# Italian contributions to ESS

ESS represents one of the forefront international research projects and is supported by member states throughout Europe, including Italy via the National Institute for Nuclear Physics (INFN), the National Research Council (CNR), and Elettra Sincrotrone Trieste. The Italian participation in ESS is coordinated by the INFN, which is internationally recognised for its scientific and technical expertise in particle accelerators. The institute has participated in the realisation of the new European neutron source since 2009.
The total Italian contribution to ESS is 110 M€, 6% of the overall construction cost of the facility. The aim is that 81% of the Italian contribution will come in the form of in-kind, through deliveries of technical equipment, personnel, or services from Italian in-kind partners, often in collaboration with national industries.

**THE INFN CONTRIBUTION**
The INFN participates along with the Southern National Laboratories (LNS), the Legnaro National Laboratories (LNL), and the Accelerators and Superconductivity Applied Laboratory (LASA) of Milan, as well as the divisions of Turin and Bologna that contributed to the design and construction of fundamental accelerator components. Thanks to the know-how acquired in the development of high technology associated with the skills of INFN designers and builders, the institute plays a significant role in the ESS project.
Notably, the INFN designed and constructed the **ion Source** and the **Low Energy Beam Transfer line (LEBT)** of the linear accelerator, built at the Sothern National Laboratories and recently integrated into the infrastructure, important to the subsequent installation of the first section of the ESS accelerator: the **warm linac.**

The INFN contribution to ESS will be completed with the delivery of **the Drift Tube Linac (**DTL), a component able to accelerate the beam up to a speed equal to almost a third of the speed of light, and preparation for injection in the superconducting linac. This state-of-the-art Italian technology was built by **the Legnaro National Laboratories, Turin division of INFN,** in collaboration with various Italian companies. Furthermore, a significant part of the linear accelerator, consisting of the 36 superconducting cavities, is under construction in Italy under the supervision of the LASA staff, from the Milan division of INFN.
LASA is an international centre of excellence in the field of advanced technologies for particle accelerators, and has recently produced the cavities used for the European XFEL, the future European electron-free supermicroscope, based in Hamburg, Germany.

**THE ELETTRA SINCROTRONE TRIESTE CONTRIBUTION**
Elettra Sincrotrone Trieste (Elettra) contributes to the realisation of ESS with different parts of the linear accelerator. The experience and the know-how gained by the designers and researchers of the laboratory during the construction and operation of Elettra, the Italian third generation synchrotron light source, and FERMI, the new seeded free electron laser, has allowed the development and consolidation of specific competences and technological capabilities that enable Elettra to play a valued role in the ESS project.
One of the most significant contributions is the provision of the 26 **power stations** that feed the spoke cavities, the first part of the superconducting linac. The equipment will be built by Italian

industry under the supervision of Elettra researchers. The type of application entails innovative technologies due to the required performance and energy efficiency demands.
Elettra has designed, and is supervising, the construction of the **magnets**, more than 200 different types, to steer and focus the protons along the required trajectory in the superconducting linac and in the following transfer lines, both diagnostic and to the target.
The construction of the magnets will be complemented by the provision of the corresponding **power converters**, presently under construction at various Italian industries. The combined design of power converters and magnets will enable optimisation of the project in terms both of energy performance and reliability.

**THE CNR CONTRIBUTION**

The CNR developed research and activities aimed at creating tools for **spectroscopic techniques** based on neutron-matter interaction: VESPA, T-REX and LOKI. These are analysis techniques that open new horizons in the exploration of advanced technological materials and processes in a very wide range of applications, from biomedicine, to energy, to microelectronics, etc. The CNR and the University Community of **physics of matter** can rely on groups and research structures with considerable expertise in the field of neutron science. These groups are well integrated into international collaborations and scientific projects whose development includes access to large research infrastructures. In this sense, the Italian scientific community is ready to tackle the challenge associated with ESS, both in terms of the implementation of **advanced analytical tools**, and in terms of the use of **techniques for investigation** of the material aimed at advancing the frontier of knowledge.

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