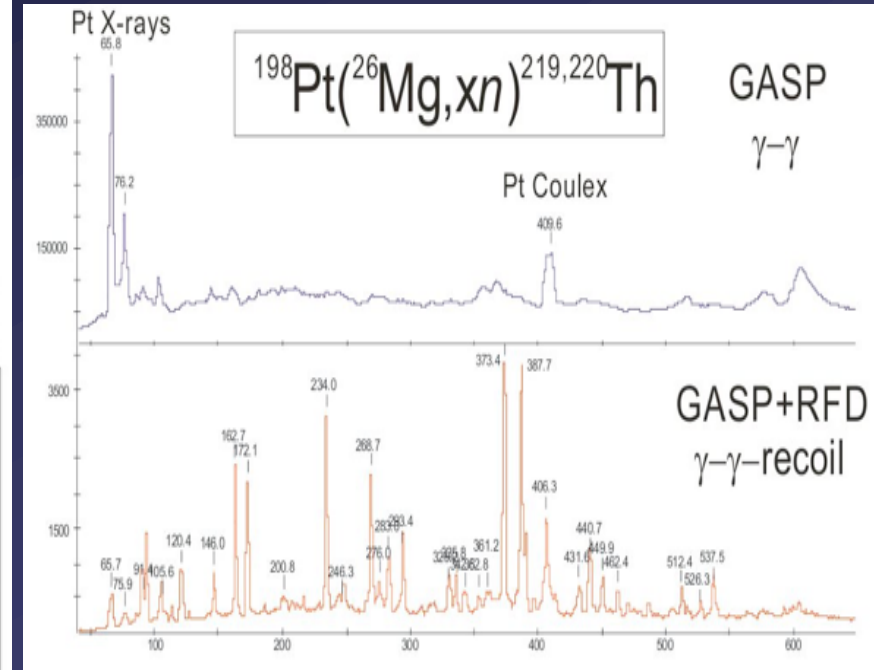
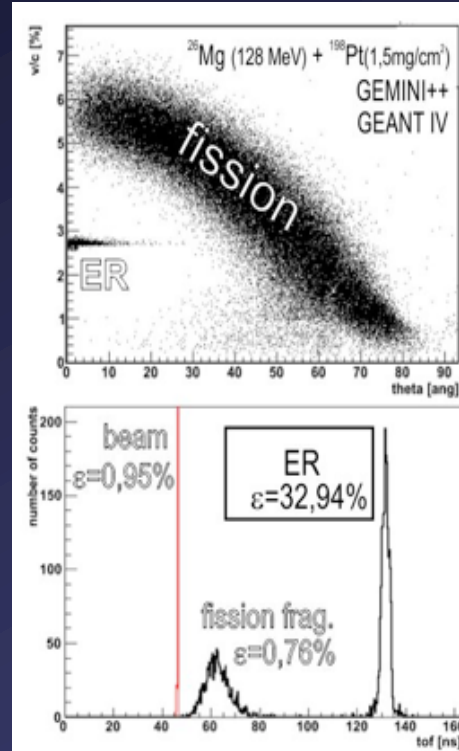
Recoil Filter Detector (RFD)

(P. Bednarczyk – IFJ PAN Krakow)

**18 elements
(3 rings)**



**Commissioning
with GALILEO
in 2018**



Important for **FUSION** reactions characterized by:

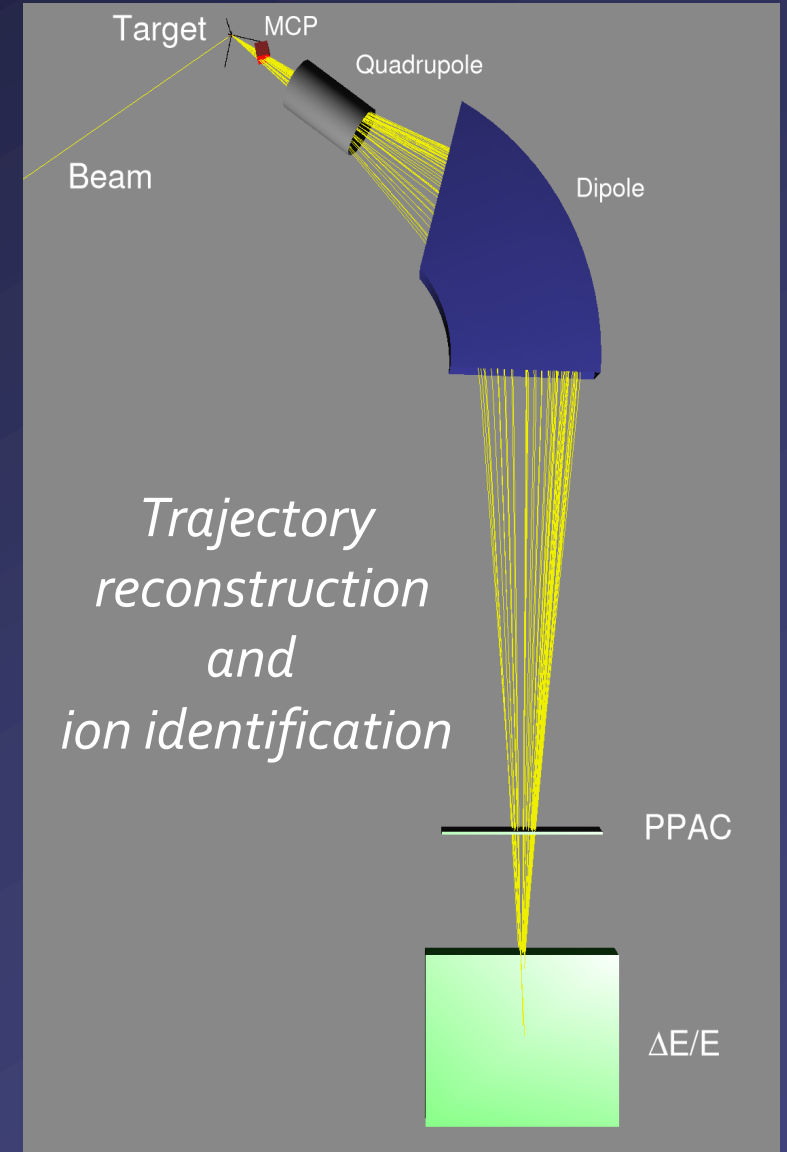
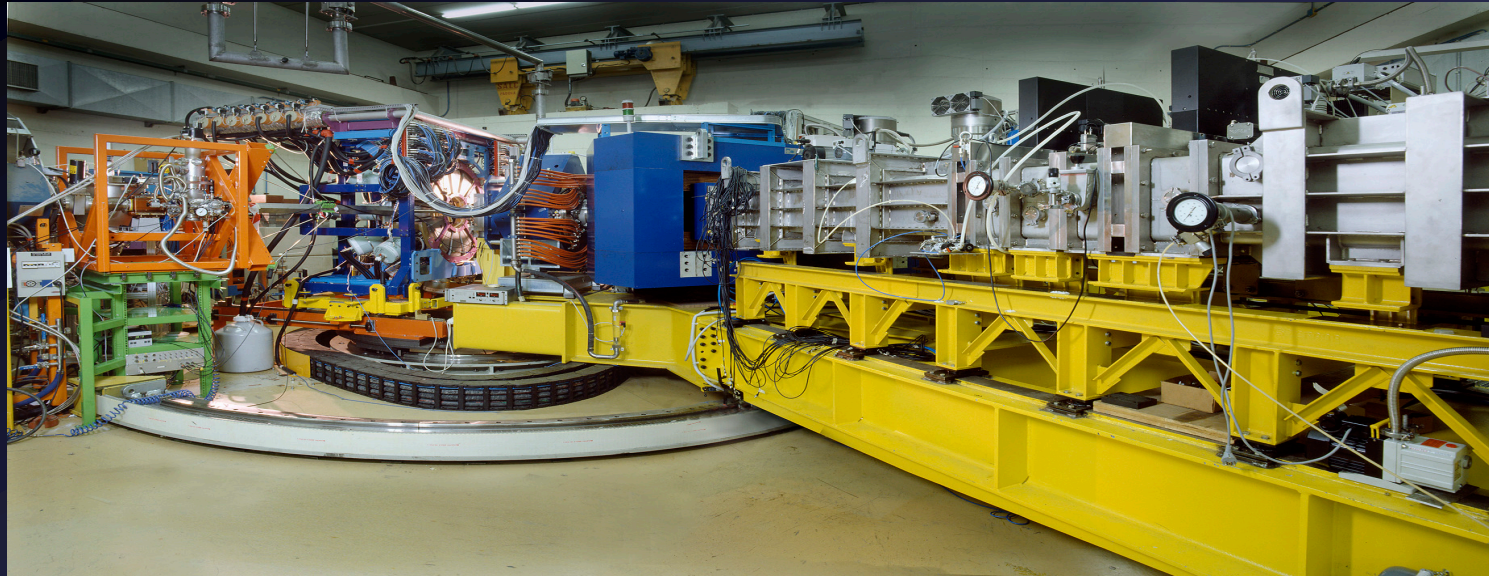
- Many evaporation residues
- Large fraction of fission
- Large amount of particle emission

Evaporation residues identification
and v/c determination via TOF



Magnetic Spectrometer: PRISMA

(L. Corradi – LNL)



Large acceptance
Magnetic
Spectrometer

$$\Delta\Omega = 80 \text{ msr}$$

$$\Delta Z/Z \approx 1/60$$

$$\Delta A/A \approx 1/190$$

Energy acceptance $\pm 20\%$

$$B\rho = 1.2 \text{ Tm}$$

Conclusions

we will be very well equipped
with Ancillaries

for AGATA @ SPES/LNL !!!

+ Additional R&D activities are also on-going

(Mini-Orange Spectrometers for electron conversion ...)



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DI MILANO



IVth Topical Workshop on Modern Aspects in Nuclear Structure
The Many Facets of Nuclear Structure

BORMIO 19 - 25 February 2018



Organizers: A. Bracco, F. Camera, G. Colò, S. Leoni;

Scient. Secretaries: F. Crespi, X. Roca-Maza

Università degli Studi di Milano and Istituto Nazionale di Fisica Nucleare (sez. Milano) are pleased to announce the **Fourth Edition** of this new series of **Topical Workshops on Modern Aspects of Nuclear Structure**.

The meetings are organized every second year in the month of February in Bormio, focusing on specific topics which are relevant for the nuclear physics community and related areas. Within the workshop, **experimental** and **theoretical** collaborations will have the opportunity to present and discuss their latest development on physics and more technical issues ([Link to Previous Edition Bormio 2016](#)).

The Workshop will be preceded on February 19th by a
Satellite Meeting focused on

"Working at the interface between Nuclear Structure and Reactions"

- more details will be provided soon -

(Please contact Gianluca Colò - Gianluca.Colo@mi.infn.it)

DEADLINE for ABSTRACT SUBMISSION
20 September 2017

E-mail: wsbormio-milano@mi.infn.it

Web-Page: <http://www.mi.infn.it/WSBormio-Milano2018/>

***** we look forward for contributions
on AGATA results *****

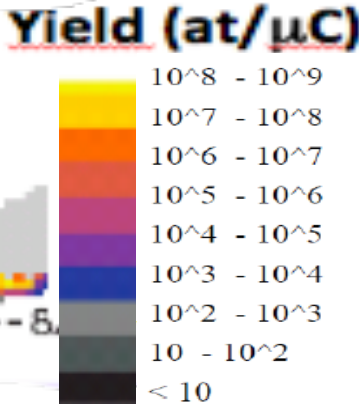
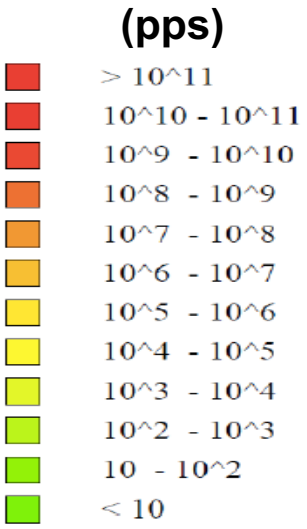
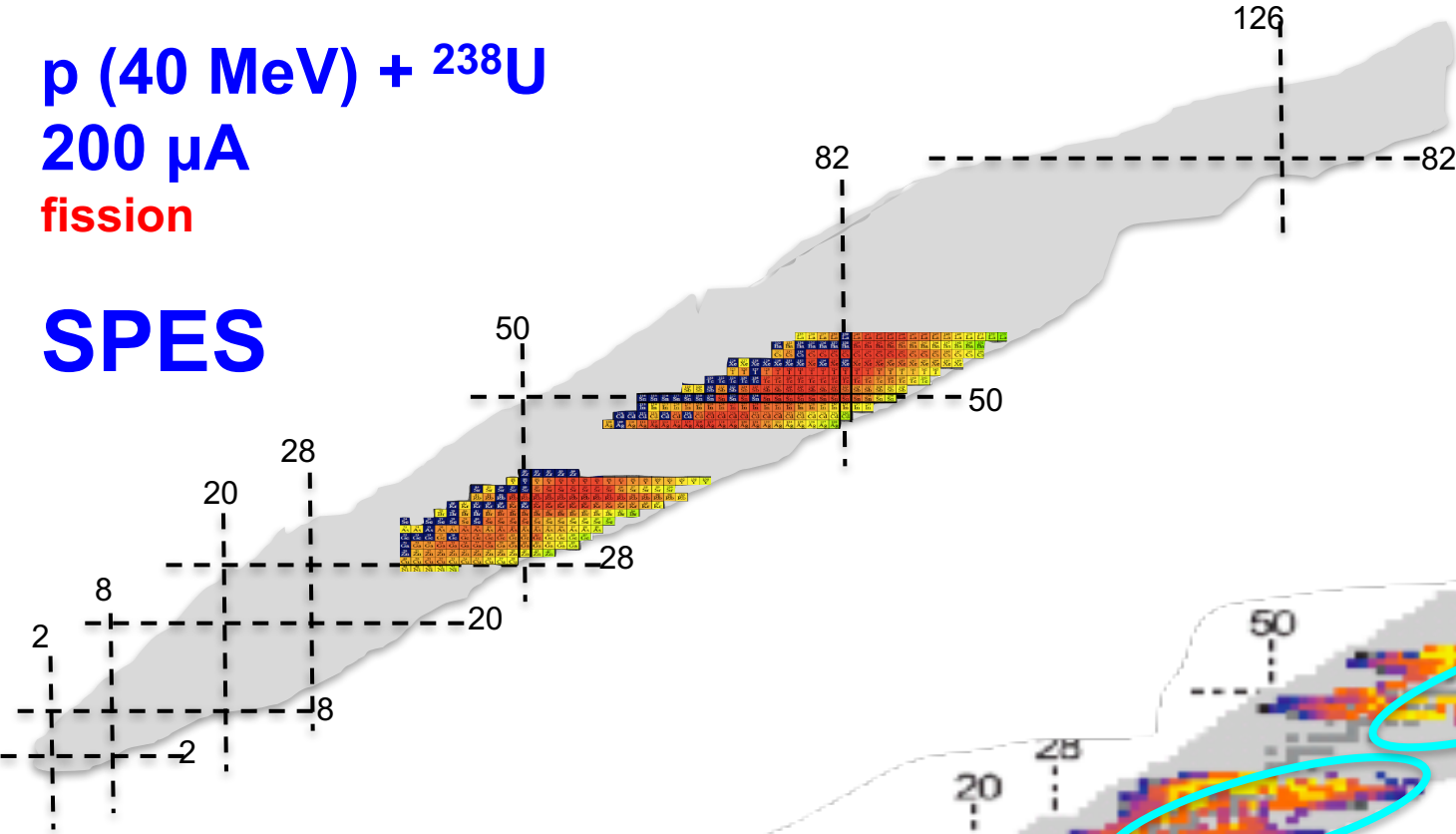
**PRIZES for Young Speakers
are offered by CAEN**

*** Thank You for the Attention ***

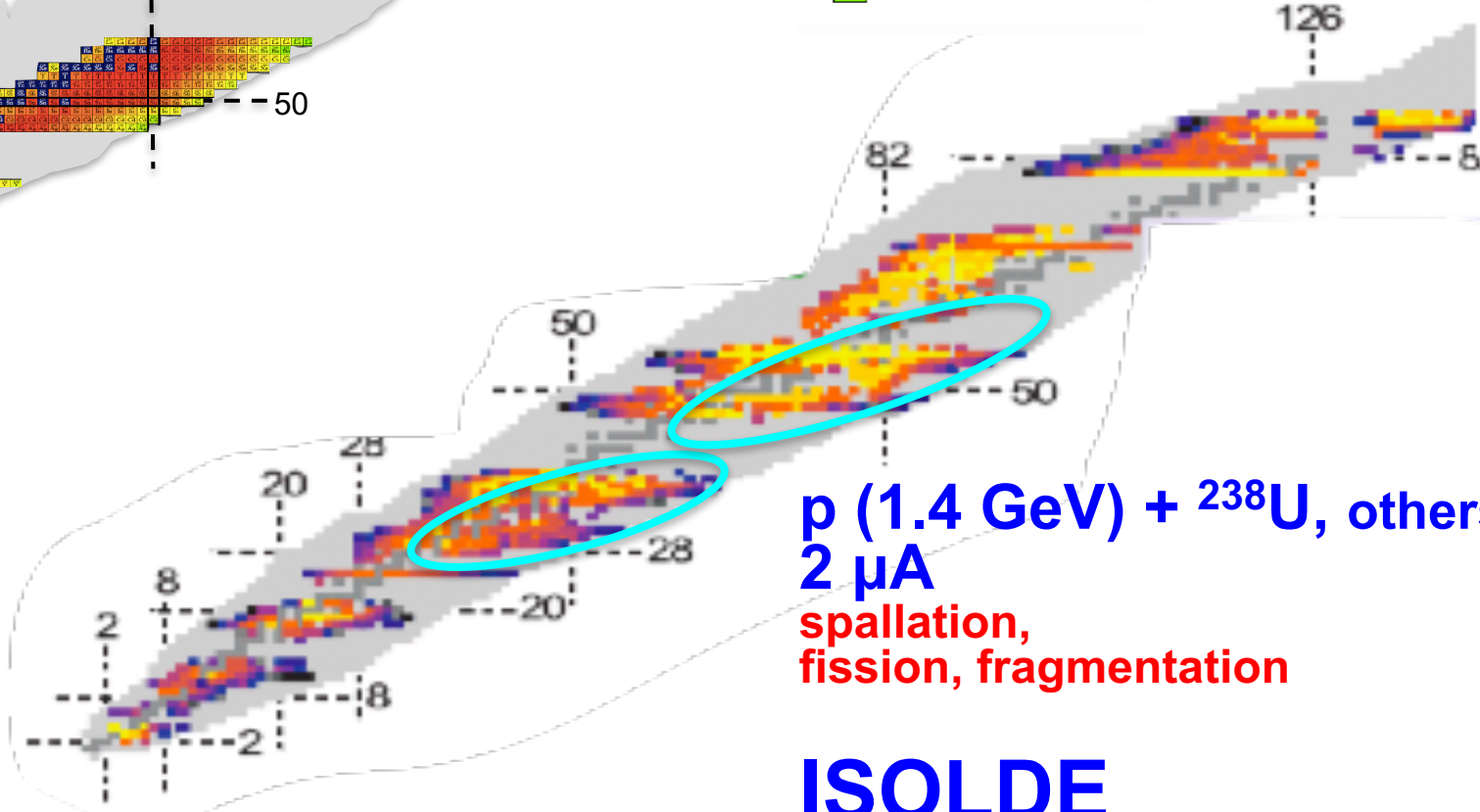
ISOL Production Schemes

p (40 MeV) + ^{238}U
200 μA
fission

SPES



p (1.4 GeV) + ^{238}U , others
2 μA
spallation,
fission, fragmentation



ISOLDE