HIGH-RESOLUTION MAGNETIC ANALYZER

MAVR

FOR

SEPARATION AND IDENTIFICATION OF REACTION PRODUCTS

“MAVR”

MAGNETIC
ANALYZER
VYSOKOGO (**HIGH**)
RESOLUTION

The goal of this talk:
1) to show the present status of the MAVR

2) describe the first experiments with gas-detector systems (target and detectors)

Collaboration:

FLNR -JINR (Dubna, RF)

INRNE, BRV, BAS (Sofia, Bulgaria)

NPI, AS, CR (Rez, Czech Republic)

INP, PAS (Krakov, Poland)

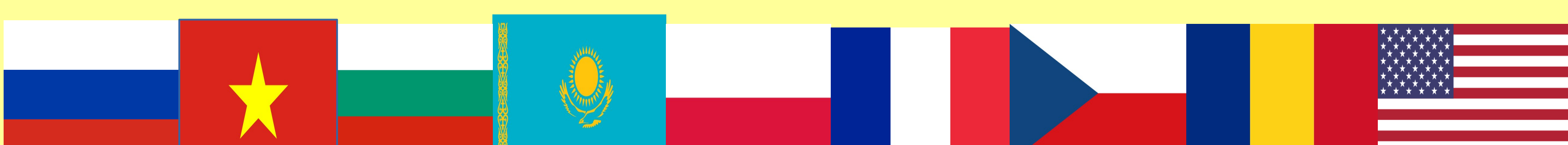
GANIL (Caen, France)

IPN (Orsay, France)

IP VAST (Hanoi, Viet-Nam)

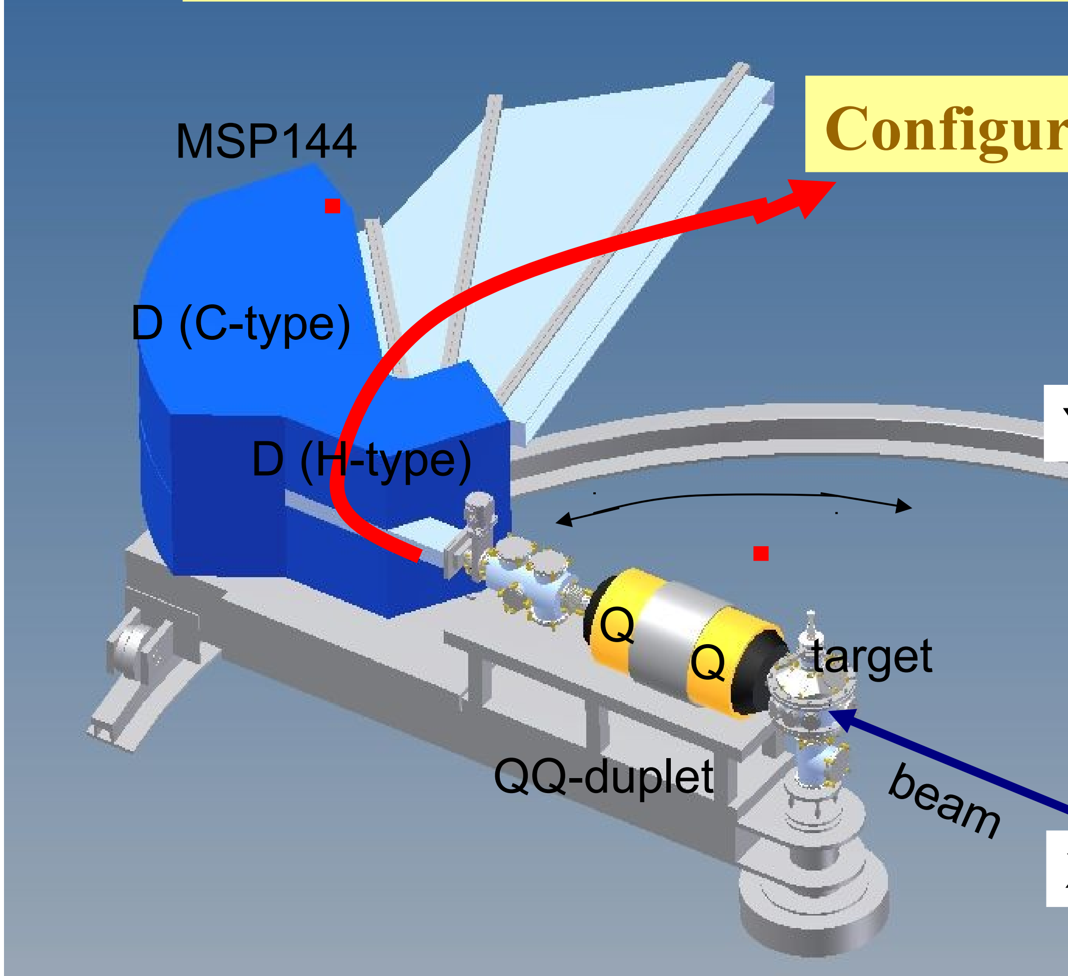
CI TAMU (Texas, USA)

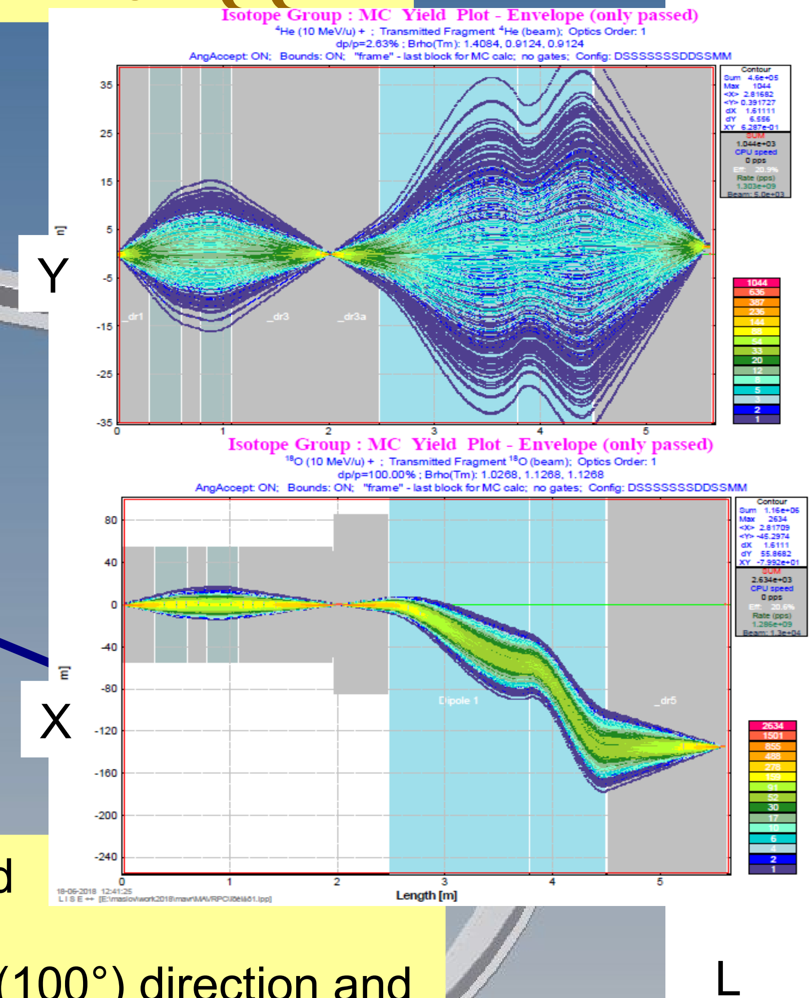
HHNIPNE (Bucharest, Romania)



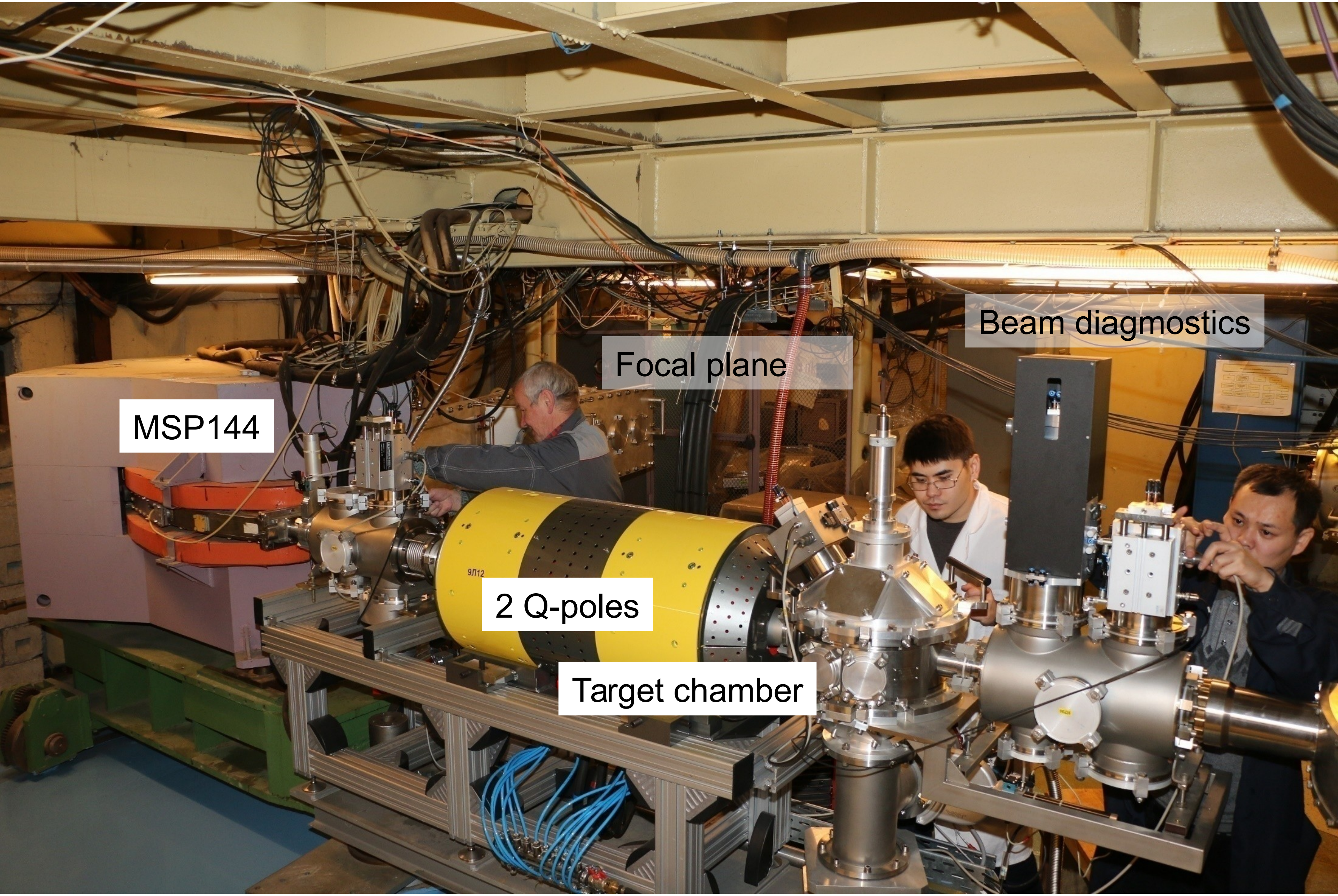
MARGETIC ANALASER HIGH RESOLUTION MAVR

Configuration QQDD





Coupled two dipoles system with not-separated yokes and same current circuit.
It allows to diverge products at the back-away (100°) direction and suppress background


Beam diagmostics
Focal plane
MSP144
2 Q-poles
Target chamber

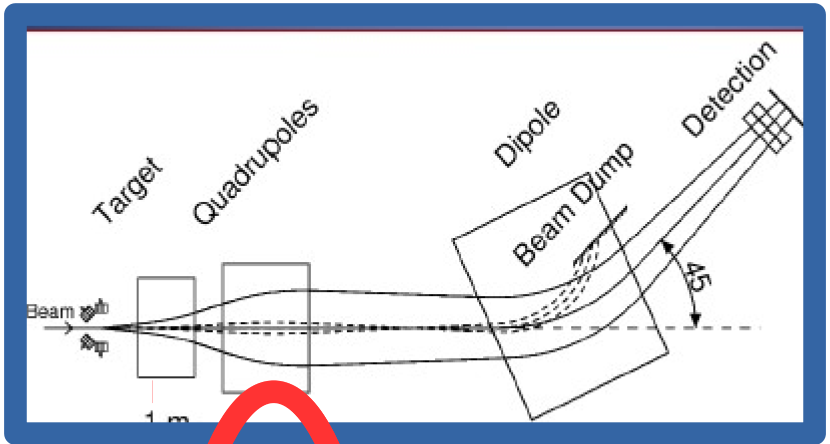
Main parameters:

- magnetic optical system is based
on dipole magnet MSP-144 and two quadrupoles.

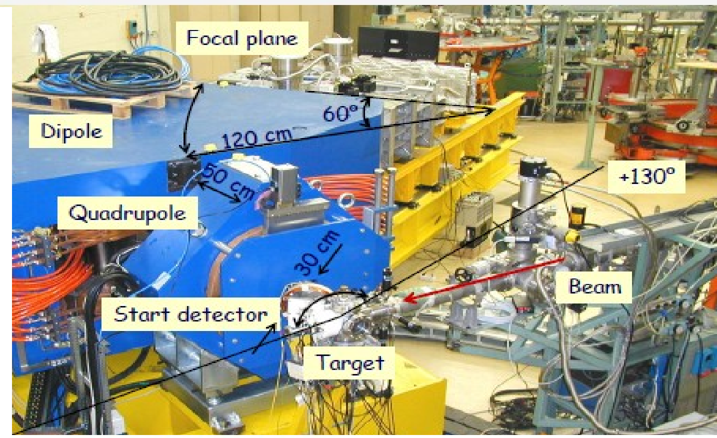
- value of the solid angle of the spectrometer 30 msr

- Focal plane length 2 m.
The large acceptance dp/p=10% at values of the momentum resolution and dispersion the value 10^{-4} and 1.9 cm/%
- The detector system
aimed to measure Q, Z and A of products with absolute accuracy by:

➔Trajectory reconstruction of the detected products will be reproduced by a drift-chamber
➔time of flight (TOF),
➔energies losses (ΔE) and total kinetic energies (TKE).



PRISMA Spectrometer

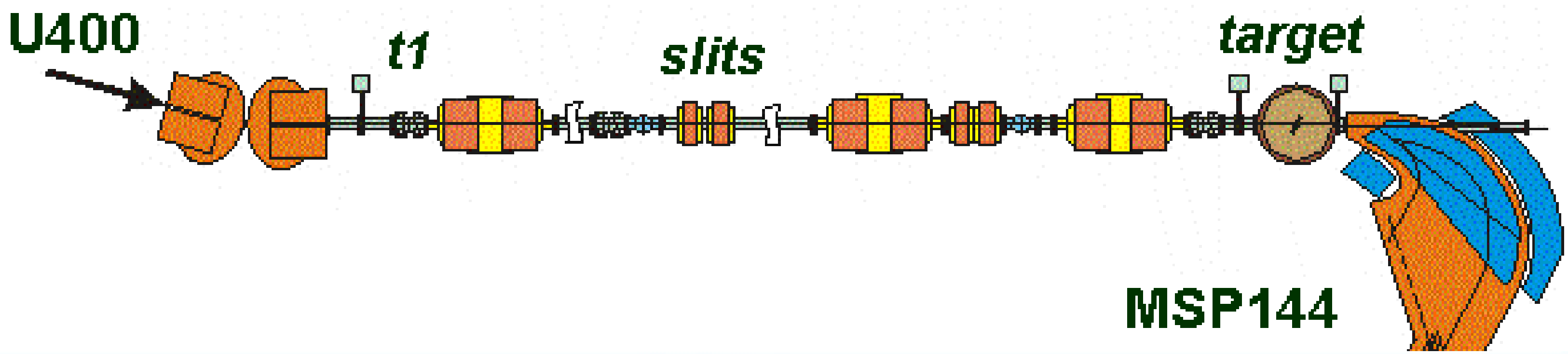


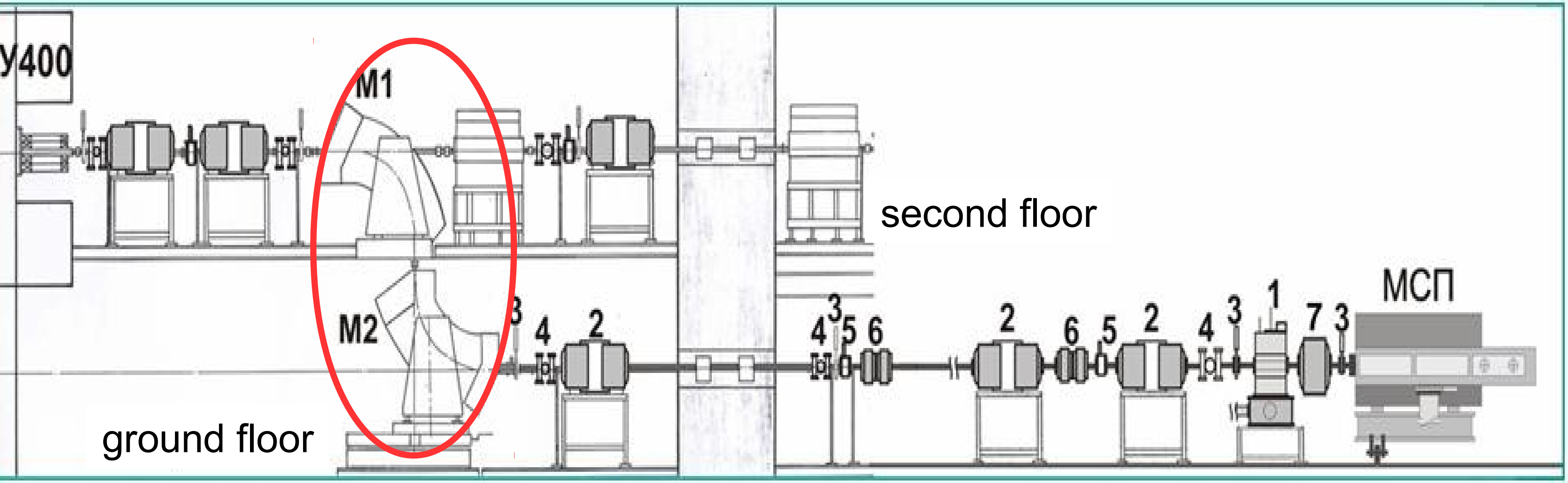
	MAVR JINR (Dubna)	VAMOS GANIL (Caen)	PRISMA LNL (Legnaro)	MAGNEX LNS (Catania)
Geometry	Q_vQ_hD1D2	Q_vFQ_h D	Q_v D	Q_v D
Brmax, T.m	1.5	1.7	1.2	1.8
Angle°	110.7	45	45	55
Angular Acceptance msr	30	70	80	55
Dispersion, cm/ %	1.5	1.8	2	3.68
Energy Resolution $\Delta E/E$	$5*10^{-4}$	$5*10^{-4}$	$1*10^{-3}$	-
Resolution Z	1/60	1/50	1/60	-

MAGNEX

MAVR

http://multi.jinr.ru/MSP.htm





The MAVR spectrometer will be used both for primary and secondary beams for the accelerator facility U400 and U400R. It will be used for the secondary beam production as well as an energy beam monochromator.

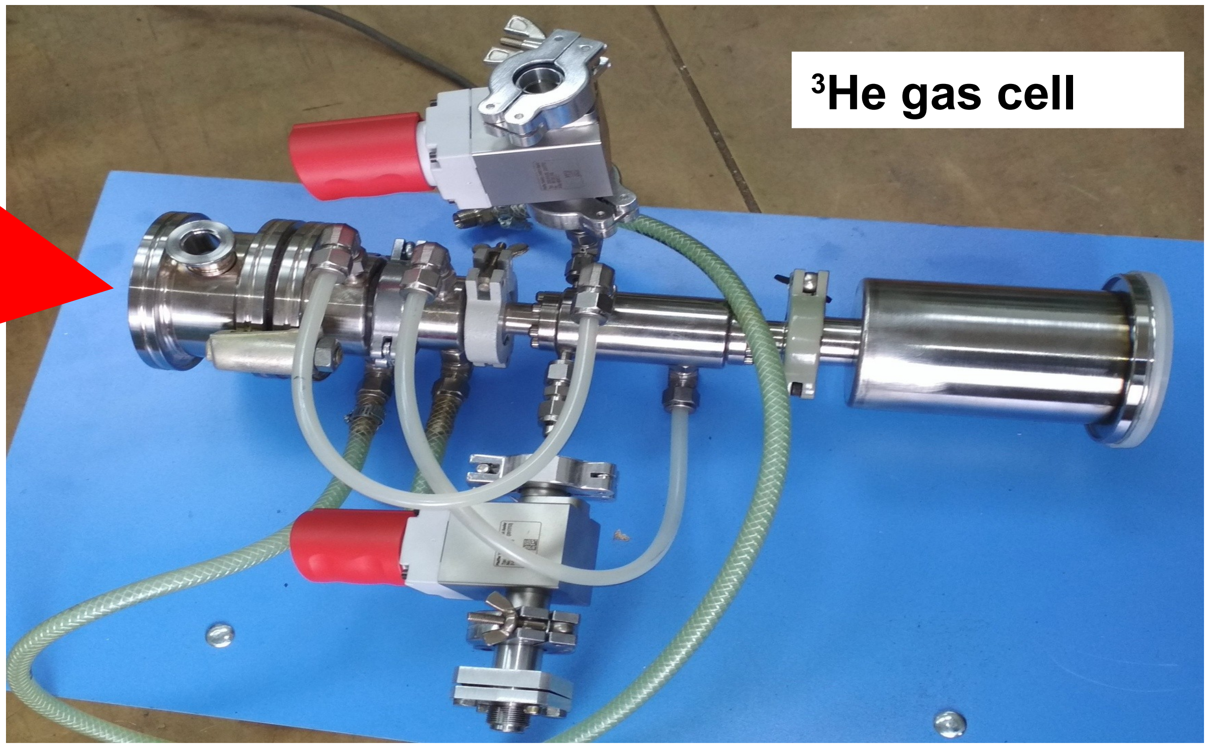
Our energy domain is E<15 MeV/A and transfer reaction for secondary beam production

Niche strategy of MARV is not Fragmentation!

$^{6}Li+^{3}He \rightarrow {}^{8}B$ (2p transfer) Q= -1.97 MeV

$^{10}B+^{3}He \rightarrow {}^{12}N$ (2p transfer) Q= +1.57 MeV

$^{10}B+^{3}He \rightarrow {}^{10}C$ (p n exchange) Q= -3.67MeV



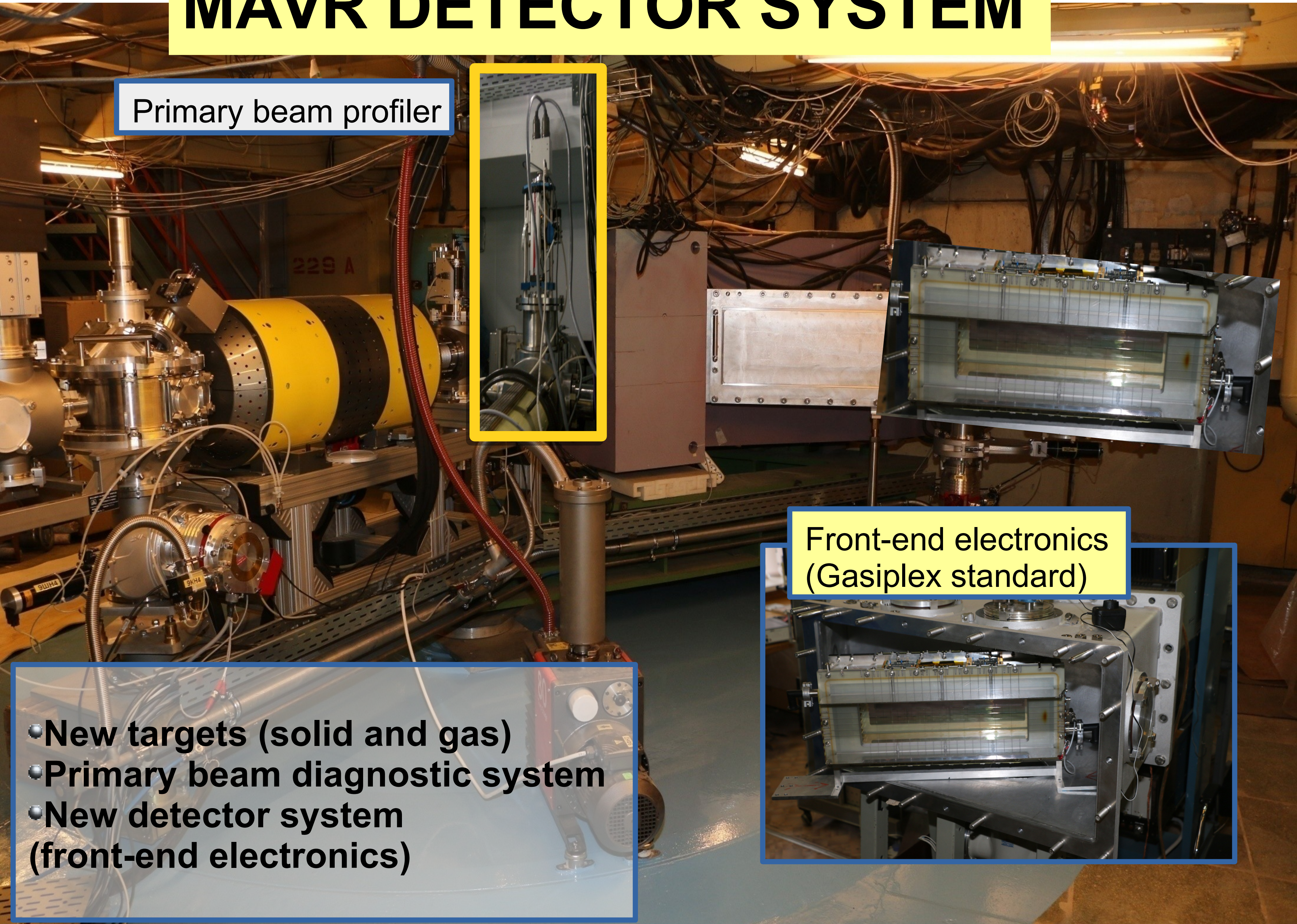
^{9}C

^{8}B

^{7}Be

$2.5e^{20}$

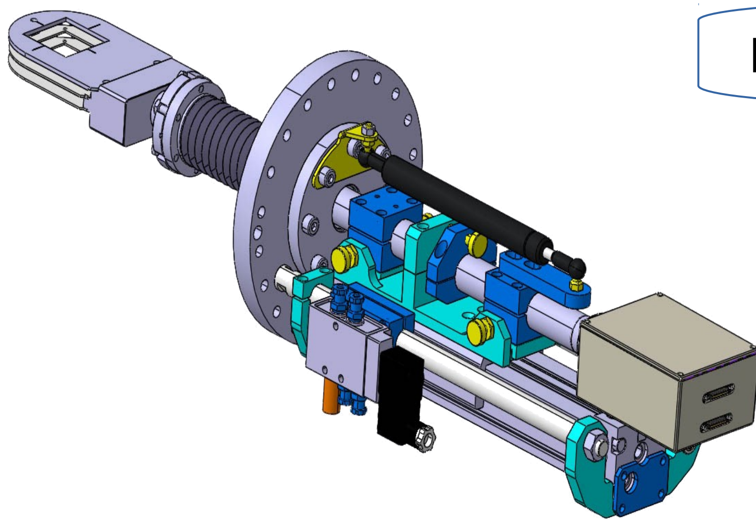
MAVR DETECTOR SYSTEM



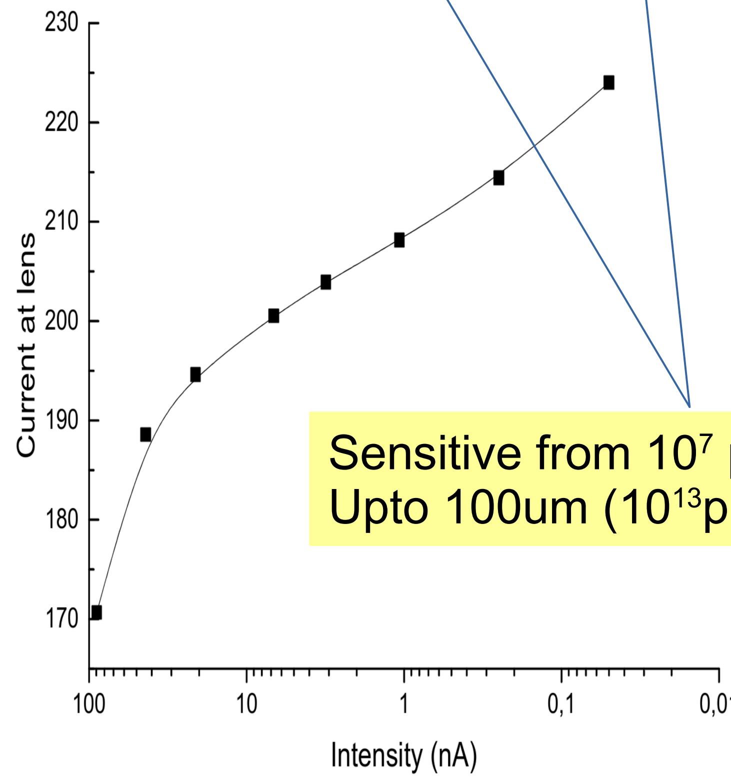
- New targets (solid and gas)
- Primary beam diagnostic system
- New detector system
(front-end electronics)

EMS beam profiler (GANIL-PANTECHIK)

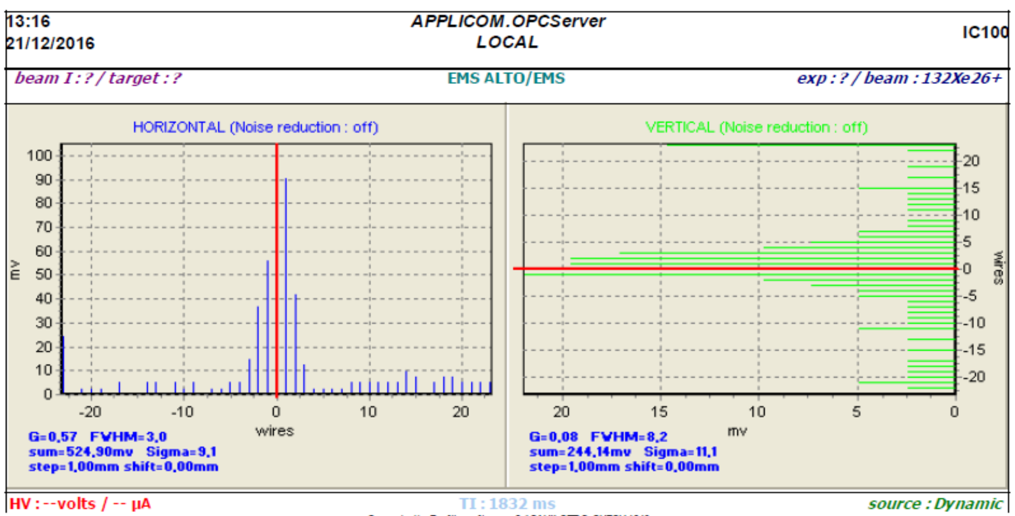
- Tested by beam of ^{132}Xe (1 MeV/A) at IC-100 (IN2P3-Dubna agreement pos. 09-84)
- Contract (JINR-Pantechik 500-2911)



Measured, Preprint JINR, P7-2017-58



Sensitive from 10^7 pps
Upto 100um (10^{13}pps)



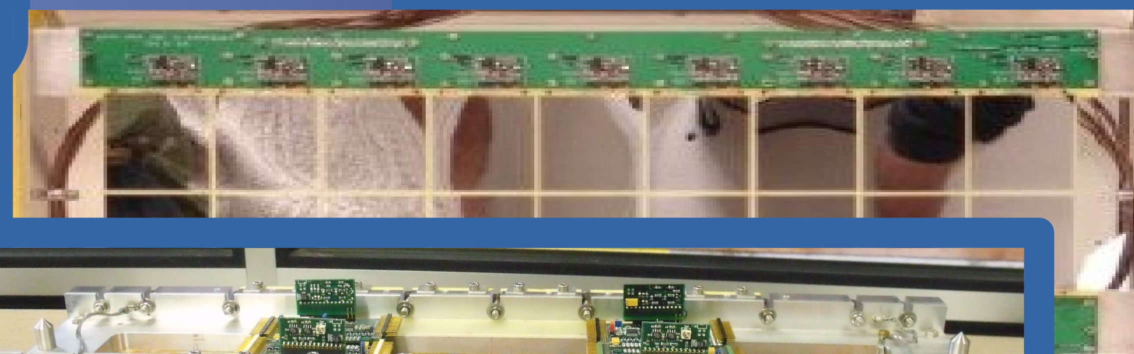
Focal Plane Setup

ASIC electronics
Application Specific Integrated Circuit

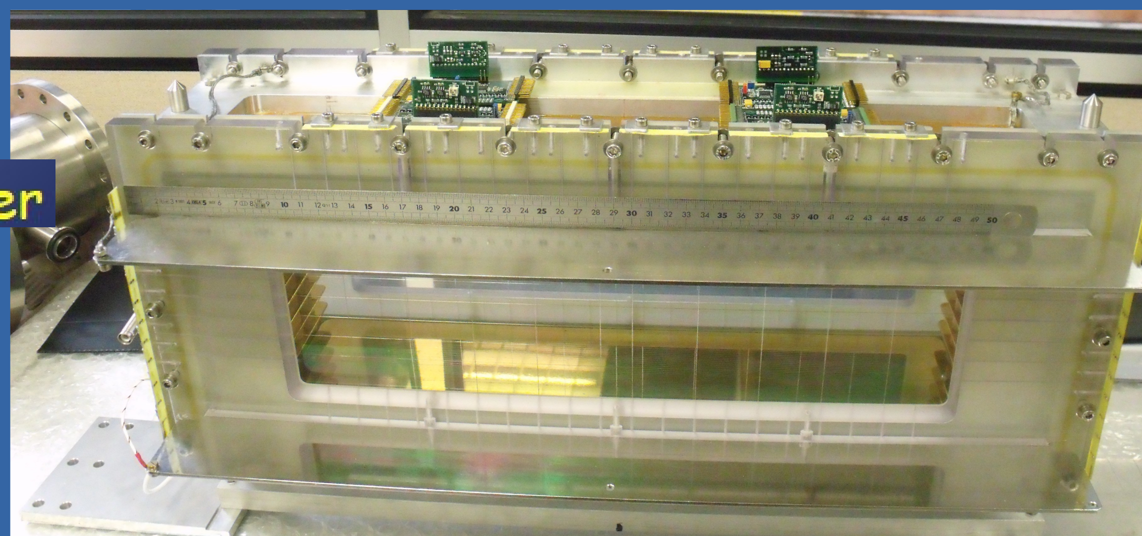
Position, dE, E_r

⊕

Si Wall



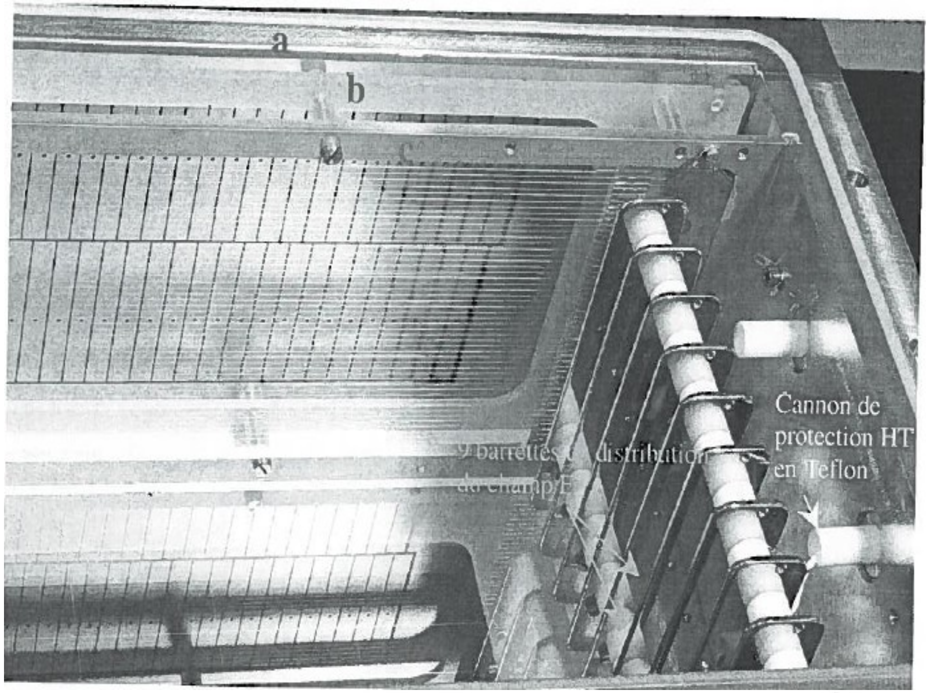
Drift Chamber

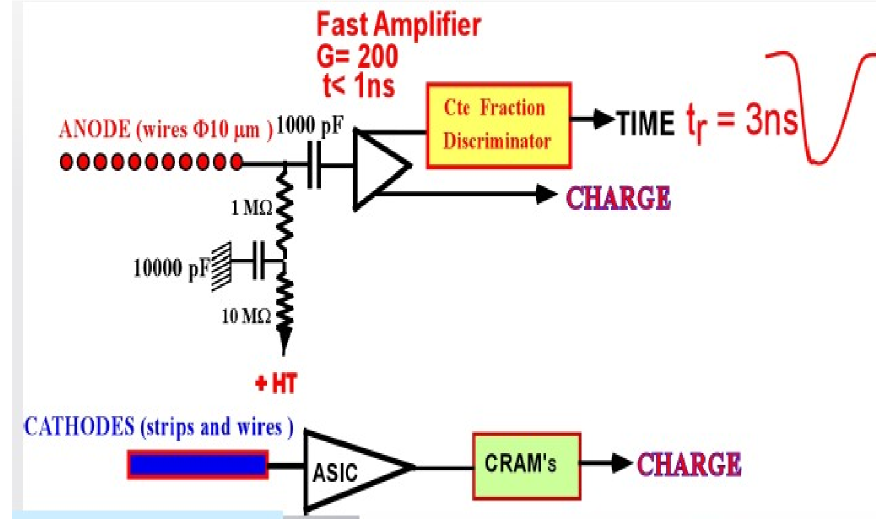


X, Y, dE_i

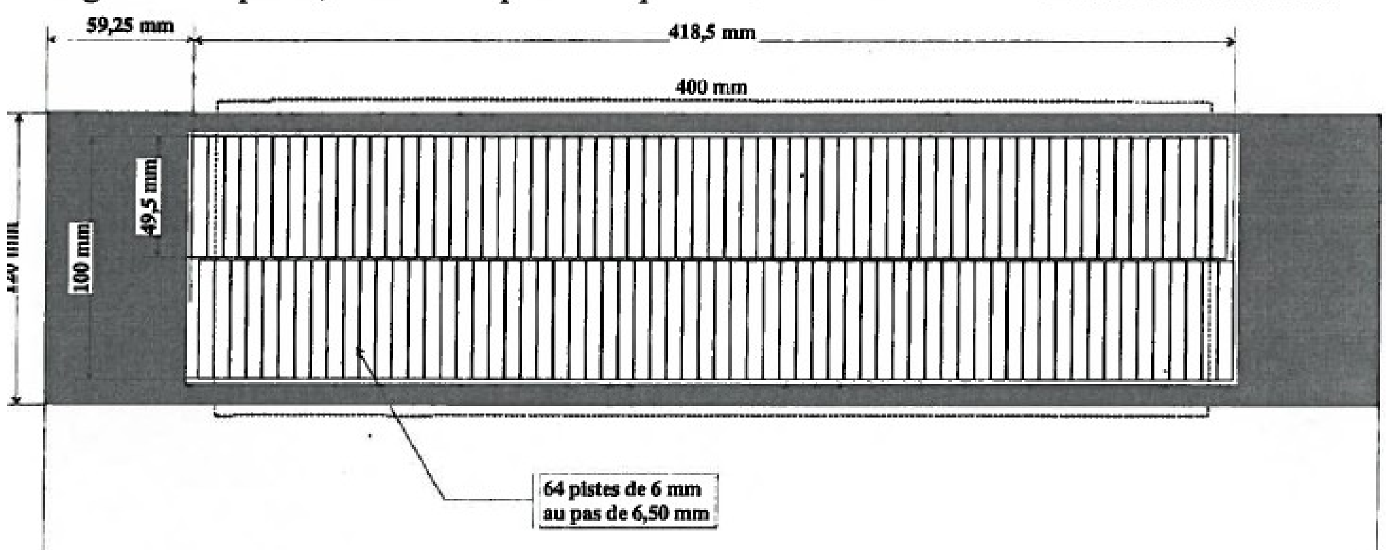
Nuclear reaction products will be identified by A, Z, and Q through measurement of the energy loss (ΔE), time of flight (T), and total energy (E) of particles, i.e., the dependence ΔE-E and ΔE-T (or E-T), which requires reproduction of the particle motion trajectory in the analyzer.

Special thanks to VAMOS people (Mayricy Reimond and Goupil Johan) for kindly delivering





C'est un circuit imprimé de 3,2 mm d'épaisseur qui ferme le détecteur et assure son étanchéité. Ce circuit porte la référence 539V1. La face électrode est constituée de deux rangées de 64 pistes, chacune disposée en quinconce comme le montre le schéma ci-dessous.



Software Spectrometer

Thanks to Frédéric SAILLANT
Luc LEGEARD, Bruno RAINE
Luigi MARTINA

File Setup Option Help

New Open Load Save

DUBNA

Add an Equipment

Add a link

Graphical

Equipment configuration

- vme
- narval
  - input
  - analysis
  - storage

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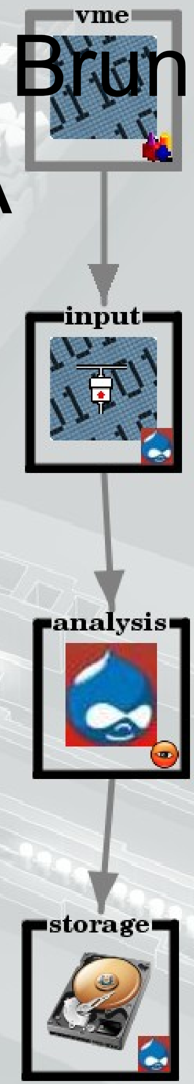
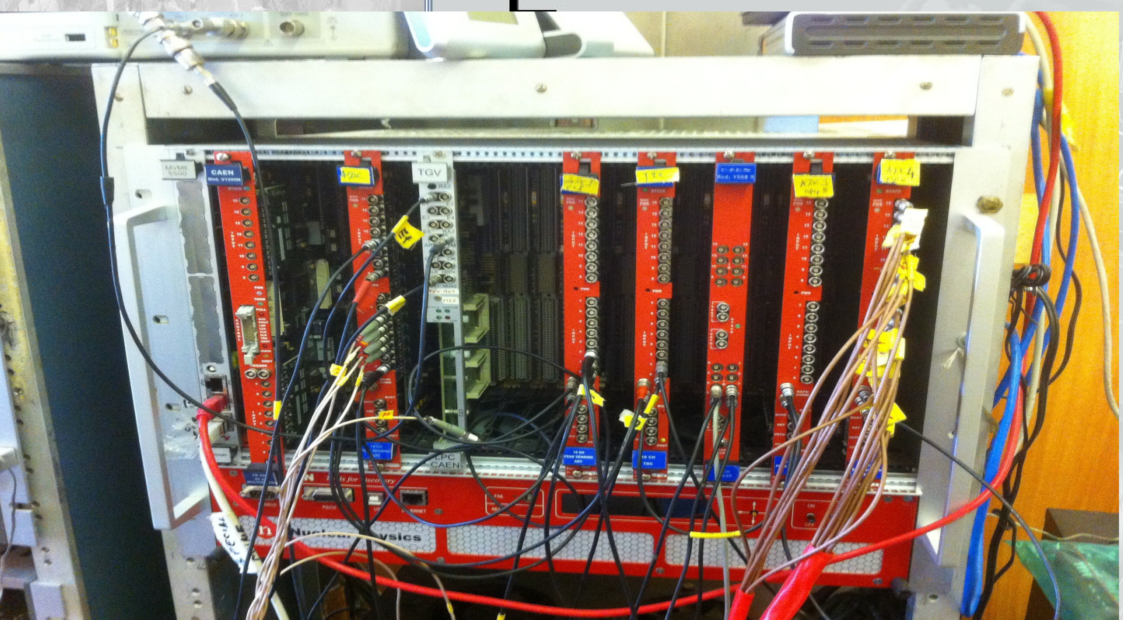




About Physics by means of the MAVR

PLANNED EXPERIMENTS

Stable beams

Multi-Nucleon Transfer Reactions as a TOOL to study n-rich nuclei

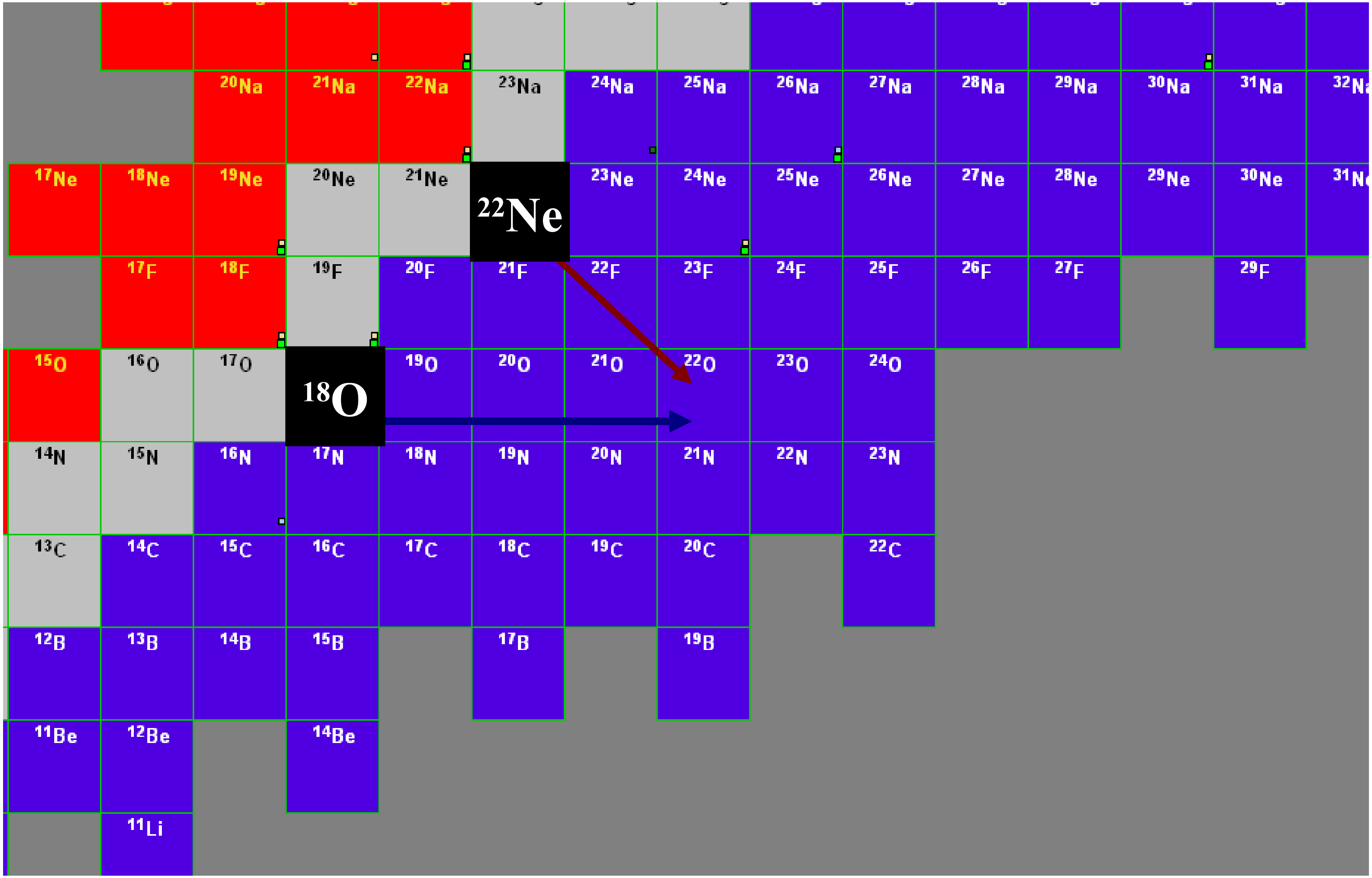
”Study of multinucleon transfer reactions by ^{18}O and ^{22}Ne projectiles on Ta target” is planned December 2018

Secondary Beams

”Search for cluster states in light nuclei (^{8}B, ^{10}C)”

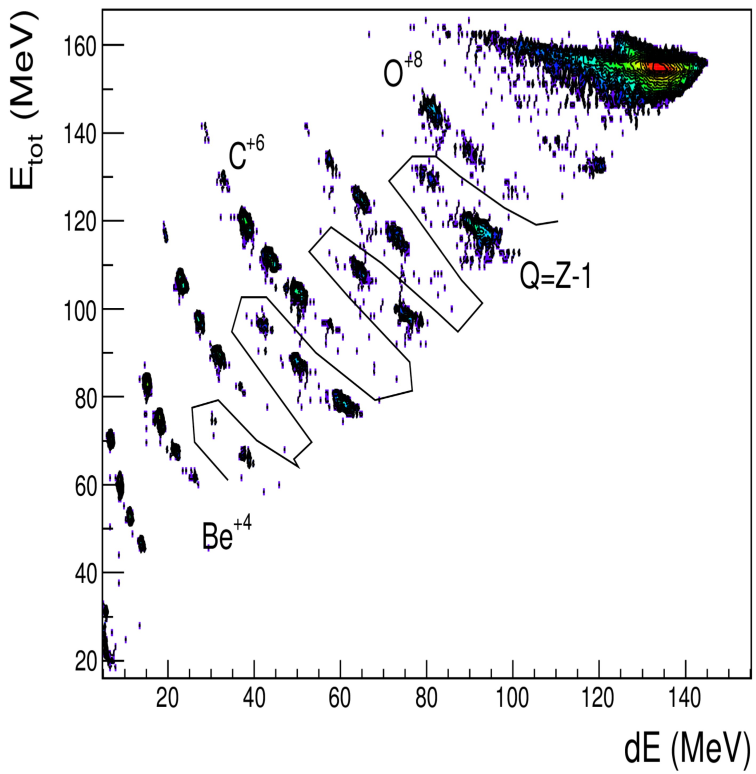
”Total reaction cross section”

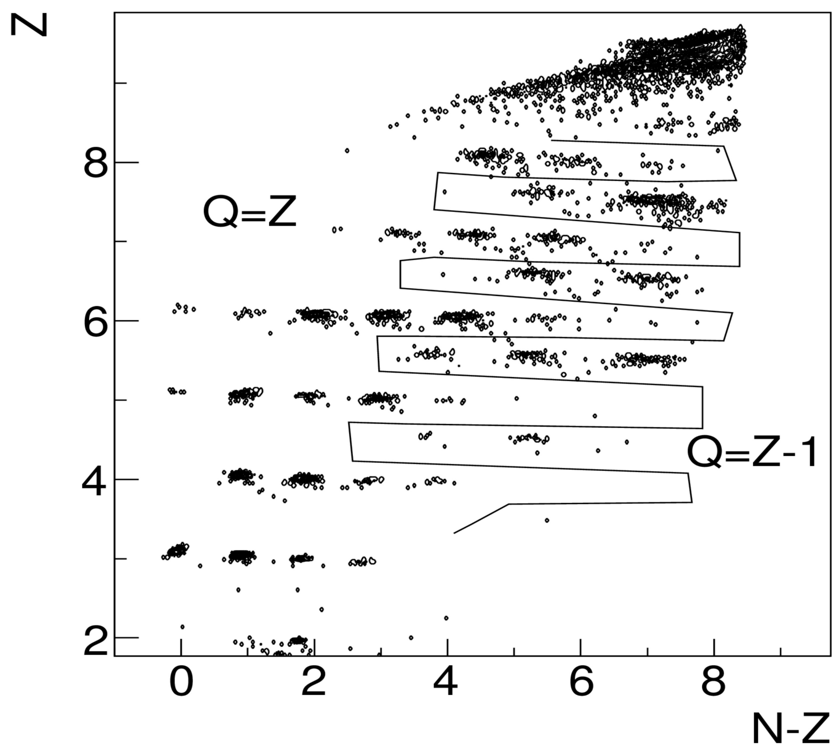
Pure neutron pick-up OR proton-stripping ?



Study of multinucleon transfer reactions by ^{18}O and ^{22}Ne projectiles on Ta target

Multinucleon transfer reactions may offer a competitive tool for the production of neutron-rich nuclei, at least for certain mass regions; they are a valuable alternative mechanism to spallation.

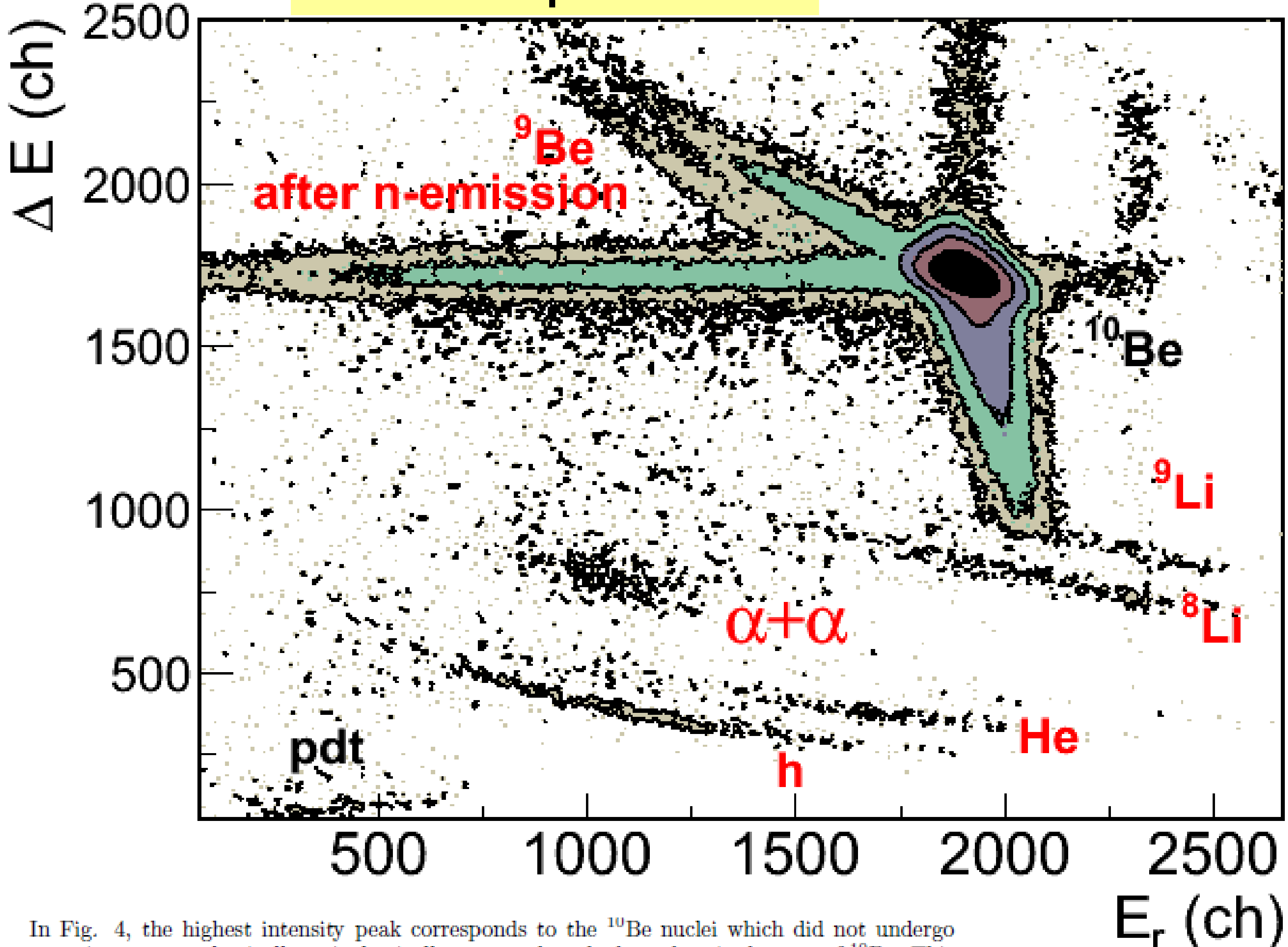




K. Mendibyaev *et al.* EXON 2016

”Search for cluster structure in light nuclei (^{8}B, ^{10}C)”

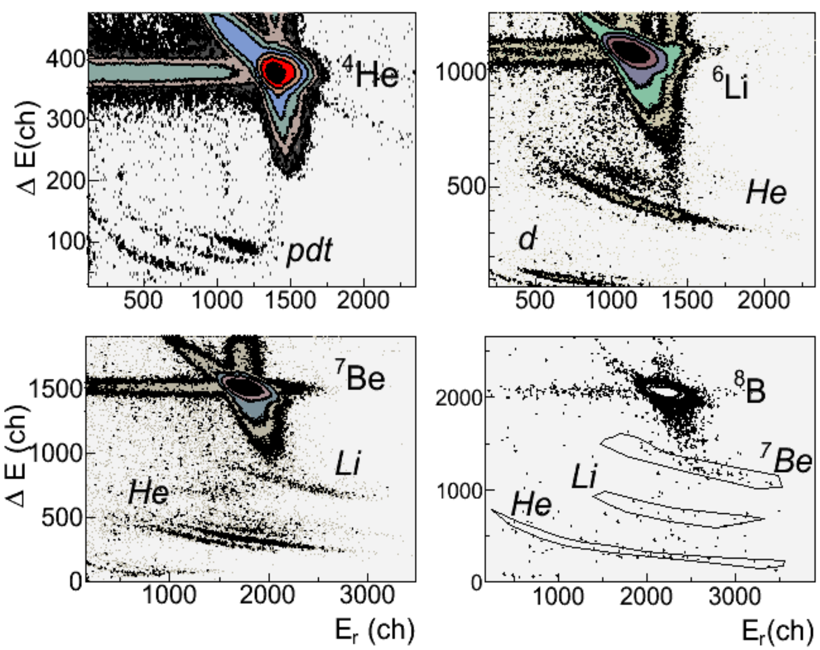
Break-up of ^{10}Be

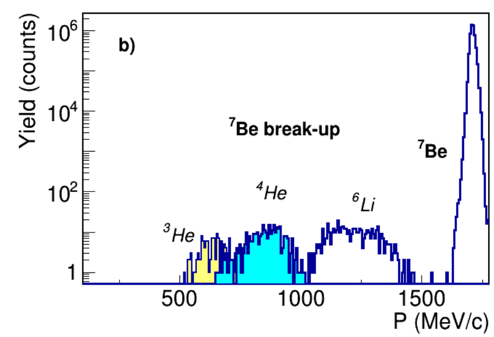


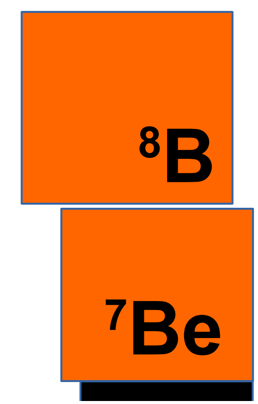
In Fig. 4, the highest intensity peak corresponds to the ^{10}Be nuclei which did not undergo any reaction or were elastically or inelastically scattered to the bound excited states of ^{10}Be. This ^{10}Be peak is superimposed on a ΔE = constant line which has two origins. For $E_{CsI} < E_r(^{10}Be)$, it originates from the reactions inside the CsI detector, whereas for $E_{CsI} > E_r(^{10}Be)$ the first corresponds to the kinematic line of elastic and inelastic scattering to bound excited states starting

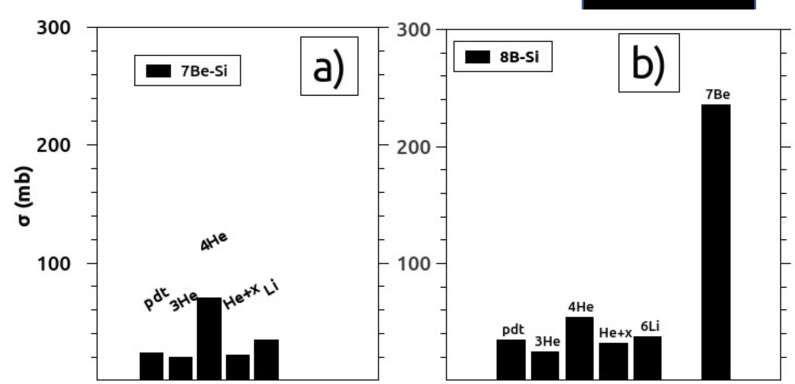
Production Reaction: ^{3}He(^{6}Li,^{8}B)
Energy: 75 MeV
Estimated ^{8}B intensity at the target: 20~30 kp/s

Purity: 70% (^{6}Li, ^{4}He and some ^{7}Be contaminants)

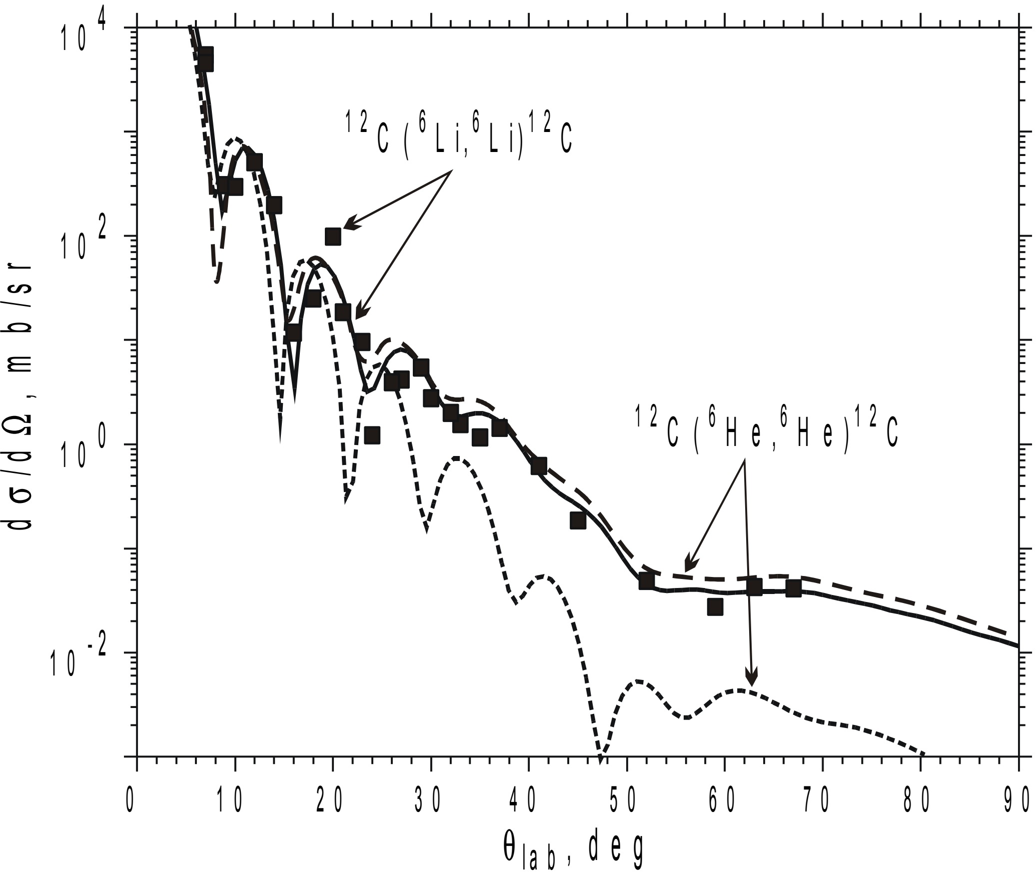




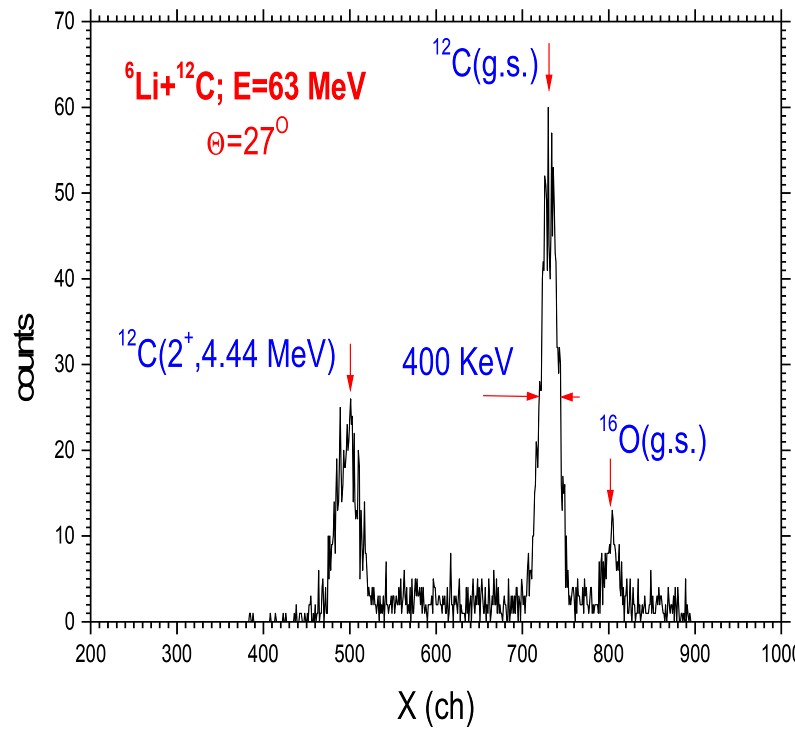




Elastic and Inelastic Scattering of ^{6}Li and ^{6}He using magnetic analyzer



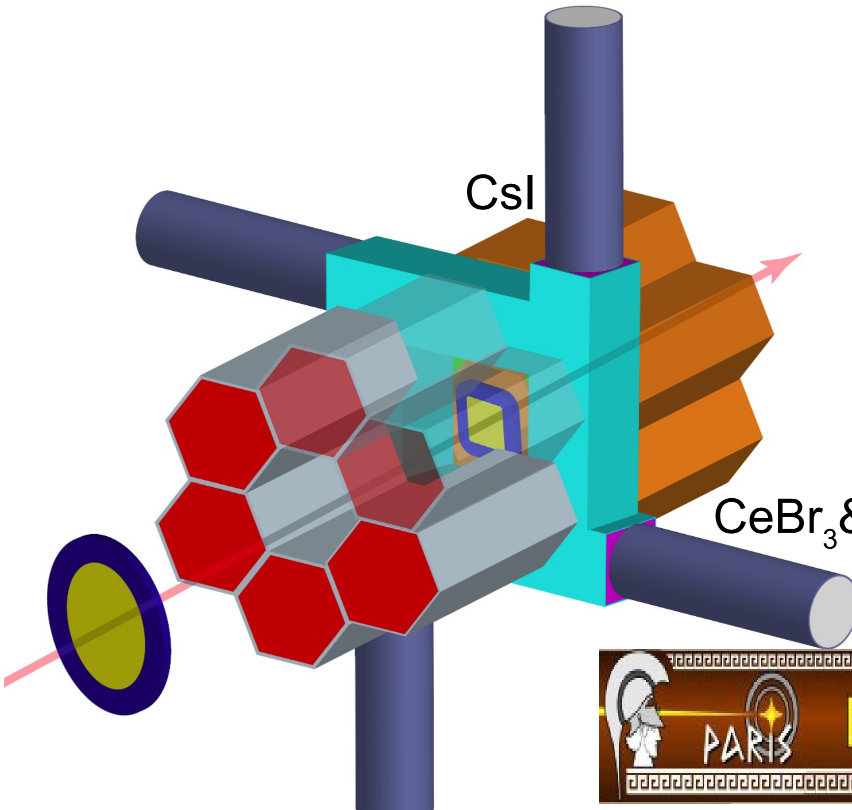
The differential cross sections of the elastic scattering ^{6}Li+^{12}C and ^{6}He+^{12}C at 63MeV.
Solid and long-dashed lines –calculations by the optical model, using the same set of parameters, for ^{6}Li and ^{6}He, respectively.
Short-dashed line – cross section of the elastically scattered ^{6}He calculated with the parameter R_I(He)=1.2R_I(Li).

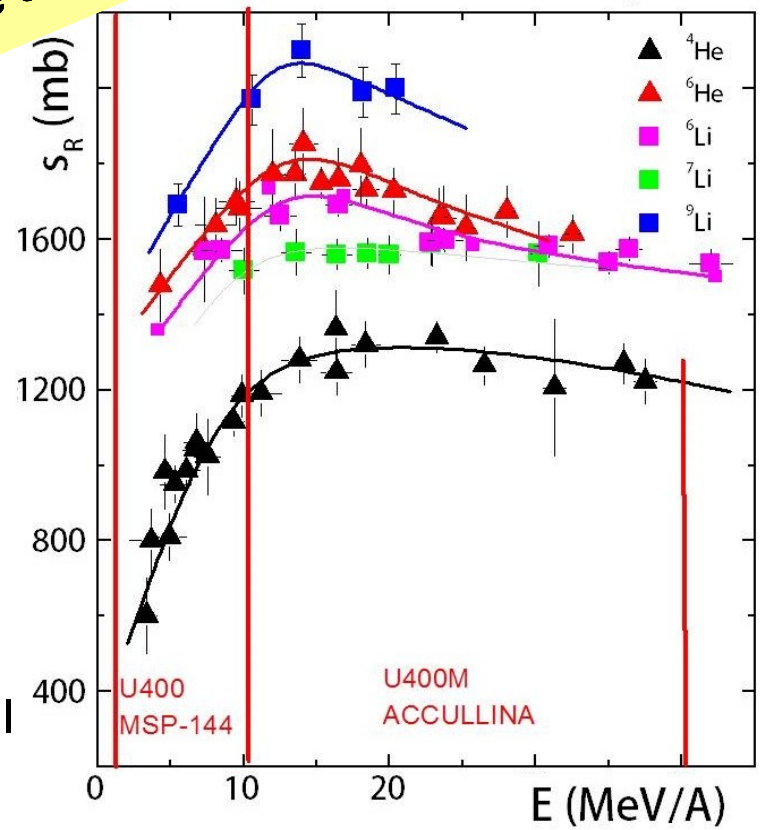


The energy of the beam - 12 MeV/A.
The thickness of the target - 100 μg/cm².
The angular aperture of MSP - Δθ=0.6°.
The total energy resolution - ΔE=400 keV.
The position resolution in the focal plane detector - 1 mm.

σ_{tot} measurement (responsible Sobolev)

Niche strategy of MARV





$$\sigma_{total} = \pi r_0^2 (A_p^{1/3} + A_t^{1/3})^2$$

PHOTON ARRAY FOR STUDIES WITH RADIOACTIVE ION AND STABLE BEAMS

PARIS

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Original Russian Text © V.V. Samarin, M.A. Naumenko, 2016, published in Izvestiya Rossiiskoi Akademii Nauk. Seriya Fizicheskaya, 2016, Vol. 80, No. 3, pp. 314–321.

Study of Ground States of ^{3,4,6}He Nuclides by Feynman's Continual Integrals Method

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Joint Institute for Nuclear Research, Dubna, Moscow oblast, 141980 Russia
e-mail: samarin@jinr.ru

THANK YOU

Why we need MAVR?

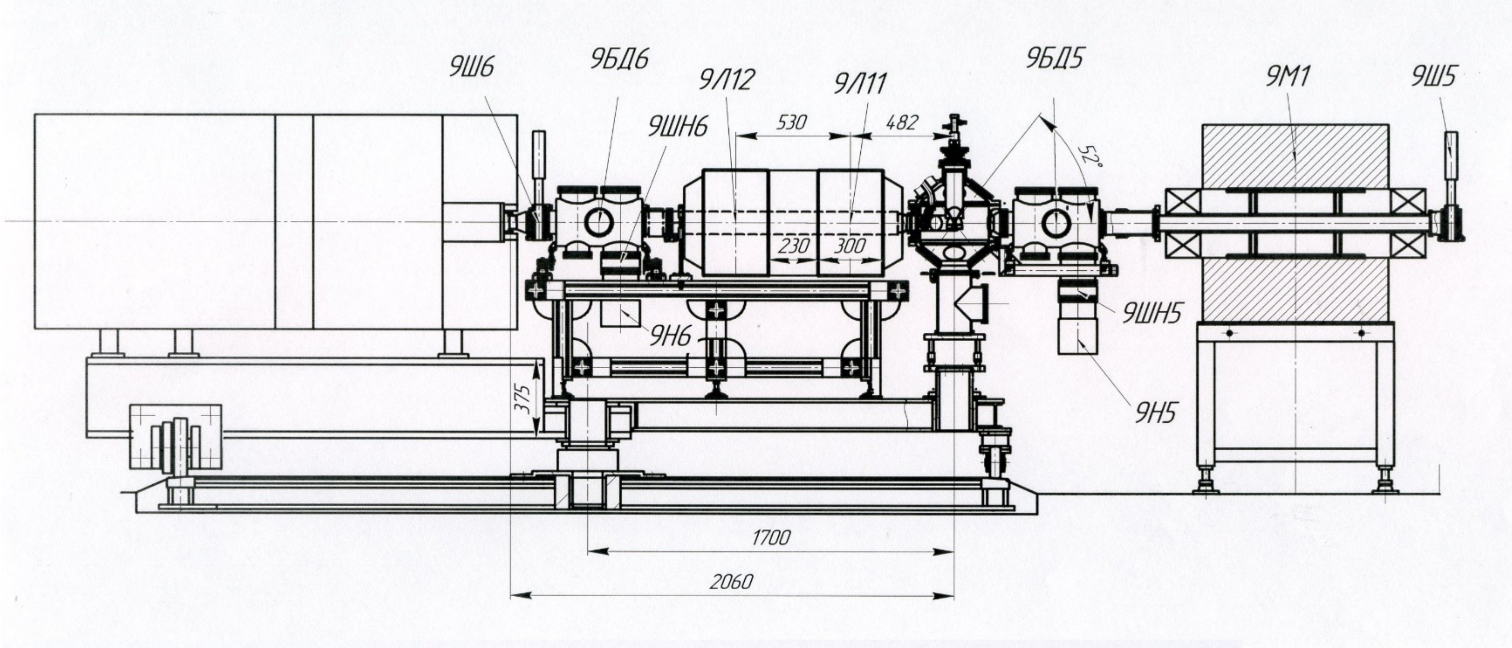
1) MAVR is an universal device study at energy domain near B_c

Expected larger value of cross section both for production and reaction with exotic nuclei at E~10-15 MeV/A

2) Comparative to TISOL method but cheaper and in-flight method

3) Universal device to mass missing method for spectroscopy and other experiments *due to dispersion etc.*

4) something else?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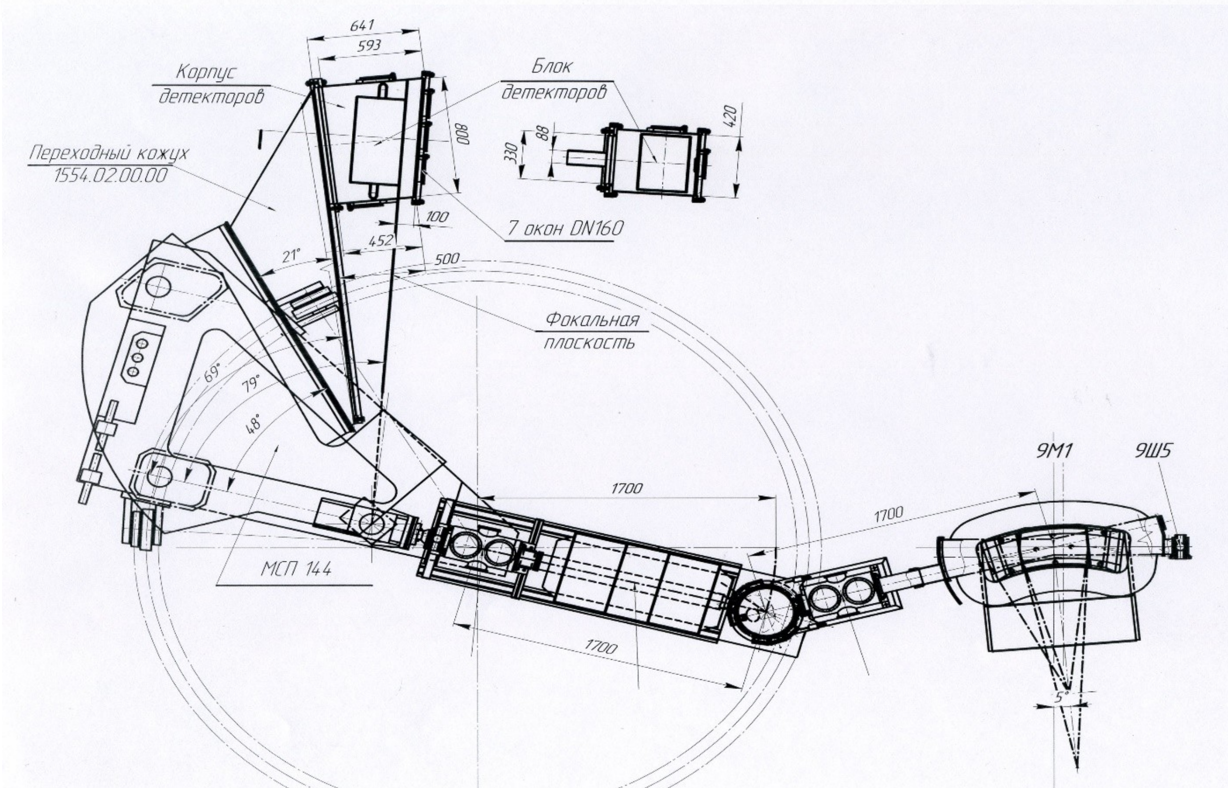
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593
Корпус
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