

ISOLDE AND NEUTRON TIME OF FLIGHT
EXPERIMENTS COMMITTEE

Minutes of the twenty-eighth meeting of the INTC
Held on Thursday 15 and Friday 16 February 2007

OPEN SESSION

Thursday 15 February 2007 at 14:00 h, Council Chamber

Introduction by the Chairman

The Chairman, M. Huysse, opened the meeting and introduced the new members of the INTC. He congratulated the organizers of the ISOLDE workshop and users meeting held on 12-14 February 2007 and acknowledged the exciting physics programme and the lively discussions.

ISOLDE Technical Report

The ISOLDE Technical Coordinator reported on the technical shutdown activities at ISOLDE, which are coordinated by Erwin Siesling (AB/OP). The main tasks are the repair of the Boris tubes, the move of the experimental setups after REX-ISOLDE to the hall extension and the installation of the ISOLDE RFQ cooler and buncher (ISCOOL).

He then informed the Committee about the proposal by the Standing group for the upgrade of ISOLDE (SGUI) to stage the HIE-ISOLDE project with the 5.5 MeV/u upgrade having highest priority. The price tag for this first stage is 13.5 MCHF and 32 full time equivalents (FTE). The external contributions to date amount to 3.8 MCHF and 4 FTE. The project is mentioned in the 4th theme of the white paper presented by the Director General to the CERN committees. Fifty per cent of the funds should arise from external contributions. Some of the activities have already started, namely the prototyping of the REX superconducting LINAC, the LARIS laboratory, and the ISCOOL project.

The outcome of the ISOLDE session of the Accelerator Technical and Operation Committees (ATC/ABOC) Review 2006 was discussed next. The aim of the meeting was to assess the performance of the CERN accelerators, identify what went wrong in 2006, evaluate the consolidation programme and define short term improvements and long term actions. In 2006 ISOLDE faced severe technical difficulties at the start-up, which lead to essentially no physics results from the first three weeks of running. The problems, partly due to a congested schedule for the shut-down work, were overcome during the year. The operation during the second part of 2006 was rather smooth, with the noticeable exception of the CERN-wide power cut on

29 July and its after-effects (lasting for more than one week). Among the conclusions of the ATC/ABOC review it was found that the ISOLDE operation is too segmented and that the manpower available for ISOLDE for radioprotection and vacuum support is critical. REX support must be assured on the same level as for the rest of the facility. Possible future actions include the separation of the function of daily technical coordination and the AB technical spokesperson for ISOLDE, and the merge or reorganization of the ISOLDE activities undertaken in the ATB and OP groups to optimize resources. The link between the users of the facility and the machine supervisors must also be re-established.

ISOLDE Physics Report

The ISOLDE Physics Coordinator, Luis M Fraile, discussed the impact of the technical problems on the physics programme. The main causes for delays and cancellations arose from the problematic start-up, the CERN-wide power cuts and issues related to the focussing of the primary proton beam. Four experiments had to be cancelled during the year, although two of them were rescheduled and successfully ran afterwards. Seven more beam times had a reduced physics output or suffered from delays.

The ISOLDE 2006 operational period and running statistics were presented next. A total of 350.5 shifts of radioactive beam have been used for approved experiments, target tests and beam development runs in 2006. The breakdown of the beam time in the different subfields is shown in Table 1. The number of radioactive shifts per running day is significantly lower than in 2005, but similar to 2004.

Table 1: Breakdown of radioactive beam shifts delivered to ISOLDE experiments in 2006

Category	Number of shifts	Percentage of total (%)
1. Nuclear Physics and Weak Interaction	186.5	53.2
2. Atomic Physics	39	11.1
3. Solid State Physics	34	9.7
4. Particle and Astrophysics	13	3.7
5. Research and Development	6	1.7
6. Biology and Medicine	1.5	0.4
7. Target and ion source development and REX-ISOLDE machine development	48.5	13.8
8. Coordinator's reserve	22	6.3
TOTAL	350.5	100

Out of the shifts devoted to *INTC experiments* (first 6 categories on the table), 41% were used by experiments at the REX-ISOLDE facility. Fifty-two percent of the shifts delivered to INTC experiments made use of the RILIS, which reached more than 2100 hours of operation for online work in 2006. A total of 196 shifts (56%) came from actinide targets.

REX-ISOLDE had a very stable operation in 2006 and achieved a record post-acceleration energy of 3.15 MeV/u for ${}^8\text{Li}^{3+}$. Furthermore, the charge breeding of heavy beams (up to A~200) was successfully tested. In the five years since the first post-accelerated beam at REX-

ISOLDE (30 October 2001), 45 radioactive isotopes of 17 elements have been delivered to REX experiments.

The priorities for beam development arising from the SGUI were then reported. The developments are grouped in three categories according to their relevance: *a)* developments required by experiments approved by the INTC, *b)* developments requested by letters of intent endorsed by the INTC and *c)* general research and development. A detailed list can be found at <http://cern.ch/isolde-upgrade>.

The proposed accelerator schedule for 2007, approved by the CERN Research Board on 29 November 2006, was shown next. Protons will be delivered to ISOLDE from 16 April 2007 and the Physics experiments can start as of 23 April 2007. The online operation for ISOLDE will end 29 weeks later, on 12 November 2007. The availability of resources, in particular uranium carbide targets, the operation of the RILIS (limited to 2000 hours per year) and the use of the REX-ISOLDE post-accelerator sets strong constraints to the schedule. Frequent changes of supercycle are also expected during 2007.

The following proposals, addenda and status reports were then presented:

1. **CERN-INTC-2007-003** and **INTC-P-222**, *Study of polonium isotopes ground state properties by simultaneous atomic- and nuclear-spectroscopy*, Thomas Cocolios
2. **CERN-INTC-2007-005** and **INTC-P-224**, *Laser spectroscopy of gallium isotopes using the ISCOOL RFQ cooler*, Bradley Cheal
3. **CERN-INTC-2006-037** and **INTC-P-160-Add 2**, *Coulomb excitation of neutron deficient Sn-isotopes using REX-ISOLDE. The case of even Cd isotopes and odd Sn isotopes*, Joakim Cederkäll
4. **CERN-INTC-2007-006** and **INTC-P-162-Add 3**, *Advanced Time-Delayed coincidence studies of $^{31,32}\text{Mg}$ from the beta-decays of $^{31,32}\text{Na}$; Addendum: Conversion Electron Study to Identify the Deformed 0_2^+ State in ^{30}Mg via its $E0$ Decay*, Peter Thierolf
5. **CERN-INTC-2007-002** and **INTC-P-193-Add 1**, *Coulomb excitation of odd-mass and odd-odd Cu isotopes using REX-ISOLDE and Miniball*, Irina Stefanescu
6. **CERN-INTC-2007-004** and **INTC-P-196-Add 2**, *Precision measurement of the half-life of the superallowed $0^+ \rightarrow 0^+$ beta decay of ^{38}Ca* , Bertram Blank
7. **CERN-INTC-2007-007** and **INTC-SR-006**, *Nuclear moments, spins and charge radii of copper isotopes from $N=28$ to $N=50$ by collinear fast-beam laser spectroscopy*, Kieran Flanagan

CLOSED SESSION

Friday 16 February 2007

Present: S. Åberg, Y. Blumenfeld, L.M. Fraile (Secretary), M. Huyse (Chairman), R. Krücken, H. Leeb, M. Lindroos, L. Linssen, G. Neyens, K. Riisager, V. Vlachoudis (part-time), U. Wahl, P.J. Woods

Apologies: Ph. Chomaz, C. Rembser, M. Streit-Bianchi

1. INTRODUCTORY REMARKS

The Chairman opened the meeting by welcoming the new members. He then introduced the general procedures for refereeing and for recommendations to the CERN Research Board.

It was brought to the attention of the Committee that a few ISOLDE experiments have not been active for long time but still have available beam time. The Committee decided to request a Status report from those experiments not active for more than 3 years. The ISOLDE physics coordinator will provide a listing for the next meeting.

There is an increasing number of experiments that present addenda to carry on experiments not always directly related to the original proposal. This can be dealt with when judging the individual physics cases, but in any case the Committee aims at restricting the submission of addenda to only the cases where it is necessary. Since users are registered at CERN on the basis of experiment numbers, the change of IS number may lead to practical problems for certain teams. The administrative structure for ISOLDE users is presently being revised and this practical issue will be addressed. The PH/IS group leader will report to the Committee in the upcoming meeting.

The ISOLDE technical coordinator reminded the proponents to contact the ISOLDE technical staff prior to submission of their proposal, in particular when beam development or non-standard targets are requested. A reminder will be included in the CDS submission interface, along with other modifications already underway. These will be reported by the INTC secretary in the next meeting.

The Committee was informed of the meeting held by ISOLDE/CERN representatives and members of GANIL/IN2P3 to enhance the exchange of know-how and underline the synergies leading to EURISOL. The discussions will be formalized in a common strategy document highlighting the complementarity and areas of excellence of the facilities. This will be presented to the INTC and the GANIL Scientific Advisory Committee. The minutes of the meeting will also be made available.

2. MINUTES OF THE LAST INTC MEETING

The minutes of the twenty-seventh INTC meeting held on 30 and 31 October 2006 were approved without amendments.

3. STATUS OF ISOLDE

The Committee acknowledged the effort made by the ISOLDE technical teams to overcome the difficulties encountered at the start-up and by the physics coordinator to accommodate for the losses in the schedule and rearrange the cancelled runs. The Committee took note of the report

on the ATC/ABOC 2006 Review held in January 2007. Concerns were raised regarding the need of consolidation of key pieces of equipment, especially the tape station, and the limitation of resources, in particular the RILIS and actinide targets. The AB management board will discuss the urgent measures to be adopted; the Committee looks forward to a report on the decisions taken.

The ISOLDE technical coordinator informed the Committee about the technical options for the installation of the ISOLDE RFQ cooler and buncher (ISCOOL) after the HRS separator. The most realistic scenario, allowing the completion of the offline tests and installation of the required infrastructure without compromising the general maintenance of the ISOLDE facility, is the second half of September. This will allow for an online test at the end of the 2007 campaign. The installation will mean that no beam can be delivered for about one week from any of the separators and thereafter only GPS will be available for general use. The Committee acknowledged the progress on the ISCOOL. A plan for online tests should be defined and the installation should be integrated in the experiment schedule by the ISOLDE physics coordinator with the aim of optimizing the time available for tests and minimize the impact in the general physics programme.

The committee took note on the report by the Standing Group for the Upgrade of ISOLDE on priorities for target and ion source development.

4. STATUS OF N_TOF

The Committee was informed about the safety and engineering constraints for resuming the n_TOF operations in 2007, as discussed in the ABOC/ATC 2006 Review. The delay for the design and construction of the new n_TOF target amounts to 15 months and the total costs for the installation to 1 MCHF. At present no resources are available at the AB department and other solutions are sought.

5. DISCUSSION ON THE OPEN SESSION AND ON LETTERS OF INTENT

The presentations of the proposals, addenda and status reports made during the open session, were then discussed.

CERN-INTC-2007-003/P-222, Study of polonium isotopes ground state properties by simultaneous atomic- and nuclear-spectroscopy

The experiment proposes the study of ground state properties of neutron deficient Po ($Z=84$) isotopes by means of in-source laser spectroscopy with the ISOLDE RILIS. It intends to make use of the newly developed Po ionization scheme. The Committee found the proposal of the greatest interest since the measurement of isotope shifts will provide further information on this region of the nuclei chart where spherical, prolate and oblate shapes coexist. For the odd isotopes the determination of magnetic moments and spins will allow for the identification of possible isomers. Nevertheless doubts were cast on the magnitude of the hyperfine splitting as compared to the laser line width. The Committee decided to **recommend** to the Research Board **the approval of 19 shifts** for the measurement of isotope shifts for even Po nuclei. After the measurements the proponents are asked to report to the Committee and discuss the feasibility of resolving the hyperfine structure of the odd nuclei and the yields of n-deficient Po isotopes.

CERN-INTC-2007-005/P-224, *Laser spectroscopy of gallium isotopes using the ISCOOL RFQ cooler*

The aim of the experiment is the study of ground state properties of both neutron-rich and neutron-deficient Ga isotopes by means of laser spectroscopy techniques. In particular the use of the bunching capability of the new ISOLDE RFQ cooler and buncher is requested to reduce the background in collinear laser spectroscopy measurements. The Committee found that the proposal will shed light on an isotopic chain where very little is known on the ground state spins, nuclear charge radii and especially static moments. The measurements will provide insight on the inversion of ground spin of n-rich Ga isotopes due to the monopole shift of the $\pi f_{5/2}$ orbital. For the n-deficient Ga isotopes it will help clarify the origin of the reported increase of matter radius with decreasing N number. The physics case for the Y isotopes was judged weak and the suitability for benchmarking the ISCOOL with Y isotopes questioned, given the possible contaminants. The Committee decided to **recommend** to the Research Board **the approval of 15 shifts** for the measurement of ground state properties of n-rich Ga isotopes with the RFQ cooler. The proponents should provide a status report discussing the measurements, and addressing the performance of the ISCOOL and the beam purity for the n-deficient isotopes.

CERN-INTC-2006-037/P-160-Add 2, *Coulomb excitation of neutron deficient Sn-isotopes using REX-ISOLDE. The case of even Cd isotopes and odd Sn isotopes*

The addendum intends to continue the investigation of the evolution of shell structure in the vicinity of the doubly-magic ^{100}Sn by means of Coulomb excitation. The Committee found the study of n-deficient even Cd related to the original proposal. In this case the half-life of the 2^+ state is influenced by the higher lying 8^+ isomers arising from the two proton-hole configuration in the $g_{9/2}$ orbital. The Coulomb excitation technique was judged well suited to study the 2^+ states. The comparison to the 2^+ states in the even Sn isotopes can provide valuable information on the evolution of proton and neutron shells and on the mixture of configurations. The Committee decided to **recommend** to the Research Board **the approval of 22 shifts** for the measurement of Coulomb excitation of n-deficient Cd isotopes. The proponents are encouraged to elaborate on the physics case for the odd Sn isotopes and address it in a separate proposal.

CERN-INTC-2007-006/P-162-Add 3, *Advanced Time-Delayed coincidence studies of $^{31,32}\text{Mg}$ from the beta-decays of $^{31,32}\text{Na}$; Addendum: Conversion Electron Study to Identify the Deformed 0_2^+ State in ^{30}Mg via its E0 Decay*

The addendum proposes a verification of the 0_2^+ assignment to the 1789 keV level in ^{30}Mg by the direct measurement of the E0 decay to the 0_1^+ ground state. The Physics case had already been judged of interest in previous meetings. Despite the fact that the measured E0 strength will depend both on the mixing ratio and on the difference of deformation between the ground state and excited configurations, the measurement may lead to the identification of the deformed intruder 0^+ state in ^{30}Mg . The INTC had requested an online test to investigate the feasibility of the experiment and the proponents have addressed the concerns raised by the Committee and improved the sensitivity of the setup by more than one order of magnitude. The present upper limit for the E0 strength ($\rho_{E0}^2 < 0.05$) makes the experiment very challenging but nevertheless the Committee decided to **recommend 22 shifts** for approval by the Research Board.

CERN-INTC-2007-002/P-193-Add 1, *Coulomb excitation of odd-mass and odd-odd Cu isotopes using REX-ISOLDE and Miniball*

The experiment proposes a continuation of the measurements of properties of low-lying nuclear levels of Cu ($Z=29$) isotopes by means of Coulomb excitation. They provide insight into the evolution of shell structure with increasing neutron number and into the robustness of the $N=40$ and $N=50$ shell closure. The isomeric beam studies on $^{68,70}\text{Cu}$ have been recently accepted for publication and $^{67,69,71,73}\text{Cu}$ nuclei have been investigated in the 2006 experimental campaign. The addendum, intending to complete the measurements on ^{70}Cu and extend them to ^{72}Cu and ^{75}Cu , was judged of the highest relevance by the Committee. The beam intensity delivered to the experimental setup in 2006 makes it possible to study the 5^- state in ^{70}Cu with a 3^- isomeric beam, as originally proposed. In the case of ^{72}Cu information on the spin and parities of the low-lying levels will be obtained from the selective population in Coulomb excitation; this will need to be complemented by other techniques. The investigation structure of ^{75}Cu will provide the first information on this nucleus from which only the half life is known. In the latter case doubts were cast on the intensity and purity of the ^{75}Cu beam after REX-ISOLDE. The Committee decided to **recommend** for approval by the Research Board a total of **15 shifts** for the $^{70,72}\text{Cu}$ experiment and to support the development of the ^{75}Cu beam.

CERN-INTC-2007-004/P-196-Add 2, *Precision measurement of the half-life of the superallowed $0^+ \rightarrow 0^+$ beta decay of ^{38}Ca*

The nucleus ^{38}Ca is one of the candidates that can contribute to the test of the conserved vector current (CVC) hypothesis by the determination of the $\mathcal{F}t$ value of the superallowed $0^+ \rightarrow 0^+$ β^- decay. This requires accurate experimental measurements of the half life, the $0^+ \rightarrow 0^+$ branching ratio and the Q_β value of the decay, together with calculations of the nuclear correction terms. The $T_z = -1$ nuclei are a good laboratory to test the nuclear corrections. The Physics case had already been positively evaluated in previous meetings. The addendum intends to repeat the half-life measurement of ^{38}Ca to reach a precision of 1×10^{-3} since the first attempt in 2006 was hampered by a decrease of the production rate of ^{38}Ca after a few hours of beam time due to wrong focussing of the primary proton beam. The Q_β value could be measured with high precision, in the experiment in agreement with a recent value from MSU. The proponents are planning the first step towards the precise determination of the branching ratio. The Committee acknowledged the effort made to successfully build a new setup and to perform the first trap assisted spectroscopy experiment at ISOLDE and decided to **recommend 18 shifts** for approval by the Research Board.

CERN-INTC-2007-007/SR-006 (IS439), *Nuclear moments, spins and charge radii of copper isotopes from $N=28$ to $N=50$ by collinear fast-beam laser spectroscopy*

The IS439 experiment aims at the study of ground state properties of Cu isotopes by means of laser spectroscopy techniques at the COLLAPS setup, providing experimental data on the evolution of the shell structure in this region. During the 2006 campaign, in spite of low Cu yields, the collaboration has been able to obtain quadrupole moments, isotope shifts and improved magnetic moments for several n-rich Cu isotopes. The enhancement in detection sensitivity allowed fluorescence measurements with intensities down to 10^6 ions/s. The collaboration requests the allocation of 9 shifts for the continuation of the measurements on

n-rich Cu isotopes without use of the ISOLDE RFQ cooler and buncher (ISCOOL), and 10 shifts for measurements on n-rich Cu isotopes after the installation of the ISCOOL. The Committee decided to **recommend 19 shifts** for approval by the Research Board.

CERN-INTC-2006-039/CLL-002 *Clarification letter: Coulomb Excitation of a ^{94}Kr Beam - Deformation Changes in the Neutron-Rich Isotope Chain* (Clarification letter on **P210**)

The proposal P210 was aimed at the measurement of the B(E2) transition probability from the 0^+ ground state to the first excited 2^+ state in ^{94}Kr by means of Coulomb excitation. The Committee found that the determination of the sign of the deformation by the measurement of the diagonal transition matrix element of the 2^+ state would have higher significance, and requested the proponents to investigate the feasibility of this measurement. The clarification letter comes as a response to this request. From the letter the determination of the diagonal matrix elements does not seem within reach, and therefore the Committee decided not to recommend the proposal.

CERN-INTC-2007-001/I-069 *Coulomb excitation of ^{84}Se*

The letter of intent requests the development of a ^{84}Se beam to investigate the feasibility of a Coulomb excitation experiment on this N=50 nucleus. The experiment would allow completing the B(E2) systematics in the region and confirming the shell model predictions. The case was judged of interest but an intermediate energy Coulomb excitation measurement has already been performed at RIKEN and a measurement is planned at HRIBF. Given these circumstances and the time required for the beam R&D at ISOLDE, the Committee did not find the Physics case compelling enough to justify the beam development. Therefore the letter of intent was not endorsed.

Out of the 204 radioactive beam shifts requested to the INTC a total of 130 have been recommended for approval by the Research Board.

6. DATES OF NEXT MEETINGS

The next INTC meeting will take place on **Monday 21 and Tuesday 22 May 2007**. The deadline for submission of proposals is **Sunday 22 April 2007**.

The other INTC meeting in 2007 will take place on Monday 12 and Tuesday 13 November 2007.

Luis M. Fraile
Tel. 73809 – 160985
Luis.Fraile@cern.ch