

**DRAFT.**

**Present :** Richard Catherall, Valentin Fedosseev, , Kieran Flanagan, Tim Giles, Karl Johnston, Gerda Neyens, Sebastian Rothe, Thierry Stora, Stefan Roessler, Bruce Marsh, Bettina Mikulec, James Cubis, Ronald Garcia Ruiz, Stefan Malbrunot

By video or phone bridge : Alex Gottberg , Thomas Cocolios, Pierre Delahaye, Bertram Blank (up to point 5)

**Excused :** Karsten Risager, Klaus Blaum

**Absent :** -

Link to the meeting : <https://indico.cern.ch/event/726282/>

**1.- Agenda, minutes of previous meeting – G. Neyens, T. Stora, All**

Minutes of the previous meeting were approved with the following comment:

The LIST : Tests with radioisotopes were done at Isolde not at Mainz university.

**2.- Options for ISOLDE offline collections at MEDICIS (Karl Johnston)**

With the new capabilities offered with the MEDICIS facility, questions arose as whether some parts of the ISOLDE program concerning irradiations/collections could take place there, especially during LS2 while some infrastructure is being replaced at ISOLDE. This option is possibly a nice opportunity for some proposals mostly in the Solid State Physics program or for joint projects, such as 53Mn implantation for a nTOF project.

Several experiments could benefit from this possibility: this would be 57Mn from ZrO targets, 73As, 67Cu for Mossbauer spectroscopy, 119Sn , 172Lu from TRIUMF for PAC – and could make a good link with medical activities, 147Gd

Additional technical questions were discussed on the collection chamber at MEDICIS: It is already equipped with beam sweeping capabilities, but it is not equipped with variable and high implantation energy (100-200kV).

The MEDICIS facility has been approved for Medical Applications, however this program does not fully use yet the full capabilities of the facility and some time could be available for the ISOLDE program. The proposed approach is to streamline the proposals from INTC through the physics coordinator Karl Johnston. For information, the present average MEDICIS membership is 50kCHF. To note that 67Cu is an interesting isotope with common request/interest for both MEDICIS and ISOLDE. Upon confirmation to the MEDICIS board, CERN Management should be approached.

**3.- Update of offline 2 separator and availability during LS2 (Tim Giles)**

The project of the Offline 2 (OL2) isotope mass separator is presented. This new offline separator serves to complement the existing offline separator (“Offline 1”). It can produce

beams at 60kV, duplicates the existing ISOLDE Front-Ends, has a dedicated laser laboratory, and a complete RFQcooler-buncher (RFQcb). The present points for improvements are the magnet power (not stable enough) and the high level controls, with the initial idea to map the existing ISOLDE control architecture. Instead a Labview-based high-level control could be adopted. The RFQcb is cooled down with water, the vacuum systems are installed and commissioning is pending. The last steps are controls finalization and tests with beams.

The foreseen activities are the commissioning of FE10 and FE11 during LS2, expected to start in November. It will include mechanical and electrical acceptance tests before its use on OL2.

Tests of cooling and bunching are foreseen.

A new TOF detector was tested already at ISOLDE (not implemented on OL2). The emittance meter is missing its control software. The Laser room equipment is progressing, its activities might be covering laser scheme development, TOF-LIS, etc

Budget : expected 2x250kCHF , spent 228kCHF, for this year 314kCHF (waiting for go/no go) : this is delaying the project and constitutes at present the main bottleneck. This is unfortunately in a context of 80MiCHF missing budget for LS2 operation.

The request for support of the Laser Lab at Offline at a level of 360kCHF was brought to EN-STI management but was not accepted.

Follow-up before summer will be required.

#### **4. Beam development activities for LS2 (Sebastian Rothe)**

The exploitation of non-actinide materials is important since they exhibit faster release properties. At present, no possibilities to handle materials at CERN exists. A derogation is being put forward to HSE. The temporary solution of using EPFL laboratories is no more possible, other options could be towards Lyon/FR or IST/Portugal.

Recent developments took place on the heat management of the targets for MEDICIS, and this could find applications for ISOLDE units. Other activities cover:

Sintering studies of UC<sub>x</sub> with INFN/LNL, material pre-treatment and conditioning for management of impurities, molecular beam chemistry with a dedicated set-up, which is used for volatilization, release and purification. Uranium carbide synthesis optimization, ThCx investigations. The development of two neutron converters (for ISOLDE and for TRIUMF), of a Mass Marker and autopsy of used targets, Design of new cavity for VADLIS 2.0, develop a low temperature VD7 ion source, progress in simulations (VSIM, COMSOL) in collaboration with SCK, TRIUMF, implement a TOFLIS for purifications, 2photon laser ionization, negative ion source for yield and purity, integrated yield measurements, unit and component stress testing (eg high temperature limits).

RILIS will investigate more elements and isomer selectivity

On the infrastructure side, the gas injection will be upgraded with a loop injection instead of a line to recirculate the gas and add a filter. The Yield Database is being elaborated. The Isolde

timing is upgraded, Lasers are set-up at offline 2 and MEDICIS, the RILIS control system is being upgraded, as well as developments of unified controls and target health monitoring.

The Priorities will need to be established as the budget and staff level will remain the same. Eventual support from the BE-OP group might be provided during LS2.

## **5. Options of on-line/off-line developments with sister ISOL facilities (A. Gottberg, P. Delahaye)**

Options for joint developments exist, with eg TRIUMF. The MoU has been signed. Common interests exist for target materials (besides ThCx), SiCs nanofibers, ongoing ion source simulations are taking place with a student using Comsol Multiphysics. A new version of the IG-LIST has been developed, general scheme developments using Ti:Sa lasers is ongoing, a dedicated stand is used to understand molecular beam formation associated with a more pragmatic approach. A multistage extraction electrode is further investigated, and finally the FEBIAD source is operated with cathode biasing instead of anode biasing.

The ARIEL project is investing extensive resources on the development of the Target and Ion source module, such as metal seals, replacement of copper parts, development of 2400A aluminum connectors, remove water cooling for the seals, and improved the High Voltage delivery system.

On New target concepts, ongoing collaboration is taking place on the p-to-n converter, and new ones could be put in place for high emissivity or TaC coating, common interest for offline tests, and collection of medically or industrially relevant isotopes.

Pierre Delahaye presented the situation at GANIL and SPIRAL 1. Very limited collaborative operation will be possible, but for instance ongoing activities are taking place within Beamlab Task of the EURISOL JRA in ENSAR2. Studies of projectile fragmentation and target combination for the production of Cl, P isotopes; VADIS is already used for SPIRAL 1 upgrade and high intensities beams were obtained in 2013, however they are difficult to reproduce. The insulators of BeO are changed into BN. In past April, 2 units were conditioned and one failed. A review was set up with U. Koester, A. Gottberg and T. Stora to rapidly find solutions, eg for better thermal protection of the insulators. Next beam time will take place on 10-11<sup>th</sup> May with Ar36 beams. Future R&D efforts will be on 28Mg, 25Al, 30P and also 56Ni that failed this year.

Other developments of a fusion-evaporation unit for N=Z beams are ongoing with the ALTO facility where tests are planned, as well as possible SnS<sup>+</sup> beam production.

Emissivity measurements will take place.

In 2019/2020, there will be 3.5 respectively 2 months of beam time will be granted, as SPIRAL 2 will start operating in 2020.

## 6. Regions of improvement with 2GeV proton beam at HIE ISOLDE (G. Neyens, J.P. Ramos, M. Mougeot, J. Cubiss, R. Garcia Ruiz, S. Malbrunot)

G. Neyens had a meeting with the directorate to elaborate on the future HIE-Isolde facility and its complementarity with the SPES, SPIRAL 2 and FAIR facilities.

The intensity upgrade might be somewhat limited as issues are found with the Ion source of Linac 4.

The beam dump project led by R. Catherall was granted a 5 MiCHF budget and is already being prepared (see last part of the minutes)

Results on simulations for Isotope production were reported with 2 codes by J.P. Ramos:

ABRABLA (Cross section), Fluka : full multiparticle transport code

ABRABLA : was run with  $1e9$  events. 2 core, and FLUKA with 100 cores

In all cases, FLUKA seems to underestimate spallation. During simulations, 2 versions had to be used Fluka2017 v1.0 to Fluka2011 v2 x.1 leading to Variation of +/- 50%

On Lanthanum Carbide targets : some increase was seen with ABRABLA for  $A=2/3$  from target); In the 100Sn region : computing cross section : x1.4 seen. For SiC: no big change. For Y<sub>2</sub>O<sub>3</sub>, CaO all light elements are enhanced.

On UCx, simulation both ABRABLA/FLUKA v2017, there is a strong gain in the radiolanthanide spallation. Folded with release, eg Radiolanthadine from ThO are released

This would be a niche unique for Isolde.

In other regions, some isotopes are enhanced : n-rich Ni (Th), n-rich fragment : x2 increase.

Proposal was made to use Geant 4 as done in TRIUMF.

Finally, for the n-converter, neutron multiplicity will be gained going from 1.4 to 2GeV

### Physics cases :

#### Ronald : Laser Spectroscopy

Collaps: Ca, Sc, around doubly magic nuclei, Ca region would benefit.

For the neutron-deficient region : n def Sn: x1.4 gain, x2 intensity

For the n-rich region with n converter: new n-converter : Sn, Sb, would be of interest.

An important case would be proton emitters : <sup>147</sup>Tm current is 200/s from Ta.

<sup>151,152</sup>Lu : from Ta Th targets at 1 ion/s : would also gain a lot.

#### Stefan : fundamental symmetry (with input from Bertram, Natal)

MR-Collaps (MIRACLS): it enhance what collaps does.

The goal is extending collaps in the n-rich region Mg<sup>34</sup> and beyond

n-def Cd, in the N=50 shell closure region : gain x2 2GeV, increased intensity.

MR-TOF wfor beam purification (SSP, medical, PUMA, fundamental symmetries)

PUMA antiproton to probe proton tail in exotic nuclei

The following part is particularly important

Some experiments will benefit on the 100Sn (2Gev) enhancement.

10C is an important case for: physics beyond the standard model, and also for 14O (input from B Blank).

For Isospin correction plots, 70Br, 66As: the gain is not large

For 32Ar, 20Mg : this covers beta delayed studies and any gain are important.

For N=Z beams Indium, gain is extremely important.

#### James Cubiss:

Interest lies with In source laser spectroscopy in the Pb region; 70 ground and isomeric states have been measured.

For 186Bi studies : 1alpha/20minutes have been used, same as Hg. Slow deformation.

For beta delayed fission : big impact on theory team (nuclear and astrophysics: end point of the r-process), also for 178Tl and 188Bi.

Possibilities in the future : Definitely niche for n-def isotopes heavy.

Joachim Cederkall :

HIE-ISOLDE cases covered : n-def Cd, In, Sn. Heavy elements (target development would be required in addition).

#### ISOLTRAP - Maxime Mouget

Interest for mass measurements lies in rp process nuclei : 56Cu is already done in USA, 58Zn, 64Ge

98Cd, 99-101In : from LaC target is already done

neutron-deficient Pb region : collaboration with the windmill/rilis groups for measurement towards 170Au

#### **Beam Dump upgrade project**

The third LS3 will take place in 2024-2025 may impact only LHC operation. The Isolde beam dumps need to be changed, as undertaken by EN-STI (TCD). Experience acquired with the exchanges of the PSB dumps will be beneficial. Funds are secured, the project will start in 2020-2022 for a change in 2024. Shielding will also be consolidated. New designs of Front-Ends will be prepared for LS3. Concerns lie with the activation of the surrounding earth and its activation.



## **6. Follow-up on previous meeting – T. Stora**

Requests about the ppm/multiuser capabilities of ISOLDE beam line should be followed-up.

## **7. AOB and next meeting**

Next meeting : planned and confirmed with a doodle poll.

Minutes by T. Stora