

Collaboration between GANIL and FLNR

Exotic nuclei, exotic beams and friendship

M. Lewitowicz - GANIL

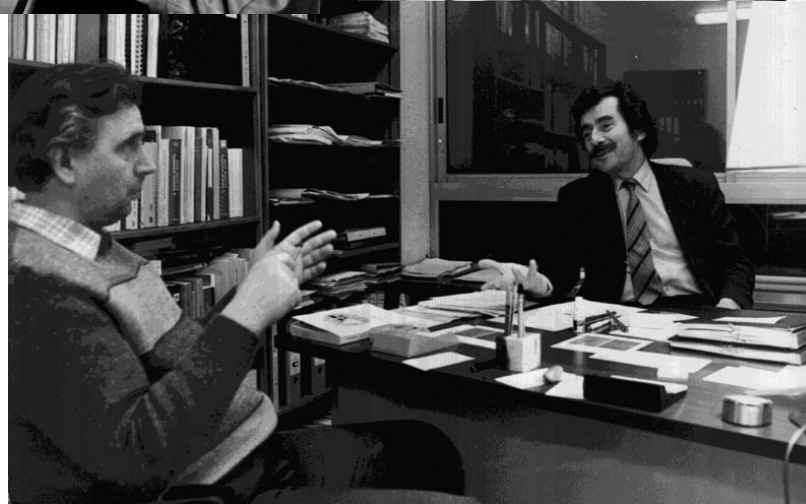
- Short history
- Scientific results
- Joint Experiments
- Technical developments
- EXON Conferences
- Summary and perspectives

- The collaboration was initiated in September 1986 by the letter of C. Detraz, the director of GANIL at that time to G.N. Flerov, the director of Laboratory of Nuclear Reactions – JINR



- October 24th, 1987 the first Dubna-GANIL-IPN Orsay joint experiment at GANIL
- In 1994 the collaboration received a 3-year grant of the French government (Reseau Formation - Recherche MERT), in 1997 the grant was prolonged for 3 more years.
- MoU JINR – GANIL/SPIRAL2 signed in 2006
- DECA (DESIR) Collaboration Agreement signed in 2012
- **1988-2018 IN2P3-JINR grants, 2001-2003 PICS of CNRS**

French-FLNR collaboration on Exotic Nuclei: first discussions 1986

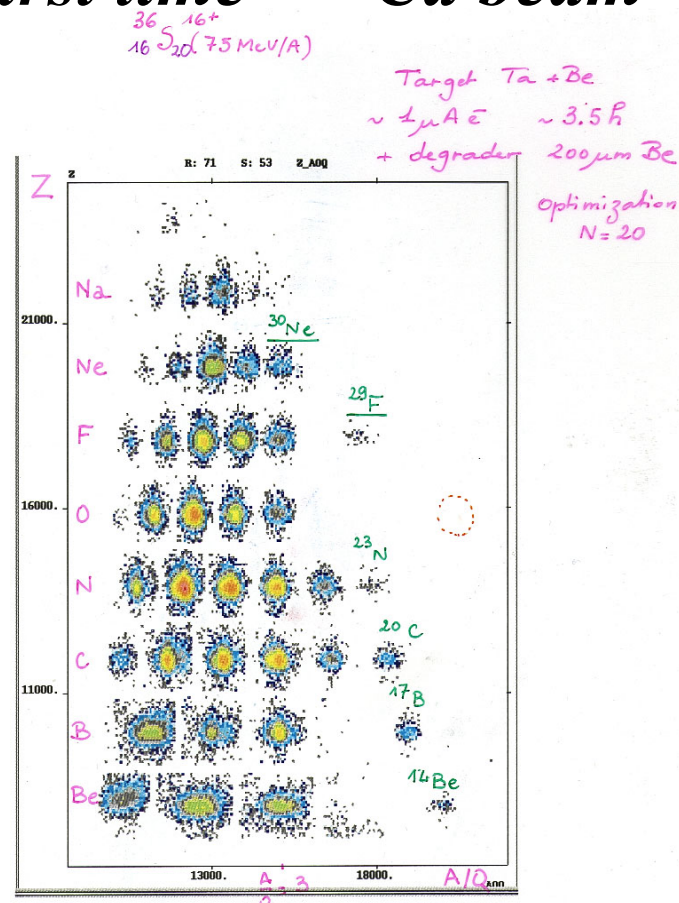
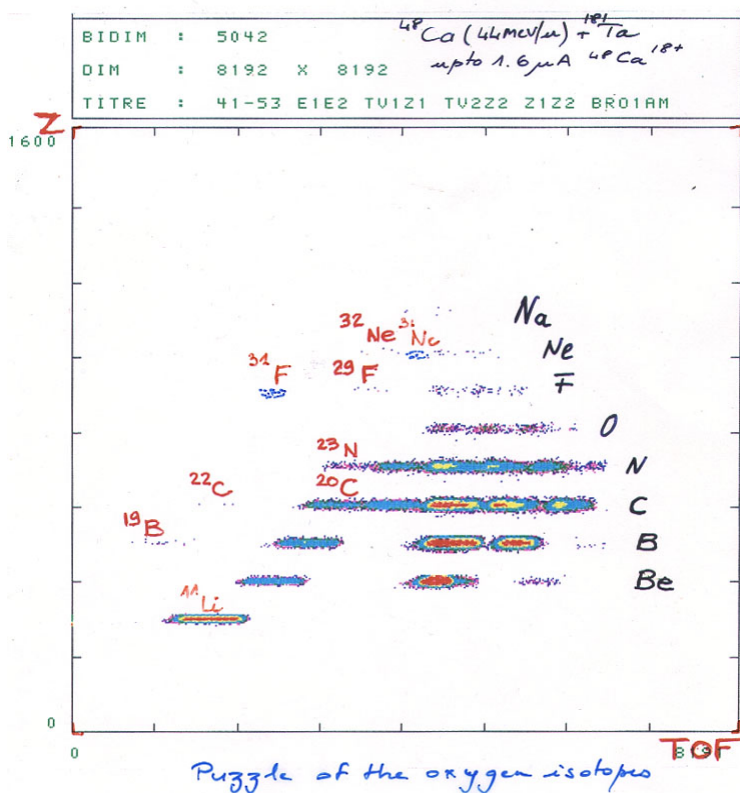


French-FLNR collaboration on Exotic Nuclei: first discussions 1986



Many new isotopes discovered and unbound character of ^{26}O , ^{28}O shown for the first time – ^{48}Ca beam

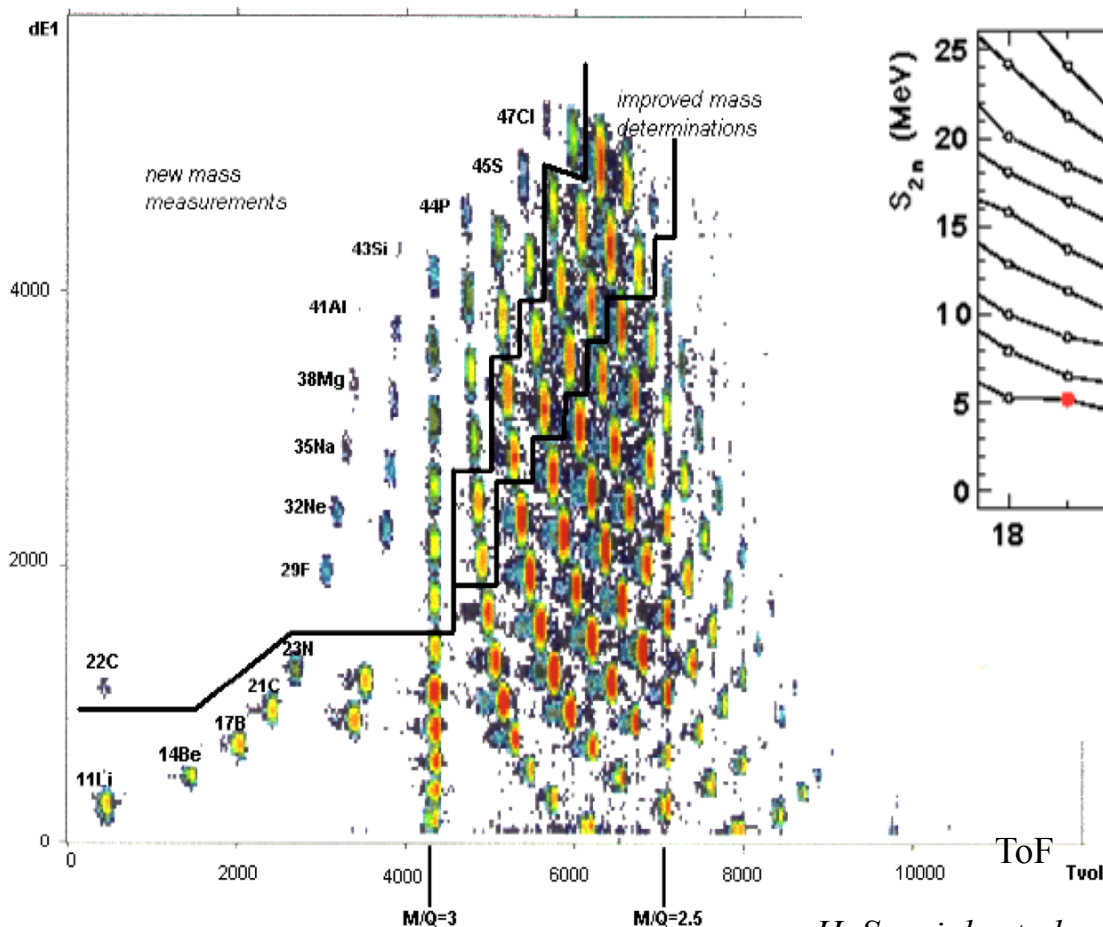
Collaboration : IPN Orsay -
GANIL Caen - FLNR Dubna



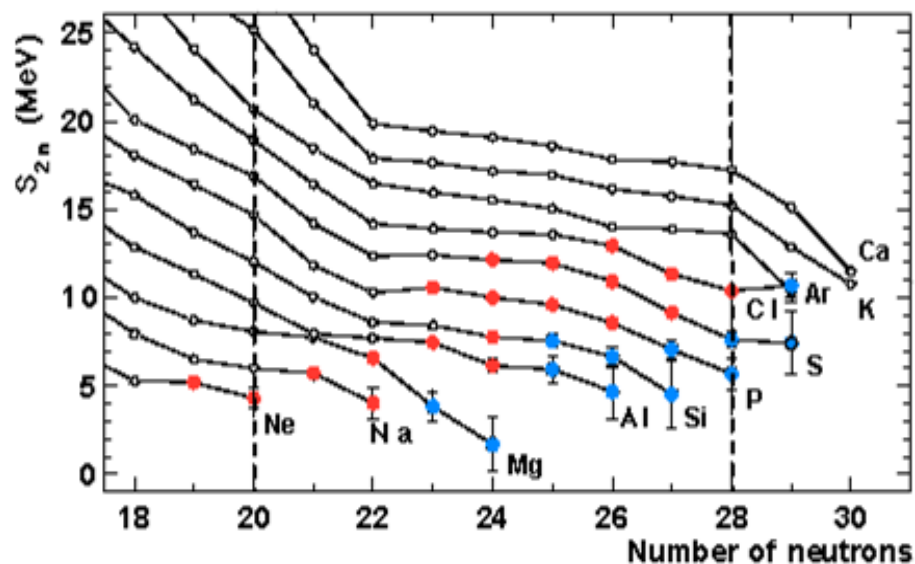
D. Guillemaud-Mueller et al, Rev. **C41** (1990) 937 O.
O. Tarasov et al, Phys. Lett. B409 (1997) 64

ΔE

New Masses (in blue)



H. Savajols et al.

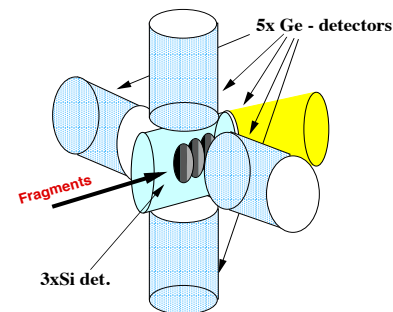
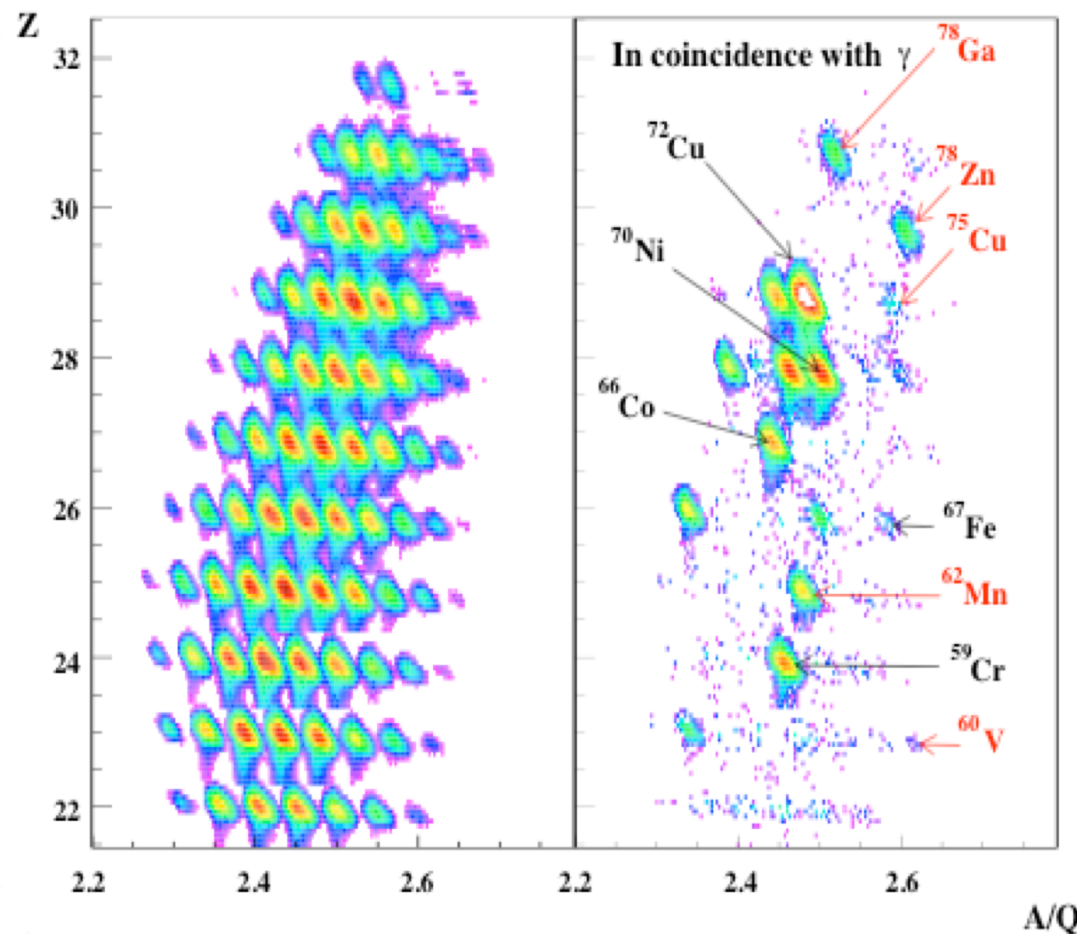


F. Sarazin et al. PRL 84(2000)5062

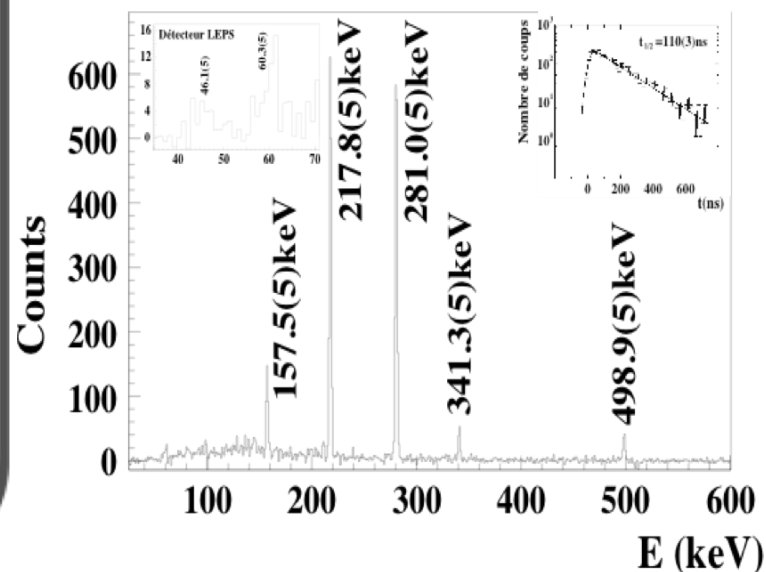
Weakening of the N=28 shell closure

Short-lived isomeric states in fragmentation reactions

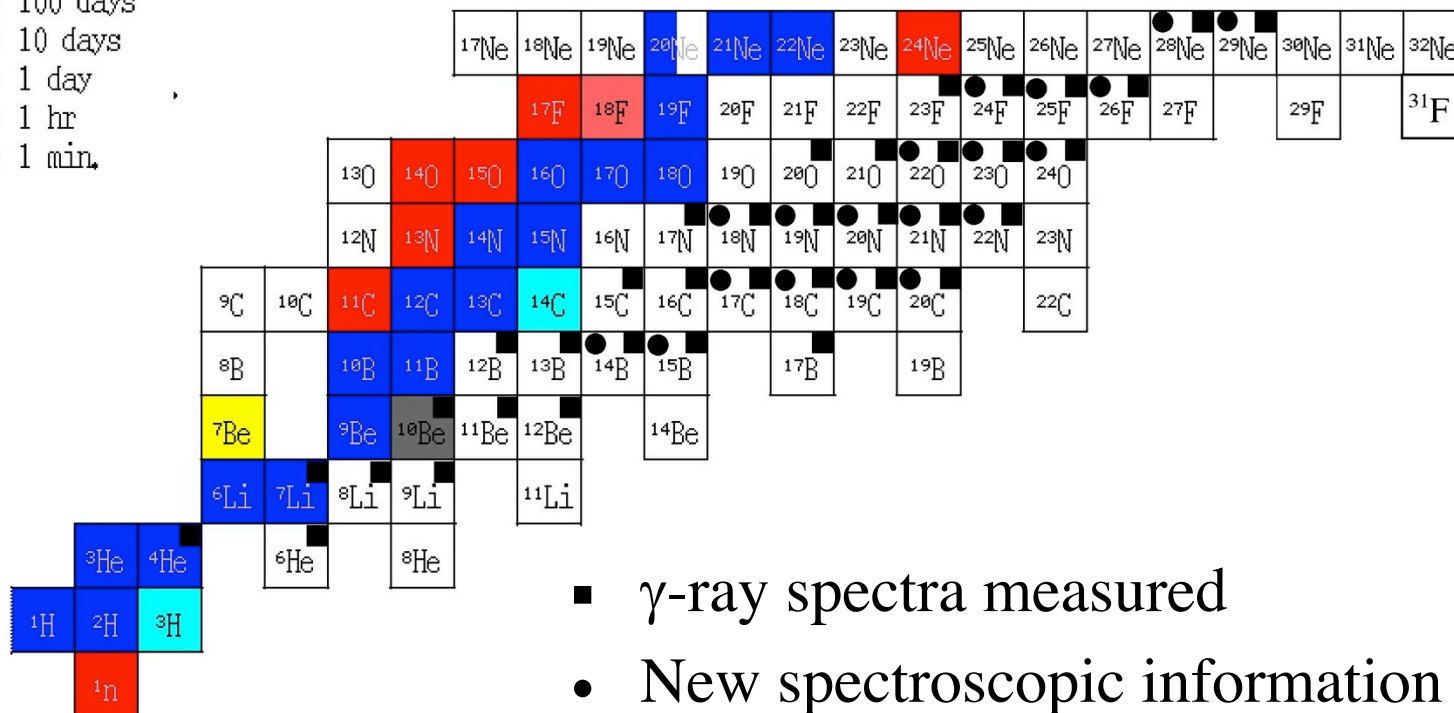
➡ Example: $^{86}\text{Kr}(60.6\text{A MeV}) + \text{nat. Ni} \rightarrow$ 20 new isomers in two few-day experiments



^{78}Ga



$^{36}\text{S} + ^{12}\text{C} \rightarrow$ n-rich beams \rightarrow very n-rich fragments



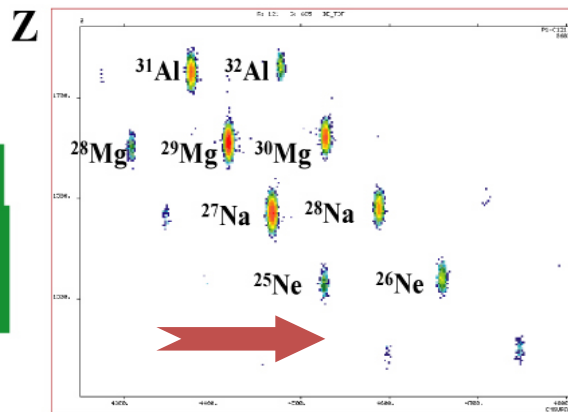
- γ -ray spectra measured
- New spectroscopic information

M. Stanoiu et al.

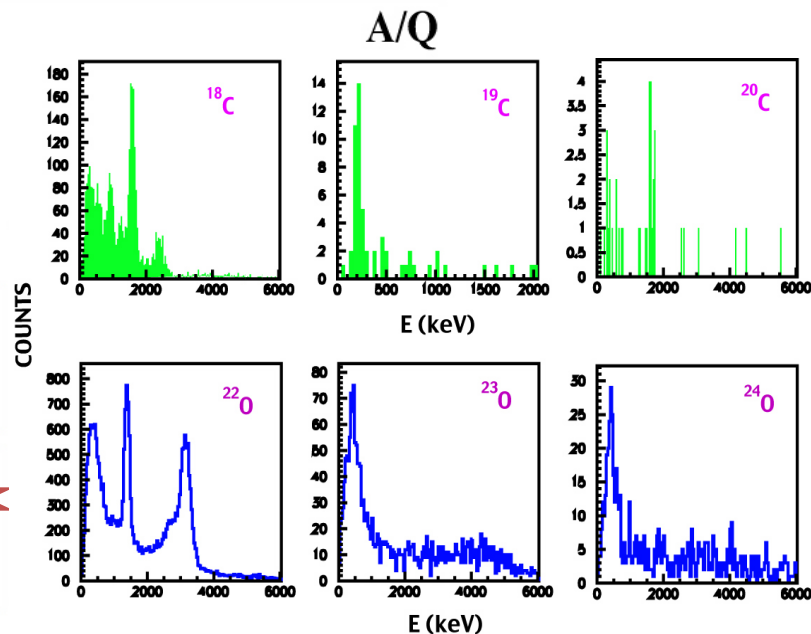
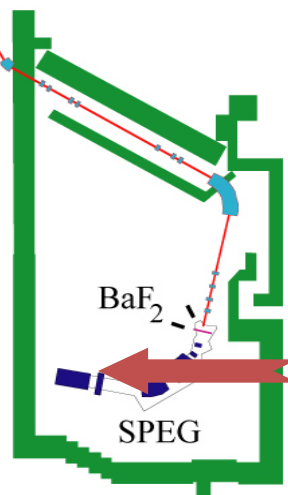
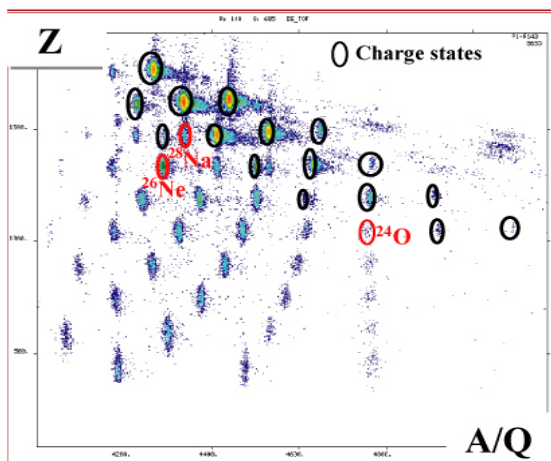
M. Stanoiu, F. Azaiez et al.

$^{36}\text{S}(78 \text{ AMeV}, 100 \text{ pnA}) + \text{C}$

Identification plot of fragments
in the end of α spectrometer



Identification plot of ternary fragments
in the end of SPEG





Hard work on mechanics



Usual chaos in the LISE acquisition room

Making Experiments Backstage

Traditional after-experiment party



... official part

Making Experiments Backstage

Traditional after-experiment party



... unofficial part (just the beginning)

IN2P3-Dubna 2006 Agreement

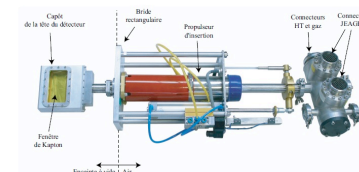
1) Neutron Drip Line Exotica in the Region of Shells N=20, 28, 40 and 50 (Physics and primary beams development: ^{36}S , ^{48}Ca , ^{64}Ni , ^{76}Ge , ^{70}Zn)

Flerov Price Winners for 2009

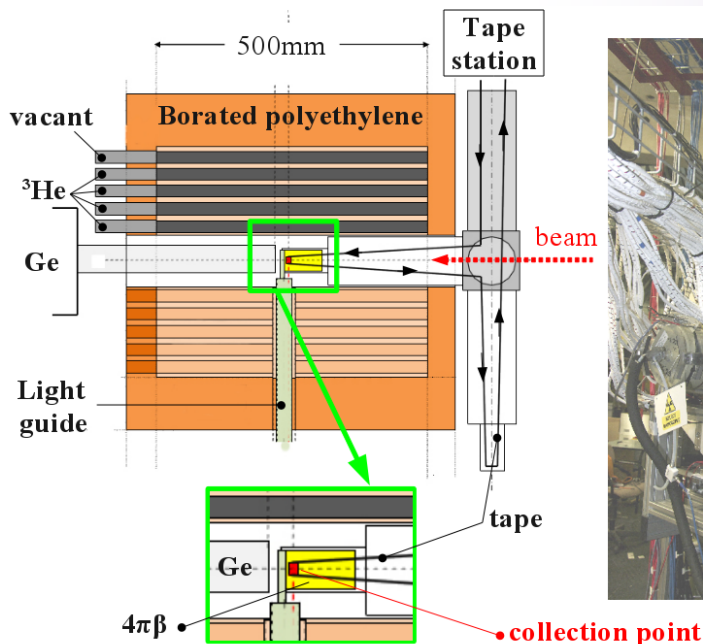


2) TETRA: High efficiency ^3He neutron detector for ALTO and DESIR

3) CAVIAR & Secondary Beam Profiler for SPIRAL2

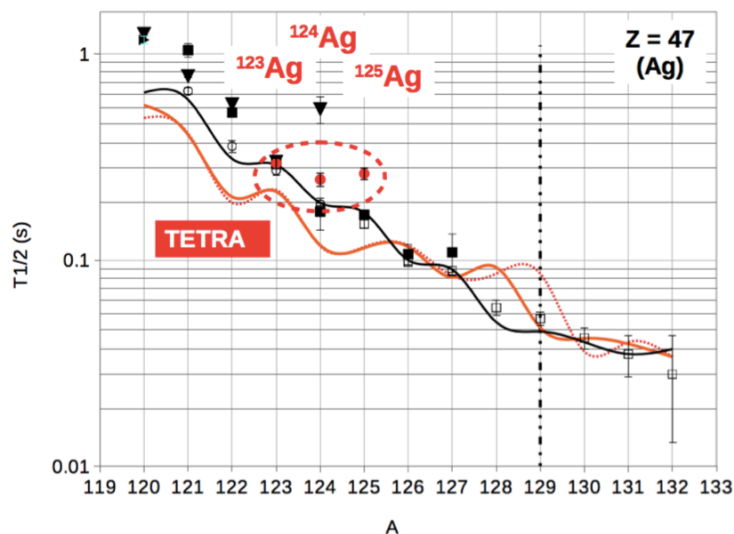


TETRA ^3He detector at IPN Orsay



ϵ (neutron) $\approx 52\%$ (^{252}Cf)
 ϵ (gamma) $\approx 0.8\%$ (1 MeV)
 ϵ (beta) $\approx 60\%$

D. Testov et al., Nucl. Inst. Meth.
 A 815 96 (2016)



**>20 nuclei have been investigated in
 experimental campaigns 2012-2017
 using TETRA decay station**

CAVIAR at GANIL and PROFILERS for beam position measurements

“Caviar” due to high granularity

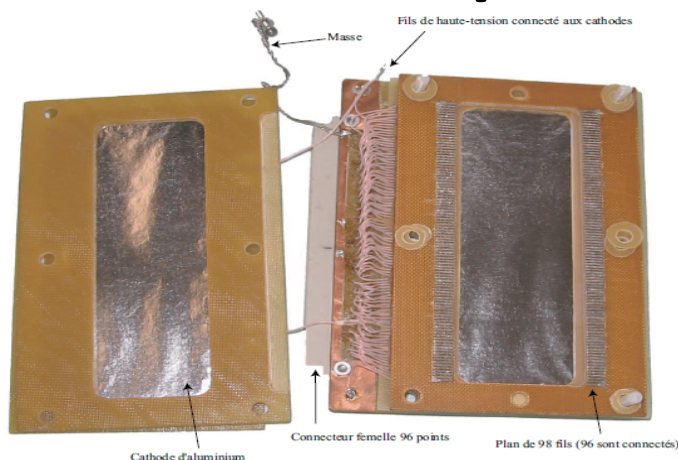
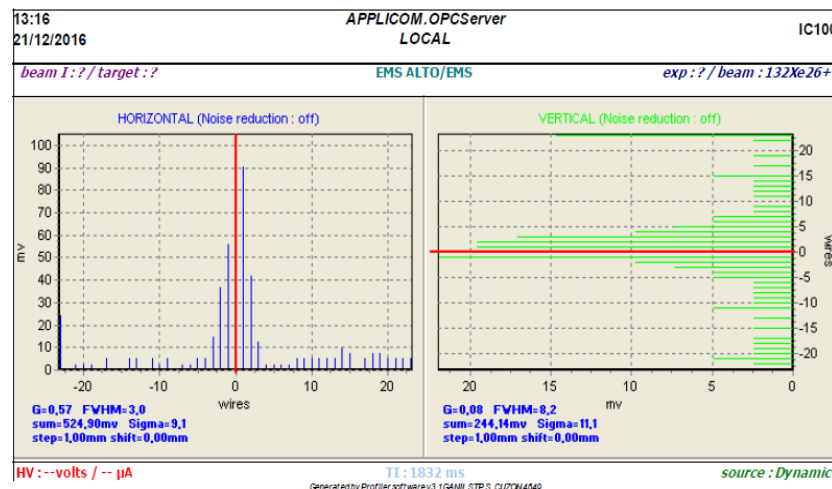


FIG. 1.3 – Photo de la tête du détecteur CAVIAR en cours de démontage.



Test of EMS (GANIL) Beam Profiler by Beam of ^{132}Xe (1 MeV/A) ions at FLNR





Foros EXON 1991



Peterhof EXON 2004

... and
Baikal EXON 2001
Khanty-Mansiysk EXON 2006
Sochi EXON 2009
Vladivostok EXON 2012
Kazan EXON 2016

Petrozavodsk EXON 2018



Kaliningrad EXON 2014

Famous EXON conferences and other important events

Exciting scientific program...



Lively discussions...



Famous EXON conferences and other important events

...spontaneous friendship...



... and dancing

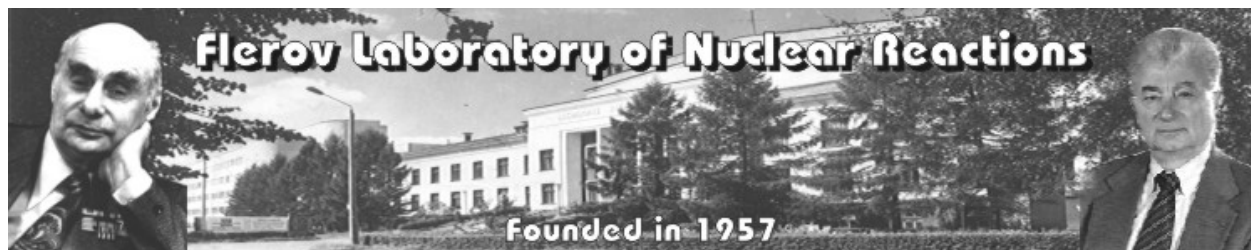


Summary and perspectives of the FLNR-GANIL collaboration

- The scientific results of more than thirty joint experiments were published more than **100** articles in the international journals and were presented on more than two hundred conferences, workshops and seminars.
- More than **15** young physicists from France, Russia, Czech Republic, Romania and Poland based their PHD thesis on the results obtained in the framework of this collaboration.
- **New experimental program with the radioactive beams from GANIL/SPIRAL 1 & 2 (S3 and DESIR) and FLNR accelerators...**

... for the next 32 years

See talks of Araceli Lopez-Martens and Navin Alahari



Thanks to all colleagues from Dubna and France involved in this great adventure and specially to friends from the FLNR and GANIL/IN2P3 who established this collaboration and friendship:

Georgi N. Flerov and Claude Détraz

Yuri Ts. Oganessian

Dominique Guillemaud-Mueller

Alex Mueller

Yuri E. Penionzhkevich

Sergei Lukyanov