



EUROPEAN
SPALLATION
SOURCE

ACCELERATORS FOR NEUTRON PRODUCTION - INTRODUCTION TO ESS

Natalia Milas

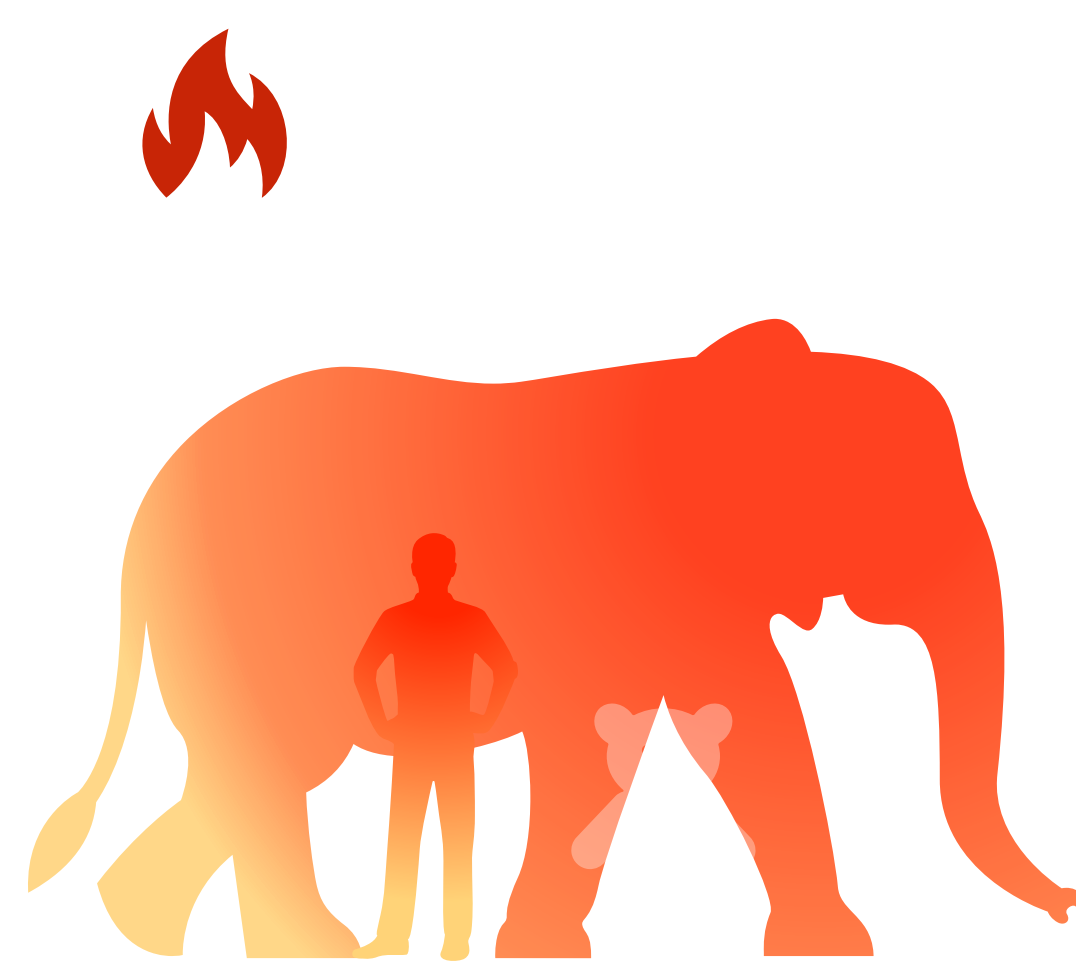
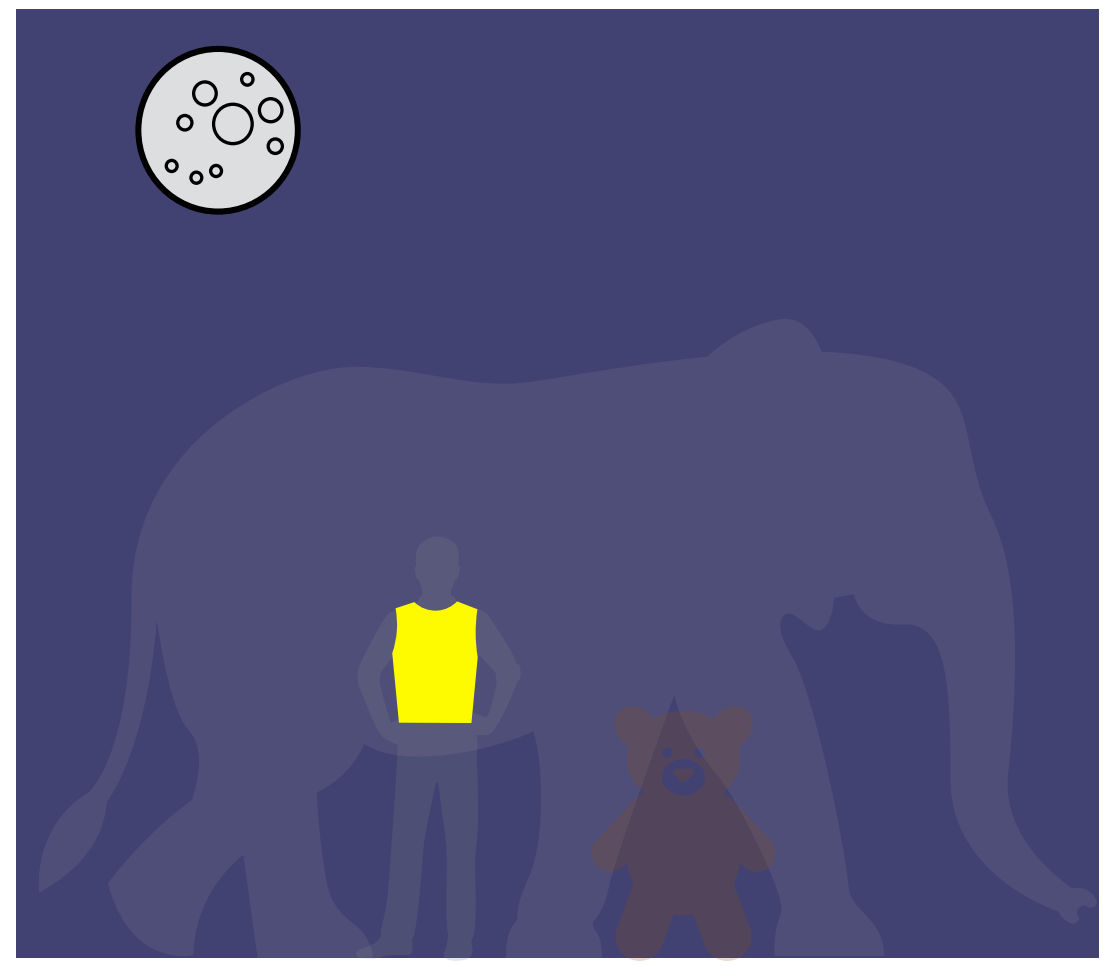
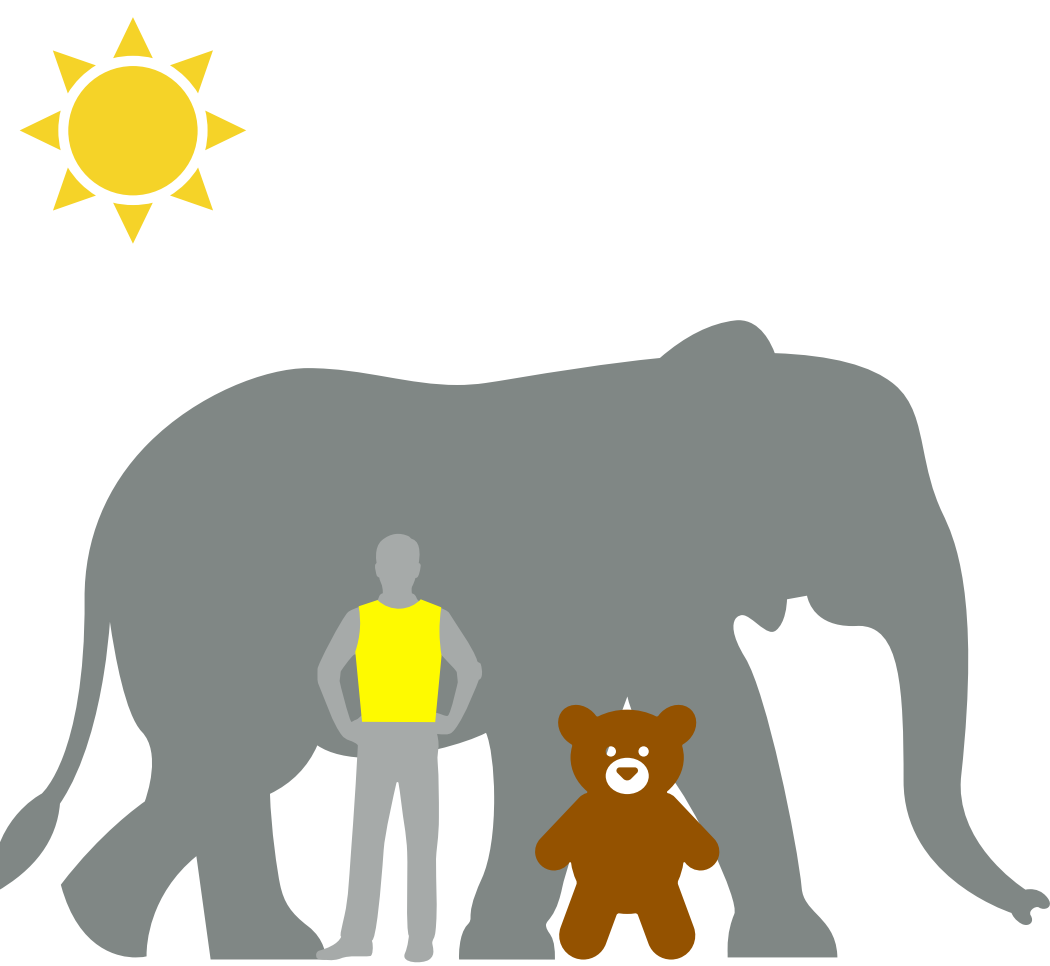
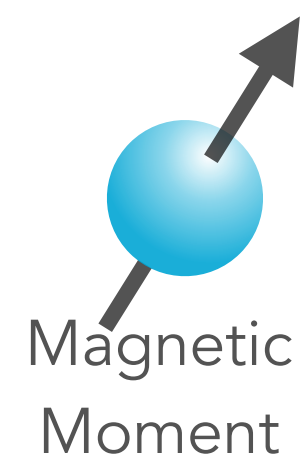
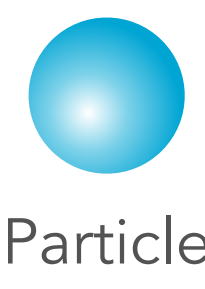
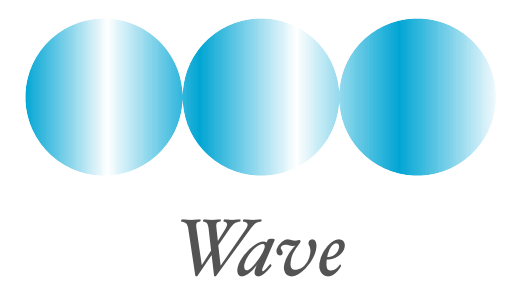
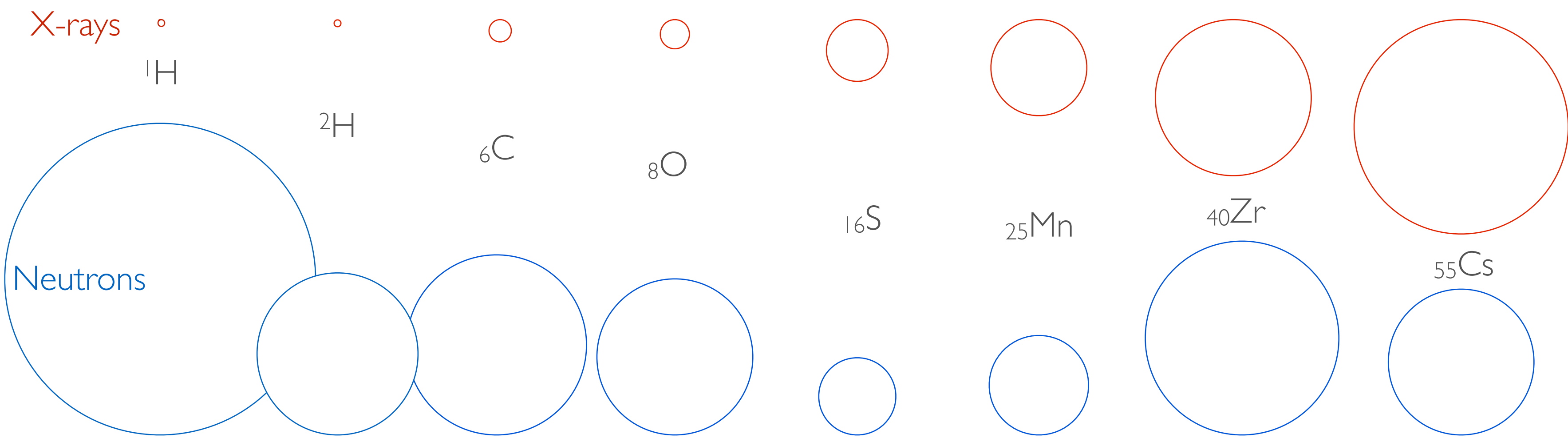
ISSE School 2026

SPALLATION SOURCES VS LIGHT SOURCES

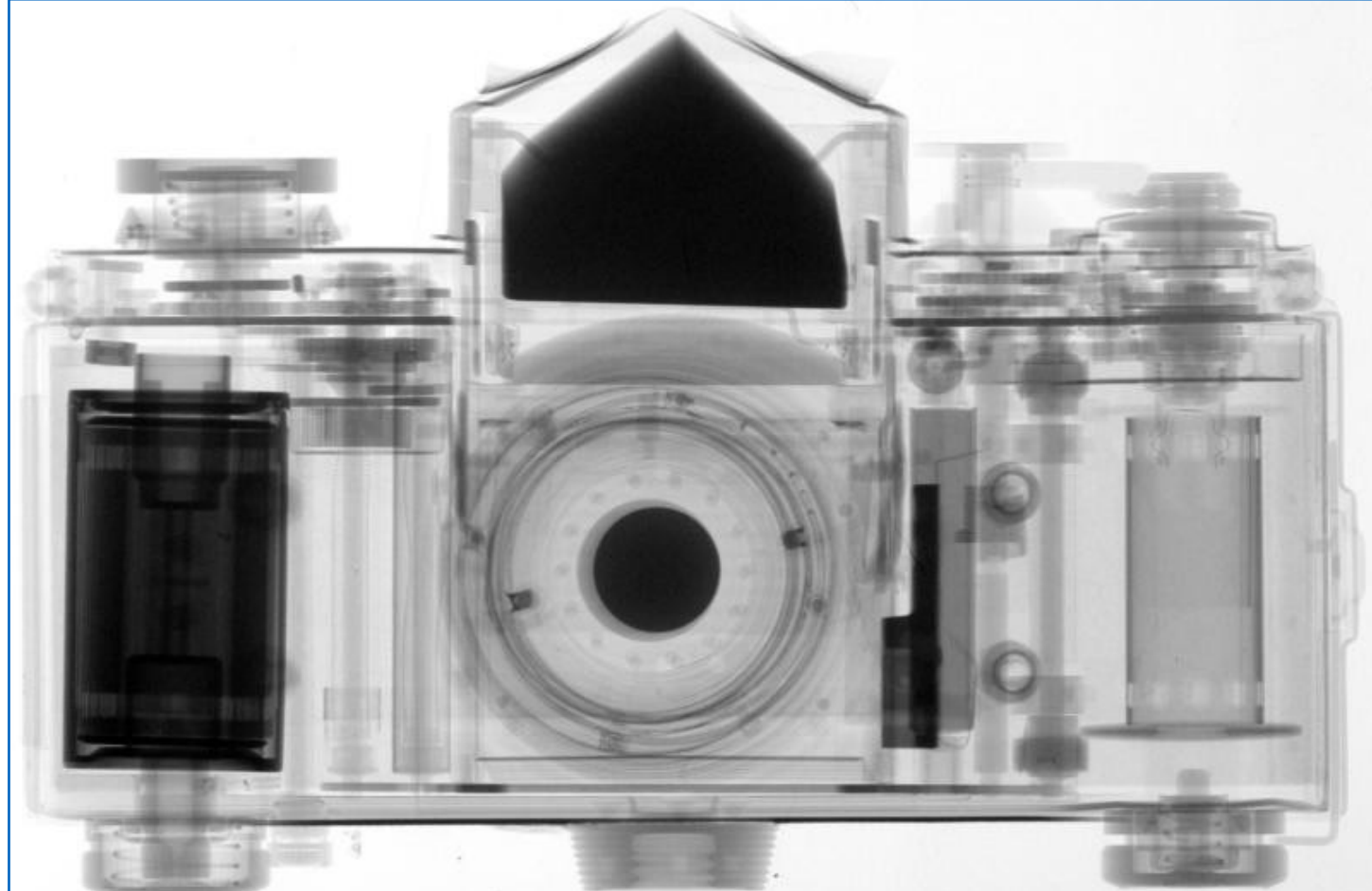
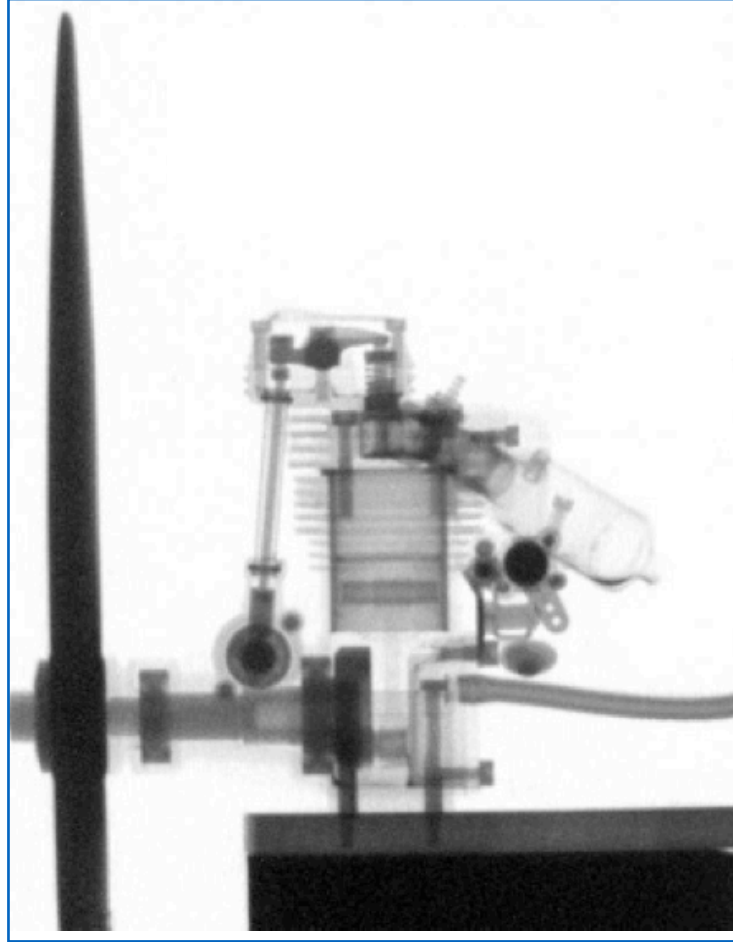
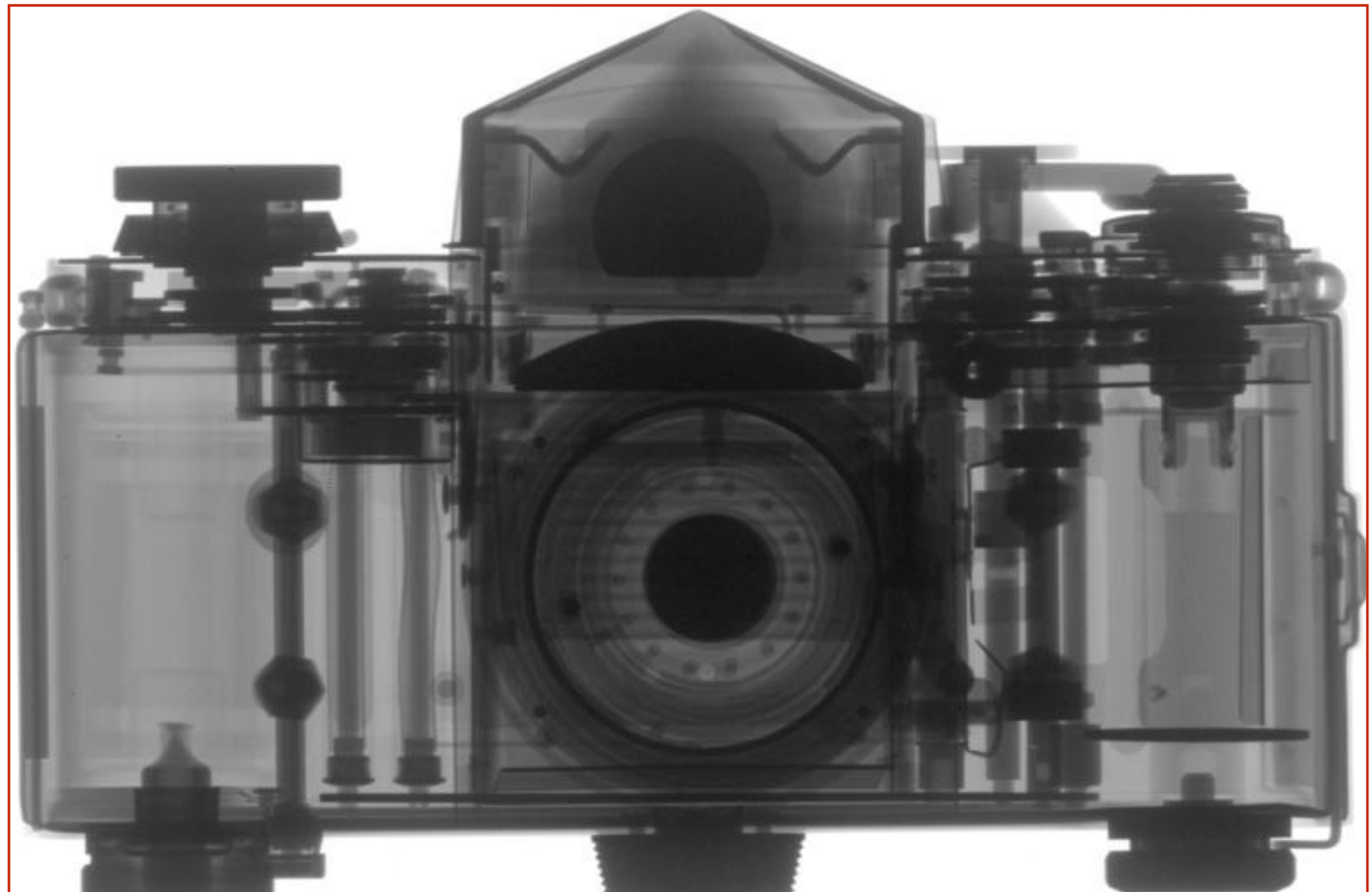
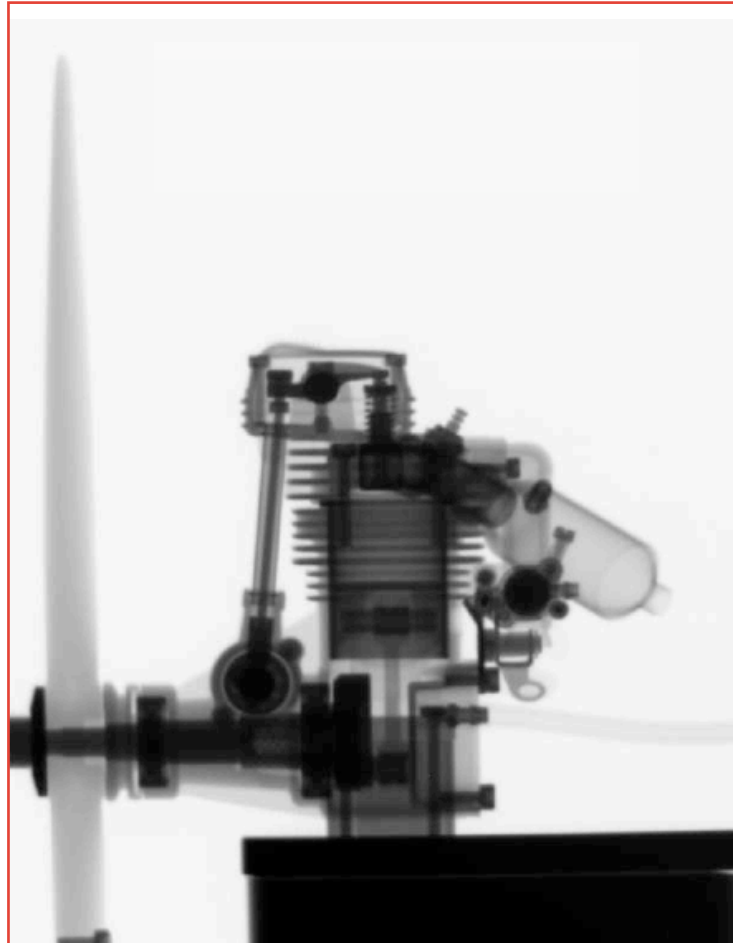
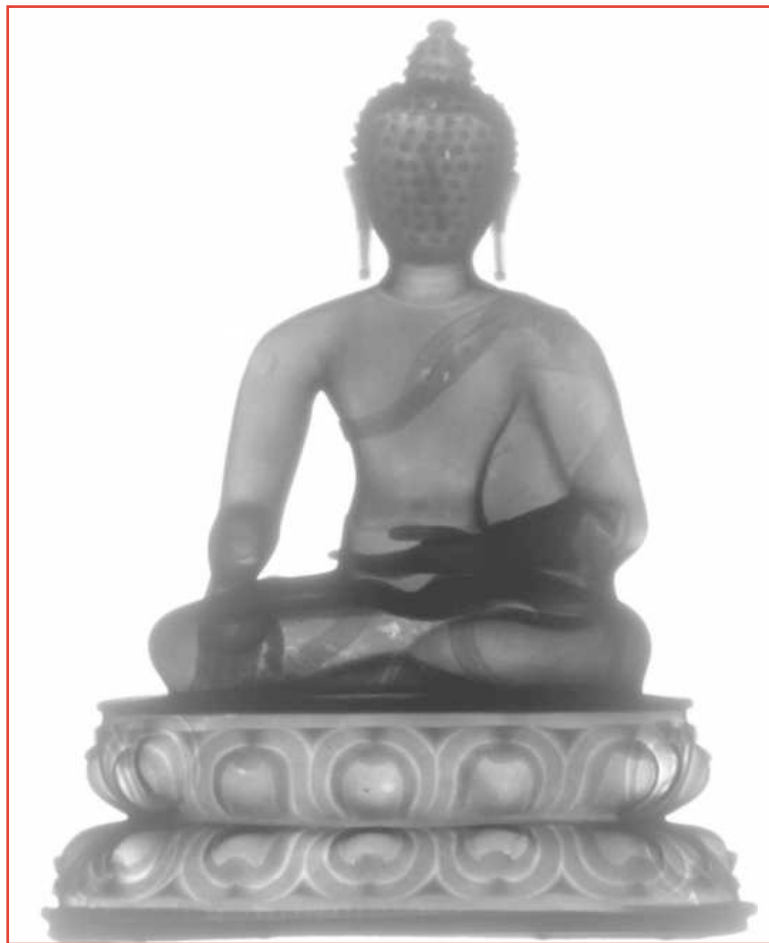


2022 June

PHOTONS VS. NEUTRONS



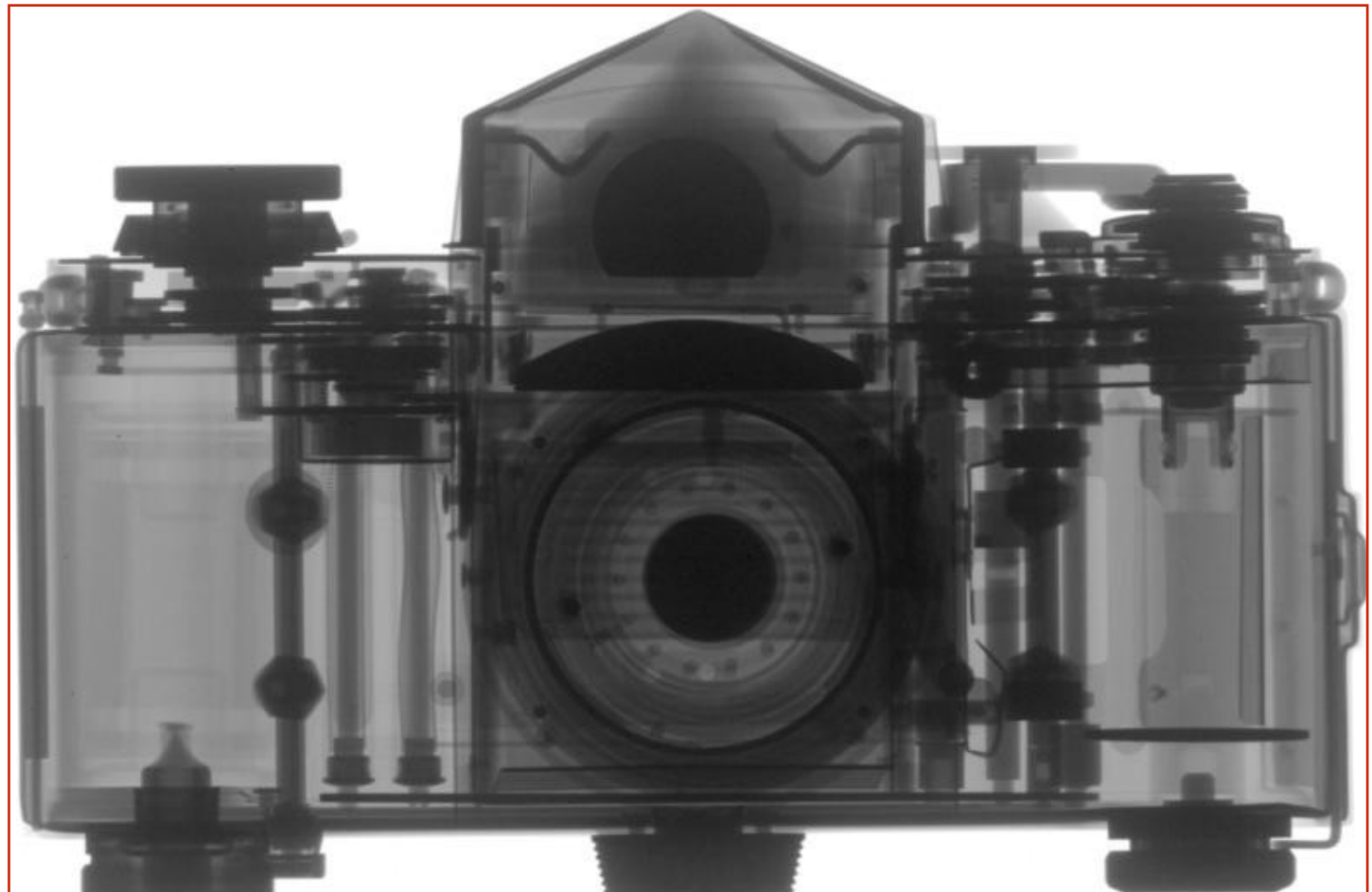
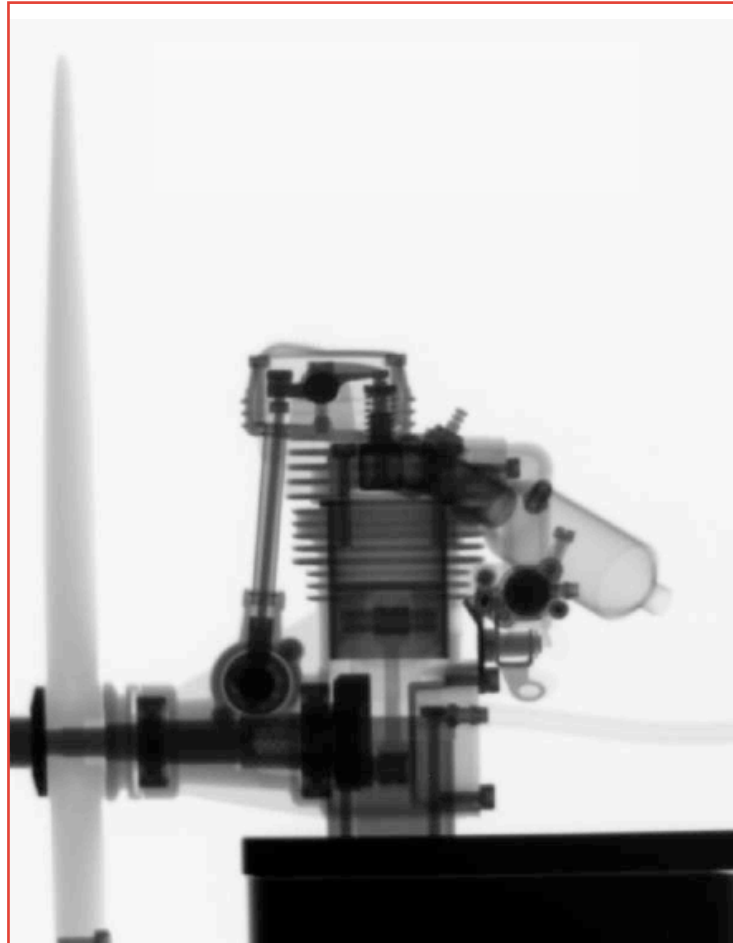
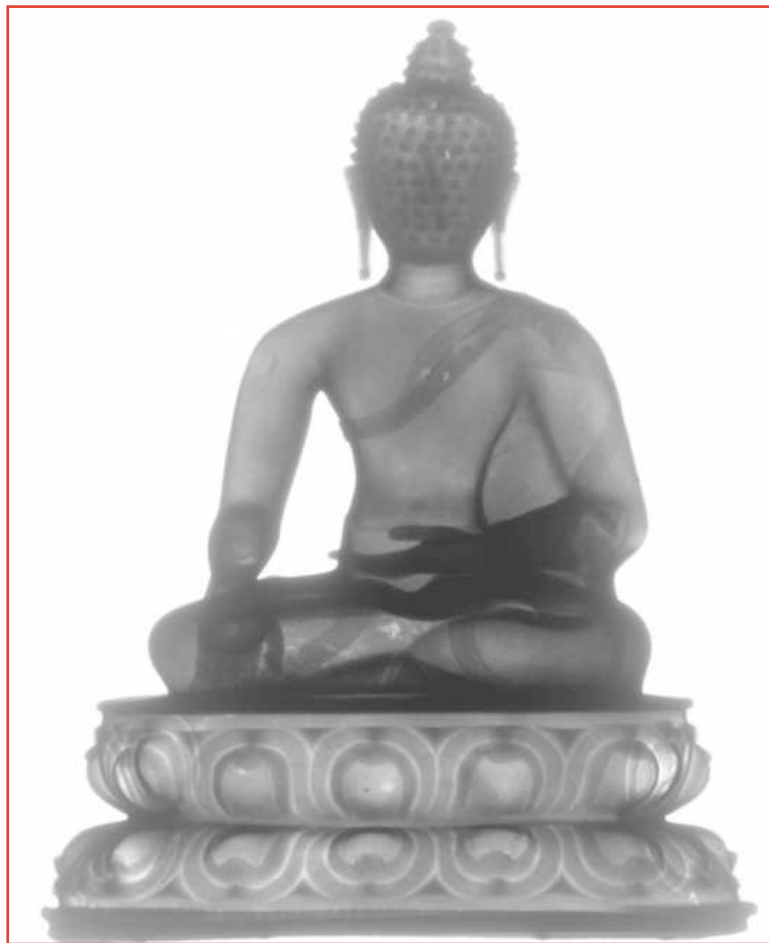
NEUTRON VS. X-RAY IMAGING



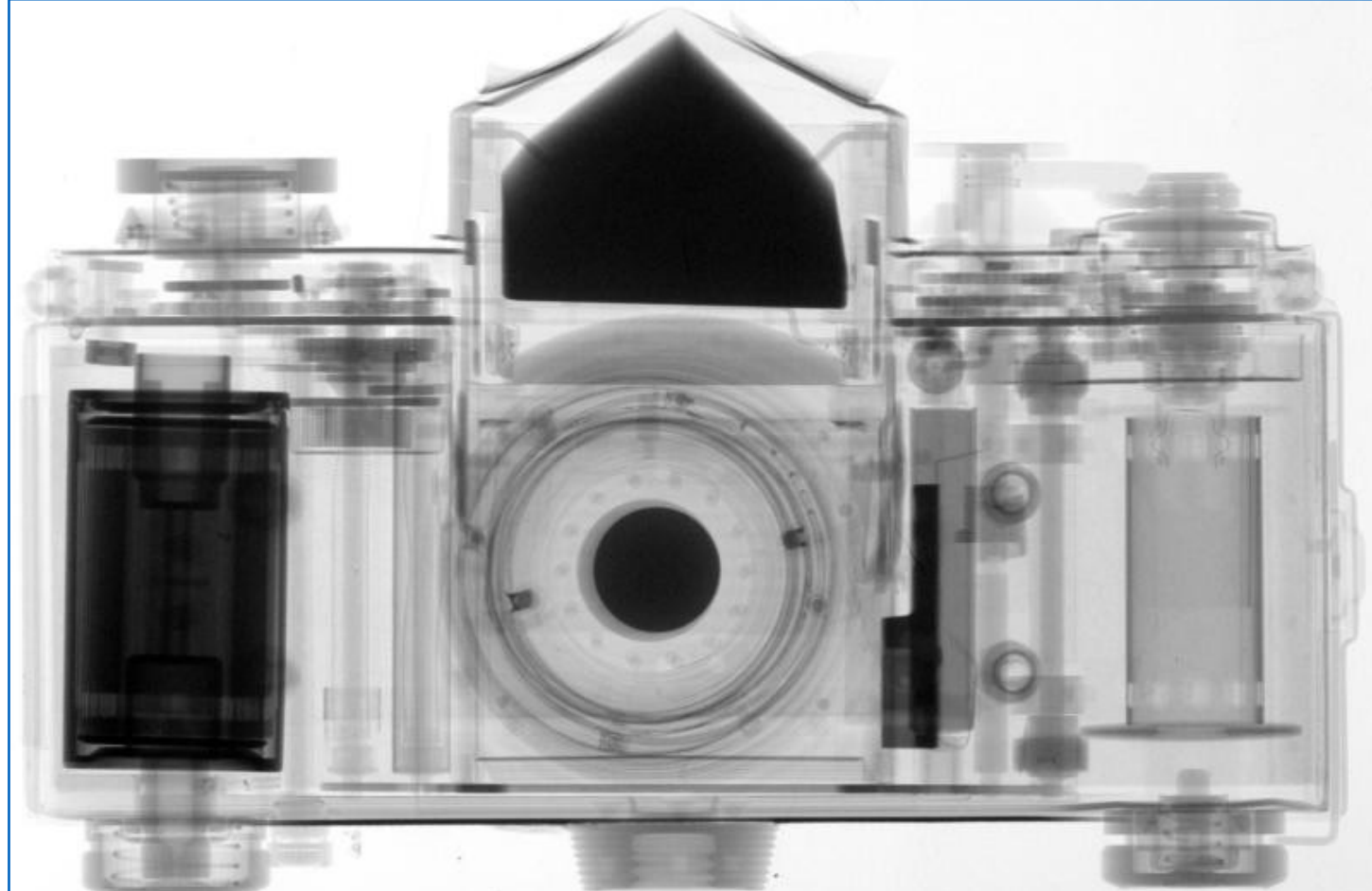
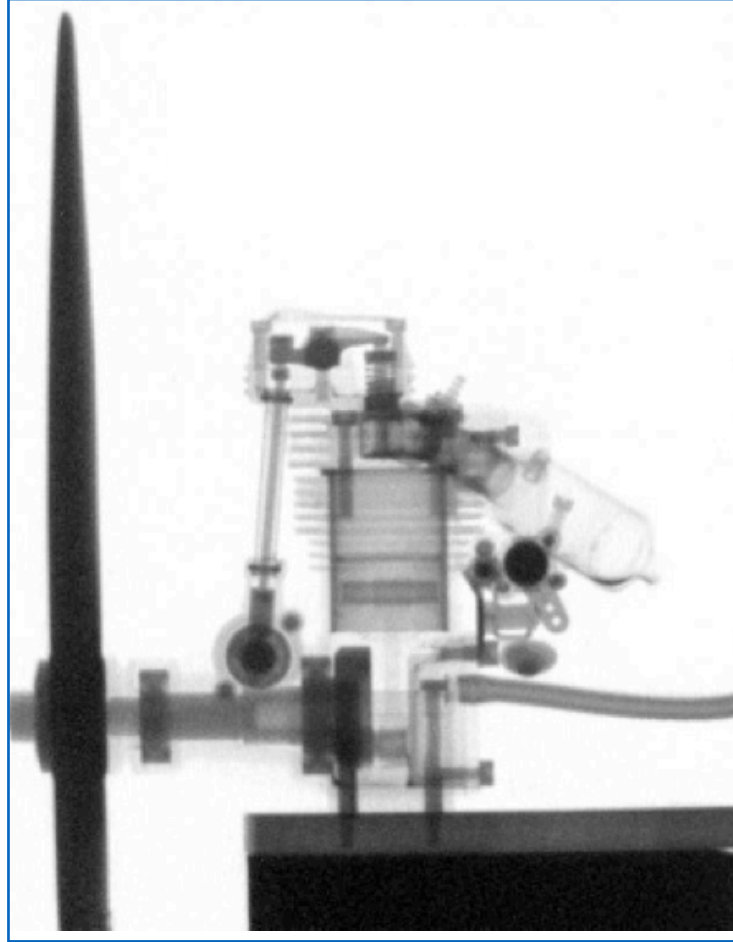
Courtesy: PSI, TUM

NEUTRON VS. X-RAY IMAGING

X-rays



Neutrons

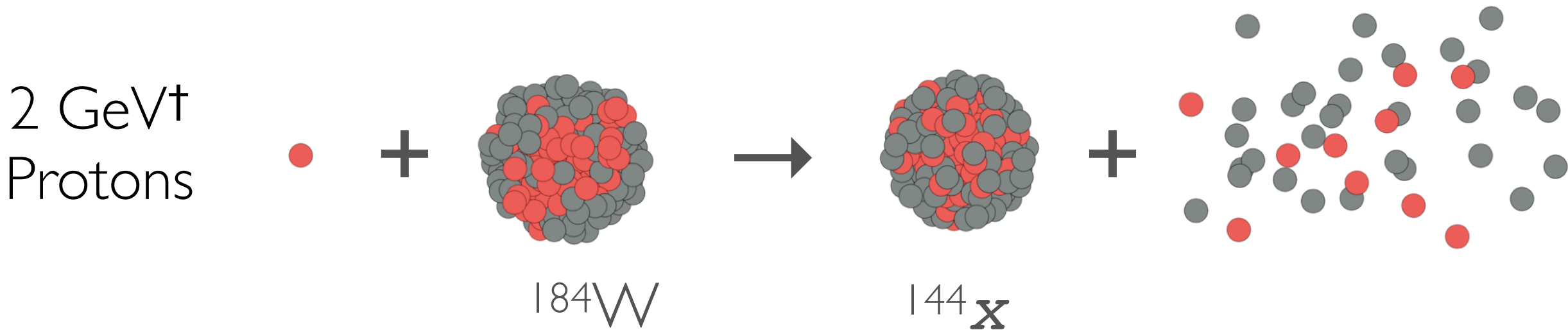


Courtesy: PSI, TUM

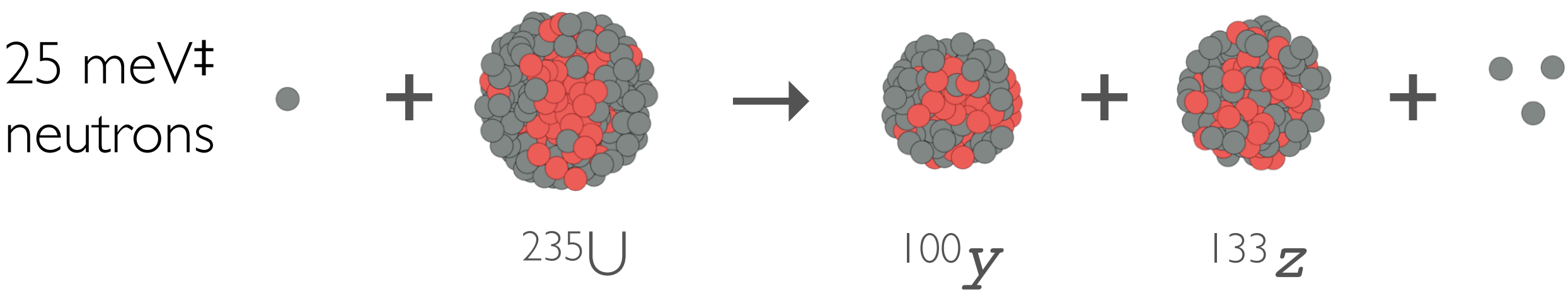
SPALLATION, FISSION AND PHOTONEUTRONS



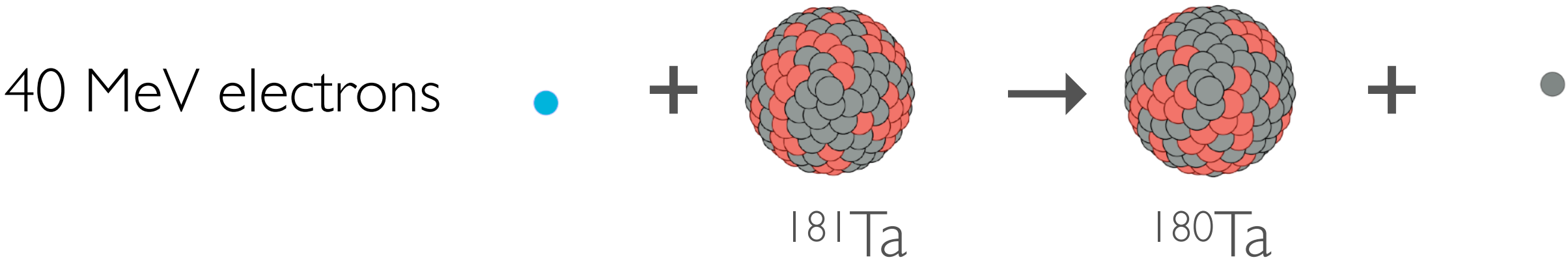
Spallation



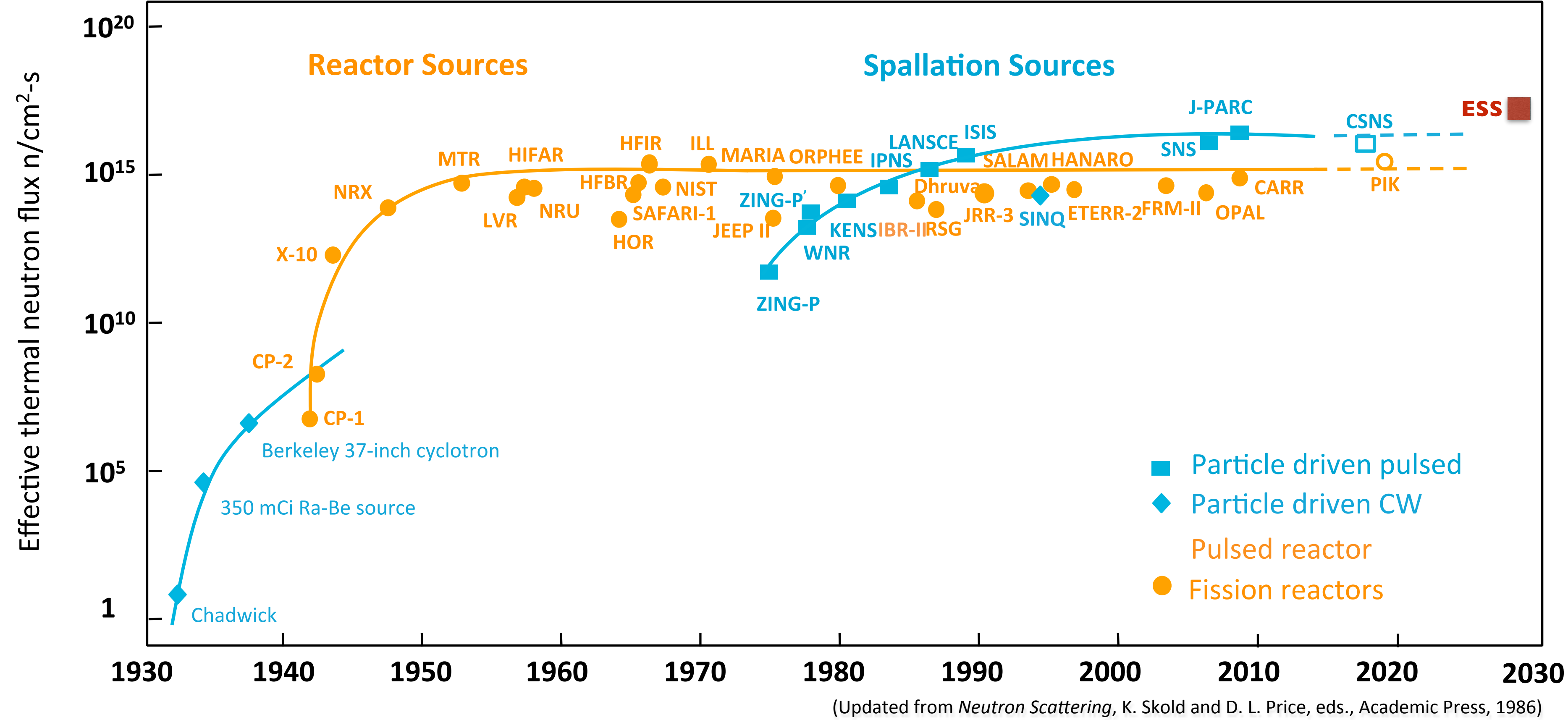
Fission



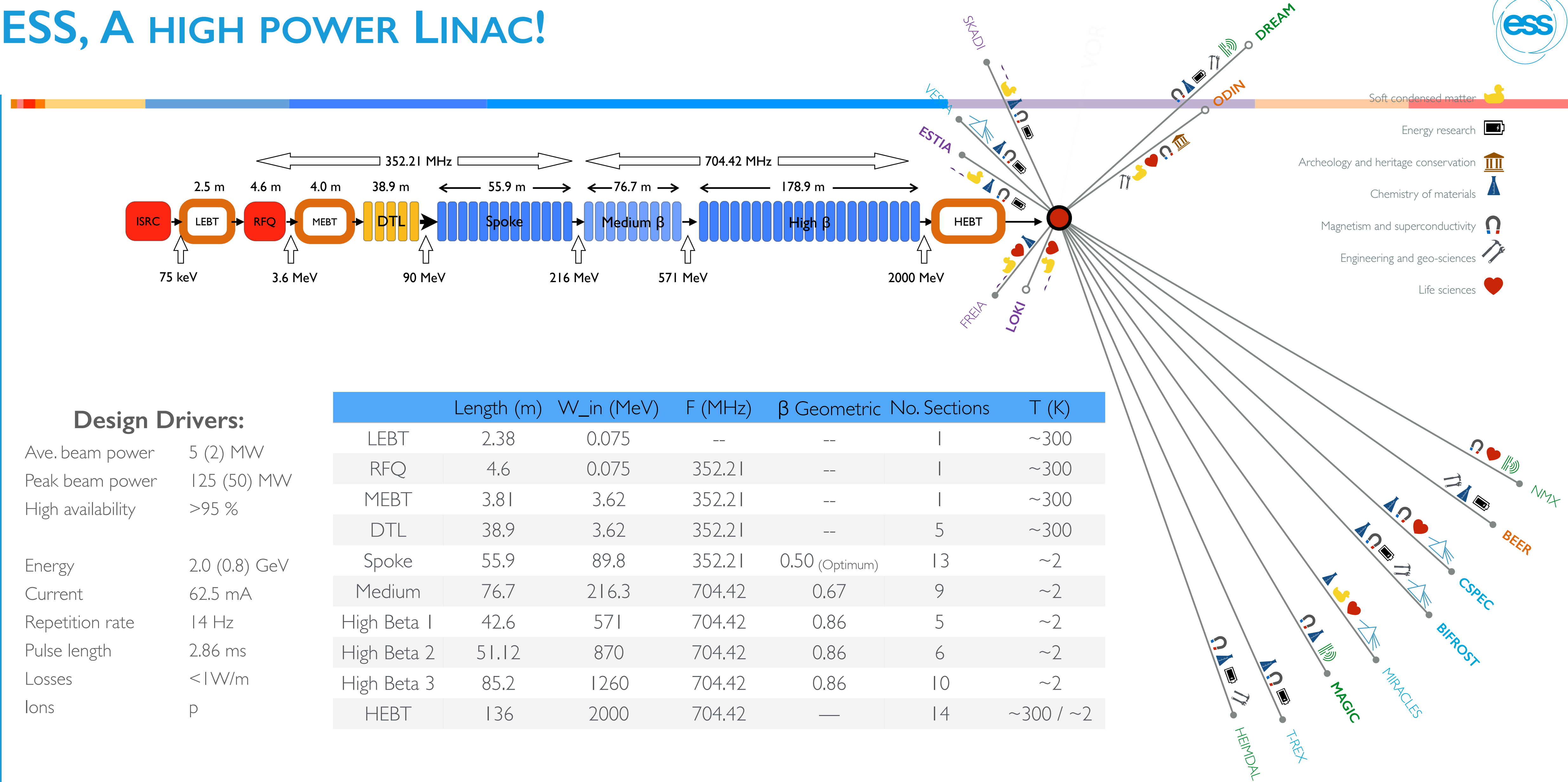
Photoneutrons



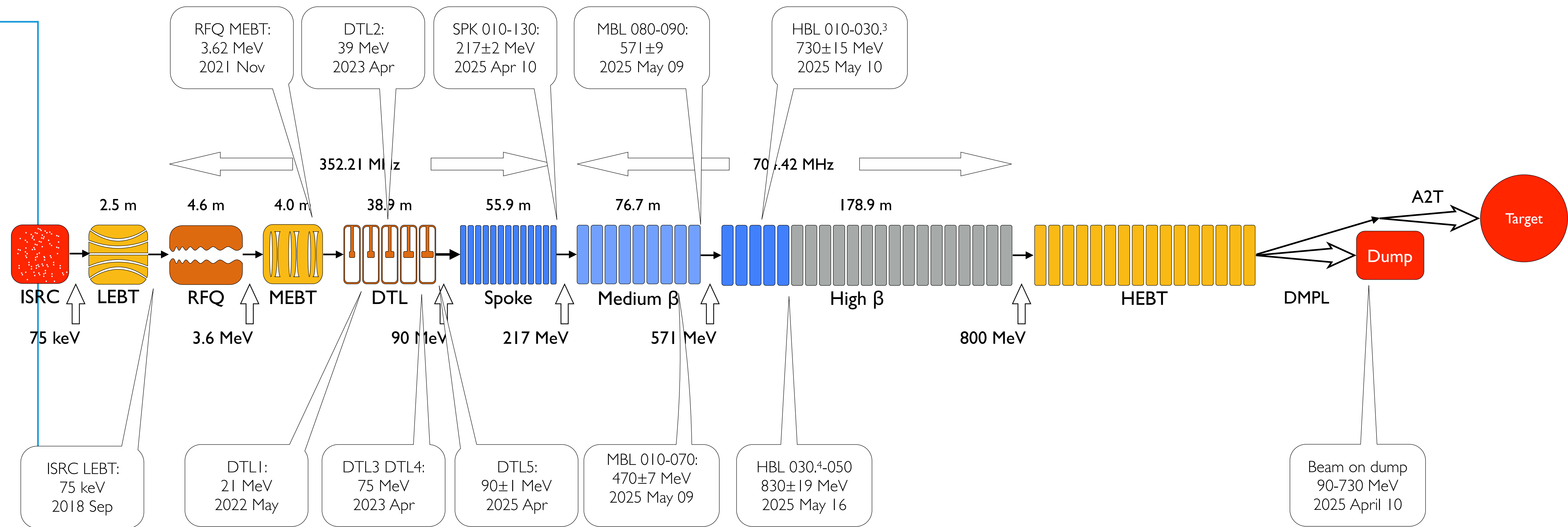
[†] ~95% speed of light, ~287800 km/s
[‡] ~7.3E-4% speed of light, ~2.2 km/s



ESS, A HIGH POWER LINAC!



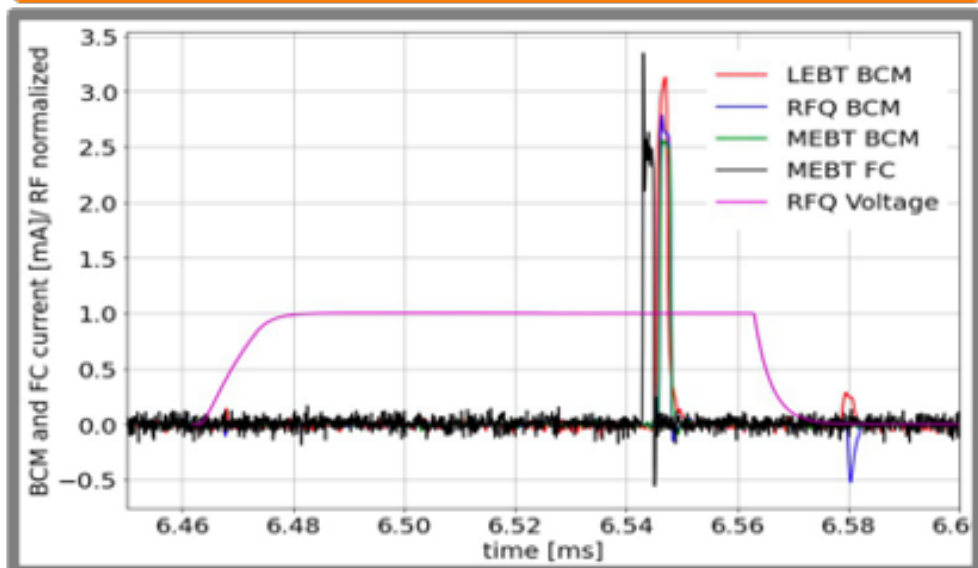
COMMISSIONING RESULTS



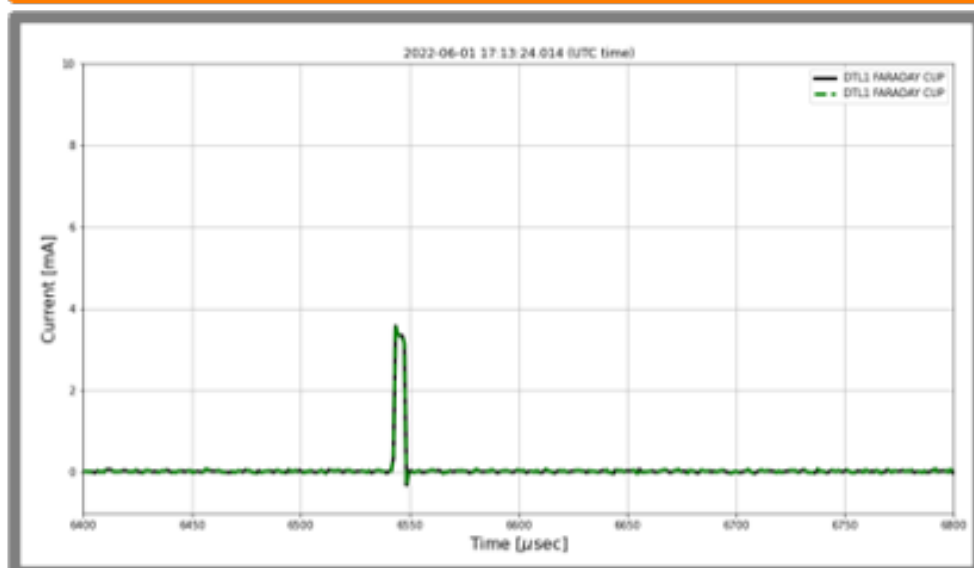
Beam: ISrc->LEBT - 19 Sep, 2018



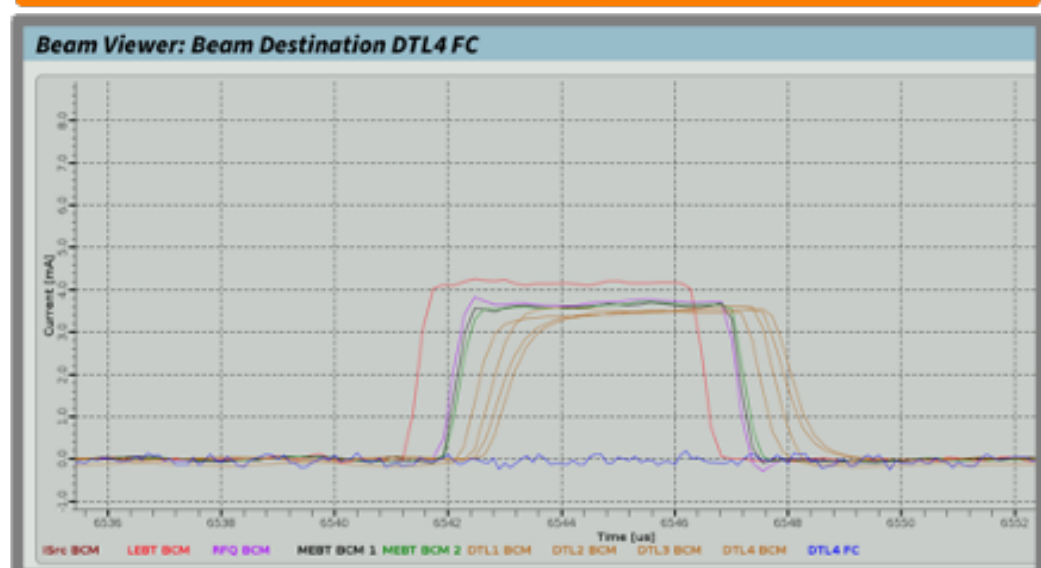
Beam: ISrc->MEBT - 26 Nov, 2021



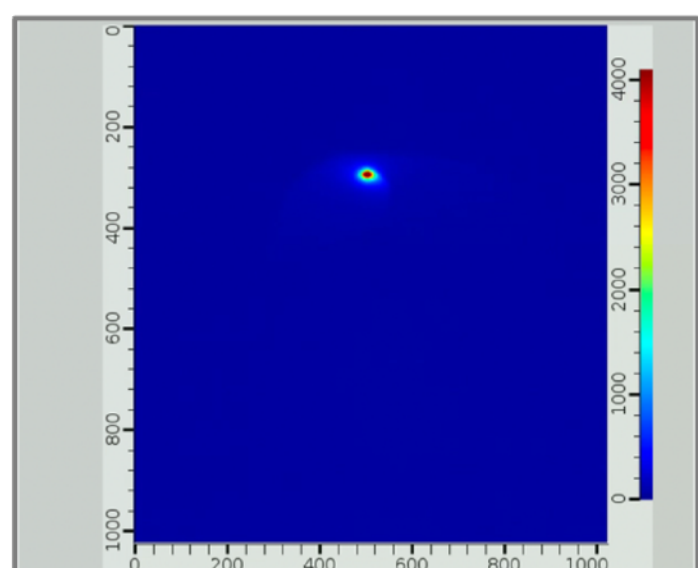
Beam: ISrc->DTL1 - 1 Jun, 2022



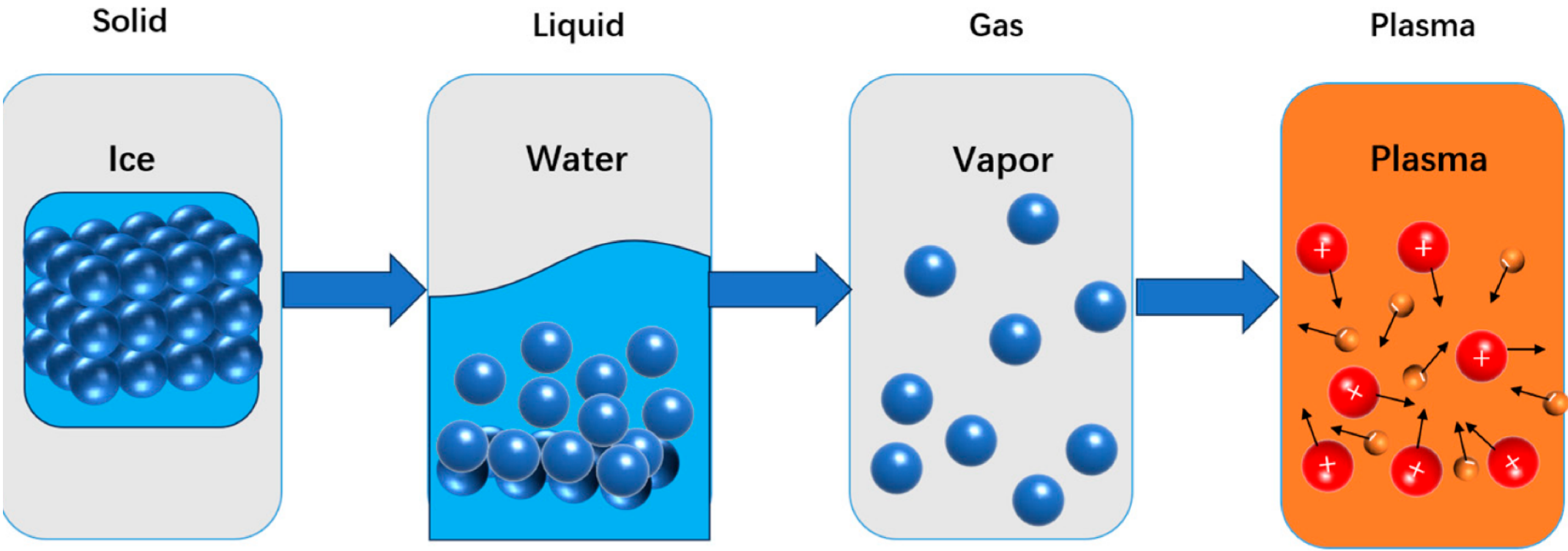
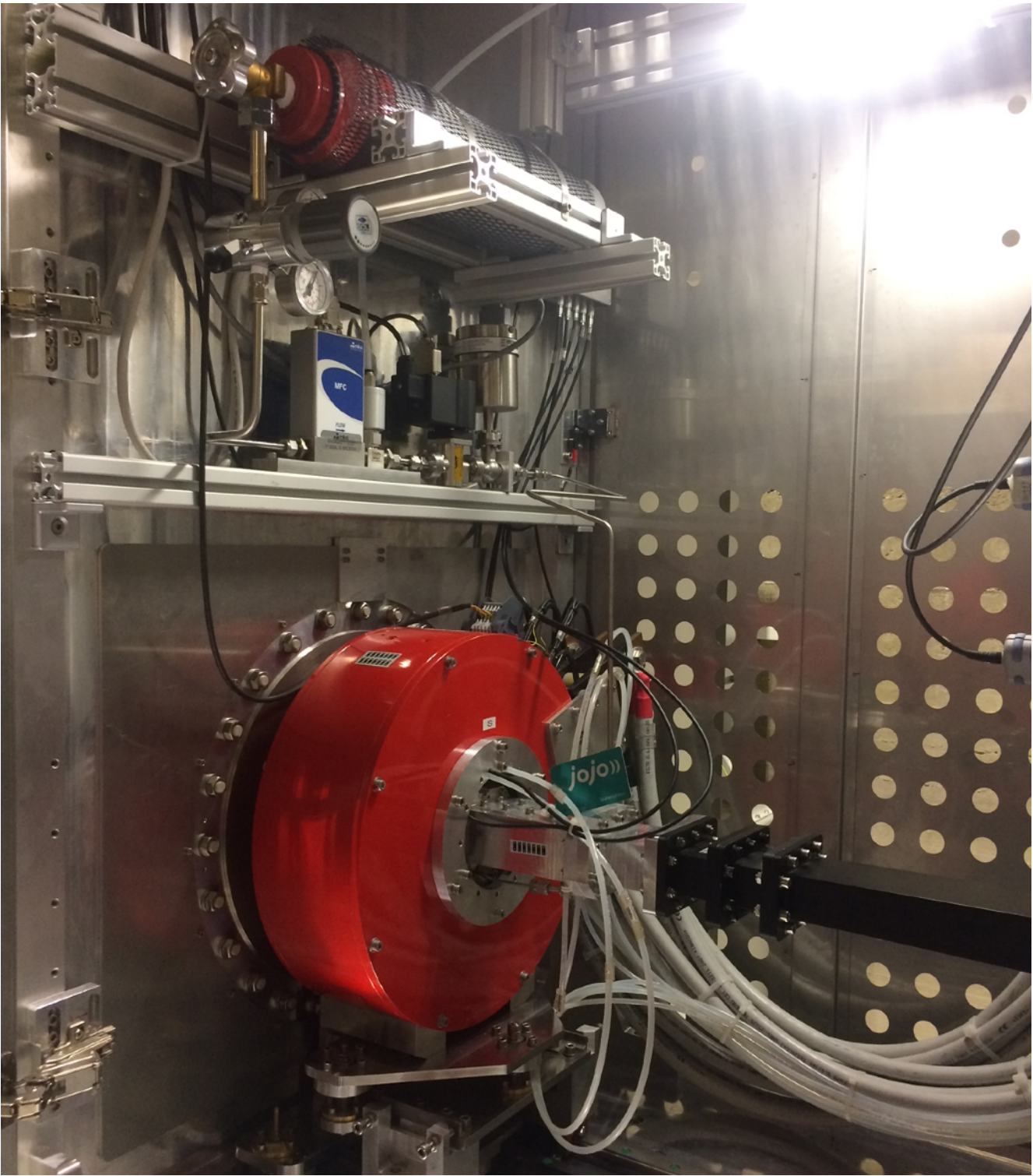
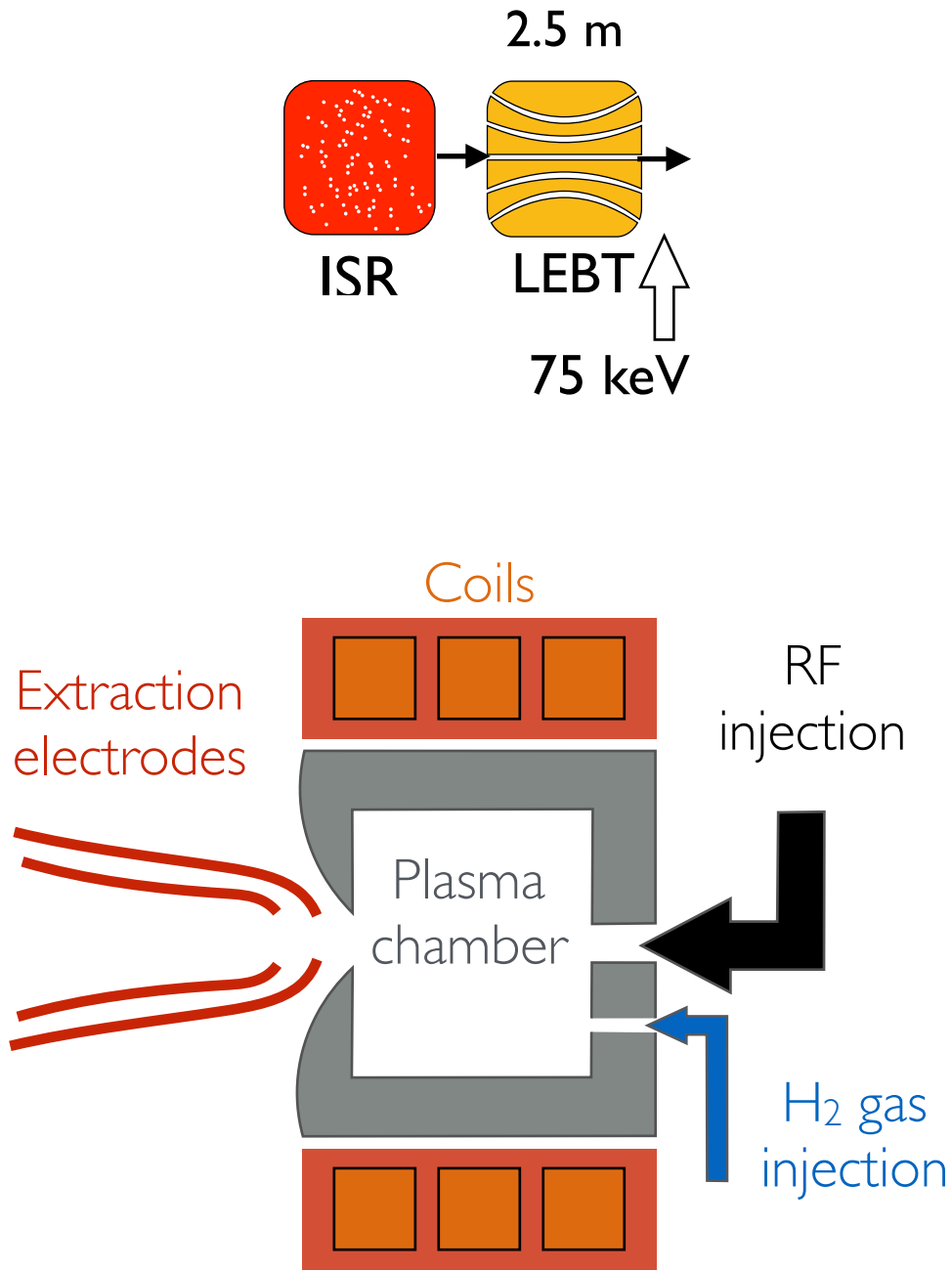
Beam: ISrc->DTL4 - 20 Apr, 2023



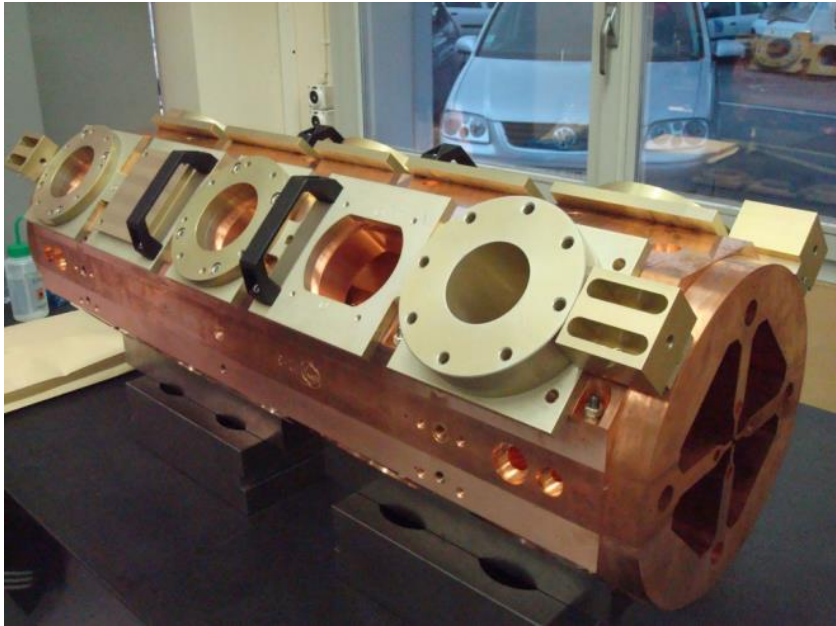
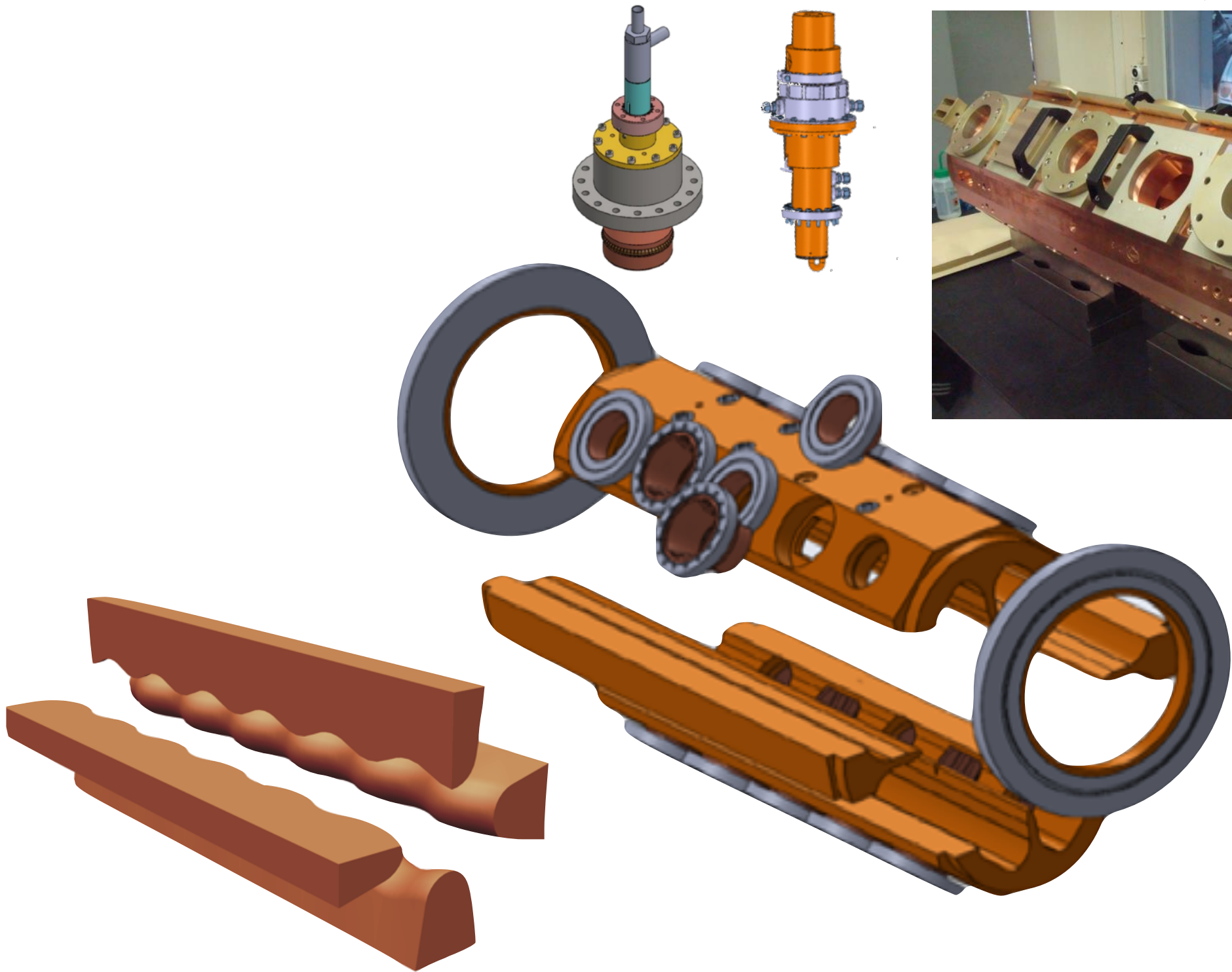
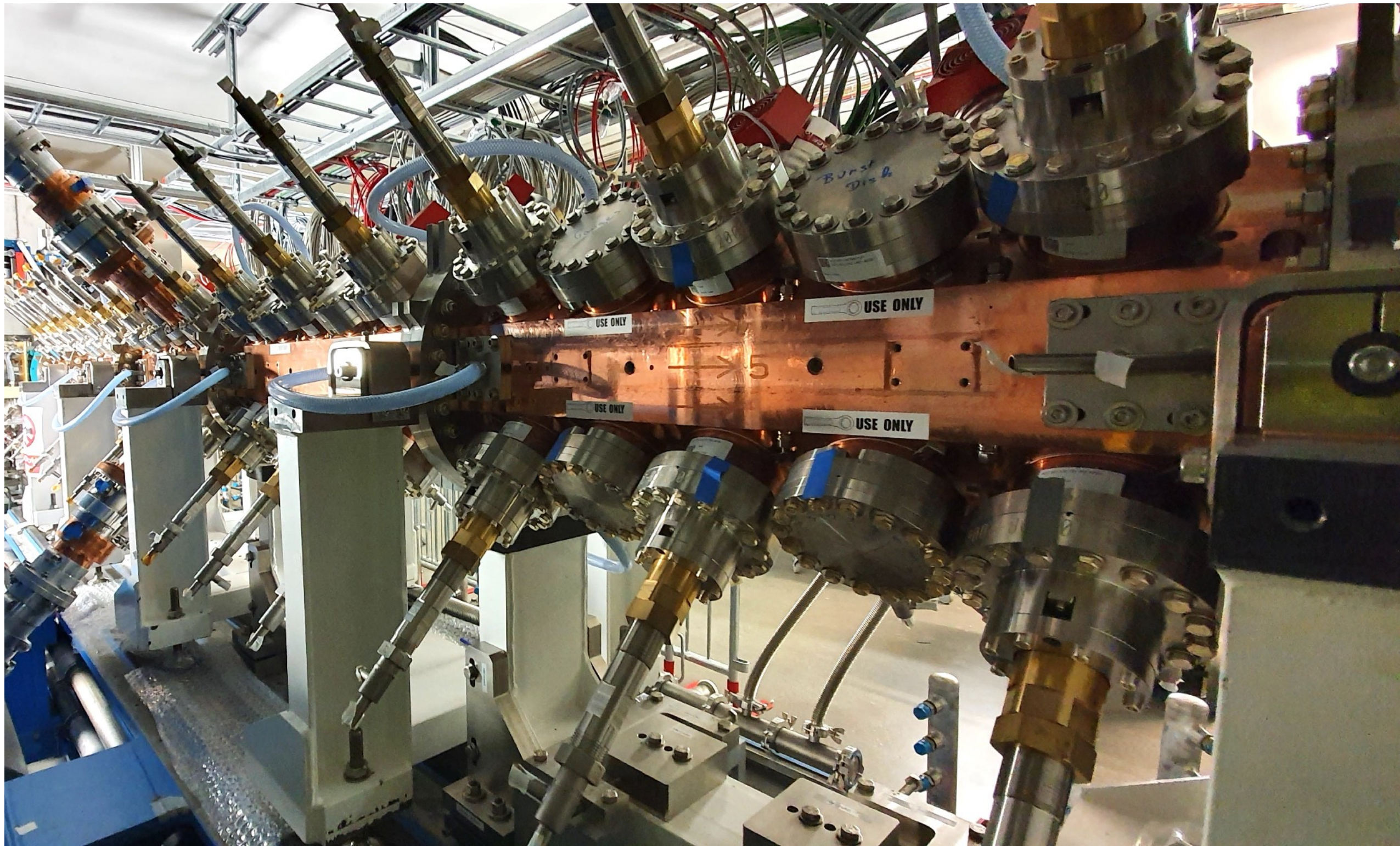
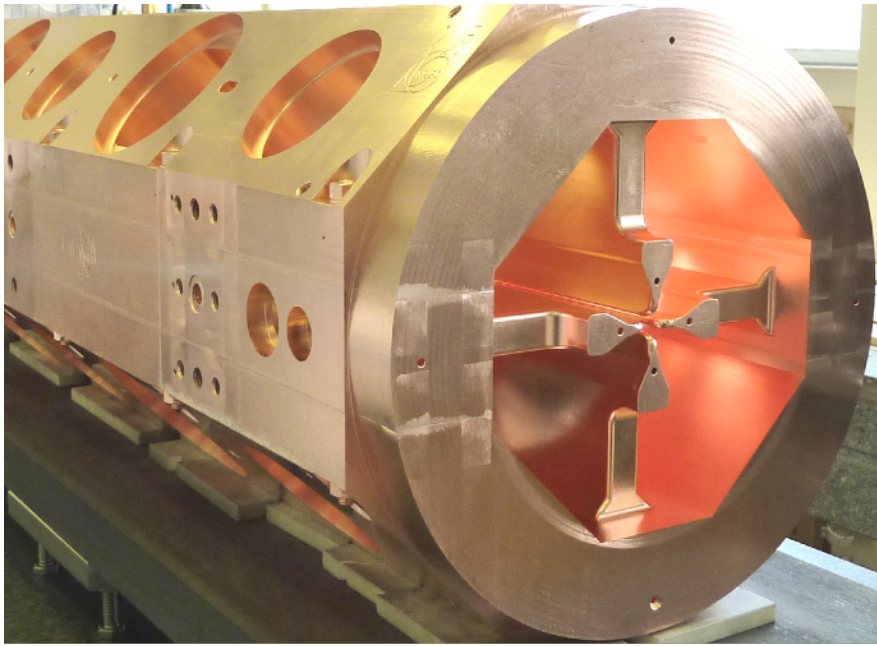
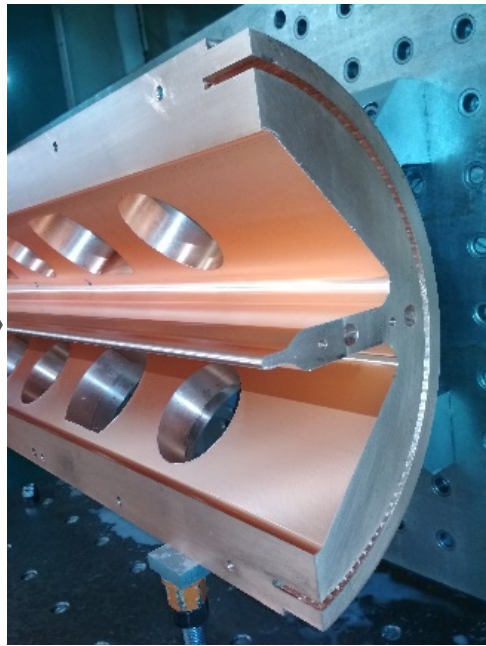
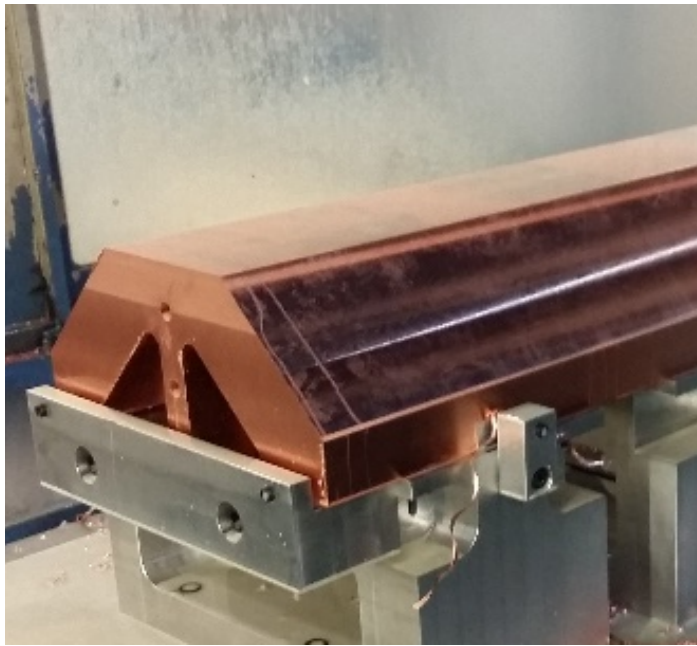
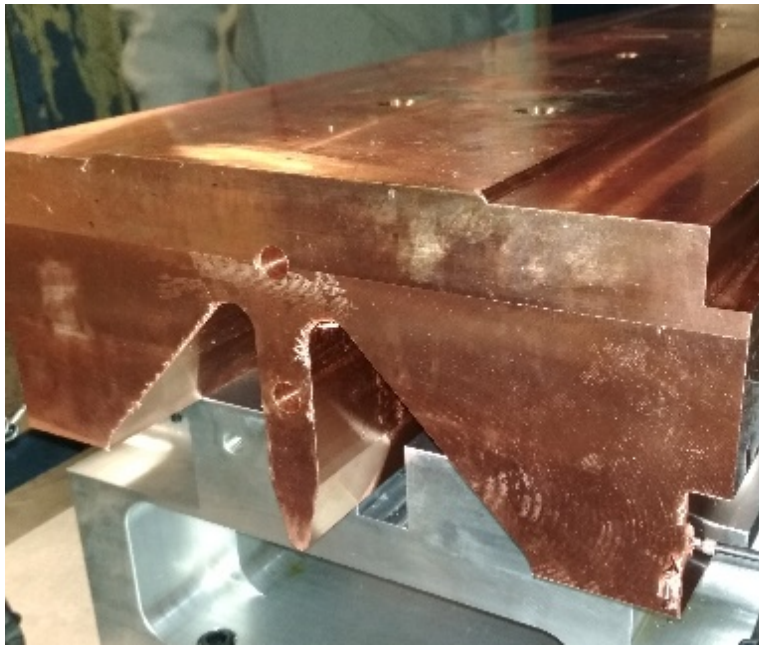
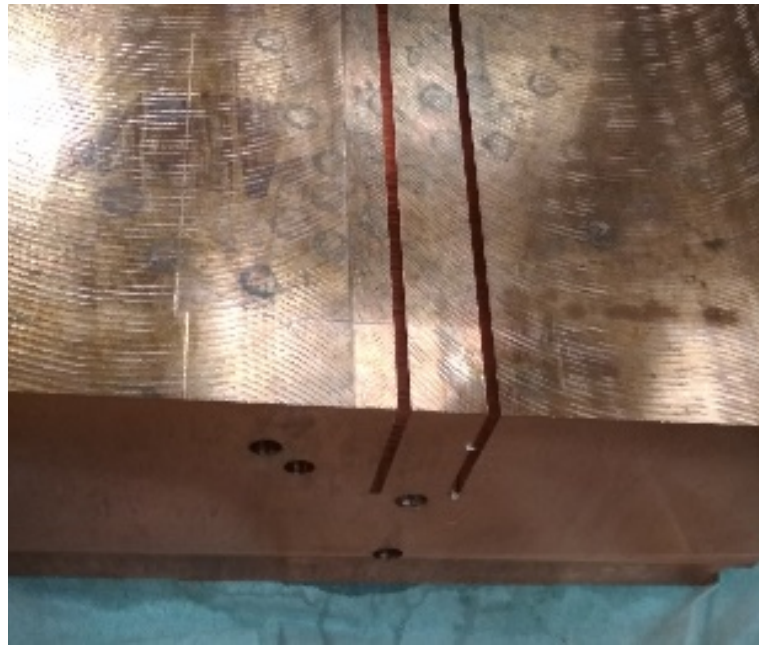
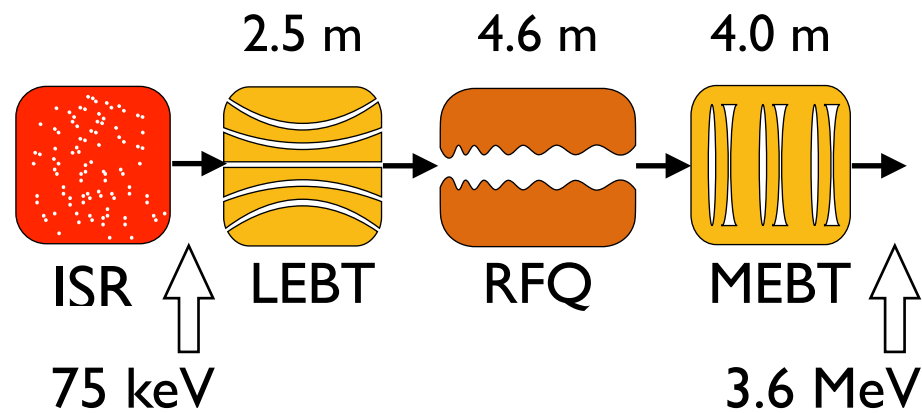
Beam: ISrc->TBD - 09 Apr, 2025



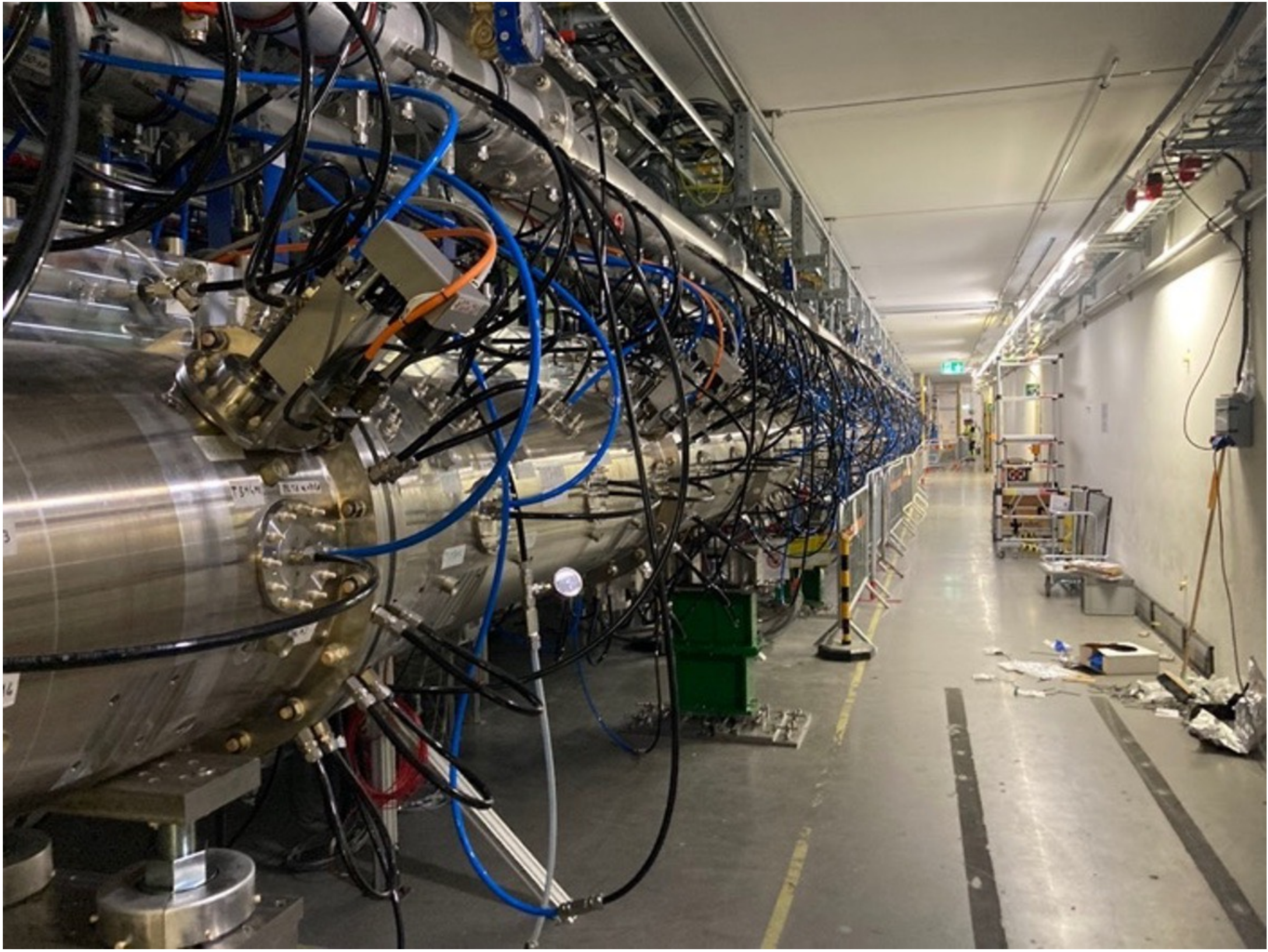
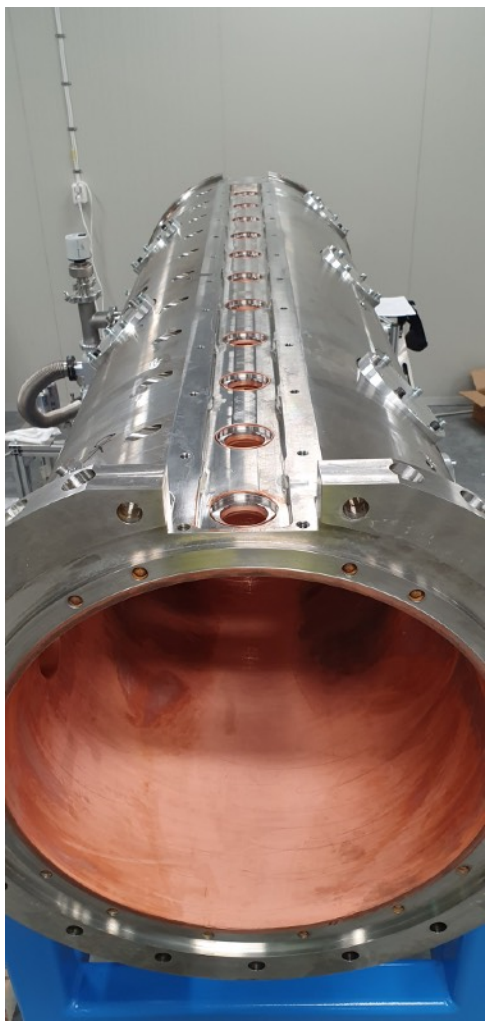
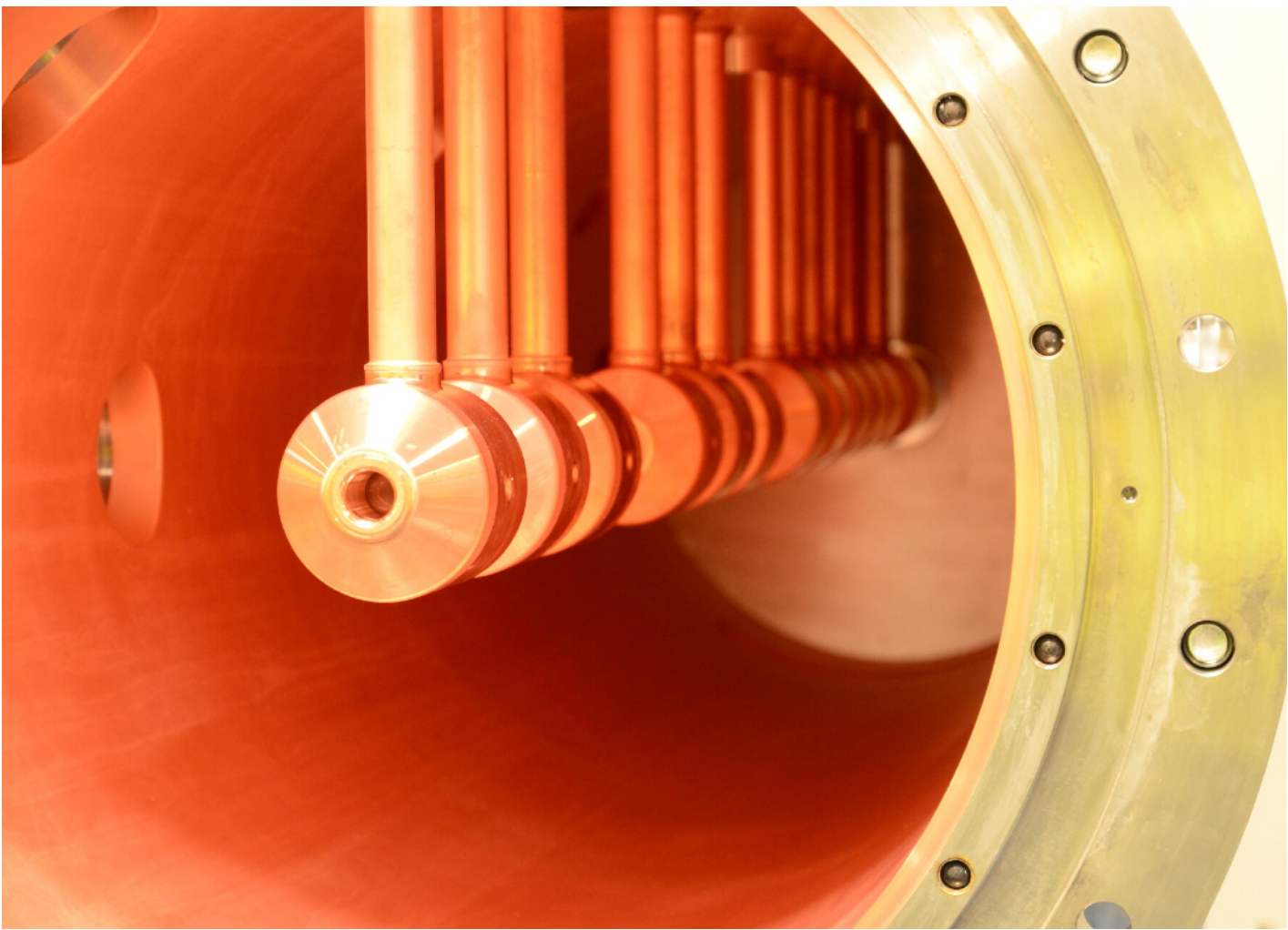
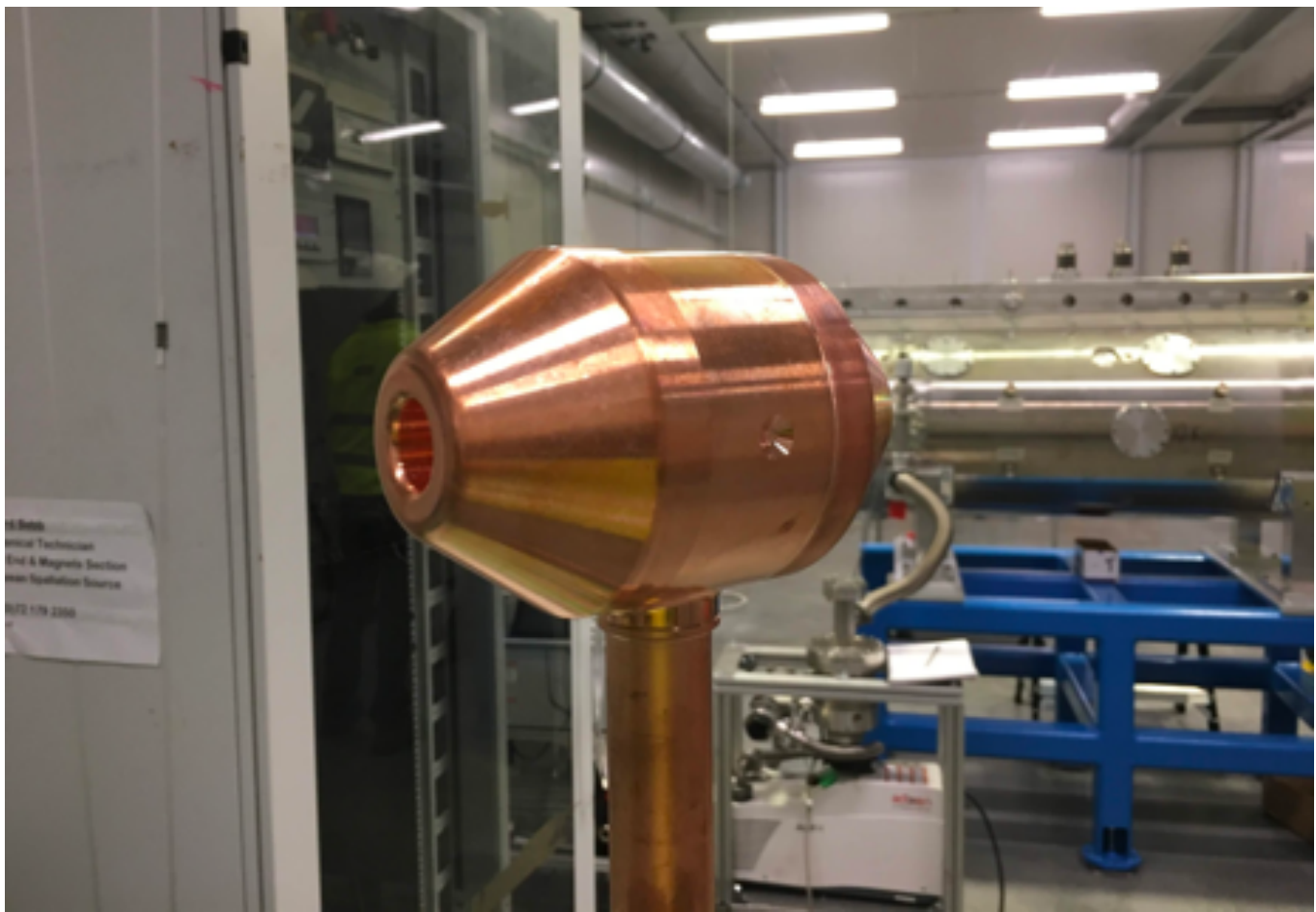
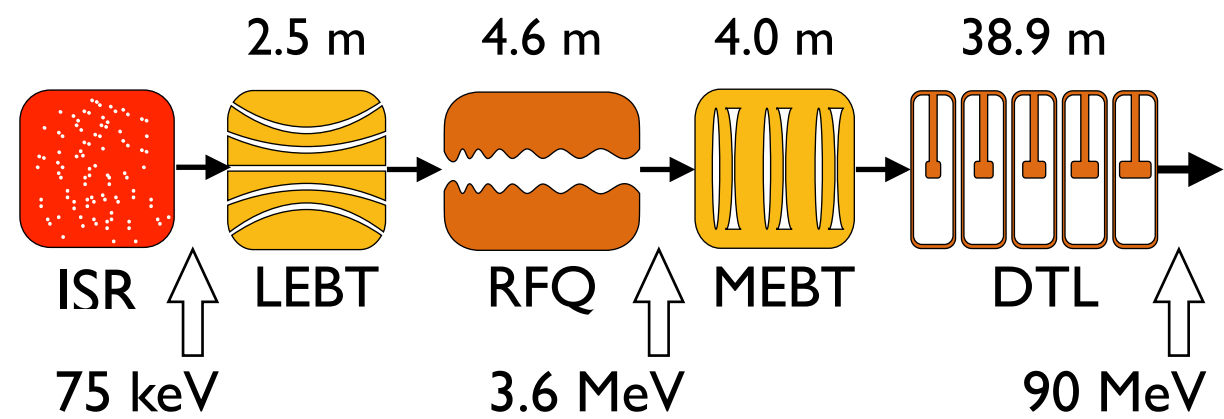
ION SOURCE



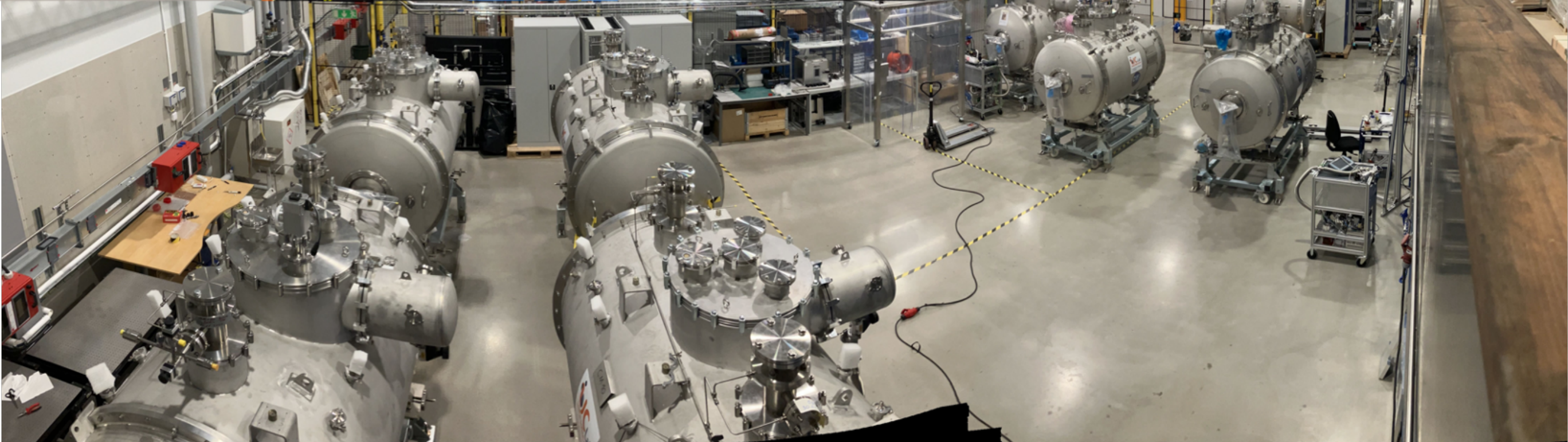
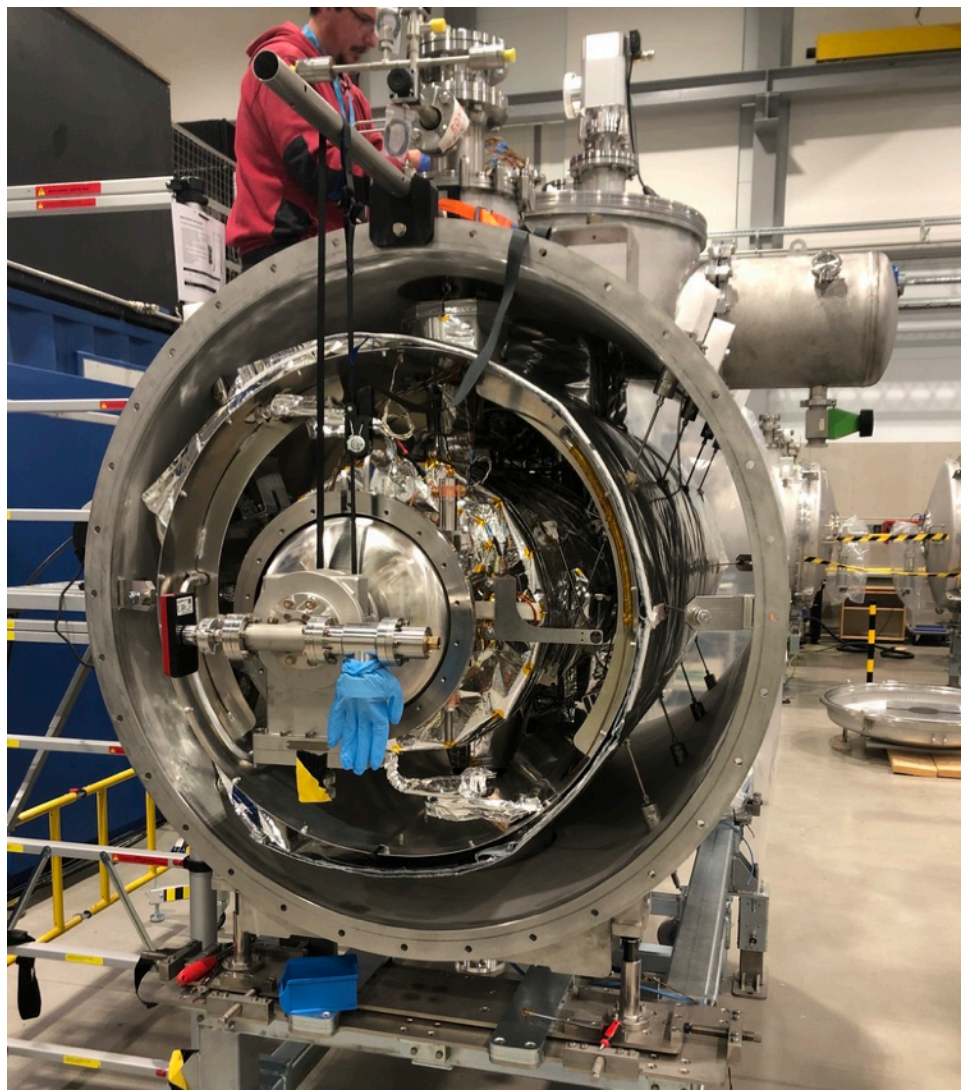
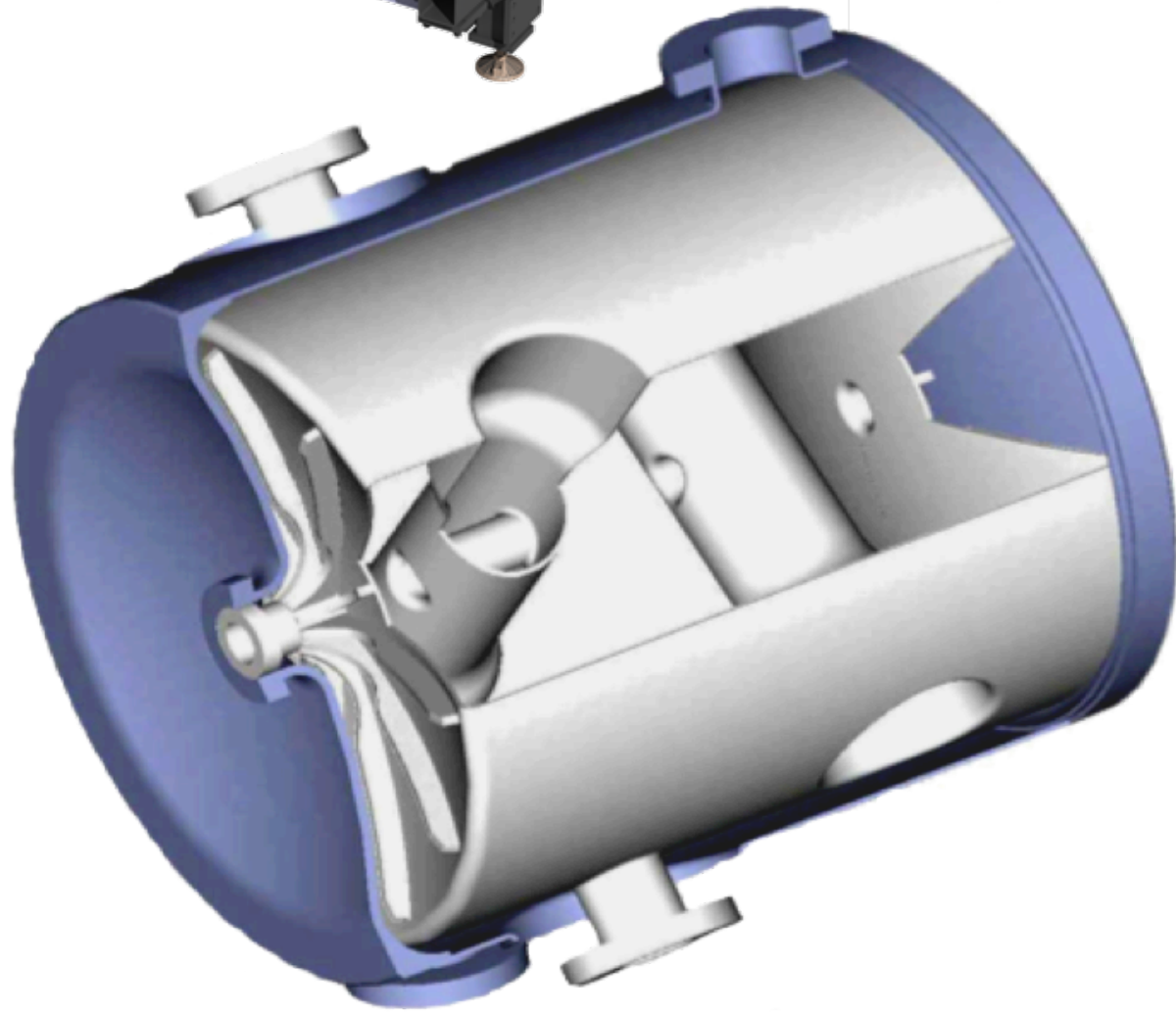
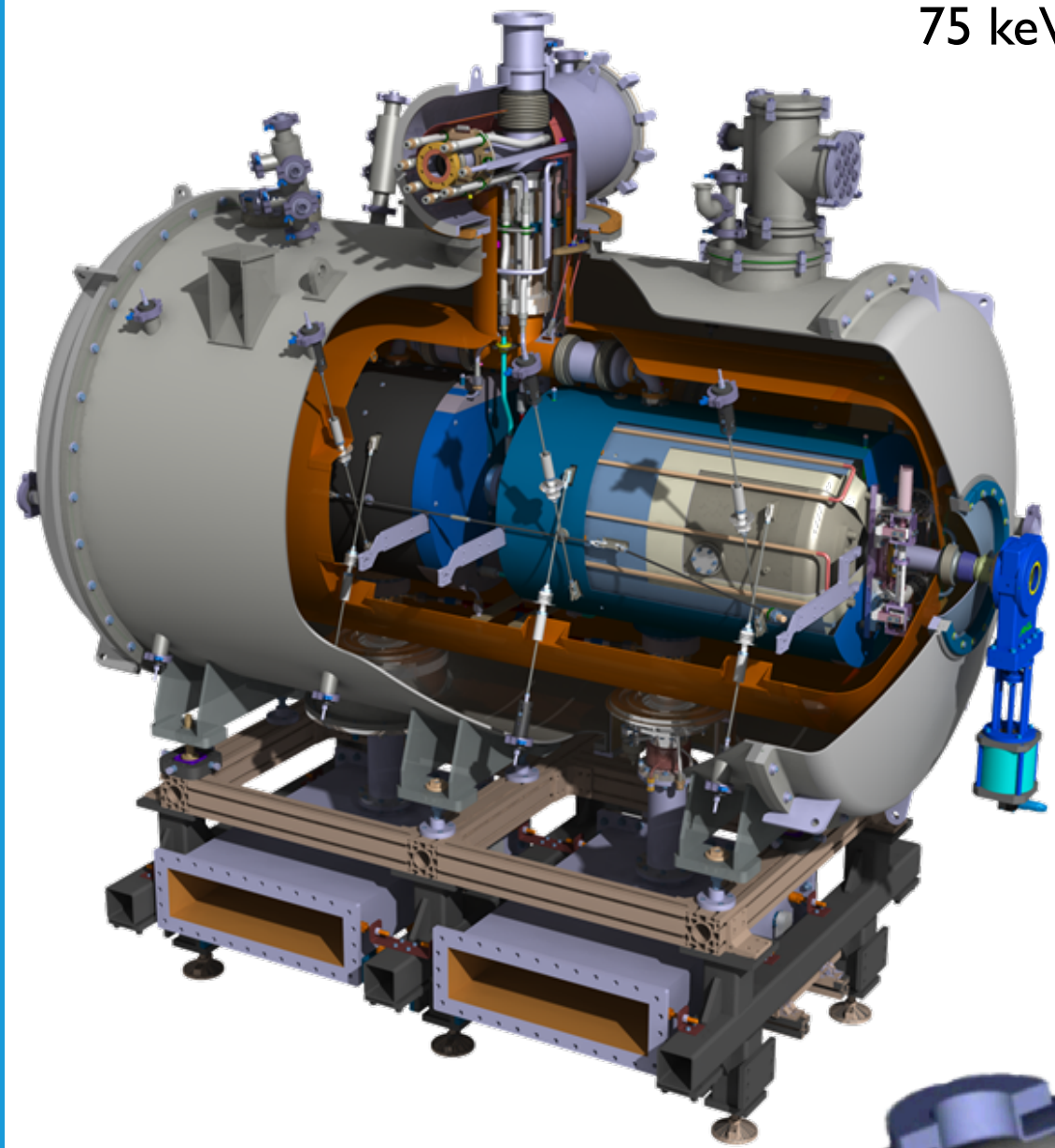
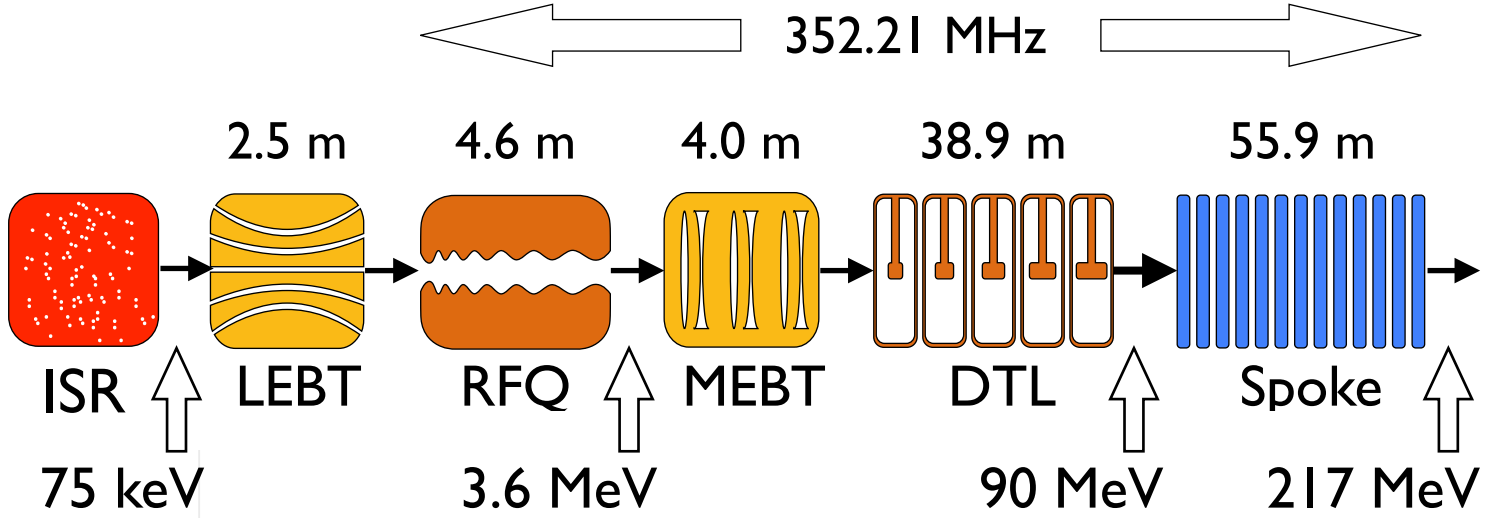
RADIO FREQUENCY QUADRUPOLE



DRIFT TUBE LINAC (DTL)

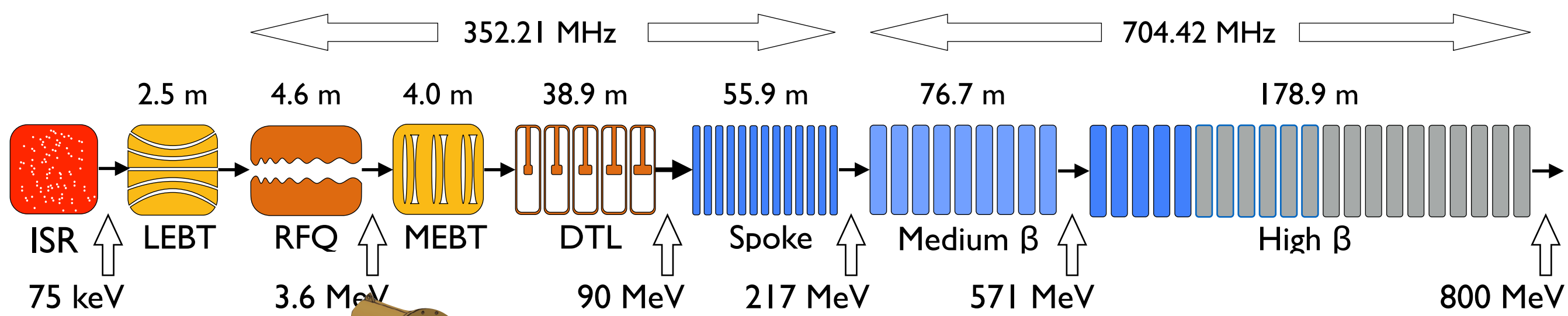
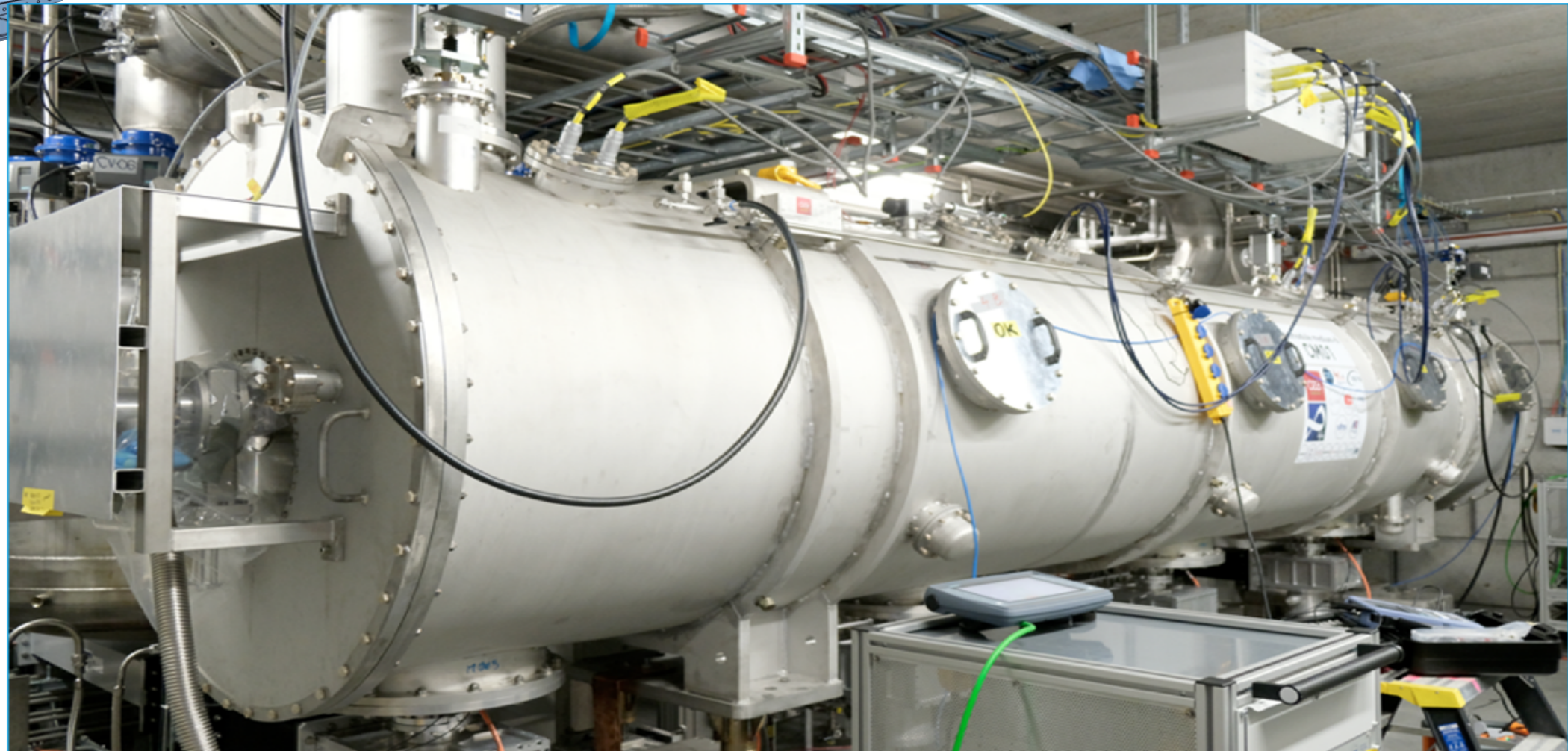
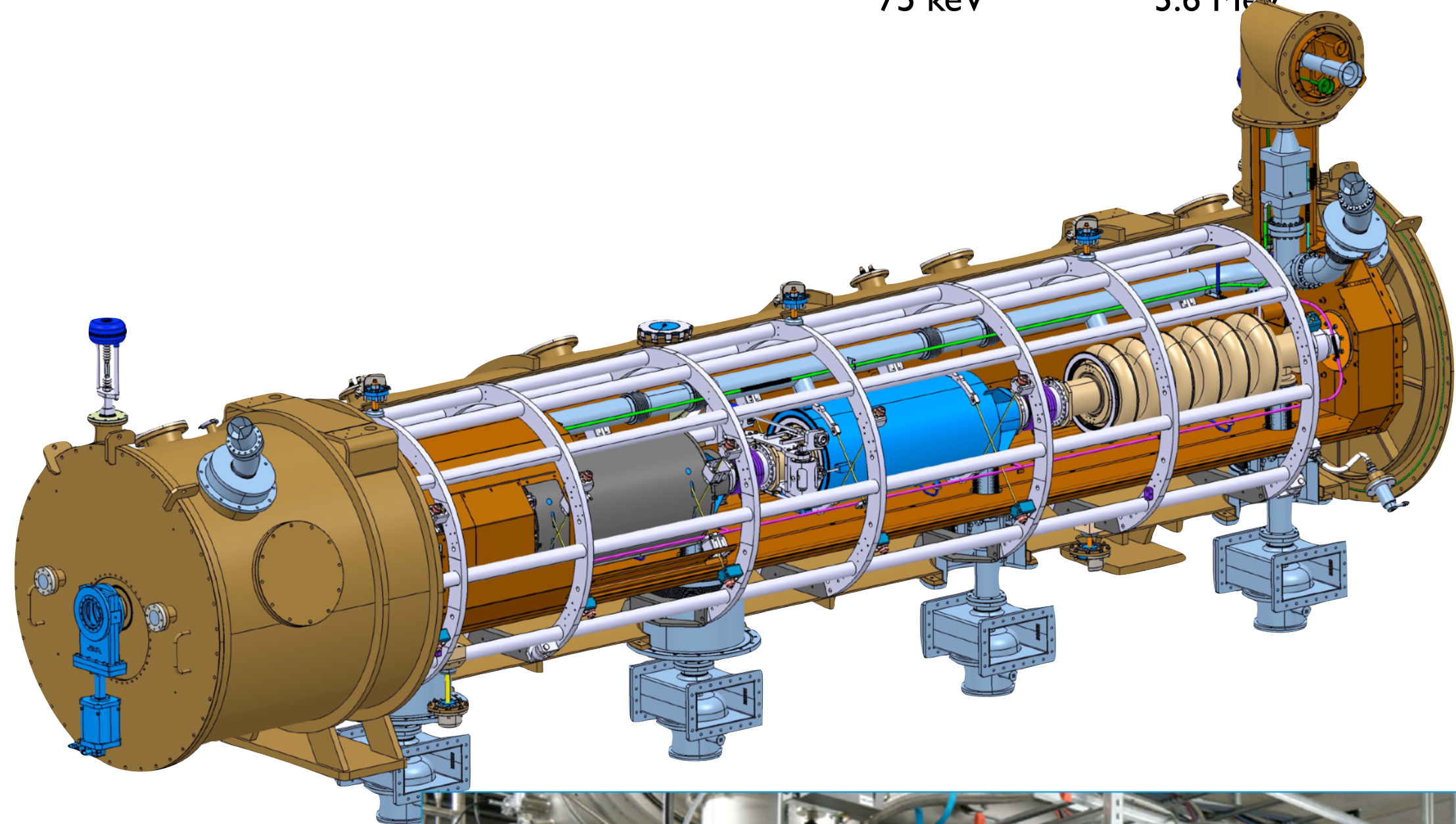


SPOKES

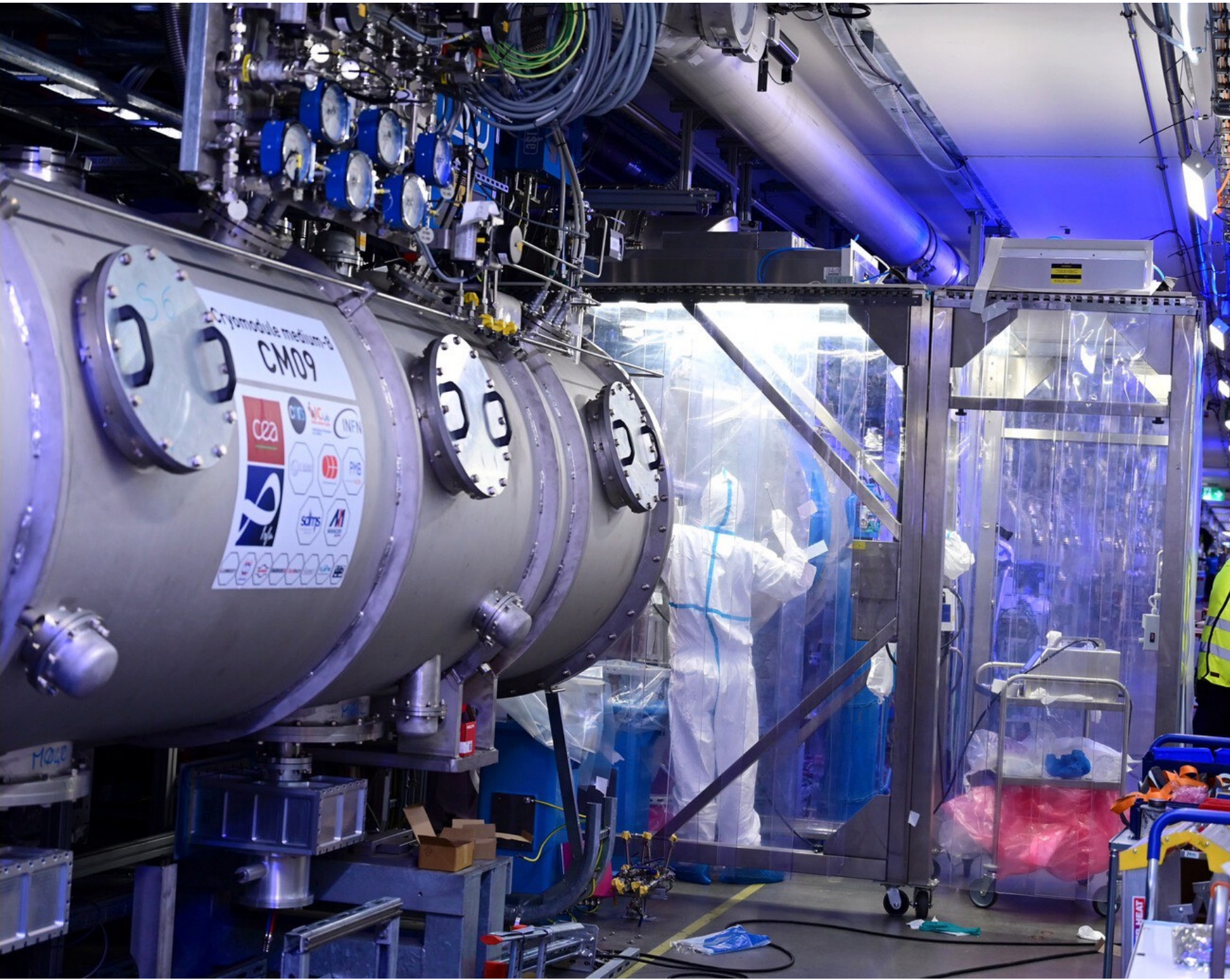
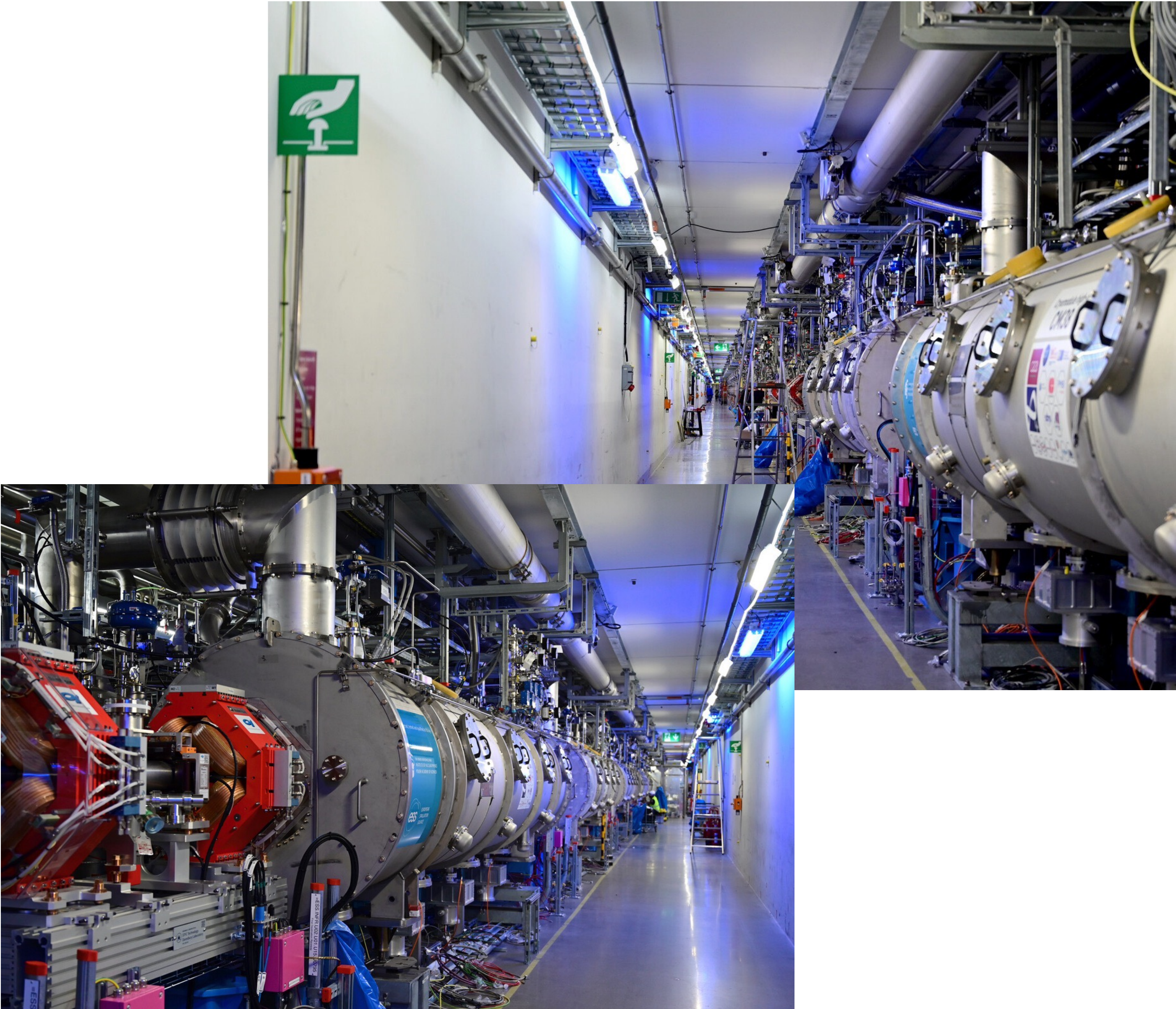


Paolo Pierini, Sébastien Bousson et al

ELLIPTICAL CAVITIES

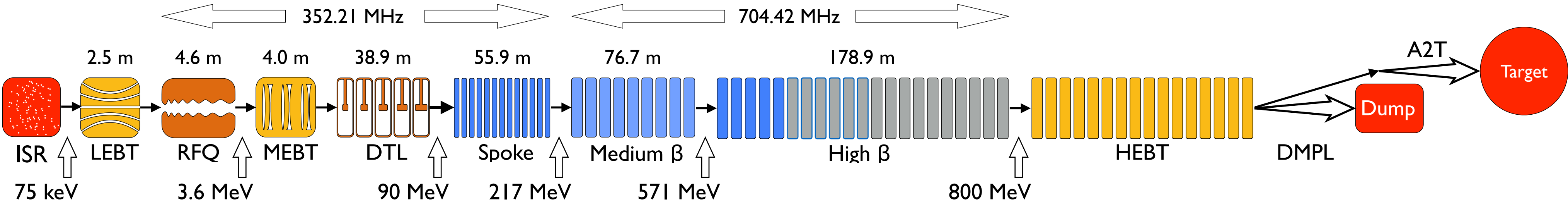
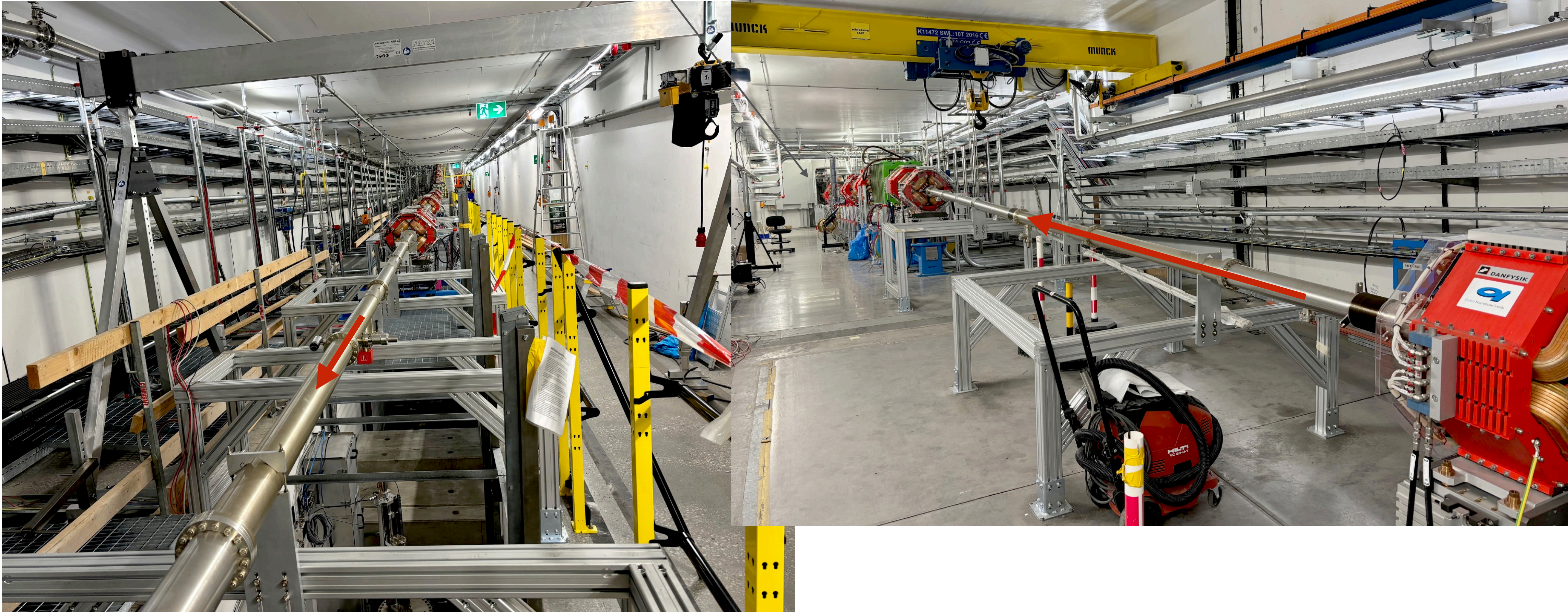


ELLIPTICAL CRYOMODULES

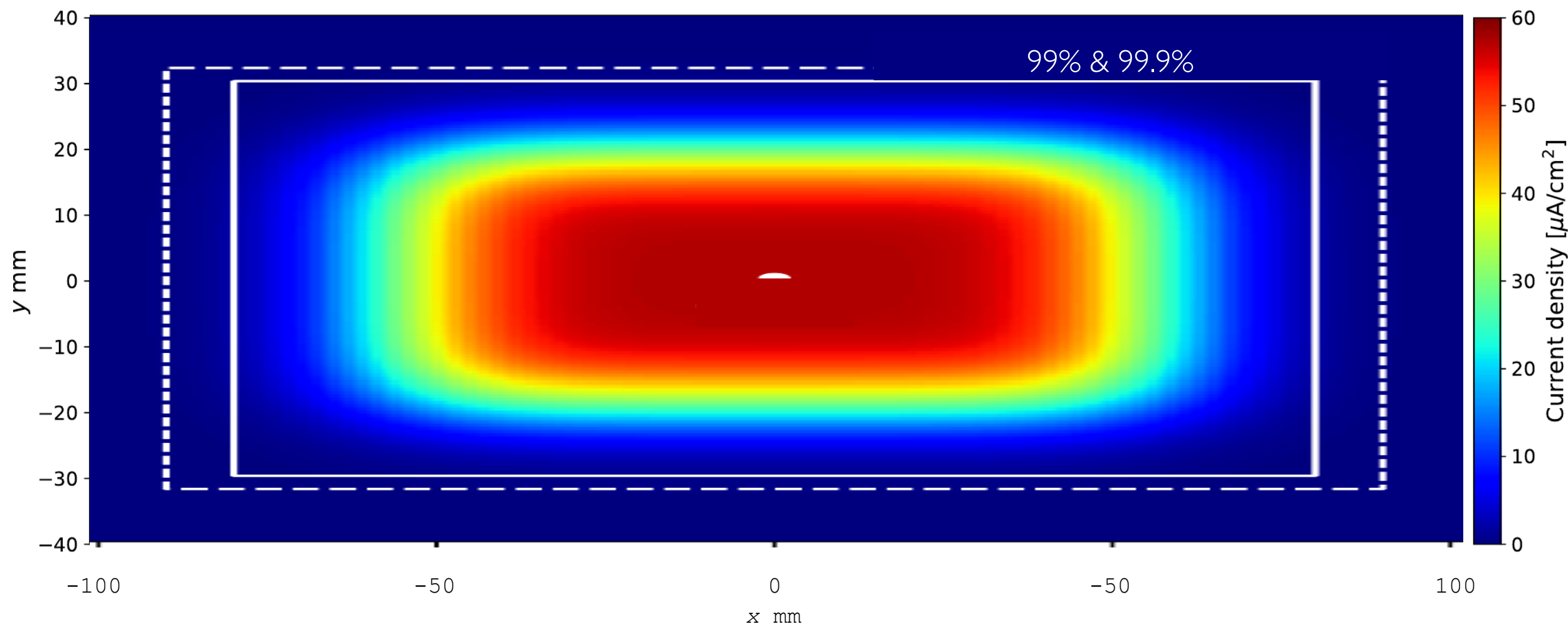
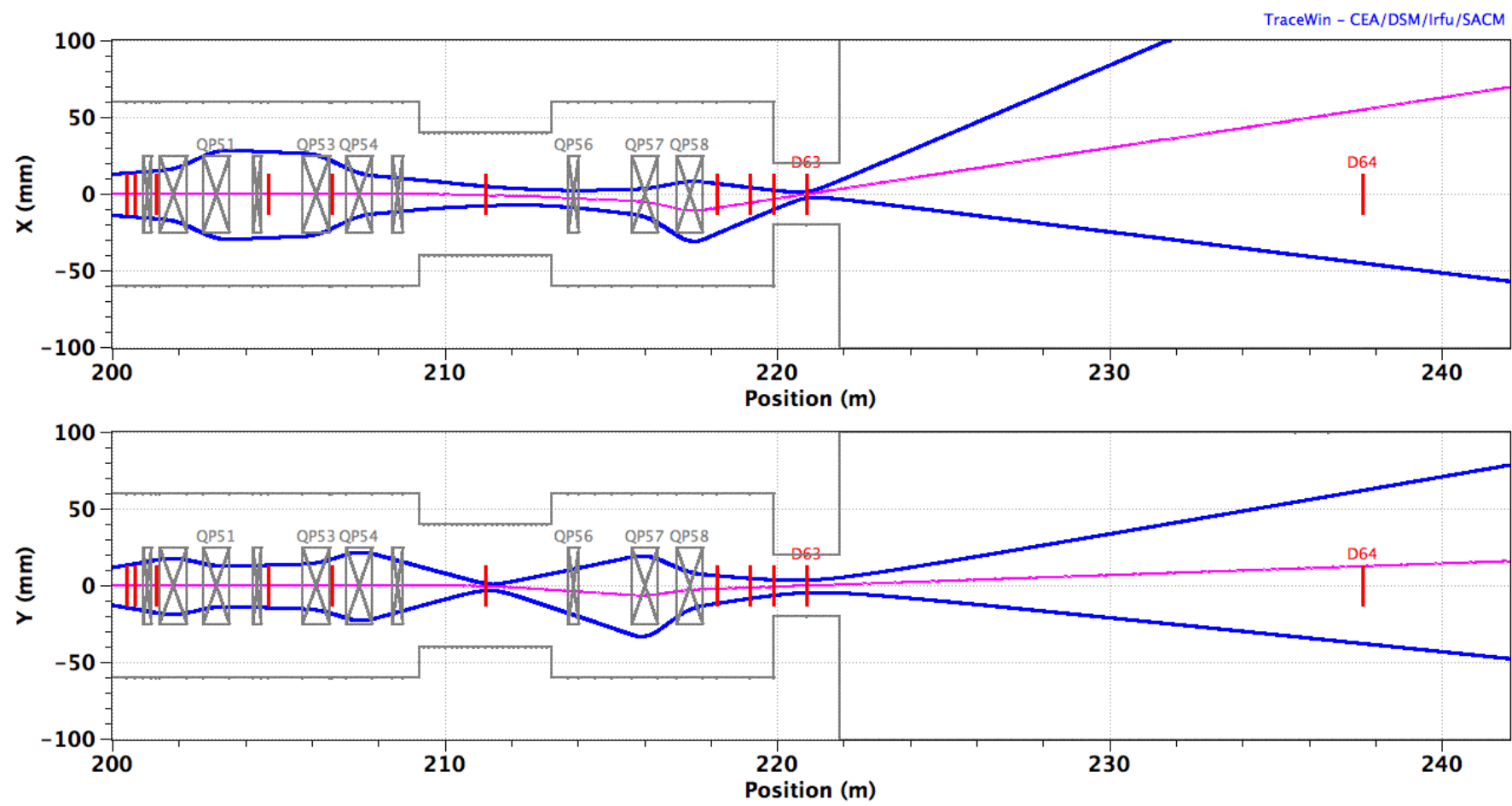
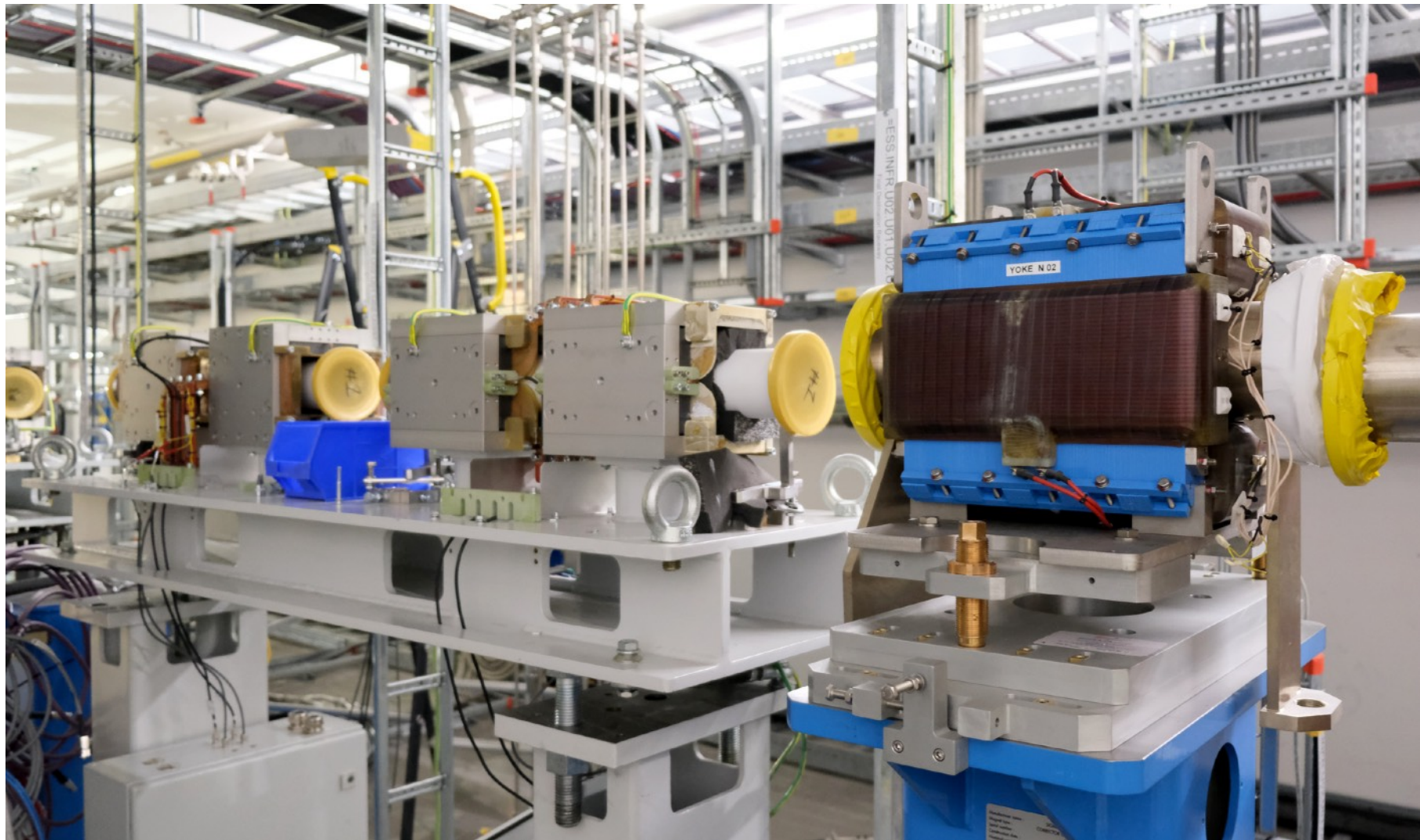


PATH TO THE TARGET

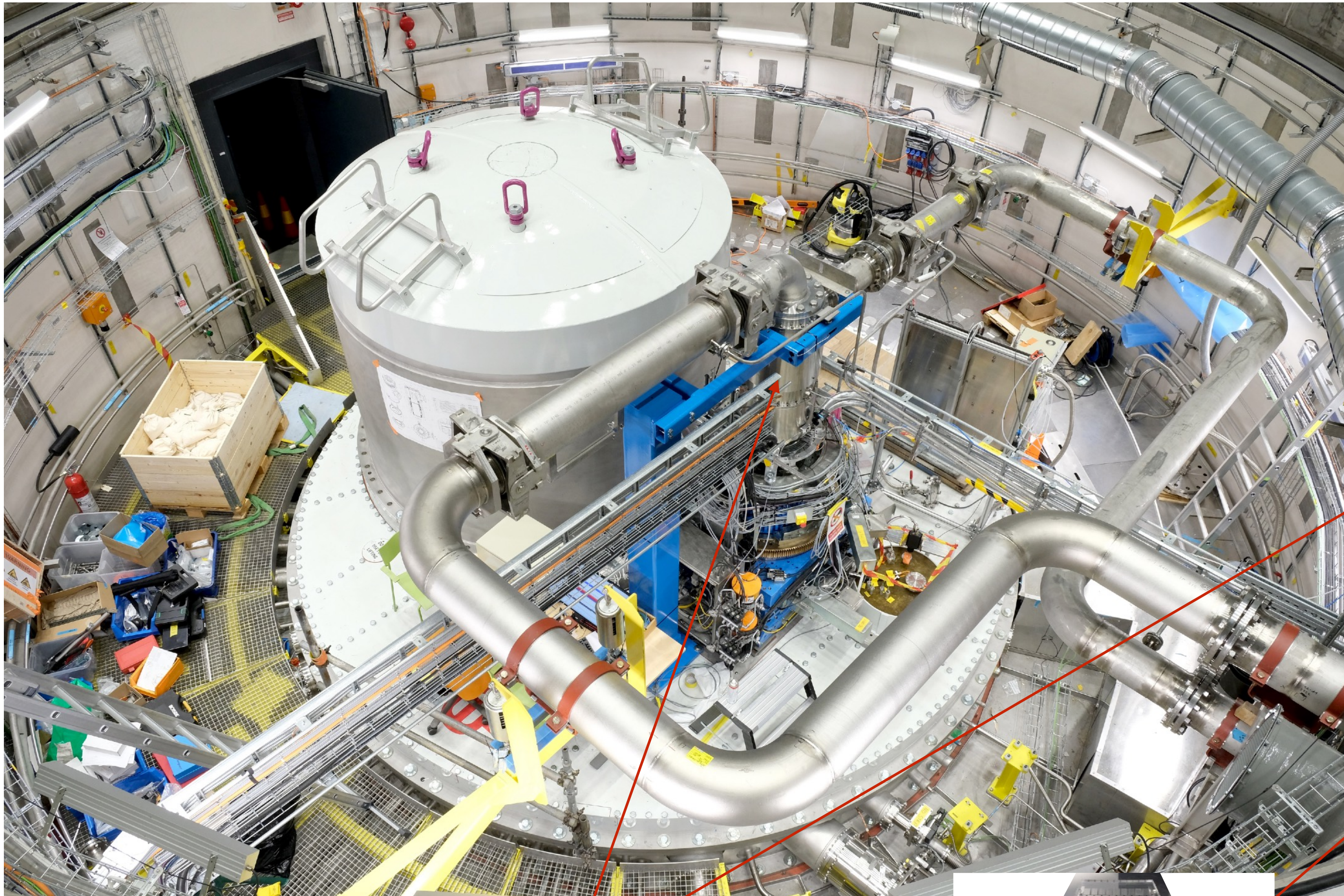
Target!



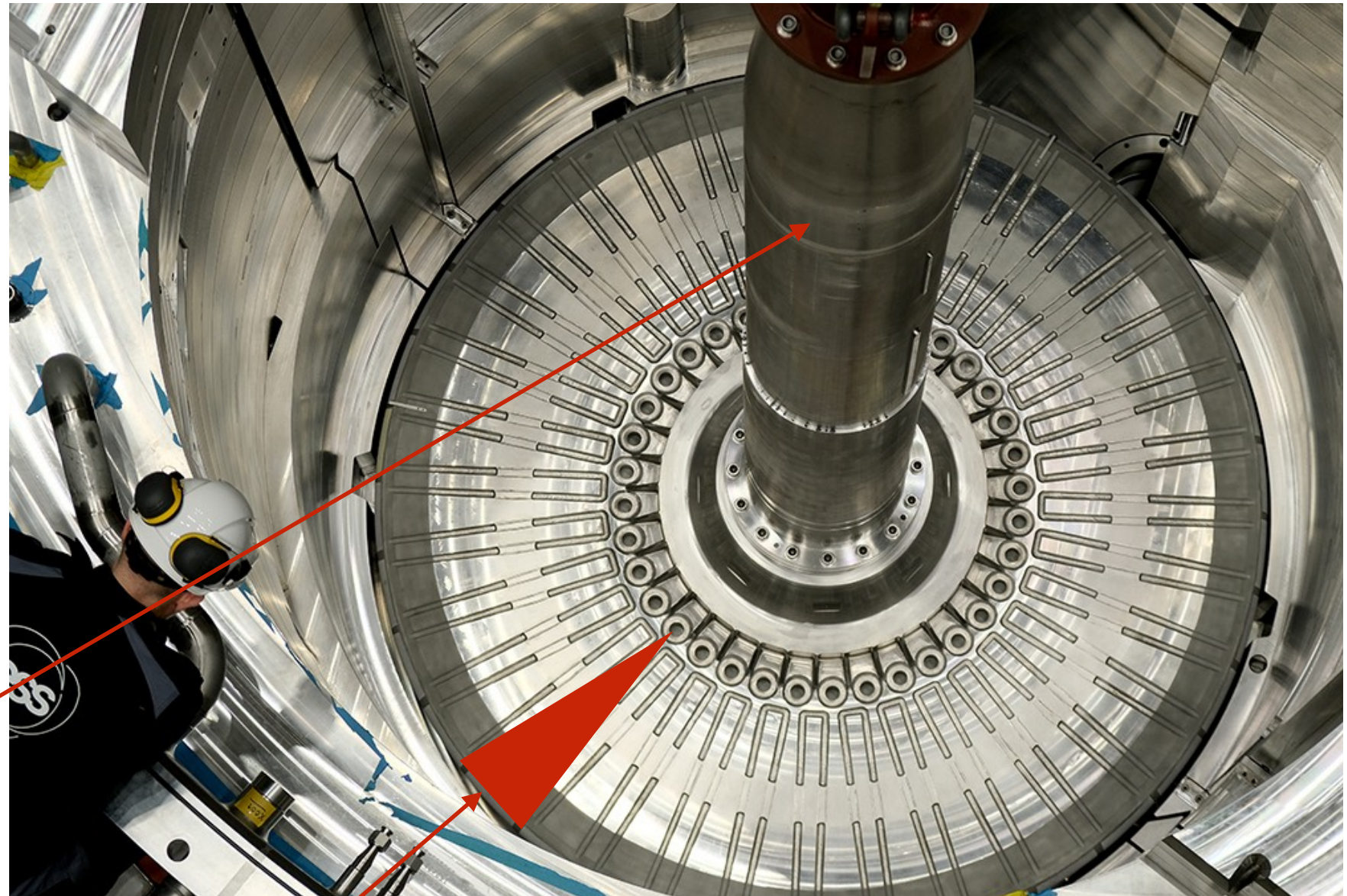
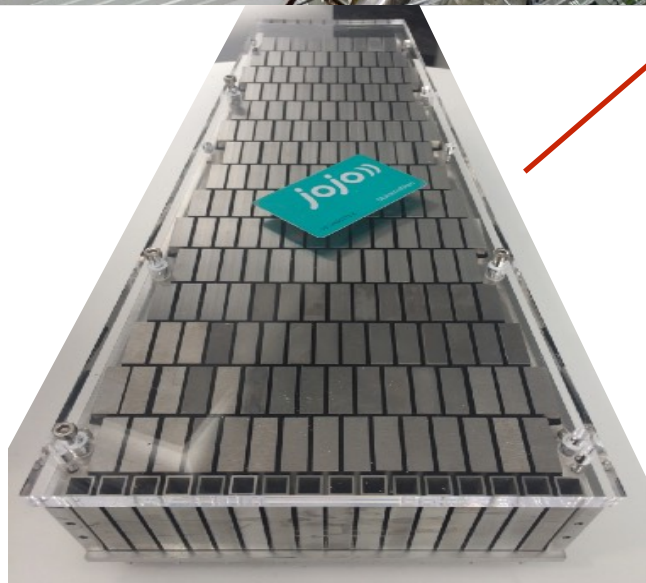
DELIVERING THE BEAM TO TARGET



TARGET WHEEL



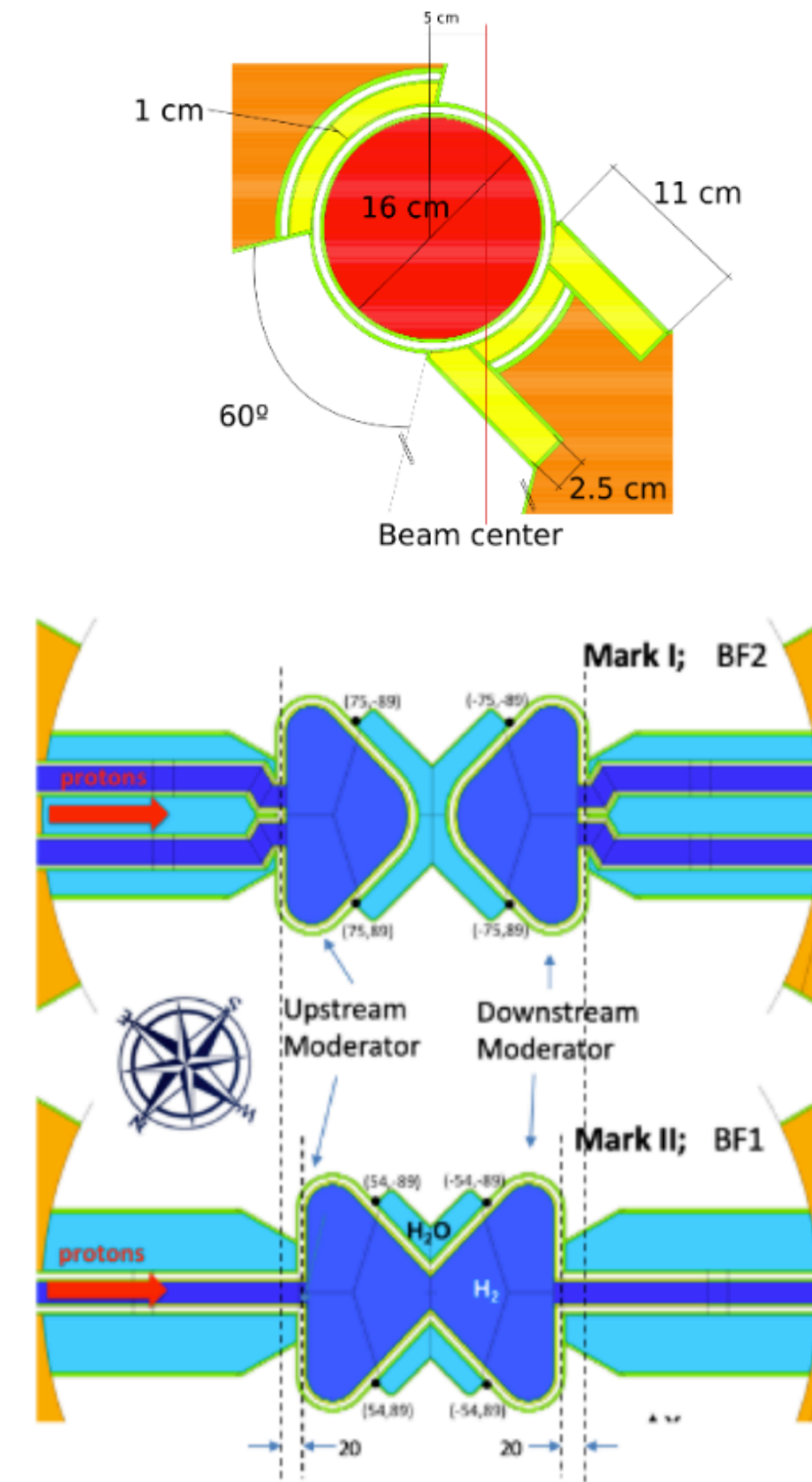
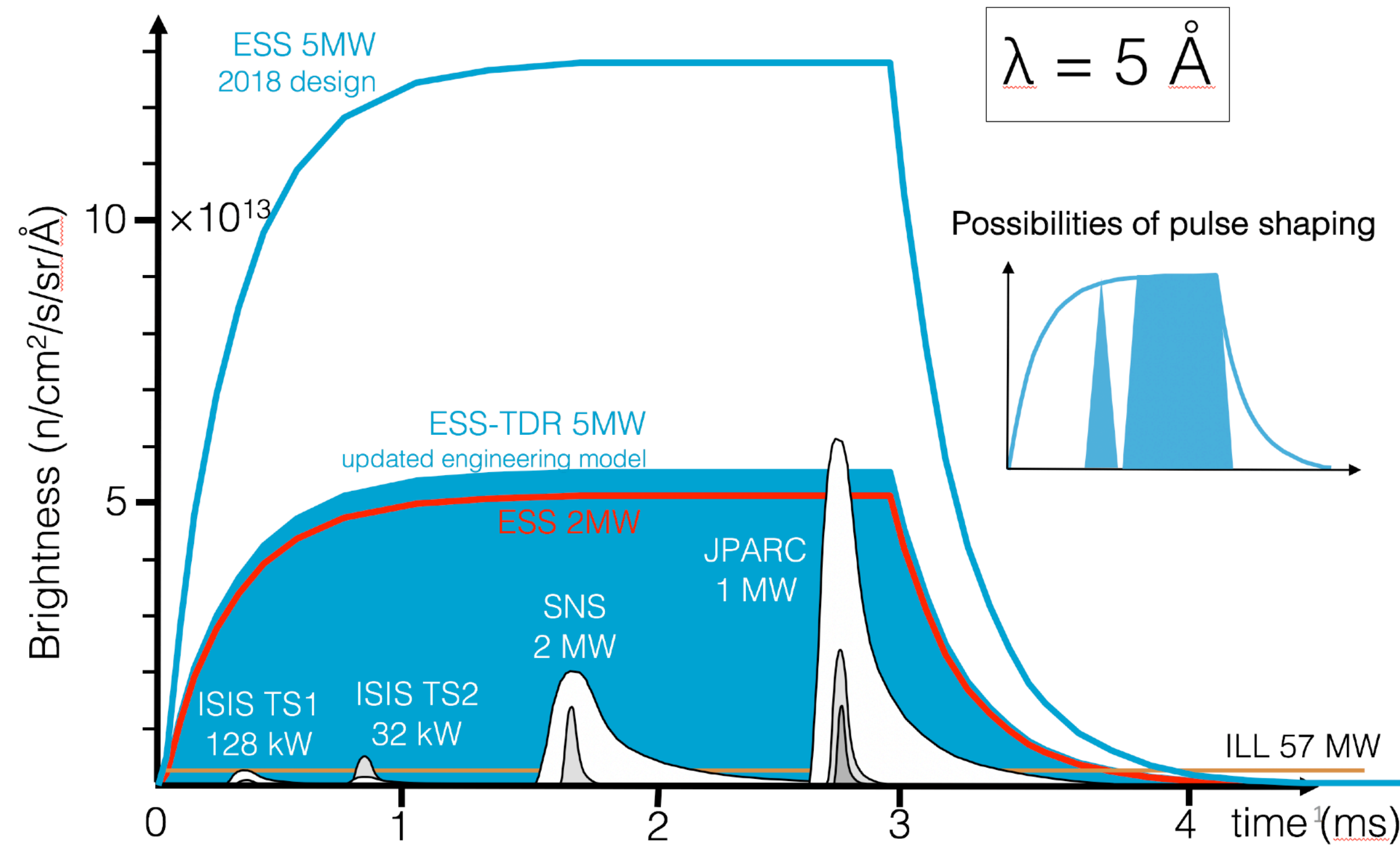
Target shaft



TARGET WHEEL

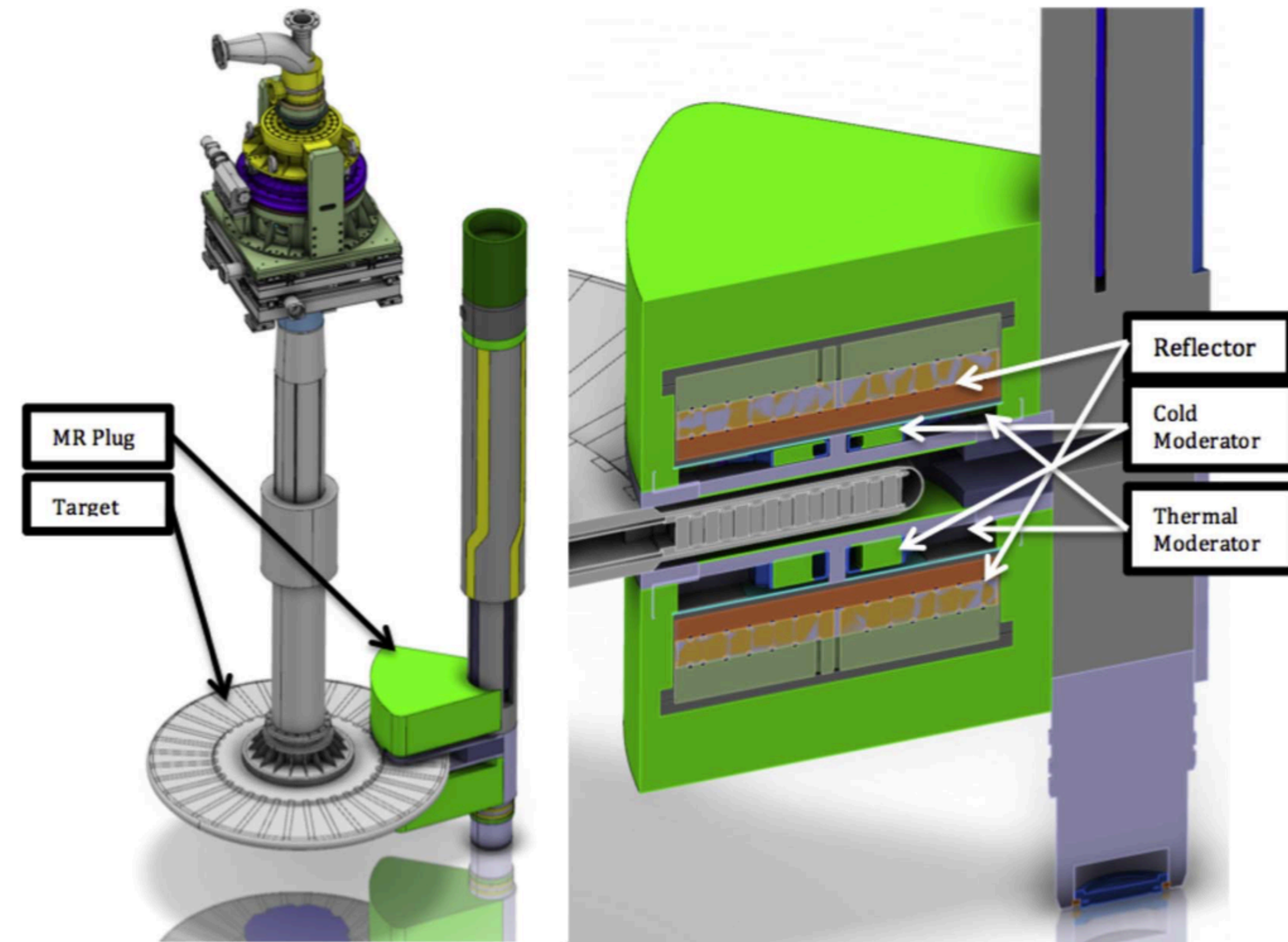
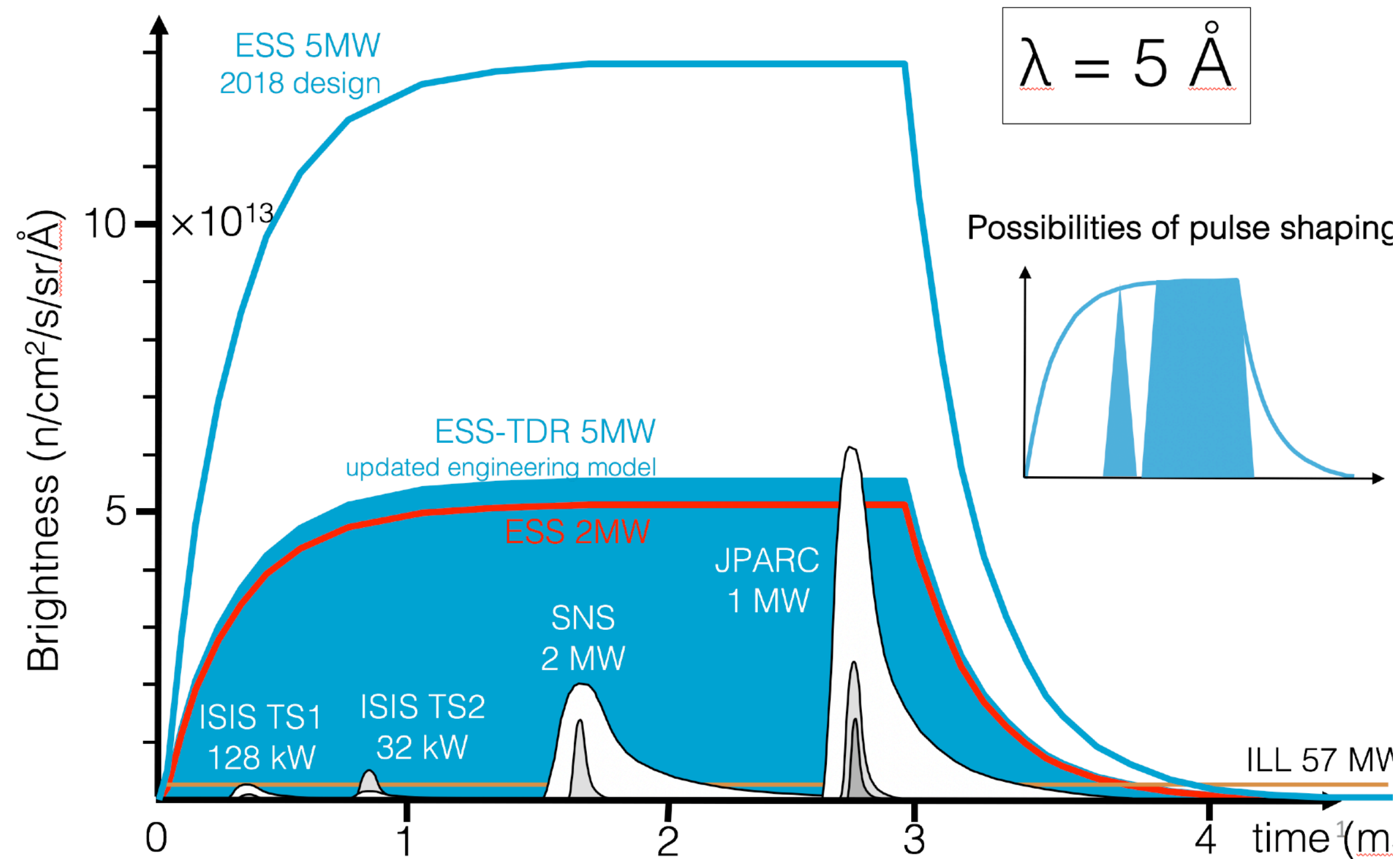


NEUTRON BEAM MODERATION



On average the neutron coming out from the target travel at 5-10% of the speed of light ($\sim 0.0001 \text{ \AA}$ wavelength). In order for those neutrons to be useful they need to be slowed down (increased wavelength). This is achieved using a para-hydrogen and water-based moderator and a beryllium-lined reflector.

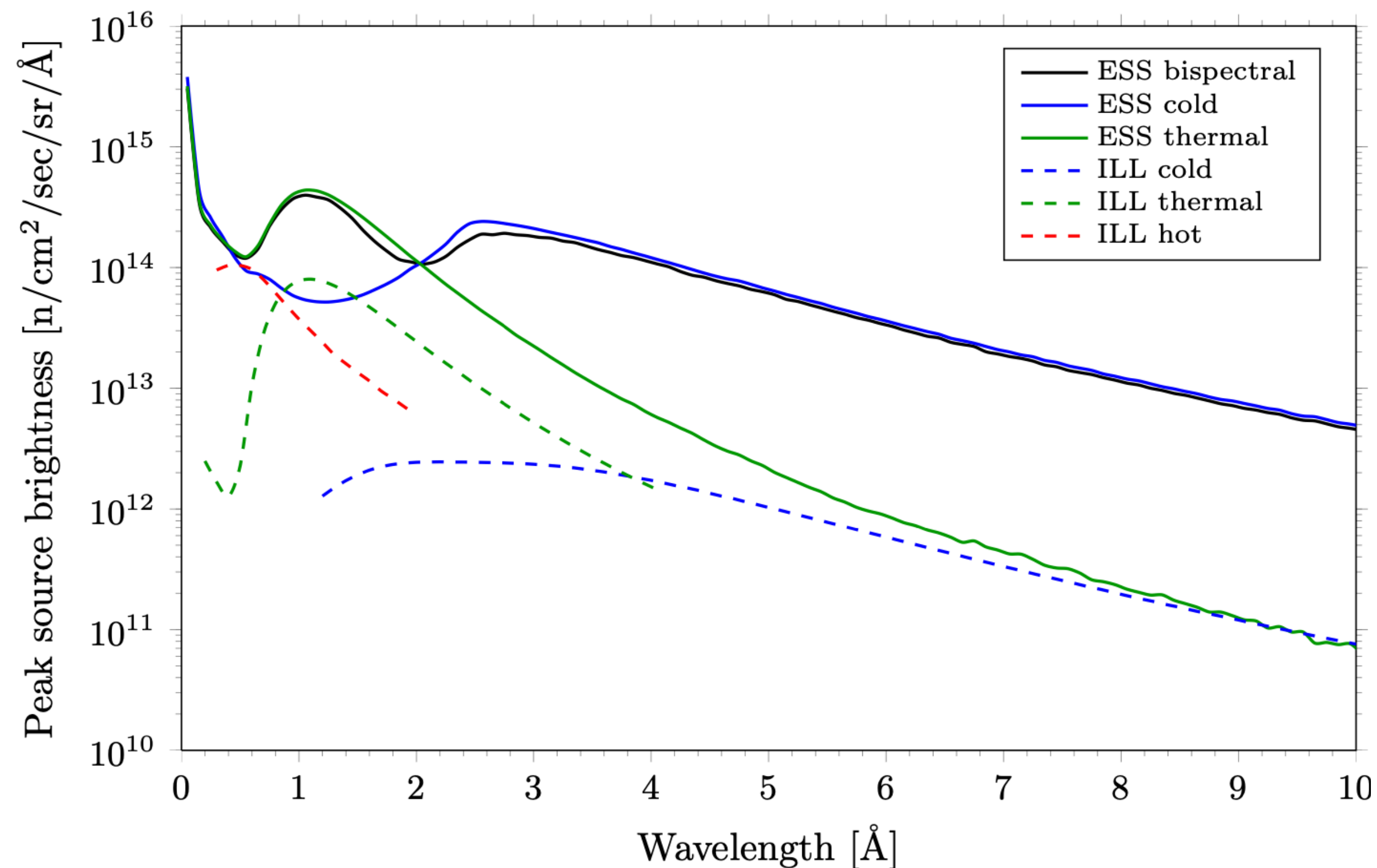
NEUTRON BEAM MODERATION



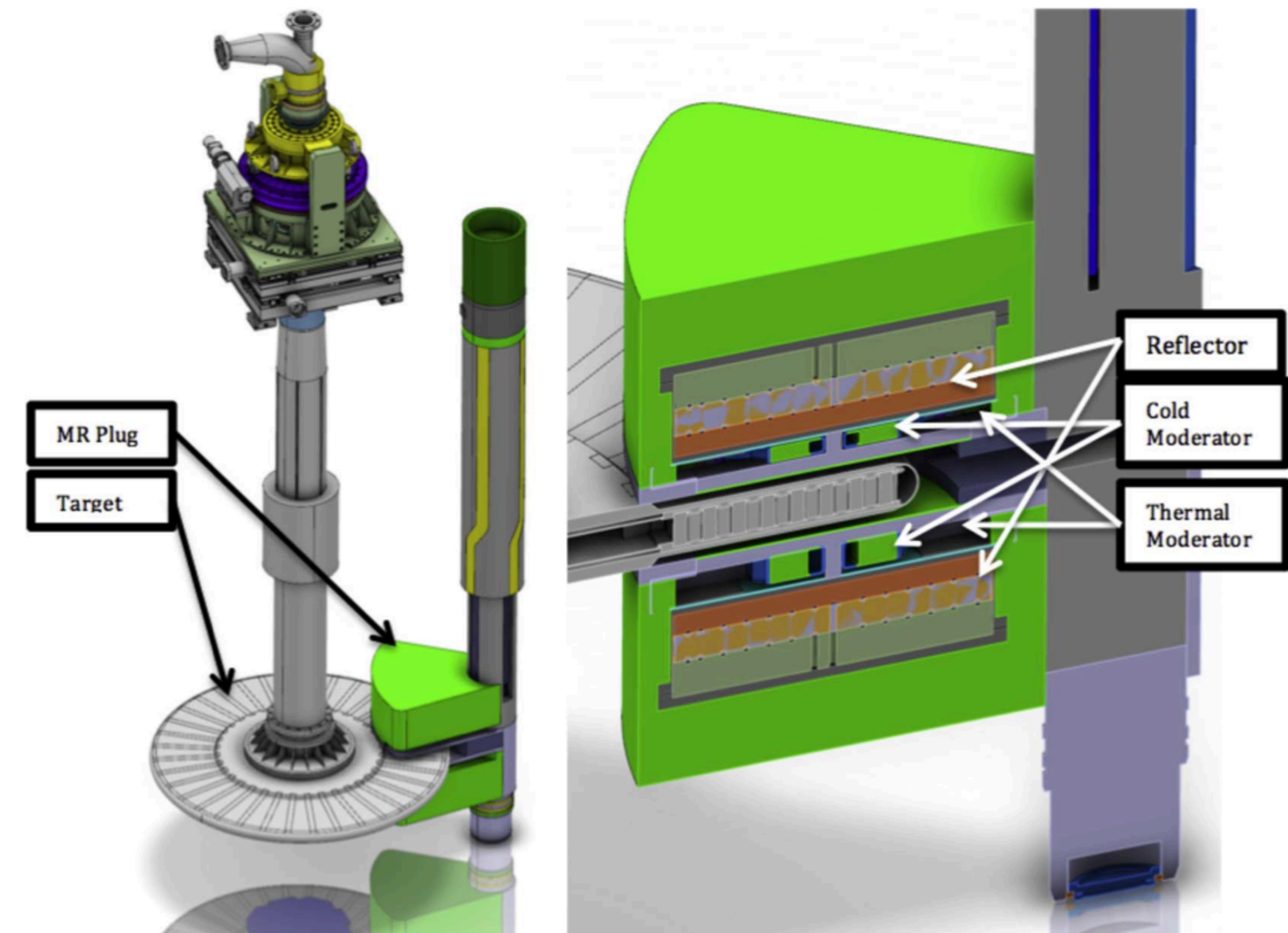
On average the neutron coming out from the target travel at 5-10% of the speed of light ($\sim 0.0001 \text{ \AA}$ wavelength). In order for those neutrons to be useful they need to be slowed down (increased wavelength). This is achieved using a para-hydrogen and water-based moderator and a beryllium-lined reflector.

Moderator has one part filled with water (thermal neutrons) and another with parahydrogen (cold neutrons). Parahydrogen is transparent to neutrons of energy 15 meV and below and thus can easily exist in the moderator and be redirected to the instruments.

NEUTRON BEAM MODERATION



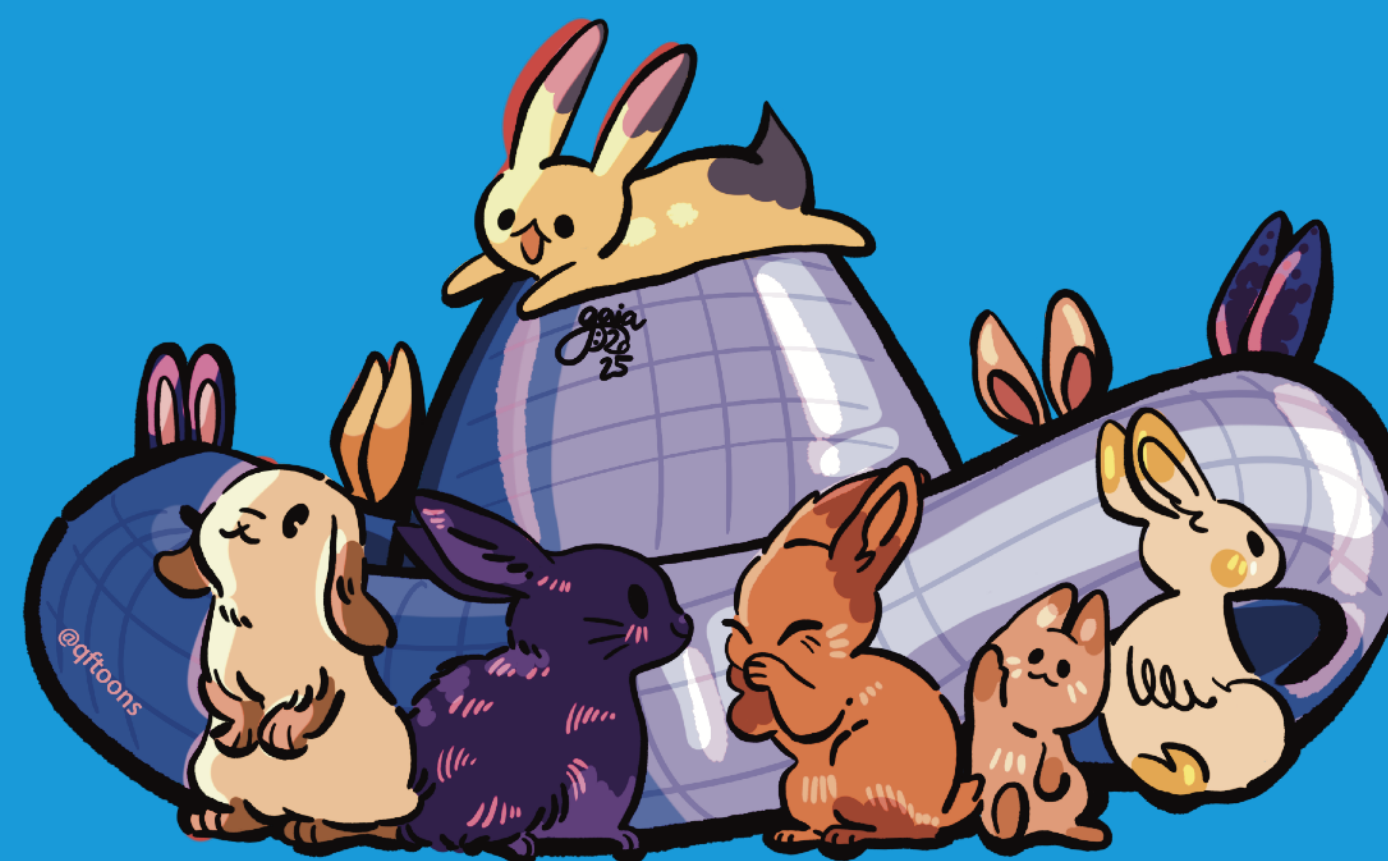
On average the neutron coming out from the target travel at 5-10% of the speed of light ($\sim 0.0001 \text{ \AA}$ wavelength). In order for those neutron to be useful they need to be slowed down (increased wavelength). This is achieved using a para-hydrogen and water-based moderator and a beryllium-lined reflector.



Moderator has one part filled with water (thermal neutrons) and another with parahydrogen (cold neutrons). Parahydrogen is transparent to neutrons of energy 15 meV and below and thus can easily exist the moderator and be redirected to the instruments



EUROPEAN
SPALLATION
SOURCE



WELCOME TO ESS AND THANK YOU FOR YOUR ATTENTION!

Contact:
natalia.milas@ess.eu