Institute of Applied Physics
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Development of deuterium-loaded targets for D-D neutron generator based on high-current gasdynamic ECR ion source.

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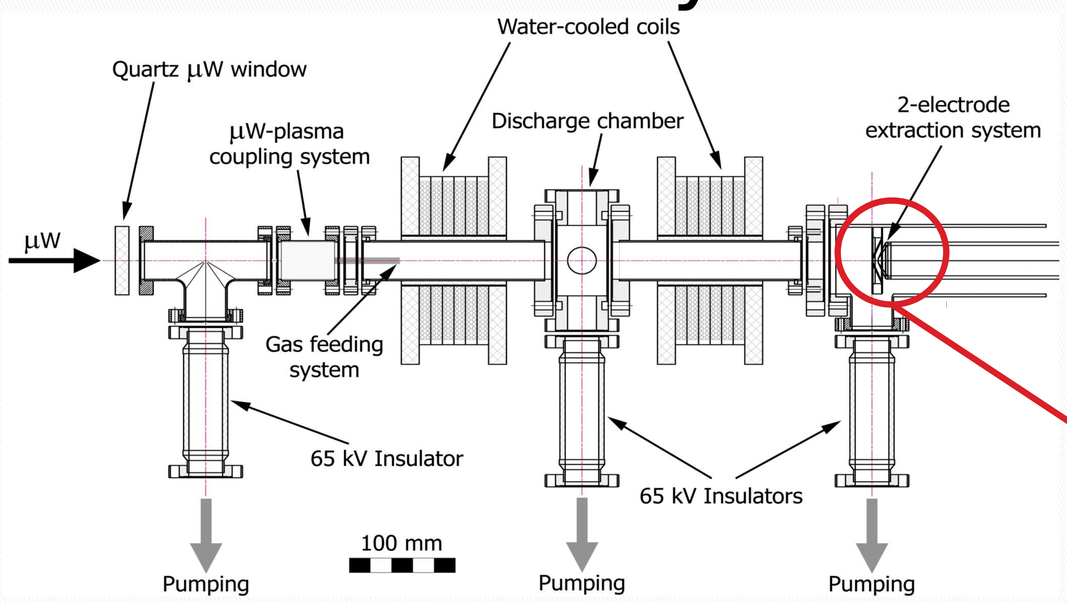
ESS Ion source:
H^+, ECR 2.45 GHz,
90 mA, 75 kV, 3 ms,
ε<0.2 π·mm·mrad

Motivation

Modern accelerator facilities require high current pulsed/CW H^+/D^+ beams with excellent emittance

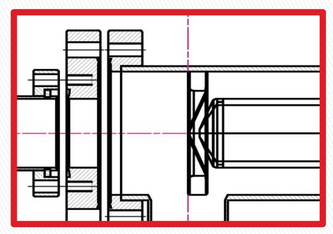
IFMIF Ion source:
D^+, ECR 2.45 GHz,
2*125 mA, 100 kV, CW
ε<0.2 π·mm·mrad

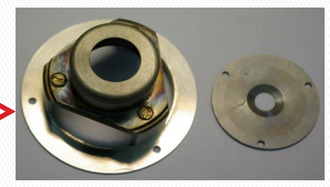
SMIS-37 facility at IAP

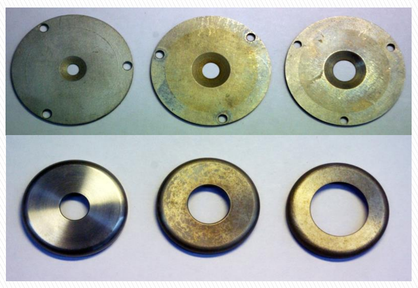


Gyrotron 37 GHz, 10-80 kW, 1ms/1Hz
Gasdynamic plasma confinement

- ✓ High plasma density >$2*10^{13}$ cm^{-3}
- ✓ High collision rate -> Low plasma lifetime ~tens of μs
- ✓ Plasma flux at the mirror point >10 A/cm^2
- ✓ T_e ~ 20-300 eV -> close to 100% ionization
- ✓ Ti ~ 1-5 eV + extraction in the area of low magnetic field -> excellent emittance

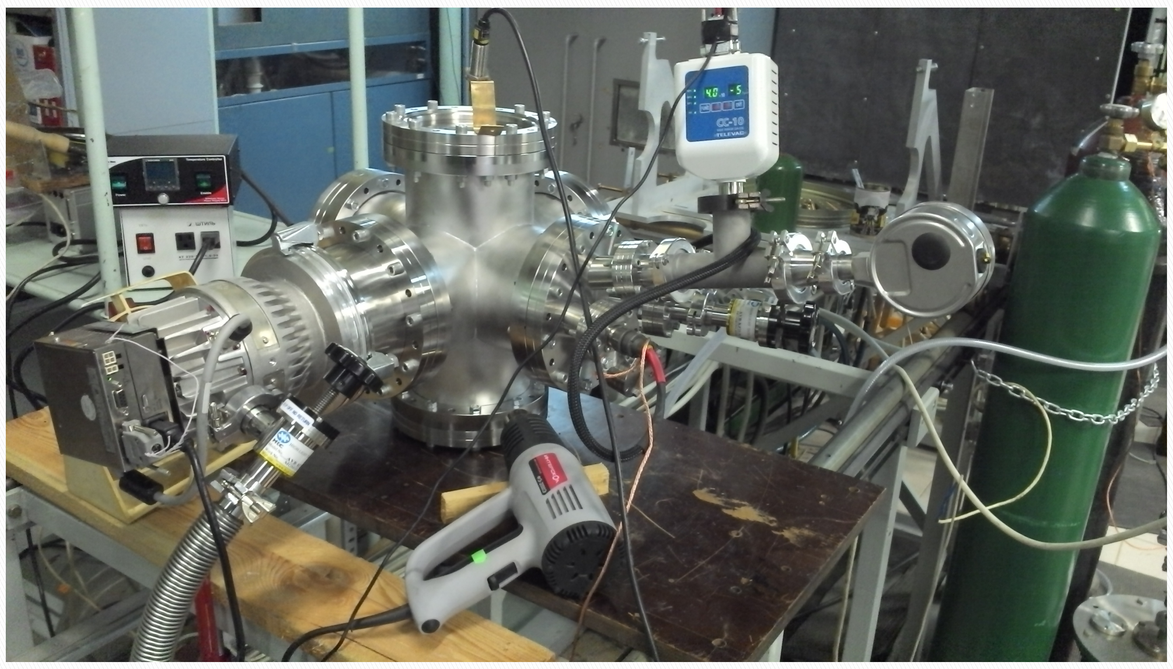




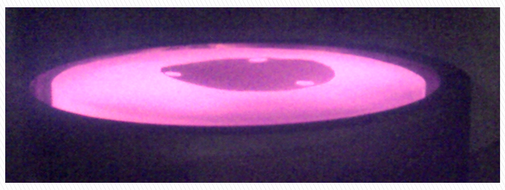


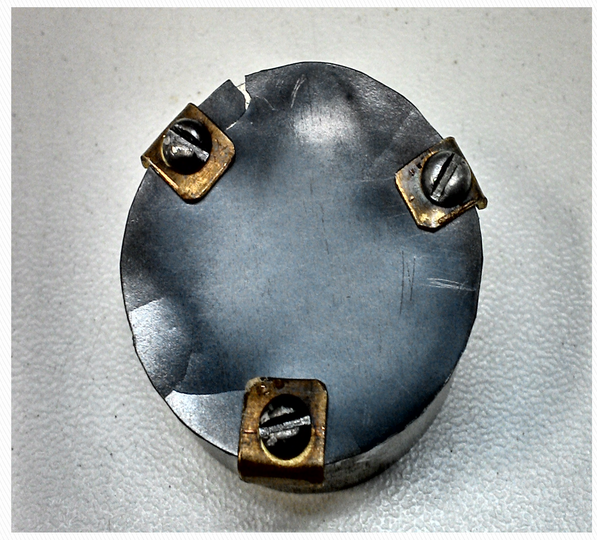
High efficiency targets able to survive 100 kW beam are needed!

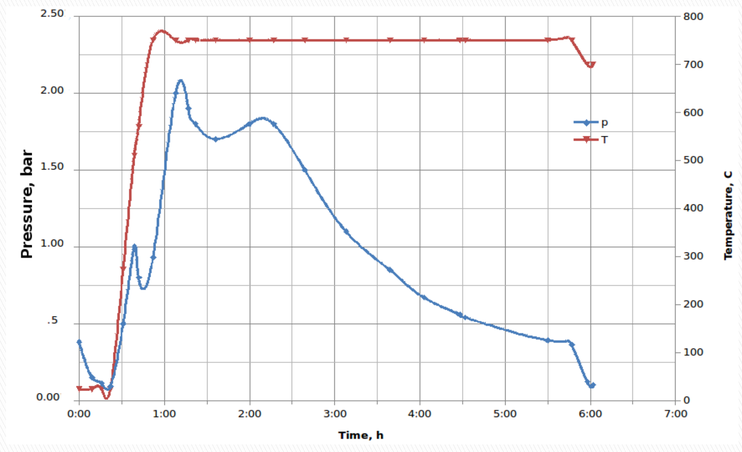
Experimental facility for target production

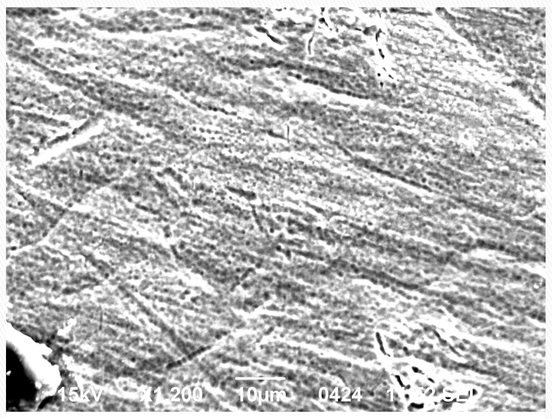


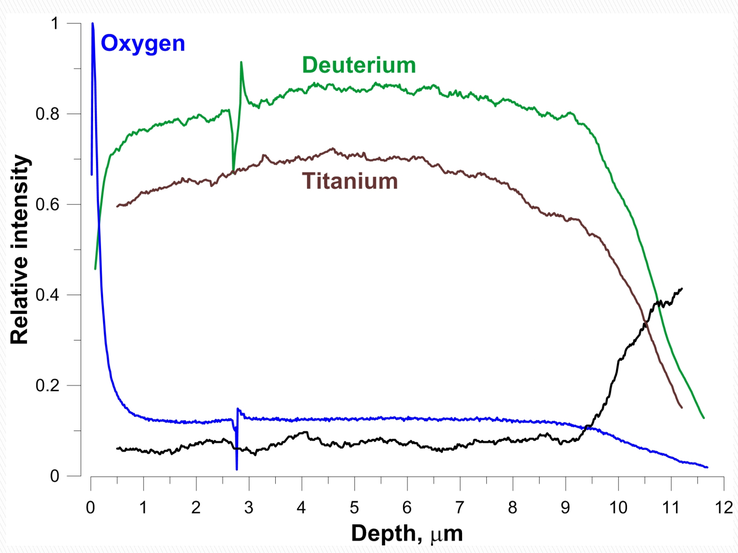
- High vacuum down to 10^{-6} Torr
- Hydrogen/deuterium pressure up to 2 bar
- RGA analysis
- Water-cooled viewport
- Target heater with programmable temperature sequence
- Temperature/pressure control

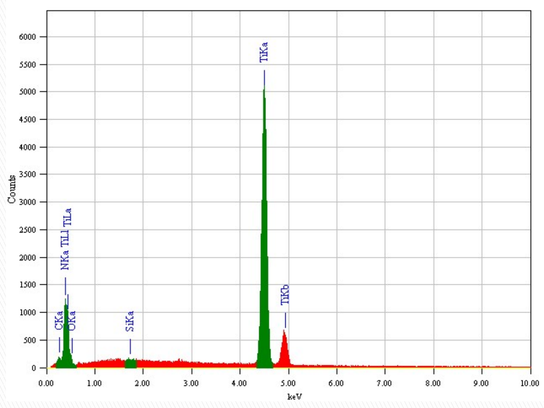












Target	Neutrons per 1 mA	Total neutron flux, 1/s
TiD_2 (IAP)	$7·10^5$	$2·10^8$
TiD_2 (Factory)	$1·10^6$	$3·10^8$
D_2O	$4·10^6$	10^9

Neutron flux of up to $2*10^8$ 1/s achieved while bombarding produced target with 500 mA of pulsed deuterium beam.

Results of SIMS analysis and K-alpha characteristic emission (electron microscope) showed that thin surface layer of oxygen reduces target performance