Draft Minutes of the 86th Meeting of the ISOLDE Collaboration Committee

held on November 5th 2019

Present: T. Bjørnstad (replacing S. Siem), B. Blank, R. Catherall, J. Cederkall (via Vidyo), D. Doherty, H. Fynbo, K. Johnston, N. Marginean, D. Naidoo (via Vidyo), A. Nannini, G. Neyens, J. Pakarinen, M. Pfützner, J.A. Rodriguez, K. Riisager, L. Schweikhard, N. Severijns, E. Siesling,

Excused: M. Venhart

Invited: K. Flanagan, G. Georgiev (via Vidyo), D. Lupascu, M. Madurga (via Vidyo), A. Obertelli, W. Venturini Delsolaro, J. Vollaire

Absent: S. Gilardoni, A. Lagoyannis

The meeting starts at 09:00 h

1. Introductory remarks

The ISCC chairperson, B. Blank, opens the meeting and informs the committee that T. Bjørnstad replaces S. Siem as the Norway representative at this meeting and that the South Africa representative, D. Naidoo, as well as J. Cederkall, the Sweden representative, will join the meeting via Vidyo.

The next chairperson K. Flanagan is welcomed to the meeting, as well as the future representative for France, G. Georgiev.

2. Approval of the Minutes of the last meeting of July 1st, 2019

The minutes from the previous meeting are approved.

3. Update on the repair and commissioning of CM4 – *W. Venturini Delsolaro*

Firstly, the committee is reminded of the steps that took place toward the repair of CM4 earlier this year after it was transported to SM18 in March. The cryomodule was then moved to the test bunker M9 on the 26th of June, after which cryogenic and RF connections were made and warm calibrations took place. However, actions required due to cryogenics limitations in M9 and the need to adapt the software involved, meant that cool down of CM4 could only start on the 1st of October. Unfortunately, the cool down power was found to be insufficient to overcome the transient heat load with the temperature reaching equilibrium at about 260K. After further investigation and simulations it was concluded that the problem is most likely due to thermal exchange with residual gas and that this issue should be solvable by installing more pumping speed; it should be fixed when using cryopumping. Further tests are now ongoing to ensure that all suspected non-conformities of CM4 can be excluded and the cool down problems experienced at M9 can be attributed to SM18 installation alone. However, if this is not the case and CM4 has to be reopened to solve any issue, there would be a delay of about 3 months; as the entire margin has already been used, the cryomodule would not be ready for

the 2020 machine commissioning run as scheduled. A decision about this matter will be taken at the beginning of December.

In reply to a question from G. Neyens, W. Venturini Delsolaro clarifies that results of tests run so far show that the problems with CM4 for which the repair was originally scheduled have been solved.

4. Update on ISOLDE front-ends and start-up plans for 2020 – *J. Vollaire*

The committee is reminded that it is planned to replace two front ends during LS2. Front end 10 has been moved to the offline 2 test bench where it is almost ready to start 9 weeks of beam tests. It is planned to transfer this new front end to the target area in January ready for testing in February. All pieces for front end 11 are ready and assembly, facilitated by experience gained with front end 10, has begun. It is hoped to transfer this second new front end to the target area in spring 2020 after testing at offline 2 is completed.

J. Vollaire briefly summarises the shutdown work completed and ongoing at the ISOLDE low energy facility as well as REX and HIE-ISOLDE. All systems are on track to be ready to start running/commissioning with stable beam in summer 2020 pending schedule approval. This would allow the intense REX/ISOLDE re-commissioning program as well as test and development runs to take place in 2020 ready for physics to start as early as possible in 2021. However, the decision on the request to start up the ISOLDE facility as early as summer 2020 is still under discussion. R. Catherall will present and defend the request to the LHC IEFC (Injector and Experimental facilities Committee) at the end of November, which will in turn make a recommendation to the Research Board for final approval of the resources and cost in December. The extra operational costs for this early start up are estimated to be 130kCHF. If the request for commissioning in 2020 is not approved, low energy physics would start about one month later than planned in 2021 and HIE-ISOLDE physics would experience a delay of about four months. The beam commissioning activities and machine studies planned in 2020 are then detailed. The committee is told that the situation with the repair/testing of CM4 means that an early start up is essential. However, J.A Rodriguez states that if the issues with CM4 are not solved much of the planned HIE-ISOLDE commissioning tests will no longer be useful.

The committee is then informed of the promising results obtained in the optimisation of UC_x target production with the carburization stage being reduced from 120 to 15 hours by increasing the pressure limit. However, the microstructural characterisation of the UC_x still has to be validated and isotope release tests will need to be carried out online.

Work that is taking place towards the restart of manipulation of non-actinide nano materials at ISOLDE is summarised. It is hoped to ensure safe in-house production of MWCNTs (Multi Walled Carbon Nano Tubes) and other non-actinide nano targets after LS2. Target disposal activities taking place at ISOLDE during LS2 are then presented, which include hot cell commissioning and oxidation of nano-size Uranium Carbide. Finally the committee is informed that the civil engineering required for the new nano-lab will begin in January 2020 making access to building 179 difficult for large items between February and May.

5. Introduction to EPIC and discussion – *K. Flanagan and G. Neyens*

The reasons behind the EPIC project are summarised. The ISOLDE facility is unique thanks to 1.4 GeV protons impacting on thick targets and has more than 50 years of experience in the production of pure radioactive isotopes and beams. More than a third of all known isotopes and more than 70 different elements are already available at ISOLDE with more than 10 permanent experimental set-ups available and even more in the pipeline. A very diverse research program takes place at ISOLDE using exotic isotopes and molecules and it can also be said that the ISOLDE facility is complementary to the new large RIB-facilities around the world such as FRIB (MSU), RIBF (Tokyo) and FAIR (Darmstadt) which are all based on projectile fragmentation. Since 2001, re-acceleration of

radioactive ion beams has been available, first with REX and now HIE-ISOLDE. RIB energies can now reach up to 9.5MeV/nucleon. On average, about 45 experiments take place every year with about 500 people coming to CERN to take part. Since post-accelerated beams became available, the user community has continued to expand with more than 900 people now registered as ISOLDE users from 200 institutes in 43 different countries. Hence, there is a need to increase capacity and capability of the facility.

K. Flanagan reminds the committee that the EPIC project (Exploiting the Potential of ISOLDE at CERN) was the ISOLDE Collaboration input to the ESPP. It includes the following four parts:

- Take advantage of LIU upgrades (the increased BOOSTER p-energy (2 GeV) and LINAC4 intensity increase (4 μA)): At ISOLDE this will produce higher radioactive beam intensities for fragmentation and spallation products but will require new beam dumps to cope with the higher power and a new transfer line from the booster to ISOLDE. The cost of this part of the project is estimated to be 9MCHF and installation work would ideally take place during LS3.
- Install additional target station(s): This will provide multiple simultaneous and better quality beams allowing parallel low/high energy experiments and hence increasing the number of users able to use the facility. Two new proton beam lines and two new target stations will be required to achieve this section of the project as well as a new high-resolution mass separator with parallel beams to low-energy ISOLDE and HIE-ISOLDE. The cost is estimated at 67MCHF.
- A new compact storage ring for short-lived isotopes: Stored radioactive beams can be used multiple times in an in-ring detector and can be cooled to deliver excellent quality beams to external experiments. Hence, the storage ring would be useful for a range of research areas. The estimated cost of such a device is 17MCHF.
- A new experimental hall: More than five new low-energy and two new HIE-ISOLDE experimental set-ups are currently looking for space that is not available in the present ISOLDE hall. A new hall would help cater for the growing interest in ISOLDE as well as the continuously expanding user community.

The impact that these upgrades would have on physics at ISOLDE is then summarized and the program of the EPIC workshop, that will take place at CERN 3-4 December, is presented. K. Flanagan explains that the EPIC project was created when the UK funding agency, STFC, requested ideas for long-term projects in particle, nuclear and astrophysics. The STFC then requested a short document outlining the EPIC project at ISOLDE which has since been submitted. The project has also been discussed with CERN management who have asked for it to be decided in detail what upgrades are required and for them to be treated together as one project. Hence, it is now important to produce a conceptual design report and set-up working groups in order to involve the whole ISOLDE community in the decisions on the future of ISOLDE and to have any chance of getting funding. The EPIC workshop in December is the first step towards the preparation of such a report; G. Neyens tells the committee that new ideas are still welcome at the workshop and can still be included in the project.

A discussion on how to move forward with the project then takes place. R. Catherall tells the committee that the EN-STI group will have a CERN fellow starting in 2020 to work on the new beam dumps and that it would be good to have someone else working in parallel on the conceptual design report. The committee decides that the December workshop should focus on making a decision about what the ISOLDE physics community wants and after that other scientific communities, experts and funding agencies can be approached. Each country's funding agencies will have to be approached separately; it is important to know if CERN will cover the civil engineering costs involved in the project, as it has done in the past, because national funding agencies are hesitant to invest in bricks and mortar in other countries.

ISCC members are urged to mobilise their colleagues to attend the EPIC workshop and become involved in the project.

6. Short History of NICOLE – *N. Severijns*

A brief summary of the history of the NICOLE experimental setup as well as its scientific output and associated manpower are presented. After the initial proposal was accepted in 1985, NICOLE was initially installed in the ISOLDE 3 Proton Hall at CERN's SC in 1988 where it was operated by the NICOLE collaboration until 1992. A team from KU Leuven, University of Bonn and Oxford University then moved the setup to ISOLDE at the PS-Booster in 1993 where it was used by two separate collaborations, one lead by KU Leuven and the other by Oxford University. During this period KU Leuven took care of full maintenance, including major repairs in 1997 and 2008, and provided the necessary budget. The scientific direction of the two collaborations as well as the results obtained are briefly presented.

The committee is told that in 2010 a super leak was observed which is very difficult to locate and repair as it only opens up at T<1.4K. At this point the KU Leuven team decided to stop its involvement in the setup as the fridge was more than 25 years old. The Oxford University team, however, decided to continue working with the setup.

N. Severijns explains the limitations of using resistors to measure the low temperatures at which the NICOLE fridge is required to operate.

7. The MultiPAc project – *D. Lupascu*

The physics behind the proposed new MULTIPAC setup at ISOLDE is briefly explained along with the use of nuclear probes at ISOLDE to study crystal ordering and defects at, for example, domain walls. Long term perspectives include the study of multiferroics, magnetic systems, Ferro-, Ferri- and Antiferromagnetic solids, magnetic films and interfaces as well as magnetic molecules. The setup could also be adapted for the study of biomolecules.

The design of the MULTIPAC setup is presented which will be 1 Ton in total and use a 9 Tesla magnet. The setup will require $2x3m^2$ floor space and a ceiling height of 3.5m to allow for inserting radioactive samples into the vertically oriented magnetic field along the room temperature bore. Cooling water will also be needed as well as 16A three phase for the 3 cryo coolers that have a volume of about $1m^3$. In order to reduce the floor space required for the coolers they could be placed on top of each other and they come with tubes of over 6m so it is possible to place them away from the setup. The cryo coolers have been designed to have a low noise level (less than turbo pumps) but it would be possible to box them if required.

D. Lupascu tells the committee that in theory the setup could be moved in and out of position but that it would be preferable not to have to do this. In addition, as the setup is not an online experiment, it could be placed in a building other than the ISOLDE hall, however, rules about the manipulation and transport of irradiated samples are becoming much stricter and should be verified.

The committee is told that a PhD student will start to work on the proof of principle experiments in Essen in March 2020 and that a technician would be available for the installation at ISOLDE, which is planned for 2021. The Universities of Göttingen and Aveiro are also involved in the project.

The committee discusses the proposed project and suggests that the next step should be the submission of a letter of intent (LOI) to the INTC. Then, if the LOI is endorsed by the INTC and the proof of principle experiments in Essen next year are successful, a technical status report illustrating readiness can be presented to the ISCC and experiment proposals submitted to the INTC.

8. Status of the NICOLE collaboration and set-up – *M. Madurga*

The technical status of the NICOLE setup is summarised. M. Madurga tells the committee that successful test runs took place in both September and October 2019 and that, based on the presented readout of temperature sensitive resistors, the NICOLE fridge has been brought back to the same stage as it was in 2009 when the last successful experiment was performed. However, when N. Severijns questions whether this conclusion can be made from the results presented, M. Maduga admits that a diffusion pump, instead of just the rotary pump used in the test runs, is probably required to reach the very low temperatures at which NICOLE needs to operate and that the actual temperature of the fridge needs to be verified using, for example, a nuclear thermometer. The committee requests to be informed whether only the tube in which the leak was found was repaired by ICE Oxford or if all the welds in the surrounding tubes were remade at the same time.

M. Madurga presents the present members of the NICOLE experiment and explains that NICOLE is an association of groups having two active experiments with the maintenance shared between these groups. Since 2012 NICOLE has been part of Serbia's commitment to CERN, led by M. Veskovic, and has received 10kCHF dedicated funding per year from the Serbian government. At present, all other funding for the NICOLE setup is either in kind or in the application stage so no commitment can currently be made about when someone can be stationed long term at CERN to take care of the setup.

Possible future experiments at NICOLE are then presented which include beta-delayed neutron and proton emission, parity and time-reversal conservation in nuclei and medical applications. Finally, M. Madurga discusses the planned technical developments and upgrades as well as improvements to the neutron detector. It is planned to apply for funding in the United States to buy a modern fridge and to explore the possibility of a Compton polarimeter that would register both the recoiled photon and electron in order to reconstruct the Compton event. The committee is told that the funding application for a modern fridge would probably take between 2 and 3 years and the construction would then take upwards of 6 months.

The committee then discusses issues such as the age of the NICOLE setup, manpower availability, the experimental programme and the planned upgrades. Final conclusions are made at the end of the meeting, after all new projects have been presented.

9. The PUMA project – *A. Obertelli*

The committee hears how the PUMA project hopes to study the existence of neutron skins and halos in nuclei by using their interaction with antiprotons. The antiprotons will be collected at the ELENA facility. Interaction of low-energy RIB's with the antiprotons in a trap, will allow the density tail of radioactive nuclei to be examined at ISOLDE and the ratio of protons to neutrons in that tail to be measured. The PUMA collaboration is developing a Penning-Malmberg trap which will store 10^9 antiprotons at ELENA before being moved to the ISOLDE hall using a power crane. The trap will require extreme high vacuum (10^{-17} mbar) which it is planned to achieve using cryopumping with the objective of minimising the amount of residual gas entering the trap. While this is one of the main technical challenges of the project, simulations have proved its feasibility.

A. Obertelli briefly summarises the status of the development of the PUMA trap and solenoid. The committee is told that, after a letter of intent was submitted to CERN in 2017, a suitable location for PUMA was identified at ELENA and an Engineering Change Request (ECR) to install the PUMA trap at ELENA has been produced. The ECR requests the allocation by CERN of the 700kCHF needed to adapt ELENA for the PUMA project. A similar study should be made to estimate the costs for changes necessary in the ISOLDE hall, in order to prepare for installation of the trap at ISOLDE. R. Catherall states that the cost of the beam line that would be needed up to MIRACLS and from MIRACLS to PUMA must be included in this request. A platform for the diesel generator required to safeguard against any power cuts is still under discussion.

The beam requirements for PUMA to operate at ISOLDE are then presented and the committee is told that floor space of 4m x 6m will be needed along with a height of 3m. The setup will also require electrical power of >90kW with power being available at both the setup's final position and during its installation using the crane. Cooling water (max 28 degrees and 40 litres/minute) as well as a vacuum of better than 10^{-9} mbar are also requirements of the setup. A schematic of the installation of PUMA is presented showing a cryogenic Paul trap, MR-ToF and differential vacuum pumps required in front of PUMA itself. MR-ToF based beam preparation is thought to be the best option for PUMA with respect to purity, timing and emittance and collaboration with MIRACLS and the University of Greifswald regarding this issue is foreseen. However, at present, there are not many options that can provide the necessary footprint in the ISOLDE hall for PUMA, the required beam optics and MR-ToF. It is suggested that PUMA could be positioned either in the high-energy zone taking beam via the NICOLE beam line, or on a platform.

The proposed schedule for the PUMA project during the period 2020 to 2023 is presented. The CERN SPSC received the PUMA proposal in November 2019 and will discuss it in January 2020; the cost implications for ISOLDE have to be prepared by E. Siesling and sent to the SPSC by January 2020 so that a decision about PUMA can be made at the next SPSC meeting. If the SPSC gives a positive response, it is then planned to submit proposals to the INTC in 2021 with the first PUMA experiments hopefully taking place at ISOLDE during 2022. Finally, the collaboration working on the project is presented.

The ISCC states that it is impressed by the work that has already taken place and supports the further preparation of the PUMA project. The committee is prepared to liberate the space required in the ISOLDE hall.

10. News from INTC – *K. Riisager*

It is explained that most nuclear physics facilities have a time-out policy for approved experiments and the INTC believes this to be appropriate as a general policy for ISOLDE. From now on experiments will be approved for the duration of a particular CERN run. This means that for the next few years experiments will be approved for CERN Run-3 (the period between the 2nd and 3rd long CERN shutdown); in special cases, longer time scales may be needed and experiments may ask to retain remaining shifts beyond this period. This new INTC policy was endorsed by the CERN Research Board in September 2019.

K. Riisager informs the committee that a replacement has already been found for one of the two outgoing INTC members and that the new INTC chairperson, M. Pfützner, will take over from April 2020 after the final experiment status reports are given in February.

11. News from ISOLDE, Collaboration matters and Update of MOU annexes approval – *G. Neyens*

The committee is informed that the Czech Technical University (Prague) has signed an institute membership agreement and paid its 10 kCHF fee for 2019. However, the Bose Institute in India has still not signed the agreement that was signed by CERN and sent to the institute some months ago.

G. Neyens tells the committee that 10 member states have already paid their membership fees for 2019 but payments from Sweden, Greece and Spain are still outstanding. Poland is unlikely to have the funds to pay its membership fee for 2019 but is still looking for a solution, and Slovakia is experiencing difficulties with the payment of the invoice that was issued to them. It is explained that a group of Portuguese institutes will make a one off contribution to the collaboration of 10K Euros of which about 7 kCHF has already been received.

It is stated that the revised ISOLDE MoU Annexes had been distributed to committee members and G. Neyens briefly presents the additional changes that have been made since the document was sent out. The positions of ISOLDE Operations Section Leader and Deputy ISOLDE Technical coordinator have been added to the list of ISOLDE management positions and it is suggested that all management positions mentioned in this list should have observer member status of the ISCC, INTC and GUI. This has already been approved for the ISCC and GUI.

The present manpower situation in the ISOLDE Physics Group is then summarised by G. Neyens.

- **Associate:** Deyan Yordanov (February to December 2019)

- **Staff Members:** Stephan Malbrunot-Ettenbauer (ERC MIRACLS) (February 2017 to January 2021), Karl Johnston (Physics Coordinator) (October 2015 to September 2022), Gerda Neyens (Physics Group Leader) (June 2017 to June 2021).

- **User:** Jenny Weterings (User Support) (2002-)

- **Research Fellows:** Hanne Heylen – COLLAPS/MIRACLS (October 2017 to September 2020), Ronald Garcia Ruiz – CRIS (January 2018 to December 2019), Maxim Mougeot – ISOLTRAP (Sept 19 – August 2021)

Deadline for new applications: 2nd March 2020.

- **Applied Fellows:** Joonas Konki – HIE-ISOLDE Experiments (March 2018 to February 2020), Simon Sels – MIRACLS (April 2018 to March 2020), Dinko Atanasov – WISArD & Low Energy Experiments (April 2019 – March 2021), Markus Vilen – MR-ToF for ISOLDE and MIRACLS (October 2019 to September 2021). Deadline for new applications is the same as for Research Fellows, 2nd March 2020.

- **Doctoral Students:** Jonas Karthein (CERN via Gentner Doctoral Program) (November 2017 to October 2020), Varvara Lagaki (CERN-MIRACLS) (September 2017 to August 2020), Simon Lechner (CERN-MIRACLS) (September 2017 to August 2020), Jared Croese (CERN- EP-SME) (February 2018 to January 2021), Peter Plattner (CERN via Austrian Doctoral Program) (August 2018 to July 2021), Katarzyna Maria Dziubinska-Kuhn (CERN-ERC Betadrop) (October 2018 to September 2021), Karolina Kulesz (CERN-ERC Betadrop) (October 2018 to September 2021), Lukas Nies (CERN via Gentner Doctoral Program) (November 2019 to October 2022).

G. Neyens informs the committee that no new European funding project has been approved to replace ENSAR2 which could mean that less young researchers might be able to come to CERN to take part in experiments at ISOLDE, and no external funding is available for hiring applied fellows. In addition, due to CERN funding issues, the number of CERN fellows at ISOLDE may be reduced in the future.

12. Discussion on space in the hall – roundup – *B. Blank and G. Neyens*

G. Neyens presents a procedure for experiments that will require space in the hall, to be followed by all experiments that would like to place a (semi-)permanent setup at ISOLDE. After a discussion, the following actions and timeline are proposed:

- At least 2-3 years before installation: Start informal discussions with those people responsible at ISOLDE (ISOLDE Spokesperson, Physics and Technical Coordinators)
- At least 1-2 years before installation: First present the project to the ISCC and then submit a letter of intent to the INTC. Both presentation and LOI should describe the aim of the physics program, a preliminary design and footprint of the setup, resources available and the services required.

- After endorsement of the physics program by the ISCC, the INTC and the CERN Research Board: Start detailed planning for the integration of the new experimental setup in the ISOLDE hall with both the ISOLDE Physics and Technical coordinators.
- When ready: Submit a proposal to the INTC to request beam based on a specific physics case.
- After the INTC has awarded beam time : Start installation in the ISOLDE hall.

The steps already undertaken by both MIRACLS and the PUMA project are summarised. MIRACLS is now approved and discussions are under way to identify a suitable location in the hall for the setup; the start of installation is planned for the end of 2020 or early 2021. If the PUMA project is endorsed by the SPSC and the CERN Research Board in January 2020, planning will begin in order to find space in the ISOLDE hall with installation foreseen in 2022/2023.

The status of the other new permanent experimental setups that are presently in the pipeline is presented. As noted in section 7, the next step for MULTIPAC is to submit an LOI to the INTC while the upgraded ASPIC setup will have to follow the above procedure from the beginning, as there are presently no INTC approved experiments associated with it. GANDALPH is currently discussing with CRIS the possibility of coupling to their Charge Exchange Cell in order to provide a source of the negative ions it requires. The joint ISOLDE, EN/EP project to build a 30kV MR-ToF for beam characterisation is still being developed. The committee is informed that the AGATA detector will not be coming to CERN in the next 8 years.

The committee then discusses the future of the NICOLE setup at ISOLDE. The discussion includes the manpower available compared to that of other permanent setups at the facility, the size of the collaboration and its finances, as well as the possibility of carrying out the proposed physics programme elsewhere. The committee acknowledged that some positive steps have been taken by the NICOLE collaboration. However, due to the lack of manpower stationed at CERN repair of the fridge has been carried out with small incremental steps and temperatures below a few 100 mK could not be achieved after more than 5 years of repair work. The ISCC decides that, if the INTC does not approve either of the two proposals submitted by the University of Tennessee at its meeting of November 6th 2019, the NICOLE setup should be removed from the ISOLDE hall. The committee will, however, consider the case for a new setup, based on a new cryocooling system as proposed by the University of Tennessee group, if and when it is developed.

13. Discussion on functioning of ISCC– *B. Blank*

After discussion, the committee decides that speakers at future ISCC meetings should upload their presentations to the meeting Indico website at least 5 days before the event. This should allow members of the committee to better prepare for the meeting and, hopefully, aid discussions. The committee prefers the ISCC meetings to continue to be scheduled the day before INTC meetings but the issue of whether 2 or 3 meetings a year should take place is still to be decided.

14. A.O.B

- B. Blank informs the committee that it is his last meeting as chairperson and that G. Georgiev will take over from him as the representative for France from the beginning of 2020. He conveys his best wishes to the future ISCC chairperson, K. Flanagan, and the committee thanks him for his hard work and input both as chairperson and representative for France.
- The committee agrees to give G. Neyens permission to, as a last resort, offer that the collaboration pay the 130kCHF required in order to ensure the requested earlier start-up in 2020.

15. Dates of the next meeting

The date of the next ISCC meeting is proposed to be Tuesday 4th February 2020, but a doodle will be sent out to confirm this.

Meeting ends at 17:15.

N.B. The overheads of the above presentations can be found via https://indico.cern.ch/event/854227/