Department of Physics

Preliminary Results:

UniS University of Surrey Guildford

Rare Isotope Identification-Stopped beam GSI Feb 2006

S.Pietri[1], Zs. Podolyák[1], P.H. Regan[1], S.J. Steer[1], D. Rudolph[2], A.B. Garnsworthy[1,3], R. Hoischen[2], M. Górska[4], J. Gerl[4], H.J.Wollersheim[4], F. Becker[4], P. Bednarczyk[4,5], L. Caceres[4,6], P. Doornenbal[4], H.Geissel[4], J. Grębosz[4,5], A. Kelic[4], I. Kojouharov[4], N. Kurz[4], F. Montes[4], W. Prokopowicz[4,5], T. Saito[4], H. Schaffner[4], S. Tachenov[4], E. Werner-Malento[4,7], A. Heinz[3], M. Pfützner[7], T. Kurtukian-Nieto[8], G. Benzoni[9], M. Hellström[2], A. Jungclaus[6], L.-L. Andersson[2], L. Atanalova[10], D. Balabanski[11], M.A. Bentley[12], B. Blank[13], A. Blazhev[14], C. Brandau[1,4], J. Brown[12], A.M. Bruce[15], F. Camera[9], W.N. Catford[1], I.J. Cullen[1], Zs. Dombrádi[16], E. Estevez[8], C. Fahlander[2], W. Gelletly[1], G. Ilie[14], E.K. Johansson[2], I.Jolie[14], G.A. Jones[1], M. Kmiecik[5], F.G. Kondev[17], S. Lalkovski[10], Z. Liu[1], A. Maj[5], S. Myalski[5], T. Shizuma[1,18], A.J. Simons[1], S. Schwertel[19], P.M.Walker[1], O. Wieland[9] .

[1]Department of Physics, University of Surrey, Guildford, GU2 7XH, UK
[2]Department of Physics, Lund University, S-22100, Lund, Sweden
[3]WNSL, Yale University, New Haven, CT 06520-8124, USA†
[4]GSI, Planckstrasse 1, D-64291, Darmstadt, Germany
[5]The Henryk Niewodniczański Institute of Nuclear Physics, PL-31-342, Kraków, Poland
[6]Departamento de Fisica Teórica, Universidad Autonoma de Madrid, E-28049, Madrid, Spain
[7]IEP, Warsaw University, Hoża 69, PL-00-681
[8]Universidad de Santiago de Compostela, E-15706, Santiago de Compostela, Spain
[9]INFN, Universitá degli Studi di Milano, I-20133, Milano, Italy
[10]Faculty of Physics, University of Soa, BG-1164, Bulgaria
[11]Dipartimento di Fisica, Universitá di Camerino, I-62032, Italy
[12]Dept. of Physics, University of York, Heslington, York, Y01 5DD, UK
[13]CENBG, le Haut Vigneau, F-33175, Gradignan Cedex, France
[14]IKP, Universität zu Köln, D-50937, Köln, Germany
[15]School of Engineering, University of Brighton, Brighton, BN2 4GJ, UK
[16]Institute for Nuclear Research, Debrecen, H-4001, Hungary
[17]Nuclear Engineering Division, Argonne National Laboratory, Argonne IL-60439, USA
[18]Japan Atomic Energy Agency, Kyoto, 619-0215, Japan
[19]Physik Department E12, Technische Universität München, Garching, Germany

RISING

The method : Fragmentation Isomer Spectroscopy@GSI

- Production of exotic nuclei relativistic fragmentation of ^{208}Pb, ^{107}Ag and ^{58}Ni on a beryllium target
- Identification of the products with the FRS spectrometer
- Measurement of the isomeric γ-decay with the RISING Ge Array

Give access to isomeric states from few hundreds of ns to several hundreds of μs

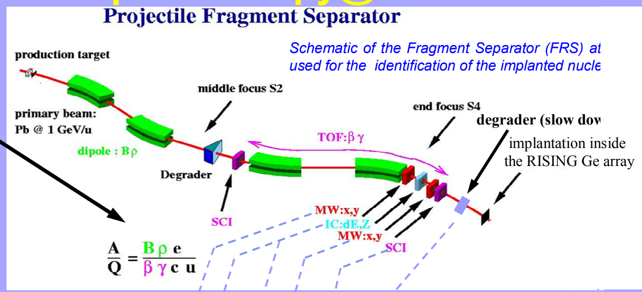
Can be used for both :

- nuclear reaction mechanism studies (through isomeric ratio)

One can study how much spin is put in the fragmentation reaction leading to the produced nuclei. Indeed you can see how often the isomeric state is populated. With selection in momentum (trough position selection in the middle focal plane) one can look at this spin population dependence of the transferred momentum.

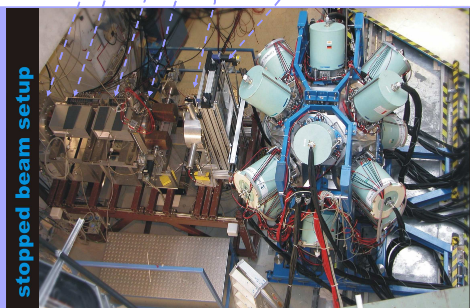
- nuclear structure (through gamma spectroscopy of isomeric decay)

The gamma decay scheme of the isomeric state will give structural information, thought classical gamma spectroscopy, of the different levels (spin, parity…).

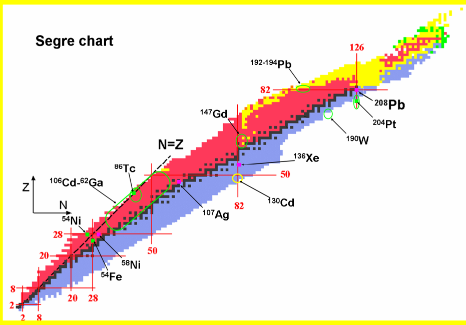


The RISING germanium array is made of 15 Eurogam clusters of seven crystals in a packed configurations. The total efficiency is estimated between 10-14%. The energy output was sent to a digital electronic and the timing was given by a analogue electronics.

stopped beam setup



The RISING stopped beam physics cases :

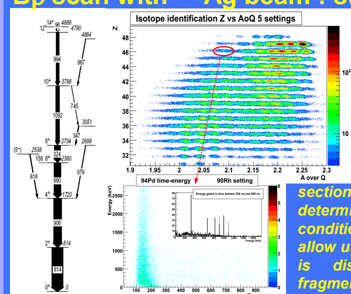


Talk of Zsolt Podolyak and Dirk Rudolf

Structure study :
N=Z line (^{86}Tc and around, ^{54}Ni)
N=126 shell closure (^{204}Pt)
N=82 shell closure (^{130}Cd and around)

Fragmentation study :
Isomeric ratio and cross section of ^{107}Ag relativistic fragmentation
Study of cold fragmentation (^{204}Pt, 4 proton "knockout")
Study of fragmentation with a ^{208}Pb beam (^{204}Pt, ^{192}Pb, ^{147}Gd)
….. (to be continued)

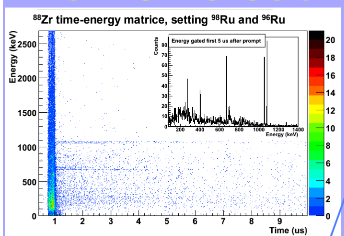
Bρ scan with ^{107}Ag beam : study of fragmentation

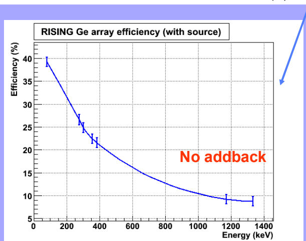


1st=12^{+} isomer N. Marginean and al., PRC67 (2003) 061301

We used one day of beam time to make Bρ scan of the fragments produced by the fragmentation of ^{107}Ag on a Be target, we will be able to get the cross section for all the fragments and the isomeric ratio of the ones with isomers. This is the first systematic study where both the cross section and the isomeric ratio will be determined from the same experimental conditions. They both together should allow us to better understand the way spin is distributed during a relativistic fragmentation reaction.

The RISING Ge array : high granularity, high efficiency with digital electronic



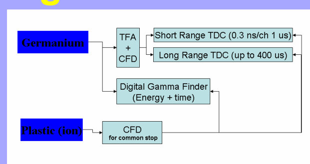


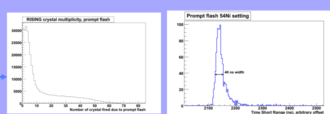
15 Euroball clusters (105 crystal) with digital electronics, gates are open for up to 400 μs at low threshold (60 keV)

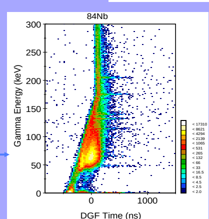
- Three different times used, 2 types of TDC and digital timing
- High efficiency, important for exotic nuclei (ex : ^{130}Cd)
- High granularity to avoid being blinded by the flash
  - When we implant a nuclei at the centre of the array, lot of low energy radiations are emitted (flash), the low threshold we have, makes several detectors blind, but the high granularity prevent big loss of efficiency
  - The prompt signal coming from the flash give our "time 0", and the width in time of this distribution is a limiting factor to see short live isomers (even shorter than the flight path through the FRS (electron conversion will not happen for the naked ion during the FRS flight path)

Digital electronics gives ~2.8 keV resolution in energy

- Even with the 25 ns internal clock we see short lived isomers,(^{84}Nb194(5)ns 5^{-})







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EPSRC Engineering and Physical Sciences Research Council

GSI Gesellschaft für Schwerionenforschung mbH, Darmstadt in der Helmholtz-Gemeinschaft