**Group for the Upgrade of Isolde - GUI Meeting -** 06th February 2017

**Present :** Bertram Blank, Maria Garcia Borge, Richard Catherall, , Thomas Cocolios (by video), Valentin Fedosseev, Karl Johnston, Bruce Marsh (invited for point 3) , Bettina Mikulec, Karsten Riisager (by video), Jose Alberto Rodriguez, Sebastian Rothe, Ronald Ruiz (replacing Kieran Flanagan), Luc Sermeus (invited for point 4), Thierry Stora, Joachim Vollaire.

**Excused :** Klaus Blaum

**Absent :** Simone Gilardoni, Alexander Gottberg, Pierre Delahaye

Link to the meeting : https://indico.cern.ch/event/606453/

**1.- New members, agenda, minutes of previous meeting**

Minutes were approved after the following comments : protons will be delivered to ISOLDE up to 28th November *(Note added after the meeting : Extra days for 2017 have been granted*), upon confirmation provided by B. Mikulec (BE-OP-PSB).

**2.- Beam Developments (TISD) activities in 2016/2017 - S. Rothe**

The new team in charge of TISD (target and ion source development) activities is introduced: its mandate is to produce new target and ion source units, new beams, and tune target and ion source units when operated at the ISOLDE facility. Matters related to Ion Sources are discussed at the ISBM meeting. It is reminded that the same resources as for the target and ion source unit assembly are shared, such as the mechanical workshop or the offline mass separator.

The development of nanostructured targets is described, together with the completion of the PhD of Joao Pedro Ramos; high and constant beam intensities are produced for exotic Li and Na isotope beams from nanoTiC-CNT targets. The possible production of Si beams is also shown. This activity is on-hold until clearance is obtained from CERN to upgrade the required infrastructures. This notably covers the acquisition of a glovebox and possible new laboratory space in Bld 179. Upon the request from B. Blank/T. Cocolios, a possible upgrade with glovebox could take place in the coming 6 months, while the approved new laboratories project cannot deliver the new infrastructures before LS2. In the mean time, contacts will be made with EPFL (CH) and IST (PT) where such activities are ongoing.

The LIEBE project for the operation of a circulating Lead Bismuth Eutectic (LBE) target with shower formation is progressing : the ion source is now performing nominally and the full assembly is ongoing. The Electromagnetic pump is developped at IPUL laboratories and is not yet performing according to the specfications, with notably early cavitations observed in preliminary test campaigns. Online tests at Isolde are expected in November 2017. Thomas Cocolios mentions that ther is possibly a proposal requesting 176Hg beams, which should be very well produced from such a unit.

The development of negative ion sources take place where different geometries, low work function materials and temperatures will be investigated. Low yields were measured possibly due to poisoning of the ion source. Synergies with the PISA system (reference chamber for atomic transition spectroscopy) developed by the RILIS group for heating and electron emission monitoring are expected. A new master student will be upgrading the set up with further gas analysis and monitoring.

The development of refractory metal carbonyl beams is progressing within the PhD of Jochen Ballof. The ionization of the molecules was observed, but require large improvement factors. Further irradiation tests are proposed at MEDICIS to check for fission product formation.

Ongoing tests with ion source and laser simulations using VSIM® in VADIS ion sources are progressing. Plans for Time Of Flight Laser Ion Sources and involvement of SCK•CEN (Belgium nuclear center hosting the ISOL@Myrrha project) have been devised.

The collaboration between SCK•CEN, TRIUMF and CERN on the development of the neutron converter for the 3 facilities is meeting regularly by videoconferencing. The aim is to operate two prototypes, one in TRIUMF and one at ISOLDE. A cylindrical target configuration is notably under consideration, for a better use of the emitted neutron spectrum.

The presentation finished with the status of the development of the Sigradur® cavities, which is a glassy carbon materials: its potential as a non porous, low work function cavity seems to be very appealing. At present, its use is limited by difficulties in integrating it and accommodating its mechanical characteristics in prototype units.

The following equipment upgrades is foreseen this year:

Glovebox

Limited RILIS capabilities at offline 1 mass separator is available, but the offline 2 mass separator will hopefully be ready for end of this year. Both facilities are located in laboratories of the ground flour, Bld 3.

Some systems RILIS (spares) can become ready for the offline 2 facility.

Bruce Marsh mentioned a system which could become available for beam developments: a pulsed stable ion beam technique is available at GANIL and could be used to perform efficiency and ion release studies. SCK•CEN will also be looking into a system for diffusion studies.

The list of expected/possible TISD activities is the following:

•Sc: Ti foils (CF4, RILIS)
 •Te: yields with RILIS
 • M(CO)x formation @ MEDICIS irradiation point
• ThO felt + Negative ion source
 • LIEBE @ GPS-online
 • STAGISO beam test
 • Si from UCx (pending INTC endorsement)
 • TiC-CNT (pending safety clearance)

Questions were raised on :

- n-rich rare earths beams

- F beams

- and how non-performing targets are addressed.

The present staff level of the activity is 2 fellows, 1 PhD student, 50% PhD student from KULeuven,1 master student from Gothenburg, and two CERN staffs (one of the two part time).

**3.- RILIS status and development plans for 2017 - B. Marsh**

B. Marsh reports that RILIS has reduced manpower as compared to 2016. Three members (1 PhD, 2 post-doc) have left while, one PhD student is present and only one CERN Fellow will start in April 2017. A second fellow will be requested. This could affect the RILIS operation. RILIS will require extended set up time and has to be operated with on-call support. No back-up person will be available. In 2016, there has been: 130 days of operation - 22 separate runs, 14 RILIS ionized elements - 3 physics run - 100% on time set up - 1 laser failure.

RILIS aims to study the ionization of the following elements: Er, Si, Se, Lu, Zn. Although the Zn beam is available, the current laser scheme is rather difficult to maintain over time due to degradation of optics. RILIS plans to investigate this issue in view of extended requests for HIE-ISOLDE. M. Borge points out that Si is not a strong request from the physics program, V. Fedosseev answers that no other request is presently made.

B. Marsh pointed out that the efficiency for the Mo beams strongly depends on the rates of dissociation vs. ionization. A suggestion is to use photo-dissociation, followed by resonant laser ionization. A test of this process using a cold ion source was proposed.

An overview was given about the RILIS developments towards High selectivity and High Resolution

A new RILIS in-source laser spectroscopy technique was reported. This technique utilizes the method of Doppler-free two photon laser spectroscopy which will enable to study light isotopes in-source. The feasibility was demonstrated with Rb beams by the collaborators in Mainz. A letter of intent was submitted aiming to study this technique at ISOLDE. A second approach to High resolution is the perpendicular illuminated LIST, currently under development in Mainz.

B. Marsh suggested a mathematical relation to derive priorities: Feasibility \* Usefulness/Resources. The following projects were assessed in this way : short LIST, Sigradur® cavity, ToF-LIS, 2 photon ionization, High resolution RILIS with a mirror in the cavity and hole in the extraction electrode.

Discussions on improvement of the LIST efficiency took place, considering approaching further the inlet repulsive electrode or narrow tubular injection.

**4. Implication of STAGISO beam delivery with maximum intensity (4 rings) - L. Sermeus**

Report on the PSB kicker arrangement and the foreseen upgrade of the driver electronics. The BT2.KFA20 kicker will be modified for LIU and afterward can be upgraded for STAGISO. For LIU, 105ns flat top stability is required, while for STAGISO, > 3000ns will be required. The thyratrons will be replaced by solid-state equipment. A question arose if the 5% expected ripple would be acceptable. This would affect the beam position.

The study cannot start before 2021 (after LS2). An inductive add-ons is also investigated. M. Borge points out that the new system should be compatible to proton energies of 2 GeV, expected for LS3. In this case, higher kicker strengths will be required.

A very first and rough budget estimate lies in the 0.5-1 MiCHF and 3-4 FTE. Such resources cannot be available before LIU is completed in 2020.

**5. New requests for 2017 - K. Johnston**

K. Johnston reports on the GUI requests for 2017.

Protons will be available : 24.April to 20.November 2017 *(Note added after the meeting : Extra days for 2017 have been granted*)

HIE ISOLDE is aimed to be available from end of June. For the operation of HIE ISOLDE period, a alternating operation for of low energy and HIE energy physics is suggested. Beam time requests for 2017 are arriving and the preliminary schedule will be assembled in the upcoming weeks.

The list of open beam requests:

* 60Zn (P448. TISD required to study impurities.)
* Sc: Reminded that TISD is required. (There are proposals pending from SSP, COLLAPS, CRIS, ISOLTRAP). IS627 accepts low rates
* Negative ions: There are open proposals (Cl). Potential negative ion period scheduled in September. The situation of the target material (ThO felt) and ion source performance should be reevaluated.
* At (P-664) production and yields
* I-169
* K (P-263), TISD required (nanomaterials).
* 80Cu (P-471) explore if anything can be seen.
* 65-76Ge (COLLAPS), Investigate impurities for 77-83Ge
* …
* F
* 57-56Co
* IS-456, Po? LIST development required
* 229Pa LOI. Yield tests with UCx

New requests for this INTC (8,9.Feb-2017)

It was noted that Zn was much requested and for extended times especially for HIE ISOLDE. But this beam remains challenging for

Negative chlorine isotopes were requested for LOI

Cr. N deficient and n rich isotopes requested, probably two different target materials required.

Ac. Yield measurements requested for medical isotopes.

Study of refractory metal beams using Mo(CO)6 breakup

Te for HIE ISOLDE , yields need to be measured.

CaO nano target material is still possible to produce.

A question was raised to have the possibility to extend the lifetime of targets. 20-25 shifts are requested for a typical HIE ISOLDE run. The backup targets might me requires.

T. Cocolios reminded that the target lifetime is limited to number of protons received. If the proton intensity is increased in future, the current targets may provide beams for less shifts. The question came up regarding the 5 target units that have developed a leak after receiving ~5E18 protons.

R. Catherall noted that the investigation is on-going and a decision was made to change the material of the O-ring seals.

A suggestion was made to replace the O-ring seals with metallic seals. This could be technically challenging.

The limit of 12 UCx targets per year is mainly due to the fact that there is an annual licensing limit to handle uranium. Therefore 12 UCx units is a hard limit.

M. Borge noted that other target materials should be prioritized over UCx, even if the yield is lower. She suggested that a factor of two reduced yield could be acceptable. Also given the reduced manpower situation for RILIS, VADIS ionization should be considered.

The LIEBE target test is foreseen for the end of 2017 operational period. 3 weeks are foreseen of which 1 week will be cool-down.

Negative ion run: The situation of the ThO felt should be followed up.

The impact of the start of the MEDICIS facility in June on the ISOLDE operation was inquired in terms of target production and operation.

R. Catherall explained that MEDICIS will be operated locally. The opening of a new position was requested. Also for Radioprotection, increased operation hours are expected to supervise the activities at MEDICIS.

Jose Albero Sanchez explained that P. Fernier can participate in the commissioning phase with MEDICIS with 50%, however priority will be given to ISOLDE operation. Conflicts with start-up of HIE ISOLDE should be avoided. E. Fadakis will be available to be consulted for OP matters.

M. Borge suggested that the list of beam requests should be sorted with respect to new beams or isotopes far from stability. She reminds that the target documentation still needs improvement. Maria reminded to provide the release curves measured by TISD to the users before their experiment.

M. Borge suggested that Users could assist with RILIS operation.

B. Marsh reminded that training is required to operate RILIS. He also reminded that RILIS is not a fully supported service by CERN and should not be compared to the ISOLDE OP. The situation is communicated to the management, but there are no resources to change the situation.

A question was asked by M. Borge regarding the list of elements that RILIS suggested to study and she reminded that the request to develop beams should be driven by LOIs or proposals. She also reminds that some beams like Se are available as Molecular beams.

V. Fedoseev noted that the list given is short but exhaustive.

T. Cocolios reminds that pure atomic ion beams are required for laser spectroscopy experiments such as CRIS and COLLAPS.

Regarding the assistance of external groups for laser ionization scheme developments, B. Marsh notes that the campaigns are usually short and the limitation of RILIS is not for the developments, which is typically topic of RILIS doctoral students of Fellows, but rather the continuous 24/7 operation of RILIS.

**6. Mode of operation for 2017 (schedule, targets (back ups), RILIS resources) - J. A Sanchez**

The main difference for this year in the HIE-ISOLDE operation is the installation of the CM3, which contains 5 additional superconducting cavities. This will have an impact on the setup time. XT03 needs to be commissioned to be used this year. XT02 commissioning is foreseen for week 47. 21 weeks of HIE-ISOLDE operation is foreseen for 2017 as opposed to 7 weeks in 2015. Weeks 9-20 will be a commissioning phase.

GPS is preferred separator for HIE-ISOLDE operation.

A proposal for the operation schedule was explained. The main features are

* The schedule is alternating between the two separators and low energy and HIE ISOLDE
* Times for target change, setup (separator, RILIS, linac), yield tests, experiment are fixed at certain dates in the week.
* Requires target changes on Friday morning and a timely provision of the target documentation

This schedule would allow 10 one-target experiments.

T. Cocolios reminded about the ongoing investigations to overcome the HRS/GPS bottleneck using the concerted switching of the switch yard synchronous to the PSB.

Richard noted that the set-up time in the proposed schedule might be too short for the low energy part.

Alberto informs that 2 operators will be present during beam set-up for HIE ISOLDE. Occasionally a third person will be present.

**7. Proton beam Intensity limitations - J. Vollaire**

The origin of the 2uA proton intensity limit was researched. It originates from a report that was filed after an incident where the activity released from ISOLDE triggered the alarms at the gates, which led to inconveniences at the RP check at the goods reception. Since then the 2uA have been set as an operational limit to avoid interference with the gate monitors. The earlier Sullivan report stated a limit of 2x10E20 protons on target. This is seen as a working assumption.

A weakness in the shielding of ISOLDE was pointed out. The location is at the Rte. Democrite near the BTY line. A relative measurement has been performed to set the alarm of the detector closest to this location inside ISOLDE. It is not evident if the radiation levels come from scattering from the GPS target or losses in the BTY.

R. Catherall suggested a test where protons will be taken with and without an installed target. Preferably before the start of PS.

Conclusion is that the operational limit of 2uA can be increased. The alarm levels within the facility, however, will not be changed. The limit of 2x10E20 POT was set for a beam energy of 1GeV. This needs to be reassessed for 1.4 GeV.

For the 2GeV upgrade of PSB, a new safety file for the Booster is required. M. Borge noted that for n-rich isotopes the 1.4 GeV need to stay an option. J. Vollaire noted further that in terms of RP co-operation of GPS and HRS is preferred.

T. Cocolios noted that there are periods with less than 1.7uA were available for ISOLDE and questioned if PSB can deliver more intensity to ISOLDE even though we would be allowed.

V. Fedosseev reminded that even though the target water distribution panel was removed from the roof of the RILIS cabin, the neutron flux from the HRS remains. J. Vollaire will work to reassess the neutron levels from HRS.

Action: RP (c.c. D. Forkel) will provide new p intensity limits to OP.

Minutes by S. Rothe/T. Stora