

Summary of the motivation, programme and outcome of the workshop

'Intensity Frontier Particle Physics with Compressed Pulses from the ESS Linac'

held at Uppsala University 2nd – 3rd March 2020

1. Motivation

The linear accelerator of the European Spallation Source, ESS, in Lund, Sweden will, with its 5 MW beam, be the world's most powerful accelerator, more powerful as expressed in MW than e.g. the CERN accelerators. Moreover, its duty-cycle at 5 MW is only 4%, which leaves room to increase the beam power and duty cycle to 10 MW and 8%, respectively. This would require an additional investment of less than ~20% of the total basic ESS accelerator investment of about 600 MEUR. This represents an outstanding opportunity for Europe, and Sweden as host country, to take a world lead, not only in Spallation Neutron Science - for which the currently specified 5 MW will be used as foreseen - but also in Intensity Frontier Particle Physics - for which the additional 5 MW will be used. This represents a position comparable to that of CERN as the world leader in the realm of Energy Frontier Particle Physics.

A crucial addition required for the realisation of the full potential of the ESS accelerator power upgrade is that of a 400 m circumference accumulator ring. This would be used to compress the accelerator pulses from ca 3 milliseconds length, as now, to ca 1.3 microsecond length. Such an accumulator ring is already being designed within the EU supported ESSnuSB neutrino Super Beam project for ESS. Other major Particle Physics projects made possible by the accelerator power upgrade and the pulse compression are experiments such as nuSTORM, a Neutrino Factory, a Muon Collider as well as Coherent Neutrino Scattering and Decay at Rest. The accumulator ring can also be used, using slow extraction methods, to produce beam pulses of intermediate length, ~100 microseconds, which will be of fundamental interest for certain important types of materials research using slow neutrons, thus significantly enlarging ESS's already would-unique capacity as a neutron spallation source.

2. The workshop

In order to explore further the possibilities outlined above, an open workshop "Prospects for Intensity Frontier Physics with Compressed Pulses from the ESS Linac" was held at Uppsala University 2-3 March 2020. The workshop poster is attached at the end of this document.

The programme and all slides used in the presentations at this workshop, as well as the list of the 39 registered participants, are available at <https://indico.cern.ch/event/849674/>. A group photograph of the participants is also attached at the end of this document.

The presentations of the specific projects, which would be made highly competitive thanks to the use of the unparalleled high power of an upgraded ESS linac and of the pulse compression provided by the accumulator ring, were:

The use of the ESS linac to create a Muon Collider
The ESS neutrino Super Beam Design Study
Short Pulses for Neutron Physics at ESS
The prospects for nuSTORM at ESS
The prospects for an ESS based Neutrino Factory
The possibilities of Decay-at-Rest experiments at ESS
Opportunities for Coherent Neutrino Scattering at the ESS

Carlo Rubbia
Marcos Dracos
Ken Andersen:
Sam Tygier
Jaroslaw Pasternak
Adrien Hourlier
Juan Collar Colmenero

Each of the speakers concluded that the project that they presented would significantly profit from the unparalleled high power of an upgraded ESS linac combined with the shortening of the linac pulses by the compressor ring.

Following these presentations some of the conditions for realising these projects at ESS were presented in the following talks:

The ESS linac modifications required for the different proposals	Björn Gålnander
High intensity accumulator rings	Nick Evans
The design of the ESSnuSB accumulator and its synergies with the different proposals	Ye Zou
Target synergies and variations for the different proposals	Eric Baussan
Space available at the ESS site for the new installations	Boris Kildetoft

In none of the talks was a particular requirement or condition indicated that would represent a 'show-stopper' for the ESS upgrade projects presented at the workshop. Neither were significant obstructions to the originally envisaged slow neutron programme foreseen. It was however made clear that a significant amount of design study work would be needed for each of the projects in order to demonstrate reliably their feasibility and cost.

Some of the presented projects might require extending beyond the current boundaries of the ESS. There are no buildings or structures on either side of the ESS that would preclude such an expansion. Nevertheless, there was a strong demand to investigate ways in which the surrounding land could be earmarked for capitalising on the vast scientific potential offered by these projects. Fear was expressed that if the need for such a potential extension was not already forwarded now to the competent authorities, it would later on be extremely difficult to acquire the necessary land because of the already ongoing expansion of the city of Lund in the same directions.

3. The outcome

It was agreed to form an ESS Intensity Frontier Project Group, composed essentially of the attendees at the workshop, that would explore the possibilities to fund an integrated design study of the proposed projects. The European Research Council (ERC) has for some time been announcing so-called Synergy Grants each year. The amount of such a Synergy Grant can be up to 10 M€ over a period of 6 years with a possibility of an additional grant of 4 M€. Unfortunately, it seems as if the next ERC Synergy Grant call will not be made until September 2021, implying possible availability of ERC funds only by Summer 2022. The possibility of applying for an H2020 Future Emerging Technology (FET Open) grant with last day of submission 16 May 2020 was also raised but disfavoured in view of the hitherto very low success rate of 1.4% of this kind of call.

The following persons have accepted to be Contact Persons for the Project Group:

For Muon Collider: Jean-Pierre Delahaye
For ESSnuSB: Marcos Dracos
For Short high intensity neutron pulses: Ken Andersen
For nuSTORM and Neutrino Factory: Jaroslaw Pasternak
For Coherent Scattering and Decay at rest: Janet Conrad

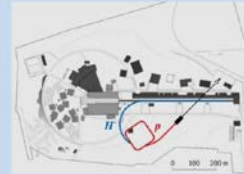
It was agreed that Tord Ekelof will call a web meeting of these Contact Persons in May 2020 in order to set up a work programme for the Project Group to prepare an ERC Synergy Grant application.

Prospects for Intensity Frontier Particle Physics with Compressed Pulses from the ESS Linac

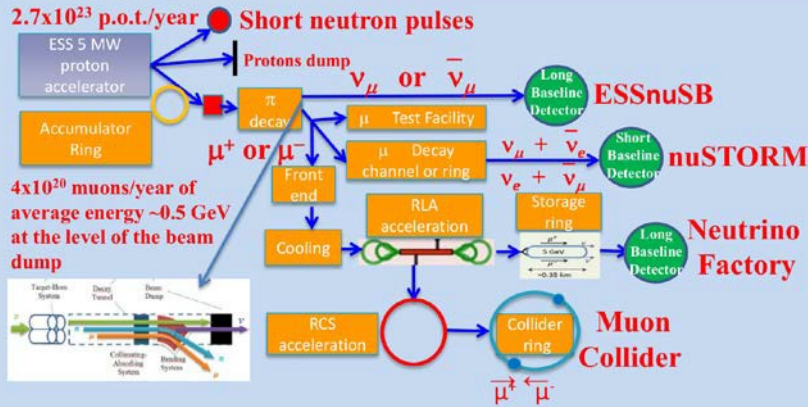


Open workshop at Uppsala University

2-3 March 2020



Program and registration at: <https://indico.cern.ch/event/849674/>



Workshop poster illustrating the proposed multiple use of the ESS accelerator in combination with the accumulator ring for different leading experimental projects discussed during the workshop



The participants of the workshop 'Intensity Frontier Particle Physics with Compressed Pulses from the ESS Linac' held at Uppsala University 2-3 March 2020