INSTITUTE OF APPLIED PHYSICS
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Status of new developments in the field of high-current gasdynamic ECR ion sources at the IAP RAS

V.A. Skalyga[1, a)], S.V. Golubev[1], I.V. Izotov[1], M.Yu. Kazakov[1], R.L. Lapin[1], S.V. Razin[1], A.V. Sidorov[1], R.A. Shaposhnikov[1], A.F. Bokhanov[1] and O. Tarvainen[2]

[1]*Institute of Applied Physics of Russian Academy of Sciences, Nizhny Novgorod, Russia*
[2]*University of Jyväskylä, Department of Physics, Accelerator Laboratory, Jyväskylä, Finland*

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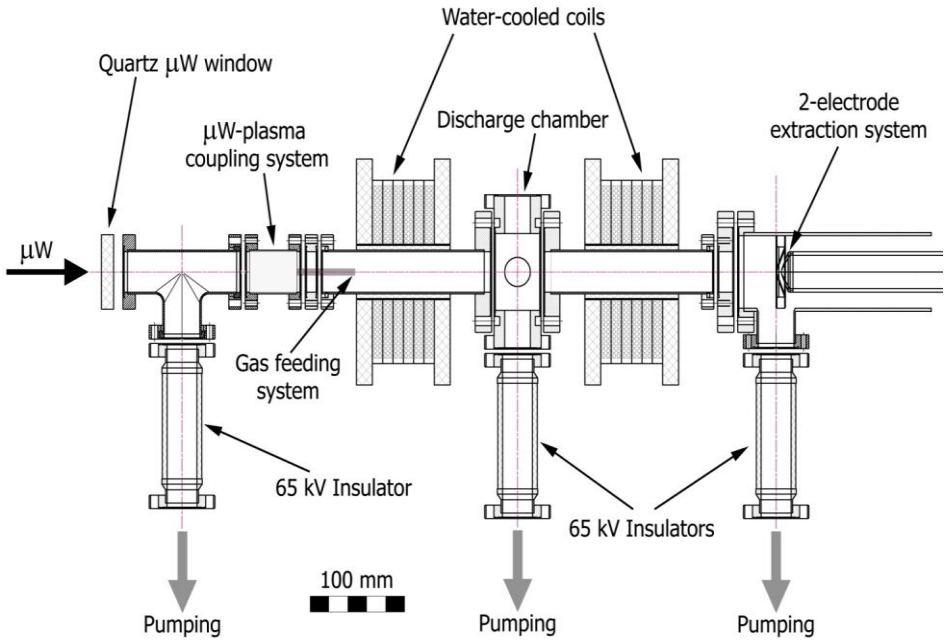
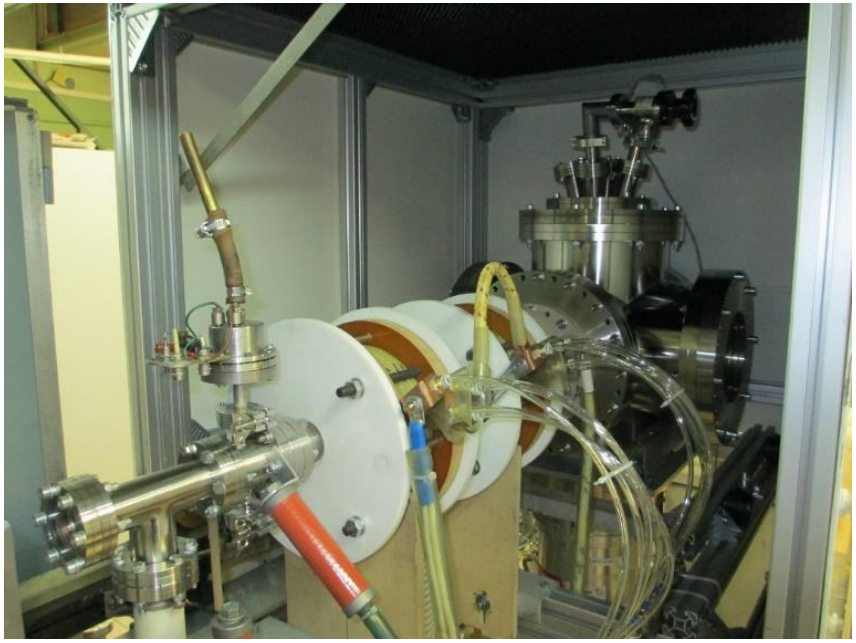
SMIS-37 gasdynamic high-current ion source





Frequency 37,5 or 75 GHz

Power up to 100 kW

Pulse duration 1 ms

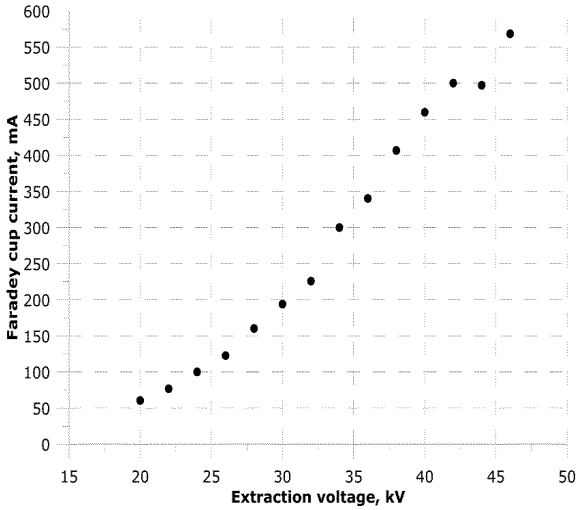
Trap magnetic field up to 5 T

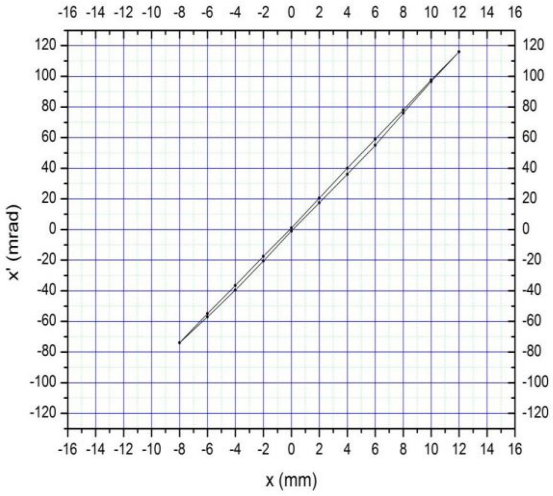
Unique plasma parameters
($N_e > 10^{13}$ cm^{-3}, $\tau \approx 5 \div 50$ μs, $T_e \approx 50 \div 300$ eV)

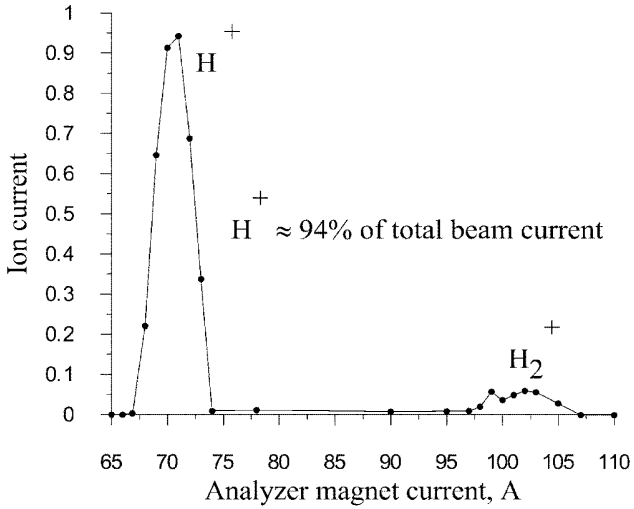
High current density ($j \approx 100 \div 800$ mA/cm^2)

Low emittance values

Proton beams production

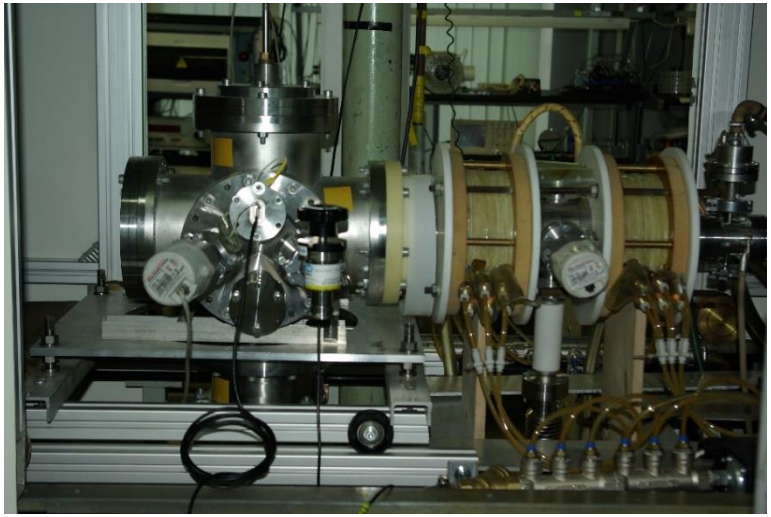


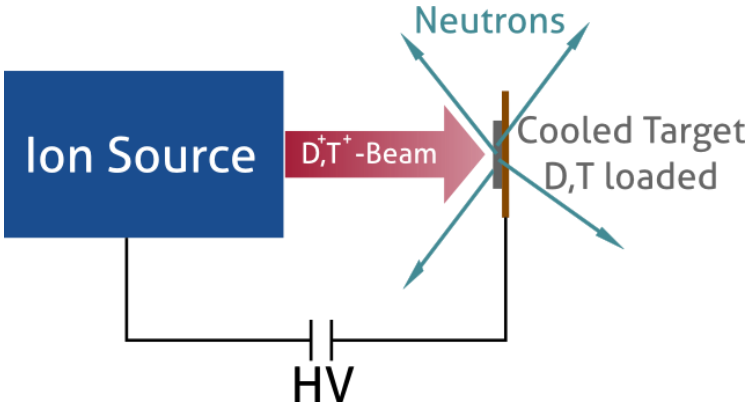




- ✓Ion beam current with 1 cm aperture extraction ~ 500 mA
- ✓Normalized RMS emittance below 0.1 π·mm·mrad
- ✓Very low molecular fraction
- ✓Possibility to switch into CW operation mode

Gasdynamic ion source for neutron production





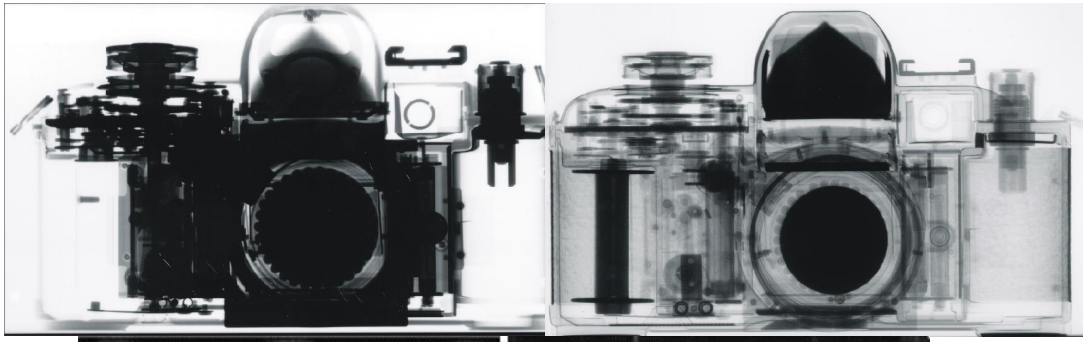
Neutron producing reaction: $D(d,n)^3He$

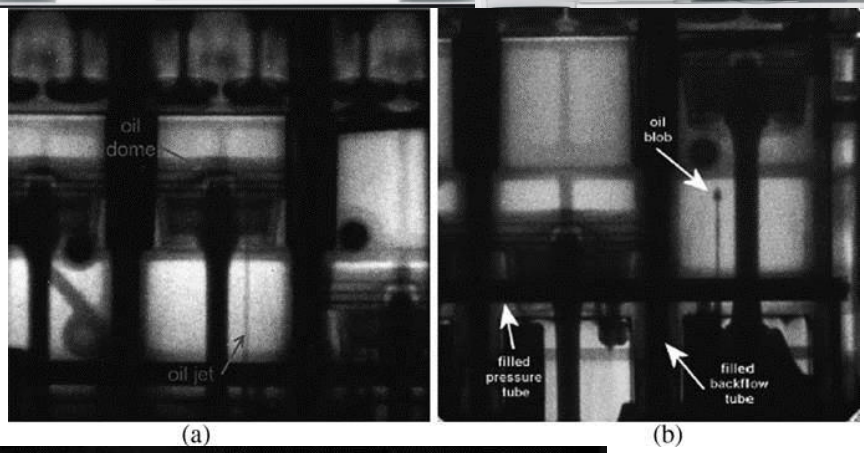
Ion beam current 1 A

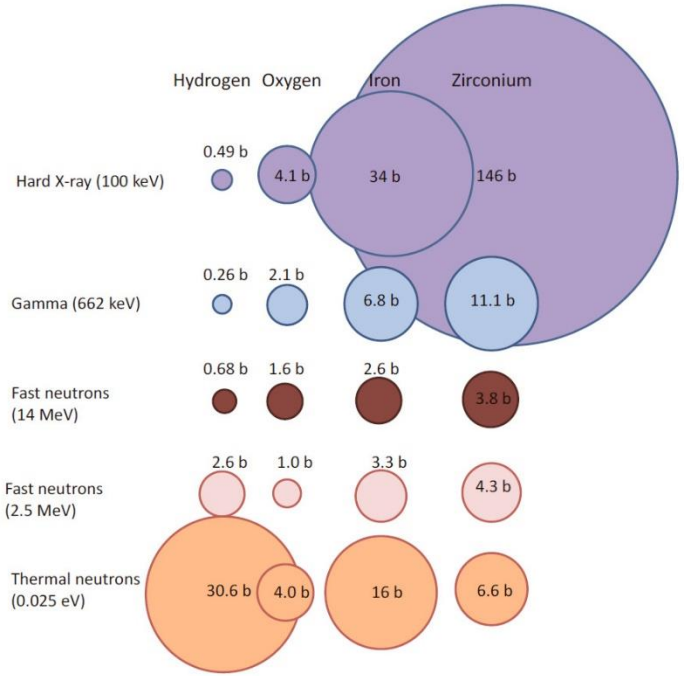
Beam energy 100 keV

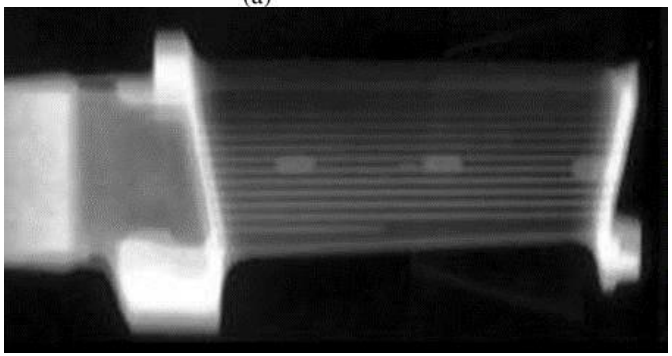
Fast neutron flux density at the target 10^{11} $s^{-1}cm^{-2}$ (**$5 \cdot 10^{12} - 1 \cdot 10^{13}$ s^{-1}** for tritium target)

Neutron tomography



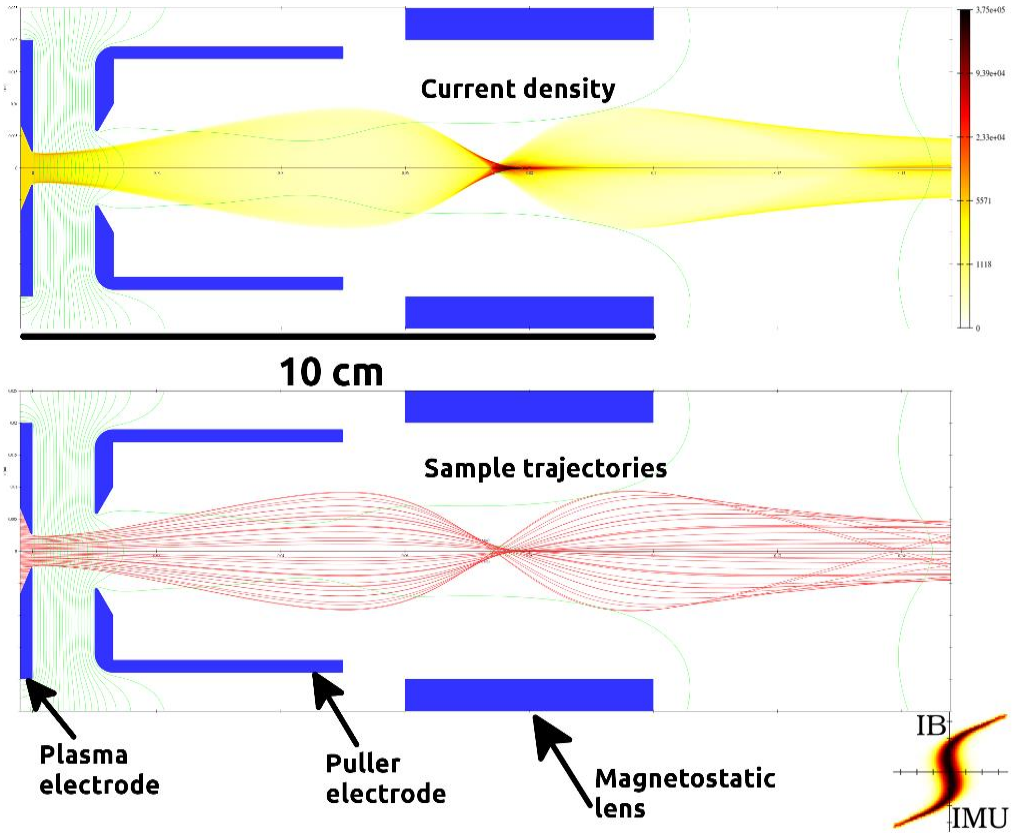


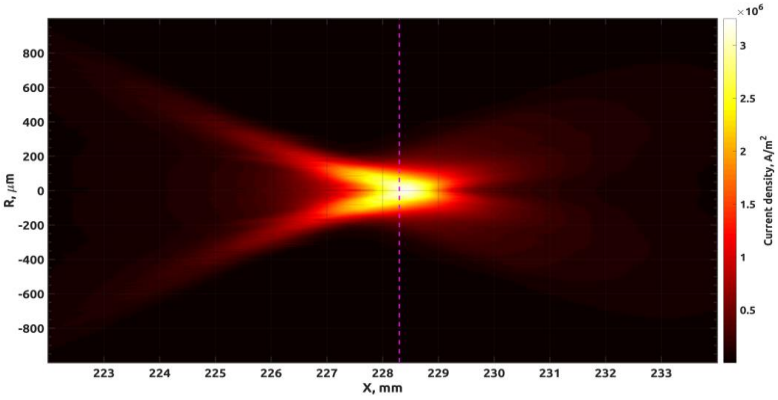


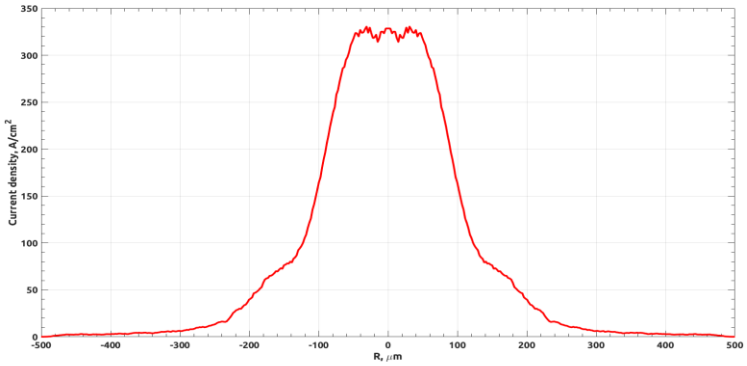


Neutron flux properties for tomography:
Flux density 10^8 – 10^9 $s^{-1}cm^{-2}$
Collimation (L/D): 100 -400

Beam focusing modeling with IBSimu

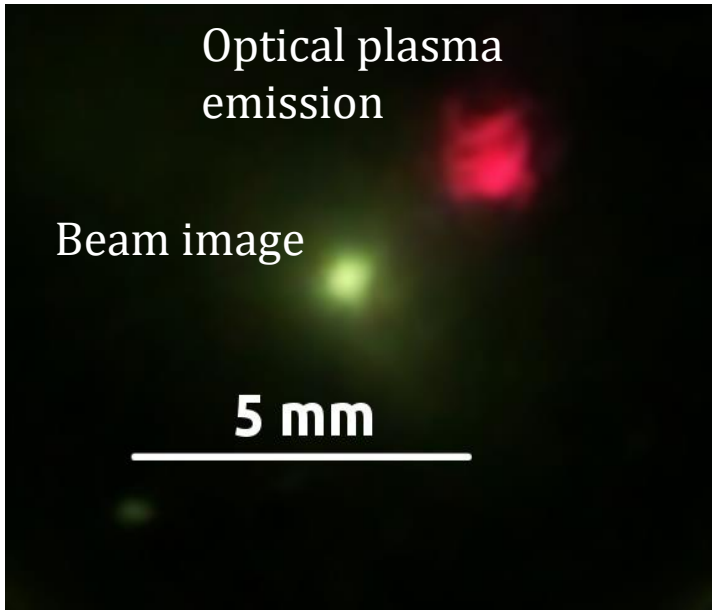


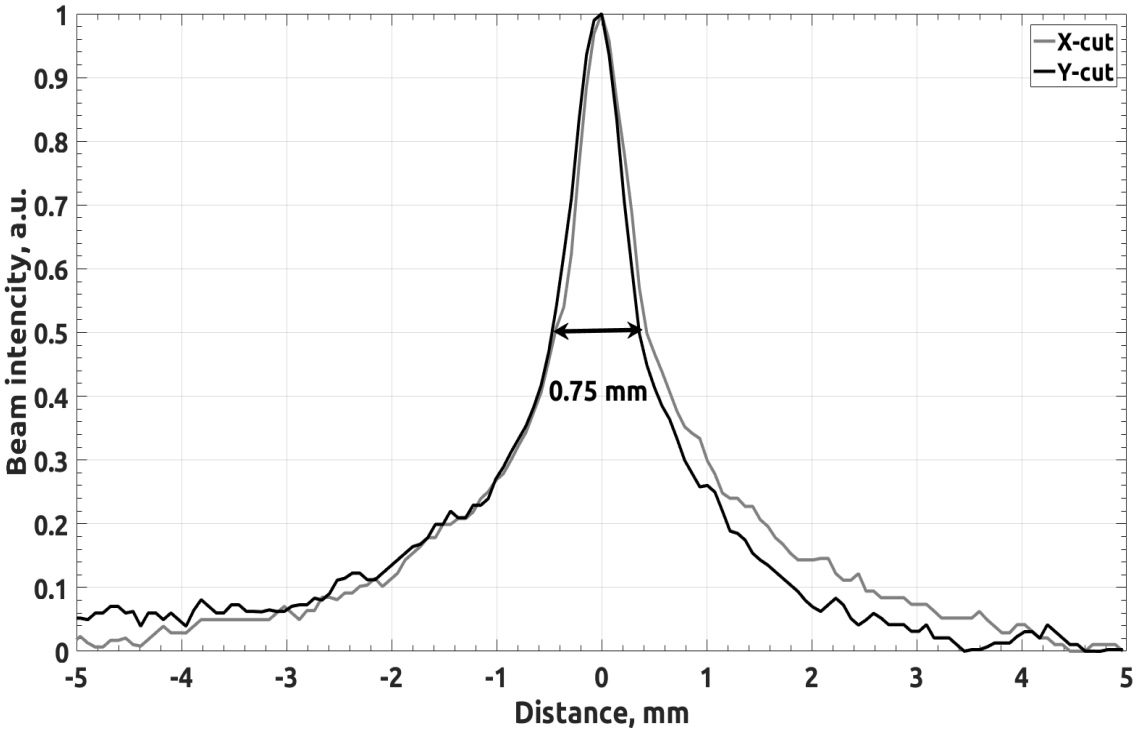




Beam size in the focal plane could be ~ 100 μm

First experiments on beam focusing at SMIS 37





- ✓ 1.5 T magnetic lens
- ✓ Beam size < 1mm

Present state of developments

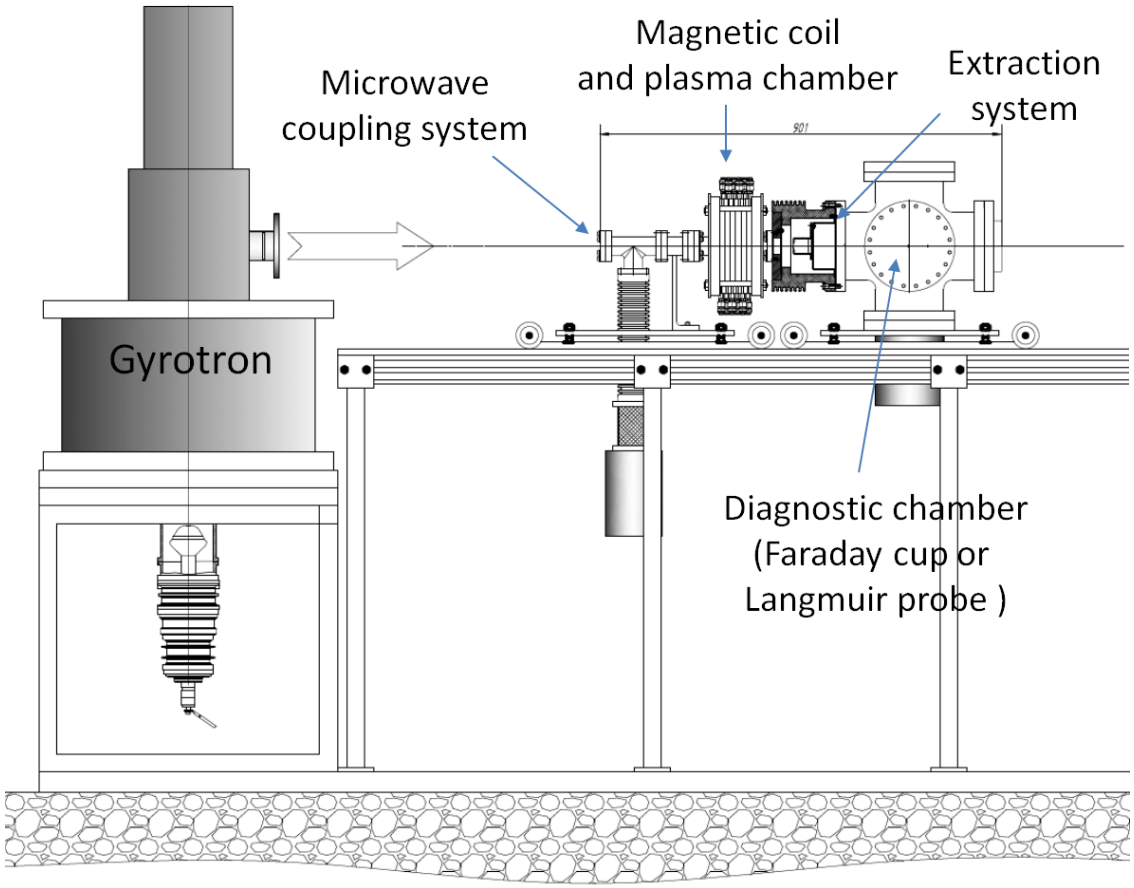
Problems

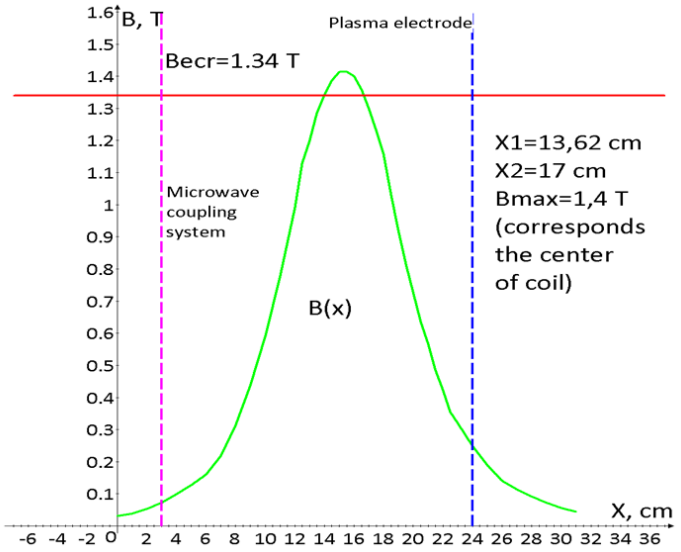
- Low repetition rate
- High level of impurities/difficulties with plasma parameters control
- High microwave power and complicated microwave sources
- Search for new applications

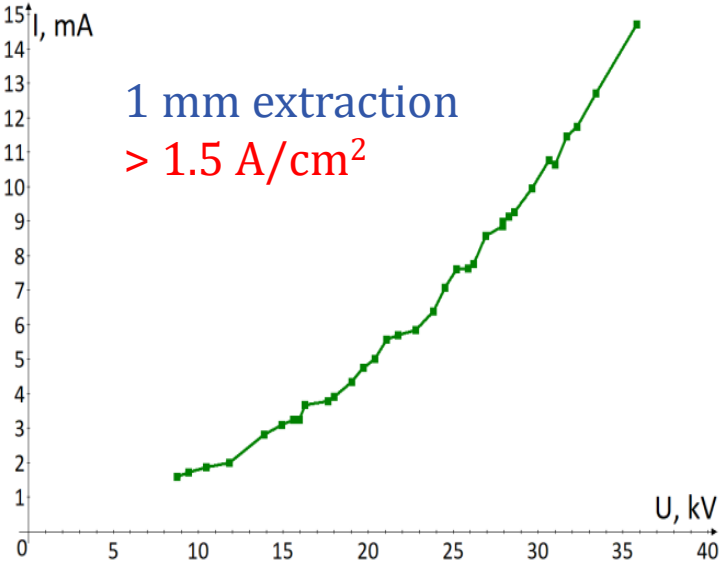
Solutions

- Transition to CW operation
- Decrease of the total power for plasma heating
- Decrease of the plasma volume
- Tests of different magnetic configurations

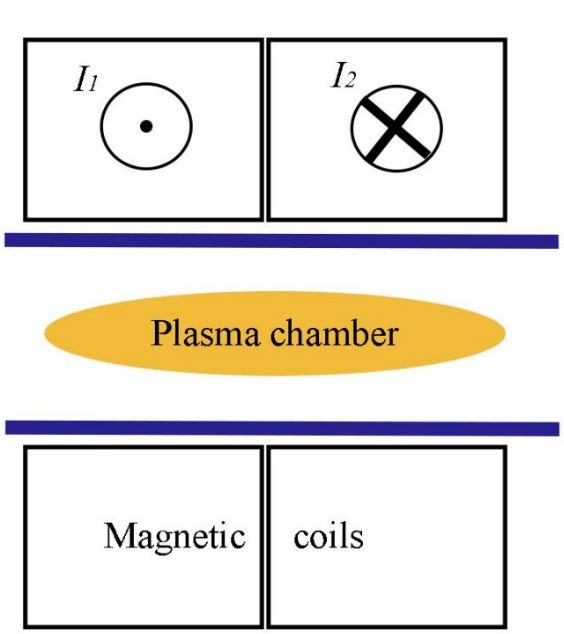
Single solenoid discharge – a away to reduce the source size

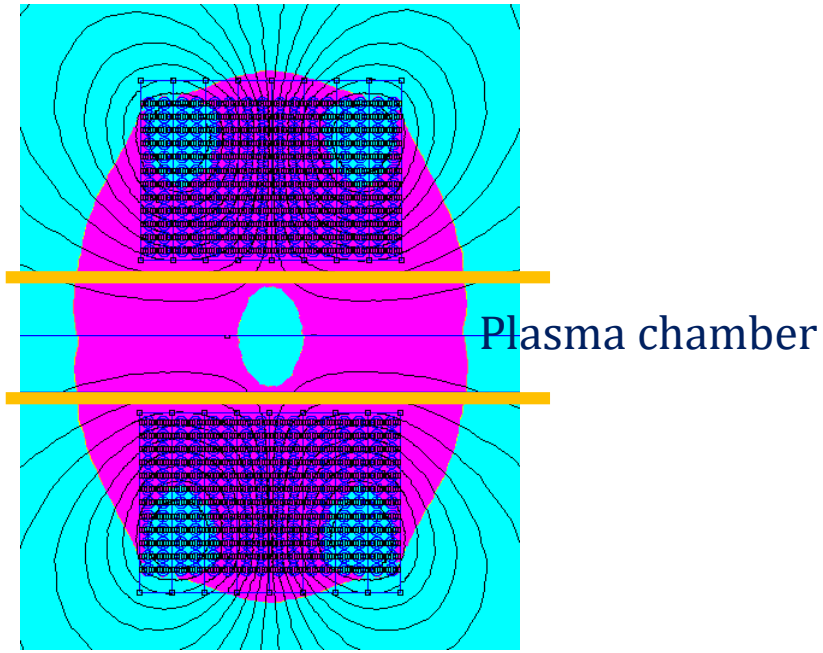






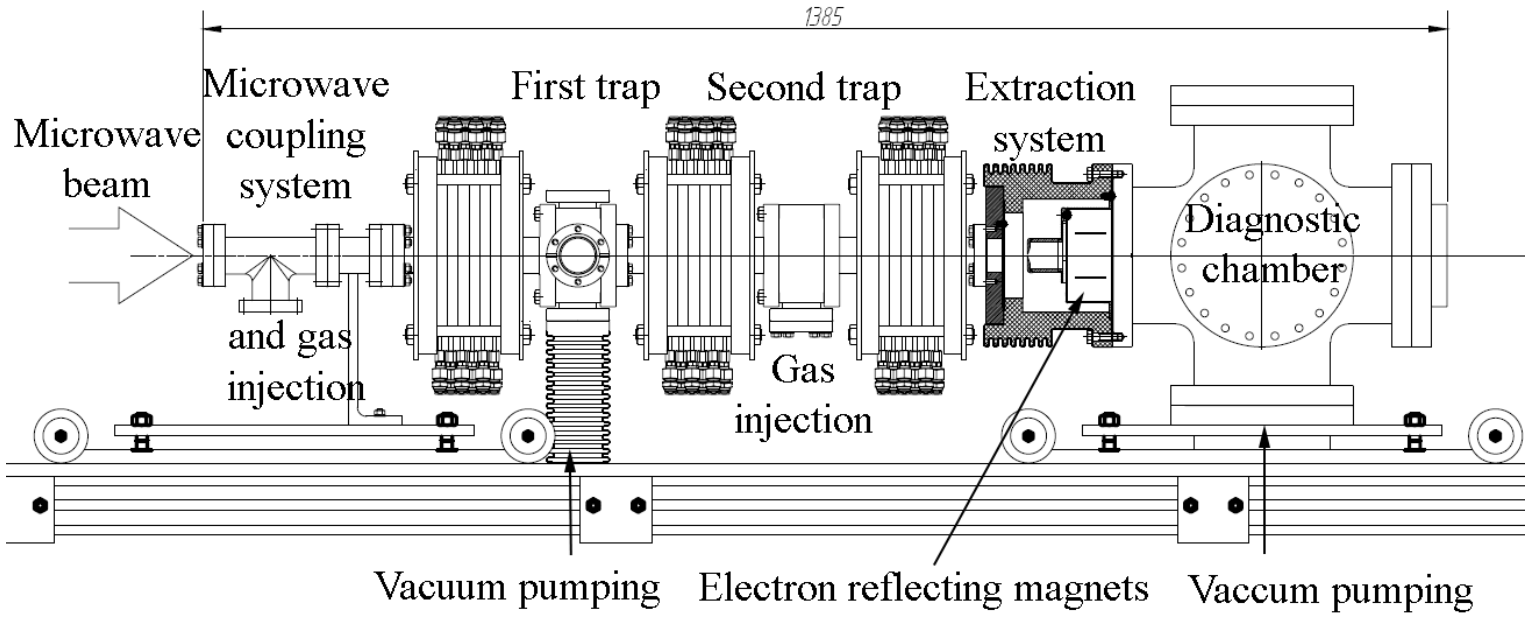
Cusp with closed ECR surface

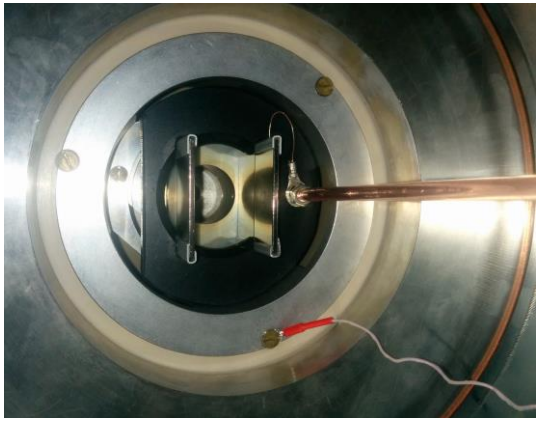


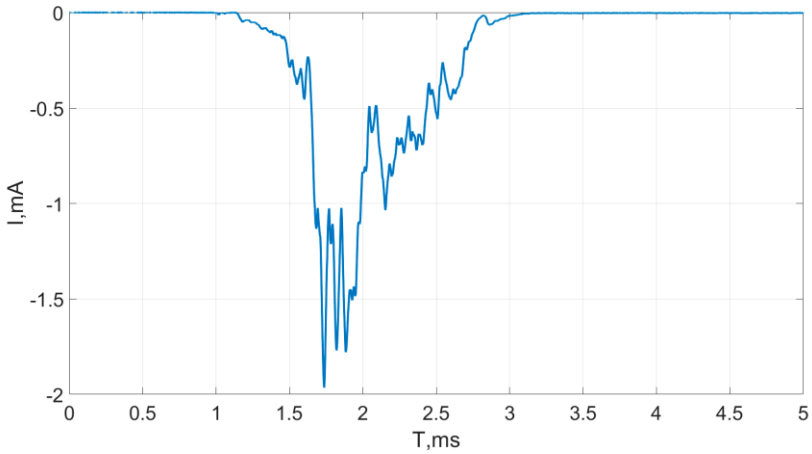


- Quasigasdynamic confinement with additional hot electron trapping
- Preliminary modeling of Grenoble 60 GHz source

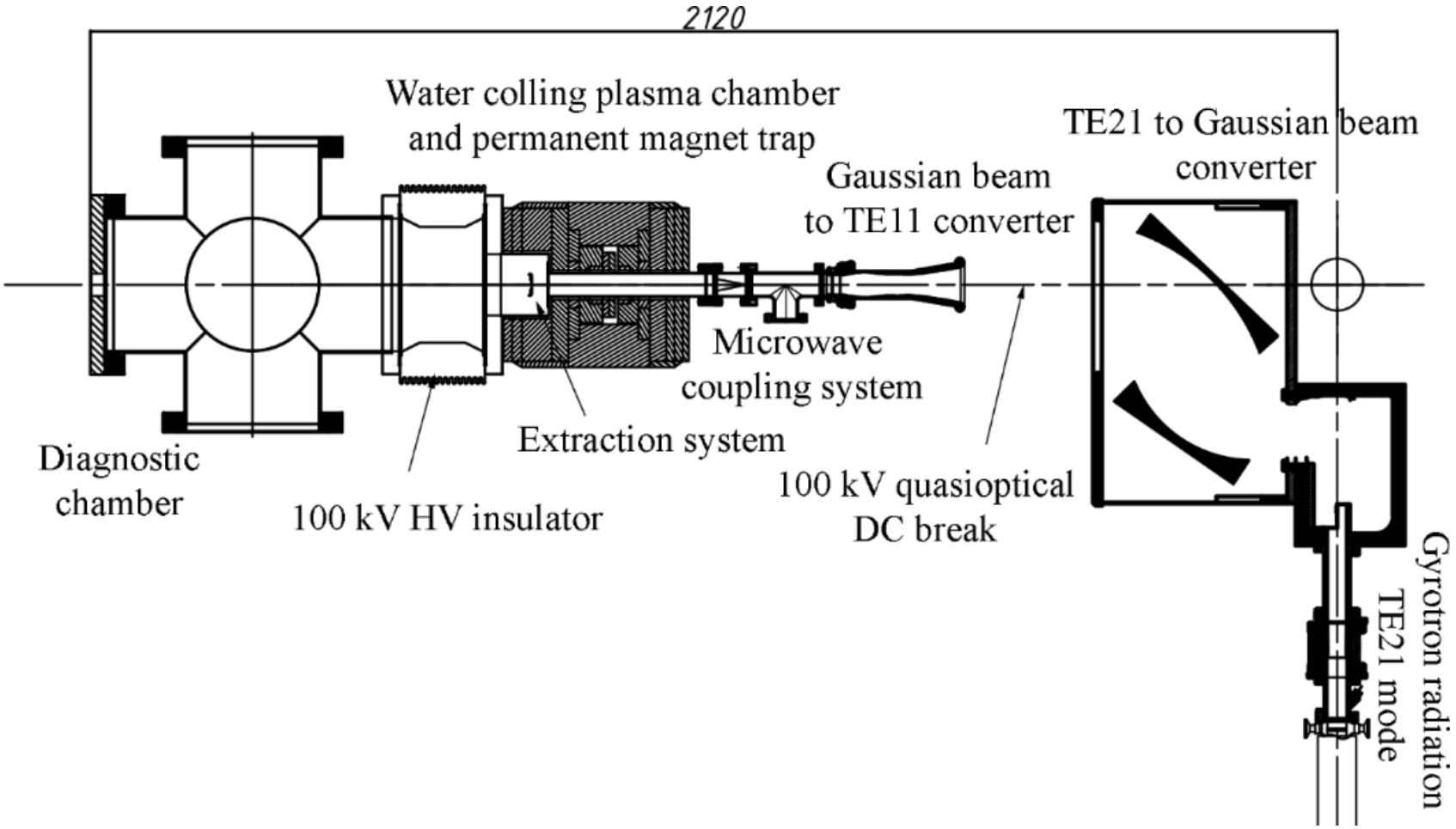
First attempt for H- production







New facility for CW operation



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Room for the new source

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Thank you!