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THE ITALIAN ACCELERATOR FOR THE INTERNATIONAL FUSION MATERIAL IRRADIATION FACILITY (IFMIF/EVEDA), IN JAPAN

The commitment of the international community in the design and testing of nuclear fusion reactors for energy production has been constant since the second half of the last century. Nevertheless, there are several critical aspects in the realisation of power plants of this type; among these, are the degradation effects on the materials implied in the construction, which are due to the large amount of high energy neutrons produced in the fusion reactions. In order to permit the proper design and validation of such plants, an intensive study phase of the mechanical properties of the reactor materials when bombarded by intense flows of high-energy neutrons, is therefore compulsory. For this purpose, in the frame of the ITER (International Thermonuclear Experimental Reactor) project, the International Fusion Material Irradiation Facility (IFMIF) will be built by an international collaboration with major contracts won by the domestic industry. Main objective of IFMIF will be the production of an intense source of neutrons with energy and flux equivalent to those that will characterise future nuclear fusion plants.

The preliminary phase of IFMIF (which is named IFMIF EVEDA - Engineering Validation and Engineering Design Activities) is the result of a collaboration between Europe - with Italy, France and Spain responsible for the accelerator and high-tech instrumentation - and Japan, which provides the infrastructure and site for experimentation in the coming years, in Rokkasho. Here, in April, a ceremony was held for the delivery of the RFQ (Radio Frequency Quadrupole), built at the INFN National Laboratories of Legnaro as the Italian contribution to the very high intensity LIPAc (Linear IFMIF Prototype Accelerator) accelerator, prototype of the IFMIF.

Designed and built by a team of physicists and engineers from LNL and from the INFN divisions of Padua, Turin and Bologna, thanks to a special allocation of 25 million euros to INFN by the Minister of Education, University and Research (MIUR), the radio frequency quadrupole (RFQ) of the IFMIF prototype accelerator is a very advanced system, capable of producing the maximum intensities of



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the accelerated particle beam. It has as its ultimate goal the production of very intense neutron fluxes to bombard the materials that will be implied in the construction of critical parts of future nuclear fusion power plants. The RFQ consists of a ultra-pure copper structure, approximately 10 metres long, constructed with high mechanical precision criteria, capable of accelerating a continuous and very intense beam of deuterons (deuterium nuclei) up to 5 MeV.

The INFN is one of the few research institutes in the world capable of providing the technologies and skills necessary for the construction of accelerators of this type. After the design and production of the prototypes and of the most complex parts, implemented within the INFN, the construction was awarded, under the supervision of INFN, to specialised companies via international tenders, in which Italian companies obtained particularly encouraging results, demonstrating the validity of Made in Italy also in areas such as very high-precision mechanics and electronics for power radiofrequency.