Special edition for the ceremony of closing the project

Darmstadt 2003 - 2009

RISING

Rare Isotope Spectroscopic INvestigation at GSI

Supported by: Belgium * Denmark * Germany * Italy * Poland * Spain * Sweden * United Kingdom

FINAL RISING SYMPOSIUM

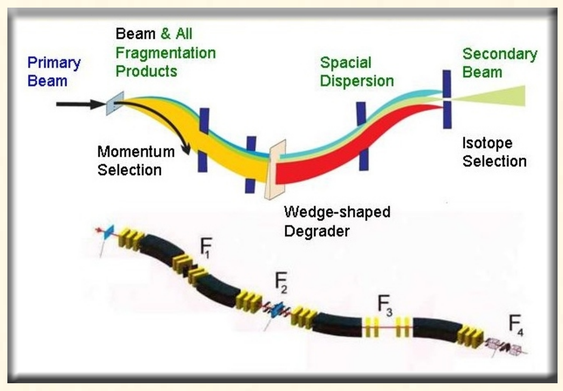
at the TU-Darmstadt on October 5, 2009

Experimental results using radioactive beams at relativistic energies and isomeric fragment beams will be presented which have been studied with three different setups for fast beam, g-factor and stopped beam measurements.

Details of the symposium can be found on the web page: www-linux.gsi.de/~wolle/EB_at_GSI/index.html

Exotic beam

GSI fragment separator's contribution to the success



The isotopic separation principle of the fragment separator FRS. Secondary beams of radioactive nuclei are produced by fragmentation or fission. The nuclei of interest are selected via their magnetic rigidity and energy loss in a wedge-shaped degrader.

Spectroscopy of nuclei approaching the proton drip-line using a secondary fragmentation technique with the RISING detector array M.J. Taylor, G. Hammond, M.A. Bentley, F. Becker, J. Grebosz, A. Banu, C.J. Barton, T. Beck, P. Bednarczyk, A. Bracco, A.M. Bruce, L.C. Bullock, A. Bürger, F. Camera, C. Chandler, P. Doornenbal, J. Gerl, H. Geissel, M. Gorska, M. Hellström, D.S. Judson, I. Kojouharov, N. Kurz, R. Lozeva, A. Maj, S. Mandal, B. Mc Guirk, S. Muralithar, E.S. Paul, Z. Podolyak, W. Prokopowicz, D. Rudolph, N. Saito, T.R. Saito, H. Schaffner, J. Simpson, D.D. Warner, H. Weick, C. Wheldon, M. Winkler and H.J. Wollersheim; J. Phys. G: Nucl. Part. Phys. 31 S1527 (2005)

Identification of heavy ion reaction channels with a new CAlorimeter TElescope within RISING R. Lozeva, J. Gerl, M. Gorska, S. Mandal, D. Balabanski, I. Kojouharov, F. Becker, J. Grebosz, A. Banu, T. Beck, P. Bednarczyk, P. Doornenbal, H. Geissel, J. Gerl, M. Gorska, H. Grawe, J. Grebosz, M. Hellström, I. Kojouharov, N. Kurz, R. Lozeva, S. Mandal, S. Muralithar, W. Prokopowicz, N. Saito, T.R. Saito, H. Schaffner, H. Weick, C. Wheldon, M. Winkler, H.J. Wollersheim, J. Jolie, P. Reiter, N. Warr, A. Bürger, H. Hübel, J. Simpson, M.A. Bentley, G. Hammond, G. Benzoni, A. Bracco, F. Camera, B. Million, O. Wieland, M. Kmiecik, A. Maj, W. Meczynski, J. Styczen, C. Fahlander and D. Rudolph; Euro. Phys. Jour. A25 (2005) 719

Identification of heavy ion reaction channels with a new CAlorimeter TElescope within RISING R. Lozeva, J. Gerl, M. Gorska, S. Mandal, D. Balabanski, I. Kojouharov, F. Becker, J. Grebosz, A. Banu, P. Bednarczyk, P. Doornenbal and H. J. Wollersheim; J. Phys. G: Nucl. Part. Phys. 31 (2005) S1917

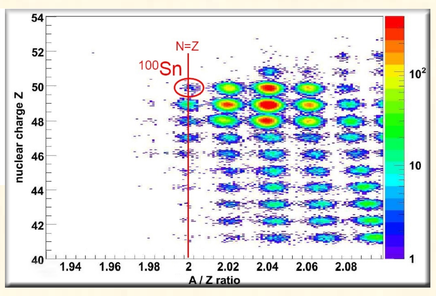
Relativistic Coulomb excitation of neutron-rich 54,56,58Cr: On the pathway of magicity from N=40 to N=32 A. Bürger, T.R. Saito, H. Grawe, H. Hübel, P. Reiter, J. Gerl, M. Gorska, H.J.Wollersheim, A. Al-Khatib, A. Banu, T. Beck, F. Becker, P. Bednarczyk, G. Benzoni, A. Bracco, S. Brambilla, P.Bringel, F. Camera, E. Clement, P. Doornenbal, H. Geissel, A. Görgen, J. Grebosz, G. Hammond, M. Hellström, M. Honma, M. Kavatsyuk, O. Kavatsyuk, M. Kmiecik, I. Kojouharov, W. Korten, N. Kurz, R. Lozeva, A. Maj, S. Mandal, B. Million, S. Muralithar, A. Neußer, F. Nowacki, T. Otsuka, Z. Podolyak, N. Saito, A.K. Singh, H. Weick, C. Wheldon, O. Wieland, and M. Winkler; Phys. Lett. B622 (2005) 29

Status of the RISING project at GSI F. Becker, A. Banu, T. Beck, P. Bednarczyk, P. Doornenbal, H. Geissel, J. Gerl, M. Gorska, H. Grawe, J. Grebosz, M. Hellström, I. Kojouharov, N. Kurz, R. Lozeva, S. Mandal, S. Muralithar, W. Prokopowicz, N. Saito, T.R. Saito, H. Schaffner, H. Weick, C. Wheldon, M. Winkler, H.J. Wollersheim, J. Jolie, P. Reiter, N. Warr, A. Bürger, H. Hübel, J. Simpson, M.A. Bentley, G. Hammond, G. Benzoni, A. Bracco, F. Camera, B. Million, O. Wieland, M. Kmiecik, A. Maj, W. Meczynski, J. Styczen, C. Fahlander and D. Rudolph; Euro. Phys. Jour. A25 (2005) 719

Identification of heavy ion reaction channels with

^{100}Sn Reveals its Secrets

Famous doubly magic nucleus and its neighbourhood



Nuclides identified in the FRS during the 15 days irradiation in the setting for ^{100}Sn

a new CAlorimeter TElescope within RISING R. Lozeva, J. Gerl, M. Gorska, S. Mandal, D. Balabanski, I. Kojouharov, F. Becker, J. Grebosz, A. Banu, P. Bednarczyk, P. Doornenbal and H. J. Wollersheim; J. Phys. G: Nucl. Part. Phys. 31 (2005) S1917

108Sn studied with intermediate-energy Coulomb excitation A. Banu, J. Gerl, C. Fahlander, M. Gorska, H. Grawe, T.R. Saito, H.J. Wollersheim, E. Caurier, T. Engeland, A. Gniady, M. Hjorth-Jensen, F. Nowacki, T. Beck, F. Becker, P. Bednarczyk, M.A. Bentley, A. Bürger, F. Cristancho, G. de Angelis, Z. Dombradi, P. Doornenbal, H. Geissel, J. Grebosz, G. Hammond, M. Hellström, J. Jolie, I. Kojouharov, N. Kurz, R. Lozeva, S. Mandal, N. Marginean, S. Muralithar, J. Nyberg, J. Pochodzalla, W. Prokopowicz, P. Reiter, D. Rudolph, C. Rusu, N. Saito, H. Schaffner, D. Sohler, H. Weick, C. Wheldon and M. Winkler; Phys. Rev. C72 061305 (2005)

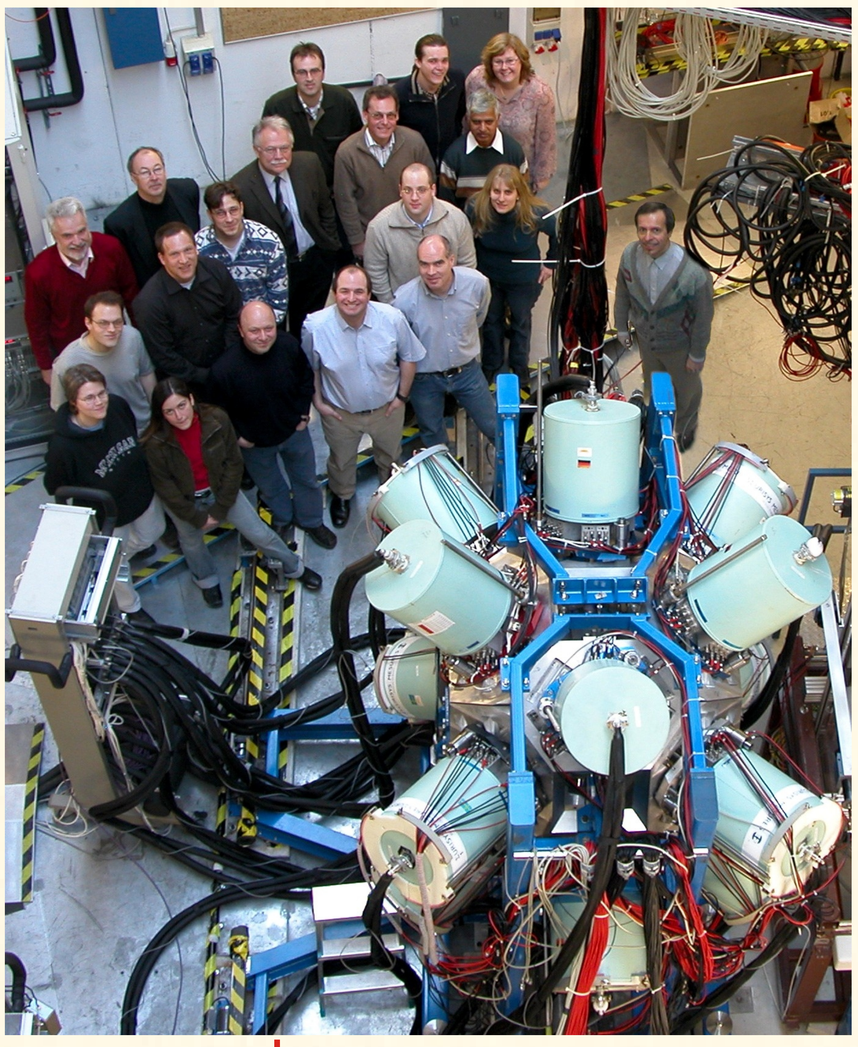
A novel Calorimeter Telescope for identification of relativistic heavy-ion reaction channels R. Lozeva, J. Gerl, M. Gorska, I. Kojouharov, S. Mandal, H.J. Wollersheim, D. Balabanski, F. Becker, J. Grebosz, A. Banu, P. Bednarczyk, P. Doornenbal and H. Schaffner; Nucl. Instr. Meth. A 562, 298 (2006)

The Cracow Code an Interactive method of sophisticated online analysis J. Grebosz; Comp. Phys. Comm. 176 (2007) 251

The T=2 mirrors 36Ca and 36S: A test for isospin symmetry of shell gaps at the driplines P.

DAY OF A TRIUMPH

Predicted Isomeric states of excited nuclei are discovered



The former GSI director Walter Henning is visiting the experimental area. Note the bird-eye view of the RISING array in its Stopped Beam configuration.

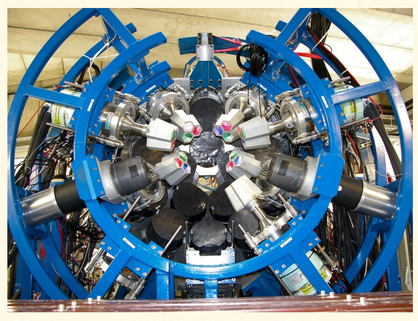
Doornenbal, P. Reiter, H. Grawe, T. Otsuka, A. Al-Khatib, A. Banu, T. Beck, F. Becker, P. Bednarczyk, G. Benzoni, A. Bracco, A. Bürger, L. Caceres, F. Camera, S. Chmel, F.C.L. Crespi, H. Geissel, J. Gerl, M. Gorska, J. Grebosz, H. Hübel, M. Kavatsyuk, O. Kavatsyuk, M. Kmiecik, I. Kojouharov N. Kurz, R. Lozeva, A. Maj, S. Mandal, W. Meczynski, B. Million, Z. Podolyak, A. Richard, N. Saito, T.R. Saito, H. Schaffner, M. Seidlitz, T. Striepling, Y. Utsuno, J. Walker, N. Warr, H. Weick, O. Wieland, M. Winkler and H.J. Wollersheim; Phys. Lett. B647 (2007) 237

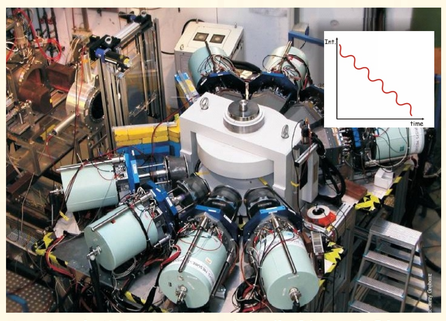
Yrast and non-yrast 2+ states of 134Ce and 136Nd populated in relativistic Coulomb excitation T.R. Saito, N. Saito, K. Starosta, J. Beller, N. Pietralla, H.J. Wollersheim, D.L. Balabanski, A. Banu, R.A. Bark, T. Beck, F. Becker, P. Bednarczyk, K.-H. Behr, G. Benzoni, P.G. Bizzeti, C. Boiano, A. Bracco, S. Brambilla, A. Brünle, A. Bürger, L. Caceres, F. Camera, F.C.L. Crespi, P. Doornenbal, A.B. Garnsworthy, H. Geissel, J. Gerl, M. Gorska, J. Grebosz, G. Hagemann, J. Jolie, M. Kavtsyuk, O. Kavatsyuk, T. Koike, I. Kojouharov, N. Kurz, J. Leske, G. Lo Bianco, A. Maj, S. Mallion, S. Mandal, M. Maliage, T. Otsuka, C.M. Petrache, Z. Podolyak, W. Prokopowicz, G. Rainovski, P. Reiter, A. Richard, H. Schaffner, S. Schielke, G. Sletten, N.J. Thompson, D. Tonev, J. Walker, N. Warr, O. Wieland and Q. Zhong; Phys.Lett. B 669 (2008) 19

Search for pygmy dipole resonance in 68Ni at 600MeV/u O. Wieland, A. Bracco, F. Camera, G. Benzoni, N. Blasi, S. Brambilla, F.C.L. Crespi, S. Leoni, B. Million, R. Nicolini, A. Maj, P. Bednarczyk, J. Grebosz, M. Kmiecik, W. Meczynski, J. Styczen, T. Aumann, A. Banu, T.

MISSION ACCOMPLISHED

Other setups - other challenges





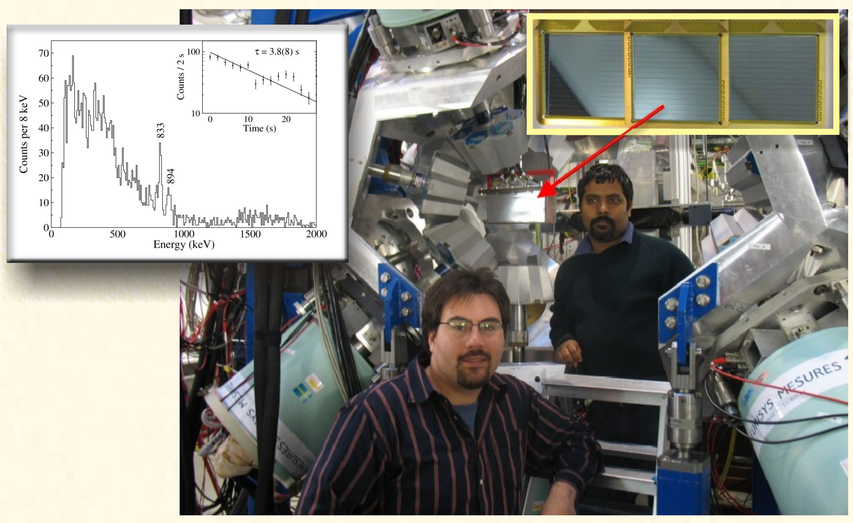
Cluster and Miniball array for experiments at relativistic energies (left) and Cluster arrangement for g-factor measurements.

Beck, F. Becker, L. Caceres, P. Doornenbal, H. Emling, J. Gerl, H. Geissel, M. Gorska, O. Kavatsyuk, M. Kavatsyuk, I. Kojouharov, N. Kurz, R. Lozeva, N. Saito, T.R. Saito, H. Schaffner, H.J. Wollersheim, J. Jolie, P. Reiter, N. Warr, G. de Angelis, A. Gadea, D. Napoli, S. Lenzi, S. Lunardi, D. Balabanski, G. Lo Bianco, C. Petrache, A. Saltarelli, M. Castoldi, A. Zucchiatti, J. Walker and A. Bürger; Phys.Rev.Lett. 102 (2008) 092502

A RISING g-factor measurement of the 19/2+ isomer in 127Sn L. Atanasova, D.L. Balabanski, M. Hass, F. Becker, P. Bednarczyk, S.K. Chamoli, P. Doornenbal, G. Georgiev, J. Gerl, K.A. Gladnishki, M. Gorska, J. Grebosz, M. Kmiecik, S. Lakshmi, R. Lozeva, A. Maj, G. Neyens, M. Pfützner, G. Simpson, N. Vermeulen and H.J. Wollersheim; Progress in Particle and Nuclear Physics 59, (2007) 355

Actively Catching

Active Stopper - the clou of the stopped beam campaign



Exotic ions are implanted in an array of six double-sided silicon strip detectors which allows conversion electron spectroscopy (see ^{205}Au graph) and subsequent charged-particle (α, β, p) decays.

Walker, O. Wieland and F.R. Xu; Phys. Lett. B660 (2008), 326

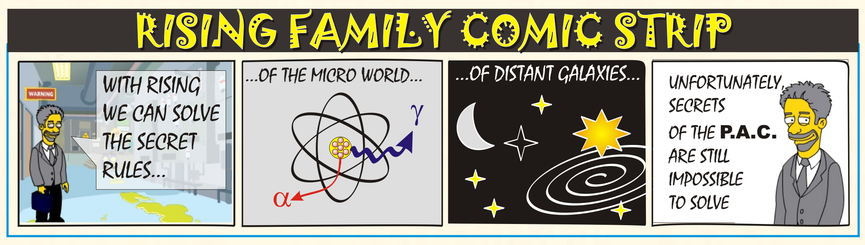
Erratum to:Neutron-proton pairing competition in N=Z nuclei: Metastable state decays in the proton dripline nuclei 82Nb and 86Tc A.B. Garnsworthy, P.H. Regan, L. Caceres, S. Pietri, Y. Sun, D. Rudolph, M. Gorska, Z. Podolyak, S.J. Steer, R. Hoischen, A. Heinz, F. Becker, P. Bednarczyk, P. Doornenbal, H. Geissel, J. Gerl, H. Grawe, J. Grebosz, A. Kelic, I. Kojouharov, N. Kurz, G, Montes, W. Prokopowicz, T.R. Saito, H. Schaffner, S. Tashenov, E. Werner-Malento, H.J. Wollersheim, G. Benzoni, B.B. Blank, C. Brandau, A.M. Bruce, F. Camera, W.N. Catford, I.J. Cullen, Z. Dombradi, E. Estevez, W. Gelletly, G. Ilie, J. Jolie, G.A. Jones, A. Jungclaus, M. Kmiecik, F.G. Kondev, T. Kurtukian-Nieto, S. Lalkovski, Z. Liu, A. Maj, S. Myalski, S. Schwertel, T. Shizuma, P.M. Walker and O. Wieland; Phys. Rev. C78 (2008) 061302

First results with the RISING active stopper P.H. Regan, N. Alkhomashi, N. Al-Dahan, Z. Podolyak, S. Pietri, Doornenbal, J. Gerl, M. Gorska, J. Grebosz, I. Kojouharov, N. Kurz, W. Prokopowicz, H. Schaffner, H.J. Wollersheim, L.L. Andersson, L. Atanasova, D.L. Balabanski, M.A. Bentley, A. Blazhev, C. Brandau, J.R. Brown, C. Fahlander, E.K. Johansson and A. Jungclaus; Eur. Phys.J. A36 (2008), 131

Isospin symmetry and proton decay: Identification of the 10+ isomer in 54Ni D. Rudolph, R. Hoischen, M. Hellström, S. Pietri, Z. Podolyak, P.H. Regan, A.B. Garnsworthy, S.J. Steer, F. Becker, P. Bednarczyk, L. Caceres, P. Doornenbal, J. Gerl, M. Gorska, J. Grebosz, I. Kojouharov, N. Kurz, W. Prokopowicz, H. Schaffner, H.J. Wollersheim, L.L. Andersson, L. Atanasova, D.L. Balabanski, M.A. Bentley, A. Blazhev, C. Brandau, J.R. Brown, C. Fahlander, E.K. Johansson and A. Jungclaus; Eur. Phys.J. A36 (2008), 131

Isospin symmetry and proton decay: Identification of the 10+ isomer in 54Ni D. Rudolph, R. Hoischen, M. Hellström, S. Pietri, Z. Podolyak, P.H. Regan, A.B. Garnsworthy, S.J. Steer, F. Becker, P. Bednarczyk, L. Caceres, P. Doornenbal, J. Gerl, M. Gorska, J. Grebosz, I. Kojouharov, N.

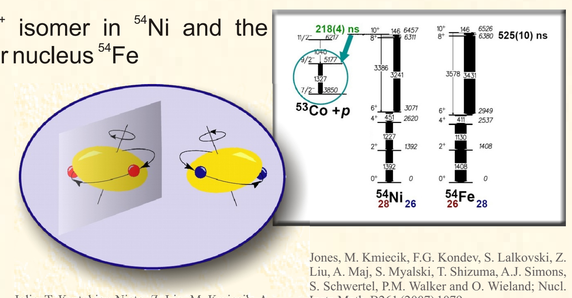
RISING FAMILY COMIC STRIP



Proton through the mirror?

Proton hunters strike again

Decay scheme of the 10^+ isomer in ^{54}Ni and the relevant decays of the mirror nucleus ^{54}Fe



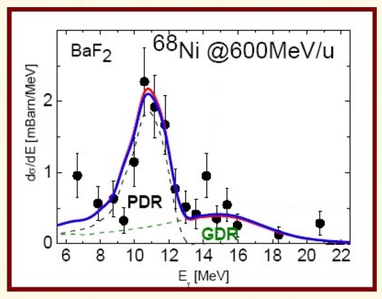
New sub-μs isomers in 125,127,129Sn and isomer systematics of 124-130Sn R.L. Lozeva, G.S. Simpson, H. Grawe, G. Neyens, L.A. Atanasova, D.L. Balabanski, D. Bazzacco, F. Becker, P. Bednarczyk, G. Benzoni, N. Blasi. A. Blazhev, A. Bracco, C. Brandau, L. Caceres, F. Camera, S.K. Chamoli, F.C.L. Crespi, J.-M. Daugas, P.Detistov, M. De Rydt, P. Doornenbal, C. Fahlander, E. Farnea, G. Georgiev, J. Gerl, K.A. Gladnishki, M. Gorska, J. Grebosz, M. Hass, R. Hoischen, G. Ilie, M. Ionescu-Bujor, A. Iordachescu, J. Jolie, A. Jungclaus, M. Kmiecik, I. Kojouharov, N. Kurz, S.P. Lakshmi, G. Lo Bianco, S. Mallion, A. Maj, D. Montanari, O. Perru, M. Pfützner, S. Pietri, J. A. Pinston, Z. Podolyak, W. Prokopowicz, D. Rudolph, G. Rusev, T.R. Saito, A. Saltarelli, H. Schaffner, R. Schwengner, S. Tashenov, K. Turzo, J.J. Valiente-Dobon, N. Vermeulen, J. Walker, E. Werner-Malento, O. Wieland and H.J. Wollersheim; Phys.Rev.C77 (2008), 064313

Isomer Spectroscopy Using Relativistic Fragmentation at the N=Z Line for A≈80-90 P.H. Regan, A.B. Garnsworthy, S. Pietri, L. Caceres, M. Gorska, D. Rudolph, Z. Podolyak, S.J. Steer, R. Hoischen, J. Gerl, H.J. Wollersheim, J. Grebosz, H. Schaffner, W. Prokopowicz, I. Kojouharov, F. Becker, P. Bednarczyk, P. Doornenbal, H. Geissel, H. Grawe, A. Kelic, N. Kurz, F. Montes, T.R. Saito, S. Tashenov, E. Werner-Malento, A. Heinz, L. Atanasova, D.L. Balabanski, G. Benzoni, B. Blank, A. Blazhev, C. Brandau, A.M. Bruce, W.N. Catford, F. Camera, I.J. Cullen, E. Estevez, C. Fahlander, W. Gelletly, G. Ilie, A. Jungclaus, J. Jolie, T. Kurtukian-Nieto, Z. Liu, M. Kmiecik, A. Maj, S. Myalski, S. Schwertel, T. Shizuma, A.J. Simons, P.M. Walker and O. Wieland; Nucl. Phys. A787 (2007), 491

Recent results in fragmentation isomer spectroscopy with Rising S. Pietri, P.H. Regan, Z. Podolyak, S. Steer, A.B. Garnsworthy, E. Werner-Malento, R. Hoischen, M. Gorska, J. Gerl, H.J. Wollersheim, I. Kojouharov, H. Schaffner, F. Becker, P. Bednarczyk, L. Caceres, P. Doornenbal, H. Geissel, J. Grebosz, A. Kelic, N. Kurz, F. Montes, W. Prokopowicz. T.R. Saito, S. Tashenov, A. Heinz, M. Pfützner, T. Kurtukian-Nieto, G. Benzoni, M. Hellström, A. Jungclaus, J. Simpson, L.L. Andersson, L. Atanasova, D. Balabanski, M.A. Bentley, B. Blank, A. Blazhev, C. Brandau, J.R. Brown, A.M. Bruce, F. Camera, W.N. Catford, I.J. Cullen, Z. Dombradi, E. Estevez, C. Fahlander, W. Gelletly, G. Ilie, E.K. Johansson, J. Jolie, G.A. Jones, M. Kmiecik, F.G. Kondev, S. Lalkovski, Z. Liu, A. Maj, S. Myalski, T. Shizuma, A.J. Simons, S. Schwertel, P.M. Walker and O. Wieland; Nucl. Instr. Meth. B261 (2007) 1079

First observation of isomeric decays in the r-process waiting-point nucleus 130Cd A. Jungclaus, L. Caceres, M. Gorska, M. Pfützner, S. Pietri, E. Werner-Malento, H. Grawe, K. Langanke, G. Martinez-Pinedo, F. Nowacki, A. Poves, J.J. Cuenca-Garcia, D. Rudolph, Z. Podolyak, P.H. Regan, P. Detistov, S. Lalkovski, V. Modamio, J. Walker, P. Bednarczyk, P. Doornenbal, H. Geissel, J. Gerl, J. Grebosz, I. Kojouharov, N. Kurz, W. Prokopowicz. H. Schaffner, H.J. Wollersheim, K. Andgren, J. Benlliure, G. Benzoni, A.M. Bruce, E. Casarejos, B. Cederwall, F.C.L. Crespi, B. Hadinia, M. Hellström, R. Hoischen, G. Ilie, J. Jolie, A. Khaplanov, M. Kmiecik, R. Kumar, N. Kurz, A. Maj, S. Mandal, F. Montes, S. Myalski, G.S. Simpson, S.J. Steer, S. Tashenov, O. Wieland and H.J. Wollersheim; Phys. Rev. Lett. 99 (2007), 132501

PYGMY and HECTOR



High-energy γ-ray spectrum measured with BaF_2 detectors.
The observed peak intensity can be explained in terms of enhanced strength of the dipole response function.

Kurz, W. Prokopowicz, H. Schaffner, H.J. Wollersheim, L.L. Andersson, L. Atanasova, D.L. Balabanski, M.A. Bentley, A. Blazhev, C. Brandau, J.R. Brown, C. Fahlander, E.K. Johansson, A. Jungclaus and S.M. Lenzi; Phys. Rev. C78 (2008) 021301

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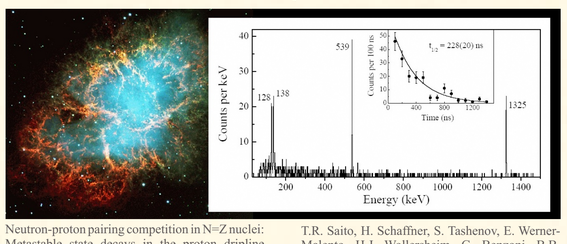
Weak deformed oblate structures in 198Os Zs.

Astrophysics at reach

^{130}Cd helps to solve secrets of Universe

The decay spectrum of the 8+ seniority isomer ^{130}Cd predicted by shell model calculation - was identified.
The mass of ^{130}Cd is not known yet.



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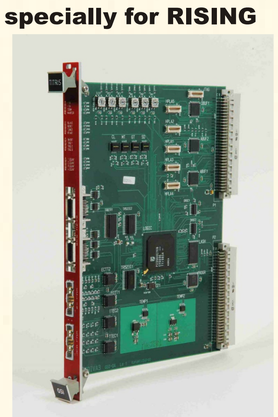
The new time stamping VME module TITRIS with a clock step of 20 ns allows an event synchronisation in different data streams of the multi branch system MBS (GSI/EE: J. Hoffmann, N. Kurz).



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