

# 1 NICE-ISOLDE, brief overview of status March 2011

The group is now consolidated (Hans Fynbo obtained a tenured position) and the last years have brought significant scientific progress. To give just one indication, during the last 2-3 years we have been invited to write four review/overview papers (5,9,14,15 in publication list).

The ISOLDE activity can cope with the 17% reduction for one year, but cannot maintain the present activity level with such support.

## 2 Plans for 2012

We shall continue exploiting the new possibilities opened up at the REX-ISOLDE post-accelerator. We have for some time been aiming for heavier nuclei (are currently involved in target developments to get new beams) and expect to be able to have first successful runs with the proton dripline nucleus  $^9\text{C}$ . The active target technique, where the gas of a TPC acts as target for nuclear reactions, will be adapted to REX-ISOLDE conditions and tested through elastic resonance scattering of the 22 ms neutron-rich nucleus  $^{12}\text{Be}$ . Among the low-energy reactions that are crucial for the astrophysical rp-process (novae, X-ray bursts) several can be elucidated by using beta-delayed particle emission to populate the relevant energy window. We are currently analyzing such data for  $^{31}\text{Ar}$  and will extend this to  $^{20}\text{Mg}$  (beamtime being approved recently).

Also with REX-ISOLDE we plan to carry out the first  $\beta$ -NMR experiment with chemistry/biophysics aim. This is a completely novel application of  $\beta$ -NMR on a world wide scale. We shall continue the studies of binding of metal ions to biomolecules, the scientific aim being elucidation of heavy metal toxicity at the molecular level, and to control the structure of the biomolecules. The results of this program will have ramifications and applications within biochemistry of heavy metal ions and biotechnology.

## 3 Budget 2012

We reduce travel and equipment as much as is realistic and have to take the rest of the reduction from personnel. That implies postponing starting new PhD positions.

- Personnel 363 kkr (cut down 27%)

- Travel 250 kkr (cut down 18%)
- Equipment 50 kkr (cut down 30%)
- M&O 310 kkr (remains 60 kCHF, cannot be changed)
- Total is 973 kkr (17% down from average of 2010–2011).

## 4 Participants

Two groups work at the moment at ISOLDE, on nuclear structure and biophysics. A third Danish group (in nuclear solid state physics, H.P. Gunnlaugsson) wishes to join, but the economic situation does not allow that for the moment.

Senior scientists: Karsten Riisager, Hans Fynbo, Lars Hemmingsen, Hans-Werner Adolph (guest professor 2009–2010, mainly financed by Villum Kann Rasmussen Fonden).

Post doc: Uwe Heinz (2008–2009).

PhD students: at the moment Jacob Johansen, Gunvor Koldste, Kasper Jensen and Monika Stachura. A further three students took their PhD during 2008–2010 (HH Knudsen, S Hyldegaard, OS Kirsebom).

Master students 2008–2011: 9 students have finished (4 working on CERN, 5 in medical physics) and 4 more students will finish in 2011 (3 working on CERN, 1 in medical physics).

## 5 Main results 2008–2011

In nuclear physics:

- First experiments where REX is combined with the Miniball gamma array for transfer-studies (already published results on  $^{32}\text{Mg}$ , our data on  $^{11}\text{Be}$  under analysis).
- Further results from low-energy nuclear reactions include a PLB on indirect detection of gamma ray emission between continuum states via complete recording of outgoing charged particles.
- From decay experiments: a significantly improved precision measurement of the decay of  $^8\text{B}$  that will lead to a more precise prediction for the solar neutrino spectrum at high energy.

In biophysics:

- Heavy metals bound to proteins: toxicity on molecular level.
- Control of the structure of proteins: Folding, misfolding and aggregation with the help of metal ions.
- Metal-modified RNA and DNA and nanodevices: binding of metal ions to RNA and DNA (still on analysis stage, collaboration with e.g. R.K.O. Sigel, University of Zürich).
- Design of test chamber and experimental set-up for biophysical applications of beta-NMR (ongoing collaboration with several groups within the ISOLDE collaboration).

## 6 Publications

For the period 2008–11 so far 33 regular papers in refereed journals (out of which 9 in letter journals), plus 19 conference contributions in refereed journals and 15 other conference contributions. The update to the list of regular publications for 2008–09 is:

1. S. Hyldegaard, M. Alcorta, B. Bastin, M.J.G. Borge, R. Boutami, S. Brandenburg, J. Büscher, P. Dendooven, C.Aa. Diget, P. Van Duppen, T. Eronen, S.P. Fox, L.M. Fraile, B.R. Fulton, H.O.U. Fynbo, J. Huikari, M. Huyse, H.B. Jeppesen, A.S. Jokinen, B. Jonson, K. Jungmann, A. Kankainen, O.S. Kirsebom, M. Madurga, I. Moore, A. Nieminen, T. Nilsson, G. Nyman, G.J.G. Onderwater, H. Pentillä, K. Peräjärvi, R. Raabe, K. Riisager, S. Rinta-Antila, A. Rogachevskiy, A. Saastamoinen, M. Sohani, O. Tengblad, E. Traykov, Y. Wang, K. Wilhelmsen, H.W. Wilschut and J. Äystö, *Phys. Rev.* **C81** (2010) 024303 (10 pages)  
“R-matrix analysis of the  $\beta$  decays of  $^{12}\text{N}$  and  $^{12}\text{B}$ ”.
2. N. Adimi, R. Dominguez Reyes, M. Alcorta, A. Bey, B. Blank, M.J.G. Borge, F. de Oliveira Santos, C. Dossat, H.O.U. Fynbo, J. Giovinazzo, H.H. Knudsen, M. Madurga, I. Matea, A. Perea, K. Sümmerer, O. Tengblad and J. C. Thomas, *Phys. Rev.* **C81** (2010) 024311 (14 pages)  
“Detailed  $\beta$ -decay study of  $^{33}\text{Ar}$ ”.
3. H.T. Johansson, Yu. Aksyutina, T. Aumann, K. Boretzky, M.J.G. Borge, A. Chatillon, L.V. Chulkov, D. Cortina-Gil, U. Datta Pramanik, H. Emling, C. Forssén, H.O.U. Fynbo, H. Geissel, G. Ickert, B. Jonson, R. Kulesa, C. Langer, M. Lantz, T. LeBlais, K. Mahata, M. Meister, G. Münzenberg, T. Nilsson, G. Nyman, R. Palit, S. Paschalis, W. Prokopowicz, R. Reifarth, A. Richter, K. Riisager, G. Schrieder, H. Simon,

- K. Sümmerer, O. Tengblad, H. Weick and M.V. Zhukov, Nucl. Phys. **A842** (2010) 15–32  
 “The unbound isotopes  $^9,^{10}\text{He}$ ”.
4. O.S. Kirsebom, M. Alcorta, M.J.G. Borge, M. Cubero, C.A. Diget, R. Dominguez-Reyes, L.M. Fraile, B.R. Fulton, H.O.U. Fynbo, S. Hyldegaard, B. Jonson, M. Madurga, A. Muñoz Martin, T. Nilsson, G. Nyman, A. Perea, K. Riisager and O. Tengblad, Phys. Rev. **C81** (2010) 064313 (9 pages)  
 “Breakup of  $^{12}\text{C}$  resonances into three  $\alpha$  particles”.
  5. B. Jonson and K. Riisager (2010), Scholarpedia, 5(7):9742  
 doi:10.4249/scholarpedia.9742  
 “The ISOLDE facility”.
  6. H.T. Johansson, Yu. Aksyutina, T. Aumann, K. Boretzky, M.J.G. Borge, A. Chatillon, L.V. Chulkov, D. Cortina-Gil, U. Datta Pramanik, H. Emling, C. Forssén, H.O.U. Fynbo, H. Geissel, G. Ickert, B. Jonson, R. Kulesa, C. Langer, M. Lantz, T. LeBleis, K. Mahata, M. Meister, G. Münzenberg, T. Nilsson, G. Nyman, R. Palit, S. Paschalis, W. Prokopowicz, R. Reifarth, A. Richter, K. Riisager, G. Schrieder, N.B. Shulgina, H. Simon, K. Sümmerer, O. Tengblad, H. Weick and M.V. Zhukov, Nucl. Phys. **A847** (2010) 66–88  
 “Three-body correlations in the decay of  $^{10}\text{He}$  and  $^{13}\text{Li}$ ”.
  7. S. Mianowski, E. Werner-Malento, A. Korgul, M. Pomorski, K. Pachucki, M. Pfützner, B. Szweryn, J. Żylicz, P. Hornshøj, T. Nilsson, and K. Rykaczewski, Phys. Rev. **C82** (2010) 044308 (7 pages)  
 “Radiative electron capture in the first-forbidden unique decay of  $^{81}\text{Kr}$ ”.
  8. K. Wimmer, T. Kröll, R. Krücken, V. Bildstein, R. Gernhäuser, B. Bastin, N. Bree, J. Diriken, P. Van Duppen, M. Huyse, N. Patronis, P. Vermaelen, D. Voulot, J. Van de Walle, F. Wenander, L.M. Fraile, R. Chapman, B. Hadinia, R. Orlandi, J.F. Smith, R. Lutter, P.G. Thirolf, M. Labiche, A. Blazhev, M. Kalkühler, P. Reiter, M. Seidlitz, N. Warr, A.O. Macchiavelli, H.B. Jeppesen, E. Fiori, G. Georgiev, G. Schrieder, S. Das Gupta, G. Lo Bianco, S. Nardelli, J. Butterworth, J. Johansen, and K. Riisager, Phys. Rev. Lett. **105** (2010) 252501 (4 pages)  
 “Discovery of the shape coexisting  $0^+$  state in  $^{32}\text{Mg}$  by a two neutron transfer reaction”.
  9. P. Van Duppen and K. Riisager, J. Phys. **G38** (2011) 024005 (24 pages)  
 “Physics with REX-ISOLDE: from experiment to facility”.
  10. Luczkowski M., Stachura M., Schirf V., Demeler B., Hemmingsen L., Pecoraro V.L. Inorg. Chem. 2008 47, 10875-10888 (impact factor 4.7)

“Design of thiolate rich metal binding sites within a peptidic framework”.

11. Heinz U., Hemmingsen L., Kiefer M., Adolph H.W. , Chem. Eur. J. 2009, 15, 7350-7358 (impact factor 5.4)  
“Structural Adaptability of Zinc Binding Sites: Different Structures in Partially, Fully, and Heavy Metal Loaded States”.
12. Selevsek N., Rival S., Tholey A., Heinzle E., Heinz U., Hemmingsen L., Adolph H.W., J. Biol. Chem. 2009, 284, 16419-16431 (impact factor 5.3)  
“Zinc ion-induced domain organization in metallo-beta-lactamases: A flexible ”zinc arm” for rapid metal ion transfer? ”.
13. Chakraborty S., Kravitz J.Y., Thulstrup P.W., Hemmingsen L., DeGrado W.F., and Pecoraro V.L., Angew. Chem. Int. Ed. 2011, 123, 2097-2101 (Impact factor 11.8)  
“Realization of a Designed Three-Helix Bundle Capable of Binding Heavy Metals in a Tris(Cysteine) Environment”.
14. M. Pfützner, M. Karny, L.V. Grigorenko and K. Riisager, submitted to Rev. Mod. Phys.  
“Radioactive decays at limits of nuclear stability”.
15. H.O.U. Fynbo and C.Aa. Diget, submitted to Hyperfine Int.  
“Structure of  $^{12}\text{C}$  and the triple-alpha process”.