

Newsletter Focus

SWEDEN: EUROPEAN SPALLATION SOURCE LINEAR ACCELERATOR GROWS



In Sweden, at the ESS, *European Spallation Source*, research centre which will host the world's most powerful neutron source in Lund, the first protons passed through the Drift Tube Linac 1, DTL1, one of the key components of the ESS accelerator built in Italy by INFN researchers.

The DTL is a linear accelerator consisting of a sequence of accelerating spaces that allow protons to gain energy each time they

pass through. The accelerating spaces are alternated with tubes, where the particles simply drift, hence the name "Drift Tube Linac," literally "drift tube linear accelerator".

ESS linear accelerator will deliver a beam of high-intensity protons directed at a target, where neutrons are generated for use in scientific research. ESS linear accelerator will, overall, consist of five DTLs, which will accelerate protons, produced by an ion source made in Italy at INFN Southern National Laboratories in Sicily, designed by the same laboratories starting in 2012 and transported to Sweden in December 2017.

In the ion source at the far end of the accelerator, plasma is produced by heating hydrogen with electromagnetic fields, as in a microwave oven. From this plasma, protons are extracted thanks to a strong electric field and brought into the first part of the accelerator, the LEBT (*Low Energy Beam Transport*), where the particle beam is analysed, optimised, and focused before acceleration begins in the subsequent part of the accelerator, the radio frequency (RFQ) quadrupole made by the French partner CEA.

After being accelerated inside the DTLs, and brought from 3.6 to 90 MeV, the energy at which they travel at about half the speed of light, the protons will pass through the superconducting component of the ESS accelerator, built in part by the INFN LASA laboratory in Milan, reaching an energy of 2 GeV and a speed equal to 95% of the speed of light, to then be directed at a target to generate the neutrons.

To date, researchers working on the experiment have completed the installation of ESS first DTL, where the first protons have been accelerated to an energy of more than 20 MeV. When fully operational, with all five of its components in operation, ESS DTL will be the most powerful Drift Tube Linac in the world. The five DTL

components were designed by researchers from the INFN Legnaro National Laboratories and at the INFN Turin division, who also coordinated all phases related to the testing and installation of the DTLs.

The ESS multidisciplinary research centre, currently under construction in Sweden, will be the world's most powerful neutron source when it goes into operation in 2025. ESS will provide unique research opportunities for thousands of scientists in a wide range of fields, from materials science to energy and from life sciences to cultural heritage applications.

ESS member countries jointly fund and build the research infrastructure, in part through "in-kind contributions," i.e., by providing technical equipment and labour hours. Italian in-kind contributions to ESS are coordinated by INFN, which is internationally recognised for its scientific and technical expertise in particle accelerators.