

Minutes of the TIARA 12th Collaboration Council meeting

CERN, 20th of February 2019

GC participants:

In person : Roy Aleksan (RA, CEA), Frédéric Bordry (FB, CERN), Phil Burrows (PB, UKRI), Antoine Chance (AC, CEA), Tord Ekelof (TE, UU), Wim Leemans (WL, DESY), Piotr Malecki (PM, IFJ-PAN) representing Marek Jezabek, Peter McIntosh (PMI, UKRI), Eugenio Nappi (EN, INFN), Jose-Manuel Perez-Morales (JPM, CIEMAT), Niels Pyka representing Peter Spiller (NP, GSI), Pierre Vedrine (PV, CEA), Maurizio Vretenar (MV, CERN)

By video: Jean-Luc Biarrotte (MB, CNRS), Terence Garvey representing Leonid Rivkin (LR, PSI), Suzanna Guiducci (INFN)

Invitees: Ralph Assmann (RaA, DESY), Sanja Damjanovic (SD, Minister of Science of Montenegro), Marcos Dracos (MD, CNRS), Gerardo d'Auria (GdA, Elettra), Michael Benedikt (MB, CERN)

Excused:

Welcome (Jose Perez)

JPM welcomes the TCC.

Approval of agenda (All)

The agenda is approved.

Approval of the minutes of the 11th meeting on November 15th, 2018

The minutes are approved.

General information (Roy Aleksan)

Wim Leemans replaces Reinhard Brinkmann as the representative of DESY. The deadline for the design study (DS) call is end November. Two presentations are scheduled: second version of a DS for FCC and hadrontherapy facility in the Balkans. From experience, each time there are two accelerator proposals, they are accepted. Proposing 3 proposals could be too risky. The total budget covers a total of 10 projects. The status of the different approved DS is scheduled. RA gives some news about INFRAINNNOV4 call. Three communities are targeted by EC: synchrotron (LEAPS), accelerator R&D (ARIES), and detector (AIDA) communities. EC has specially discussed with these 3 communities and ATTRACT. The still estimated budget per proposal is 10 M€. Discussion of FP9 is seriously starting in 2019. TIARA is in good position to discuss for FP9. Sustainability issues could be discussed within ARIES.

Updates on on-going projects

ESSnuSB (Marcos Dracos)

2 projects are running: COST action and EuroNuSB DS. EuroNuNet is a COST action for networking the neutrino-antineutrino community. ESSnuSB is aimed to add a neutrino facility near ESS facility. MD

explains the choice of the distance of the far detector and lists the possible candidate mines. The features of the DS are: 4 years, kick-off meeting on 15 January 2018 at Lund (ESS), end date on 31 December 2021, total cost of 4.7 M€, 3 M€ funded by EC, 6 WPs, and 15 participating institutes within 11 countries. MD shows the structure of ESSnuSB organisation and lists the participants. There is a clear synergy between EuroNuNet and ESSnuSB with a good overlap between both working groups. MD shows the status of hiring. Almost of post-docs are engaged. MS lists the 20 deliverables. 5 of them have already been delivered on time. The deliverable D6 (design of H⁻ source and its integration into ESS and RF upgrade studies) has been postponed from end February to end May. MD lists the 18 milestones. 3 of them have been delivered. MD shows the dissemination activities. A document has been submitted to the European Particle Physics Strategy Update (EPPSU).

MD explains the interest to use the second oscillation maximum to reduce systematic errors (5%, T2K after 10 running years 6%). ESSnuSB is the most sensitive to the value of δ_{CP} in comparison with other neutrino facilities (DUNE and T2HK). MD emphasizes that 2 mines are aligned for ESSnuSB: Zinkgruban (360 km) and Garpenberg (540 km). Using both improves the sensitivity.

The first annual meeting took place on 4-9 November 2018. MD goes through the different WPs:

- WP1 (management)
- WP2 (linac)
- WP3 (accumulator). Different schemes are being studied (from one to four rings). More rings has an impact on the cost but can save space charge effects.
- WP4 (target station). The design, already done within EUROnu, is being optimized for ESS.
- WP5 (detectors). Near detector is studied in collaboration with T2K. Its requirements have been delivered in August 2018. Far detector is MEMPHYS-like.
- WP6 (physics). MD shows the obtained precision with different scenarios.

MD explains there was a first report from the International Advisory Panel (IAP). MD goes through dissemination and outreach activities. ESSnuSB has a dedicated website: <http://euronusb.net>. First outreach action where the far detector is assumed to be located is scheduled in February 2019 with a high school and a symposium. Next annual meeting is scheduled in Zagreb in October 2019.

MD shows the schedule: construction from 2027 to 2034 and data taking from 2035.

ESS is having a lot of problems in funding and has decided to go down from 3 MW to 2 MW. TE explain that there is a hope to have time for an upgrade to go to higher power. The total cost to upgrade the RF power is 100 M€, small compared to the total cost of 1.5 G€. However, situation is so serious that only 3 of 20 instruments will be funded in 2021. High priority is in building other instruments. Having another purpose (neutrino) could push to more energy (and beam power). Linac should be able to handle 4 MW. ESSnuSB uses 4 targets which have to handle less than 1 MW each. DUNE or T2K target can manage more than 1 MW. Targets should thus be able to handle the beam power. Reaching systematic errors of 5% is reasonable with ESSnuSB. Going below 6% will be very difficult for T2K.

CDR is to be delivered in 2021. Political support is necessary to go to TDR. Preparatory phase is scheduled from 2022 to 2024. The TCC reminds that being on the ESFRI list is mandatory to go to the preparatory phase. Next ESFRI call is in 2020. ESSnuSB has thus to apply to go farther.

CompactLight (G. d'Auria)

GdA shows the CompactLight (XLS) collaboration (24 institutes, 3 of them are out of Europa: 1 in China and 2 in Australia). GdA lists the participants. The features of CompactLight are: 3 years, start date on 1st January 2018, total cost a bit above 3.5 M€, 3 M€ funded by EC. The objectives are: high brightness electron injectors, very high gradient accelerating structures and undulators (cost drivers).

GdA shows the project structure and the interactions between WPs. GdA explains how the schemes will be selected, shows the time plan of the project, and lists the accomplished activities. Kick-off meeting took place on 25 January 2018 during CLIC 2018 workshop. First mid-term review took place on 19-20 June 2018. XLS user meeting took place on 27-28 November 2018 to understanding what photon beams users exactly need. First XLS annual meeting took place on 10-12 December 2018. GdA

lists the deliverables. 3 of them have been released. 5 are coming before June 2019. GdA lists the main talks given about CompactLight. GdA goes through the different WPs:

- WP1 (management and technical coordination, Elettra) and WP7 (global integration with new Research Infrastructures, Elettra).
- WP2 (FEL science requirements and facility design, UKRI). Survey was sent to over 50 European experts in October-November 2018. GdA lists the preliminary parameters of the CompactLight FEL. A repetition rate of 1 kHz is very challenging and may downgrade between 100 Hz and 1 kHz according to the results from the study. Pulse duration (0.1-50 fs) and pulse energy (<0.3 mJ) are within the state of the art. GdA shows one possible but preliminary configuration: 50 pC, 60 A from the gun, final peak current of 6 kA. Electron beam can be extracted at different energies: 5 and 7 GeV to get different photon energies (soft and hard X-rays).
- WP3 (gun and injector, INFN). Different solutions are considered like S-band (conventional), X-band (challenging), or DC gun. Compression schemes are considered (velocity bunching and/or magnetic chicane). Linearizer is addressed: X-band or K-band (very challenging) linearizers or passive linearizer (based on wakefields). X-band diagnostics are also being developed. GdA shows the example of the C-band gun design (240 MV/m and RF pulse < 150 ns).
- WP4 (RF systems, CERN). A 36 GHz linearizer is under development. Key goal is to standardize RF unit (X-band technology) to simplify the preparation of future construction projects and to save cost (industrialization). The linac is beyond the state of the art (a factor 2 comparing with SwissFEL). The availability time is to be maximized and should be greater than 95%. RF structure is optimized (length, and iris aperture) to find a trade-off between machine compactness and RF power requirements. Baseline accelerating gradient is 65 MV/m to reduce breakdown issues. GdA shows preliminary parameters of the RF structure.
- WP5 (undulators and light production, ENEA). GdA shows the different considered structures. GdA gives the example of one possible undulator. Gain length and saturation lengths are short (0.5 m and 13 m). GdA shows preliminary parameters for hard and soft X rays.
- WP6 (beam dynamics and start-to-end modelling, UA IAT).

Second mid-term meeting is scheduled in July 2019. The end deliverable of this DS is the design of a 5 GeV linac with FEL and its cost analysis. There are two options for the soft X-rays. Design will be probably taken by different institutes to propose a machine for their country. In 2020, a proposal and a site will be selected to go to ESFRI roadmap. A FEL has a huge cost and this cost increases with reducing the wavelength. As a comparison, the total cost of LCLS (1.3 km long, wavelength of 0.1 nm) is about 300 M\$. The cost of SwissFEL (750 m long, wavelength of 0.1 nm) is about 280 MCHF. The total cost of E-XFEL (superconducting, 3.4 km) is 1.2 G€. One of the activities of WP7 is to see how to save money in comparison with other NC machines. The total length of CompactLight is 300 m, which enables to save building. Other activities is to reduce the gap of undulators, their total length, and thus the building cost.

EuPRAXIA (Ralph Assmann)

CDR is to be delivered on 31 October 2019. RaA shows the structure of the project: 8 funded WPs and 7 in-kind WPs. The objectives are to build a 5 GeV electron plasma accelerator by solving the quality problem and demonstrating benefits in size, cost, or performance versus established RF technology. RaA reminds the strategy for accelerator innovation, lists the main features of the final electron beam (energy of 1-5 GeV, bunch length of 2-35 fs, and repetition rate of 1-100 Hz), the involved technologies, the acceleration schemes with achieved key parameters, and the beam transfer issues. RaA emphasizes the robustness of some results. New idea to reduce final energy spread is to couple a magnetic chicane to compress beam between 2 stages. Tests will be performed on ATHENA installation. RaA lists the main laser requirements. A lot of effort is needed to reach such an average power (more than 1 kW). One big issue is the laser efficiency: only 5% with pump lasers. Kilohertz 100 J lasers should fit in an area of a few tens of square meters. Advantage of lasers is to be stackable.

Combining fibre lasers is a studied option: European laboratories are skilled in this research field. Transport of the power to target is challenging with R&D needs: cooling, damage protection... RaA shows the state of the art of lasers (pulse energy and repetition rate). RaA explains that the key word is compactness which has driven choices. RaA shows the EuPRAXIA facility with two schemes: laser-plasma accelerator (LPA) to 5 GeV (DESY) or beam-driven stages to 1 GeV (LNF). RaA shows the concept of different user platforms in parallel and the EuPRAXIA market distributed between beam users. The different possible applications are listed. A survey was done with responses from 20 groups. French groups are missing. RaA explains the concept of open innovation. RaA shows the connection with other European countries. RaA gives some details on the LNF site. Construction is scheduled very soon. RaA gives some details about the site at DESY and its applications with 2 options (1 GeV and 5 GeV FEL). RaA gives the context with ATHENA flagship funded by 30 M€. Helmholtz institute visited DESY on 20 November 2018. RaA focuses on CDR writing (document of 400 pages). RaA shows the project timeline. Operation is planned from 2030. EuPRAXIA should apply to ESFRI in 2020 to begin the preparatory phase in 2022. How to keep funding, how to define collaborative structures, and how to follow up R&D after end of DS are big worries. An input was sent to EPPSU on 18 December 2018. The project has received support from Helmholtz association. RaA concludes that the project is on track for CDR in October 2019 but funding after the DS is an issue.

The level of funding expected for TDR is 50 M€ with a common effort of R&D. Applications should be distributed. With 2 complementary building sites (plasma driven and laser driven), 2 preparatory phases can be proposed. A strong argument is the strength of European laser industry and the need to defend this leadership. LNF site has already special funds to improve the infrastructure, and to upgrade SPARC lab. Within LEAPS, accelerator R&D is especially for photon sources and FELs (undulators). Competition with ARIES (generic R&D for accelerator) is to be avoided. This issue between TIARA, ARIES and LEAPS is to be clarified for FP9. WL explains that in the US, funds are driven by HEP roadmap. Accelerator R&D funds are going down there. Currently, it is difficult to define roadmap of light sources for 5 next years. Collaboration between US and DESY already exists. The construction cost of EuPRAXIA is estimated at several 100s M€. The TCC reminds that the cost of SwissFEL is 200 M€. EuPRAXIA project should be cheaper. Nevertheless, the extra cost of TDR is explained by a greater need for R&D.

SEEIST (Sanja Damjanovic)

Steering committee took place on 20 November in Vienna to coordinate this DS phase. Project has received 1 M€ to start the preparation. Logo exists now. 3 WGs have been defined: accelerator design (Maurizio Vretenar, CERN), R&D scientific accepts (Marco Durante, GSI), user tasks (Cosylab). To apply to the 3 M€ of the DS, a legal status is needed. Current status is an established association with Swiss law, which is not very known by EC. A lawyer in Geneva has been contacted. Money should arrive in the next 2 weeks. Building capacity is an important aspect for medical applications and hosting people. In 2020, 0.5 M€ will be spent to pay fellows. SEEIST will apply to Marie-Curie call: submission deadline is beginning of June. SEEIST will ask for 15 researchers from 15 countries by hoping students from Balkan countries. MD agrees to send the proposal to TCC under condition of not distributing them. Preparation of the DS call is of utmost importance and should start in March. Discussion with EC should speed up. Kick-off meeting will be organized in Montenegro, perhaps in June. Other event will be organized as a Minister meeting. Connecting both events will be tried.

The TCC insists that the proposal must be very well structured. DS call will open in July and close end November. Structure of the proposal will be divided in 3 aspects:

- Scientific excellence (top priority). Proposal should be aware that the goal covers medical and technological points of view. Beam time will be dedicated to treatment and to research. Obtaining certification of dedicated time to research should help. Scientific objectives are still

under discussion and should be settled end June. A non-exhaustive list is: innovation, science for peace, development for society, technological transfer ...

- Impact. Addressed questions are benefit from project to society and dissemination activities.
- Implementation

The current project structure is divided in 3 WPs: coordination and project management, medical centre and cancer therapy design, and technical and scientific design. The structure should be settled end March. A total number of 3 WPs may be too small and should be discussed. Help from TCC is welcome. Technical design but also technological transfer are to be cared. Estimated cost is 3M€ with a project duration of 3 years from Q2 2020 to Q1 2023. Envisaged participant institutes are CERN, GSI, and other institutes to be confirmed. The TCC insists on the importance to get a WP breakdown in order to get people involved and to know who is contributing. More detailed WPs are needed. A list of deliverable should be made as soon as possible. By June, more concrete document should be available. The TCC asks about the current collaboration with other hadrontherapy centres. WL recommends to discuss with ELI beamlines. The TCC asks about the scientific challenge. A workshop took place in Washington to address the major difference between short and long pulse treatment. The pulse length seems to be important for the oncology. Indeed, a long burst or a chain of short burst can have the same integrated dose but with peak doses, biological effects and oxidation damage are different. Such a mechanism is not well understood. ELI beamlines enable to go to a very peaky time structure in Prague. Having short pulses should be possible with SEEIST and drive the technology choice.

The TCC concludes that to have much more details and information from the proposal is important and is expected at the next TCC meeting early July. Structure of the proposal should be shown. FB is confident: MV is in charge of one of the WGs. Information should be shared.

Status of EuroCirCol and preparation of new DS (Michael Benedikt)

MV shows the general progress. Deliverables and milestones are on time. Project is prolonged with no extra cost to keep structure through European strategy, for FCC week in June 2019, and for beam screen tests at KIT. MB shows the status of KARA tests. Future steps are an upgrade of the beam screen at 77K (tests were performed at room temperature). Costs are shared with CERN. FCC week will take place on 24-28 June 2019 in Hotel Crowne Plaza in Brussels with final EuroCirCol DS meeting. Registration is already open. MB shows a draft programme. Different volumes of the CDR are accepted for publication in European Physical Journal C (Vol1: Physics) and ST (Vol 2 FCC-ee, Vol 3 FCC-hh, Vol 4 HE-LHC). Preprints are available since 15 January 2019. Summary documents were provided to EPPSU. Future DS project is focused on pre-implementation aspects of FCC-ee. MB reminds the structure of the call. A CDR for FCC-ee has already been released. However, for EU, EuroCirCol was only focused on hadron machine. MB explains the goals of the DS for FCC-ee. MB lists the high priority topics for a construction project by 2026 and the 7 WPs:

- Management and coordination (CERN).
- Particle accelerator/collider design (TBD).
- Key technology R&D (TBD). Additional matching funding might have to be found elsewhere.
- Infrastructure design (TBD).
- Host state realization concept (CEREMA, France). Other beneficiaries are identified.
- Cost benefit analysis and impact preparation (University of Milano, Italy: M. Florio)
- Public engagement (CERN)

MB has already discussed with Mr Froissard: he is open but this new DS should be very separate from previous work, which is not a showstopper: work here is complementary. Discussions will be launched later about possible WP coordinators when WPs are well defined. In EPPSU document, first phase is tunnel construction, lepton collider implementation, and operation for 15 years. Second phase is removing lepton collider, FCC-hh implementation, and operation for 15 years. SC magnets are already in EuroCirCol and cannot be put in this DS. EuroCirCol programme continues with different structures. This second DS is addressing other topics. **At next TIARA meeting, more details should be available.**

General discussion on projects to be supported for next DS call (All)

So far 2 projects are proposed: FC-ee and SEEIST projects. With 2 proposals, we should be able to go through and can support both. For SEEIST, although several participating countries are within EC, Montenegro is out of EC. To have a competitive DS is preferred before asking EC support for such a facility. Second step is to get money from EU for real implementation. The first M€ already comes from EC. Market is very competitive for hadrontherapy machines. Scientific case should be well addressed with clear innovation. There is a clear synergy with PIMMS2. Maurizio Vretenar is the leader of WP1. SEEIST project has a real value: a unique biological centre for research. PIMMS2 addresses a new way to do hadrontherapy machines. Marco Durante is creating a network for radiobiological research and is involved in SEEIST project. In parallel, science for peace is one of the aspects of the SEEIST project like in SESAME project.

The TCC strongly supports both preparations. The TCC asks for more details at the next meeting.

Different funding options are under discussion within EuPRAXIA consortium. If successful, EuPRAXIA is a good opportunity to study feasibility of a plasma collider. EuPRAXIA received a good support from EU and can ask EU for advice to continue the studies. Rumour that some projects could directly apply to preparatory phase without being in the ESFRI roadmap should be checked with EC.

INFRAInnov4 proposal (Roy Aleksan)

New INFRAINNOV4 call is to be issued by EC with 2 kinds of calls: one call focused on access to infrastructure and the other one to boost co-innovation projects with industry (R&D). Only 3 communities are targeted (10 M€ each) for the latter: synchrotron light (LEAPS), accelerator R&D community (ARIES), detectors (AIDA). There should be coordinated action between these 3 communities to avoid duplication. ATTRACT is also invited to this meeting and is pushing for detector development. AIDA aims detectors for HEP whereas ATTRACT aims more general applications. Meeting with AMICI took place in Salerno end January to see how to integrate infrastructure in this call and show that R&D and infrastructures are working together. It is not clear how AMICI will continue. It could possibly be integrated in INFRAINNOV4 with a special WP dedicated to technological infrastructures but funding would be very limited. For FP9, a new tool for technological infrastructure is under study. Laser technology is crucial and should be pushed. It is already funded with is a small WP within ARIES (TNA for laser). One should investigate whether a project within the proposal for INFRAINNOV4 is possible. In FP9, one should aim at much larger and bigger projects. Within ARIES, WPs are developing technology with industry but at small scale. Ambition is to go to higher level although not guaranteed. A structure proposal to INFRAINNOV4 call is to prepare. Discussions about this structure will be undertaken at the next ARIES annual meeting in Budapest in April. 3 ways are identified:

- ATTRACT-like. Project initiates open call to the community which makes proposals. EC delegated the ability to submit calls.
- We can internally select some calls.
- We start with a few projects we can start immediately and money is reserved to launch calls: mix of both above.

Call will be frozen in the 4-5 months. Size of companies is not a problem. The community wishes to support network. At next meeting, MV and RA will report about the continuation of this discussion.

AOB (All)

Next meeting is scheduled end June/early July. GSI is a candidate to host the next meeting of TIARA with the opportunity to show progress of FAIR construction. A doodle will be sent. Meeting will last 2 days (begins at 2 pm and ends at noon the day after).