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Design of the proton injector for compact neutron source DARIA

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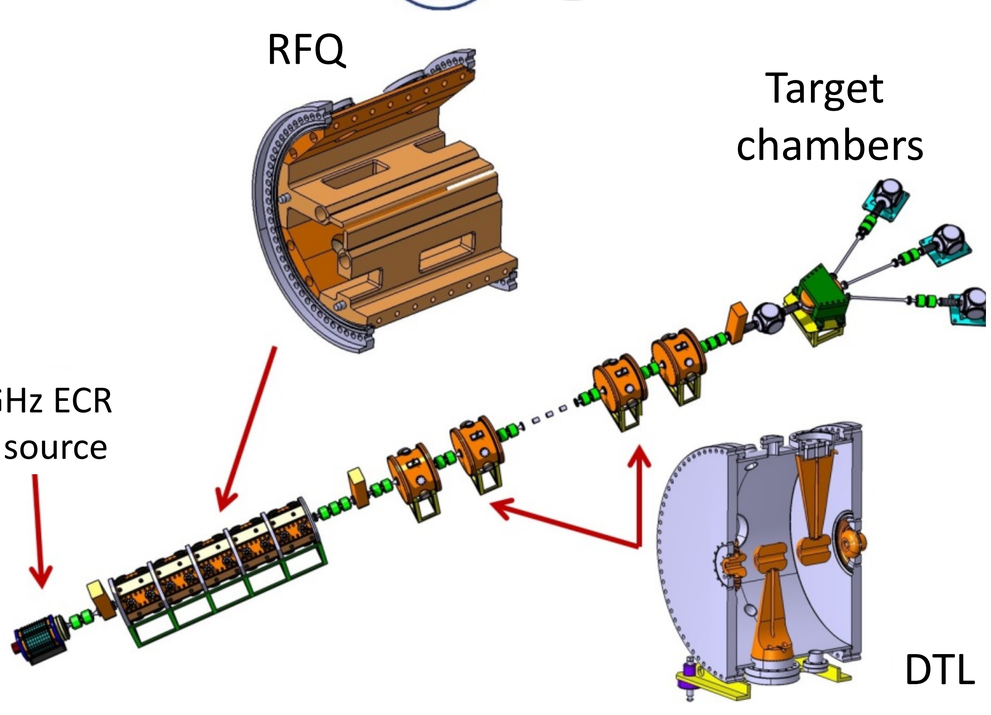
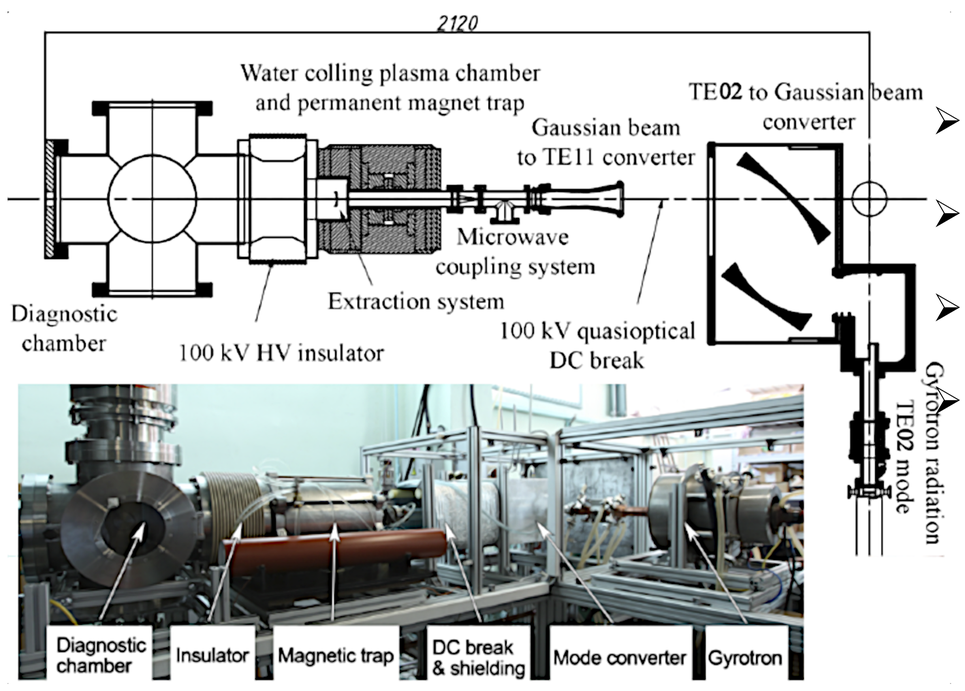
Abstract: Project of the proton accelerator-driven compact neutron source DARIA(Dedicated for Academic Research and Industrial Application) is developed in order to replace small and middle flux neutron sources based on the nuclear reactors. DARIA has a uniquely high ratio of efficiency to cost due to deep optimization of each key element of the system (proton injector and accelerator, target, neutron moderator and neutron instruments. A unique ECR ion source, developed at the IAP RAS, would be used as a proton beam injector. In such device the plasma is heated by the powerful 28 GHz gyrotron radiation, providing a record level of volumetric energy input for such systems over 100 W/cm^3. The high plasma density and the optimal electron temperature provide proton beams formation with a current of up to several hundred mA and an emittance that meets the requirements of modern accelerators. The paper discusses the advantages of using such an ion source, its scheme and design performance.

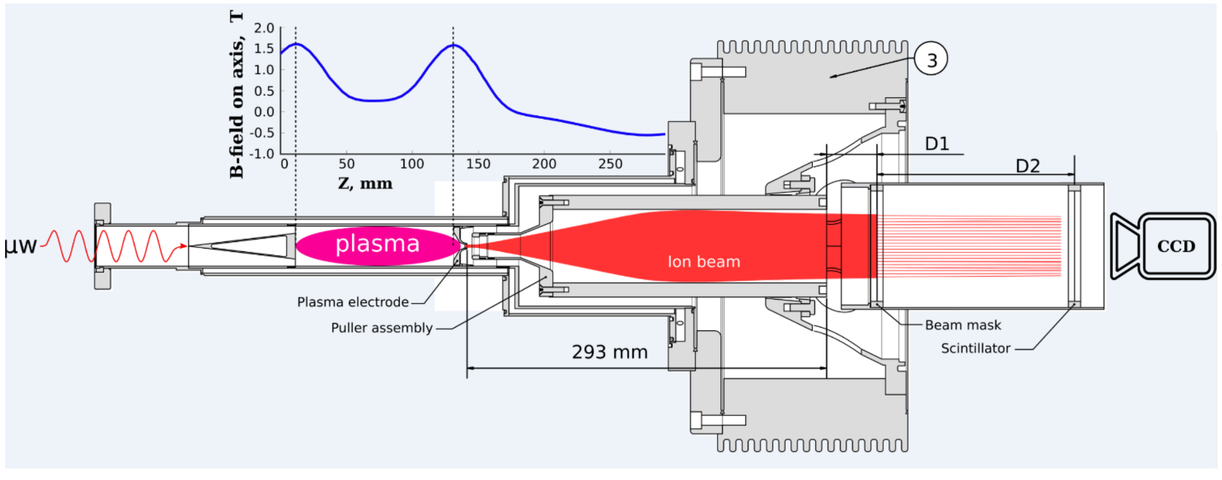
DARIA - neutron source Dedicated to Applied Research and Industrial Applications



GISMO experimental facility



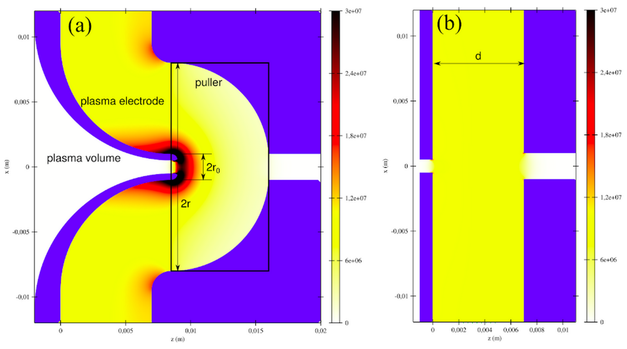
- Gyrotrons: 28 GHz/10 kW;
- Operation: Continuous wave or pulsed
- Permanent magnet trap with 1.5 T field at mirrors
- Ion beam energy: up to 100 keV



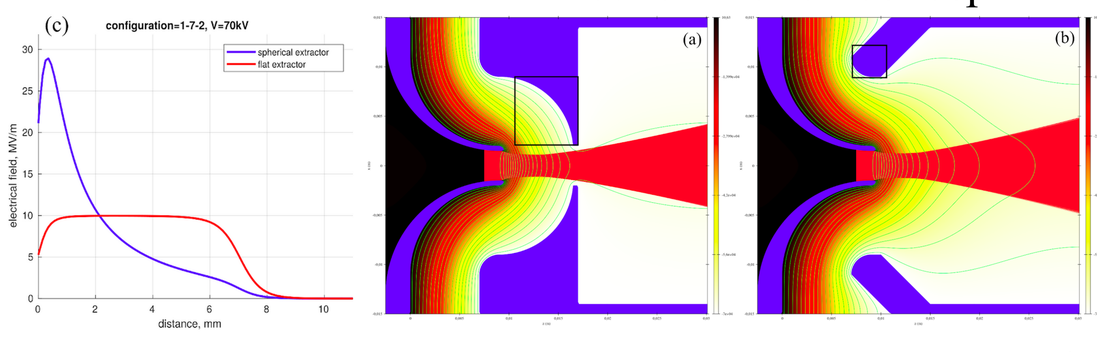
DARIA requirements:

Beam current 70-100 mA
Normalized RMS emittance < 0.5 π·mm·mrad
Pulse duration 100 uS
Repetition rate 100 Hz
Have been already fulfilled at GISMO

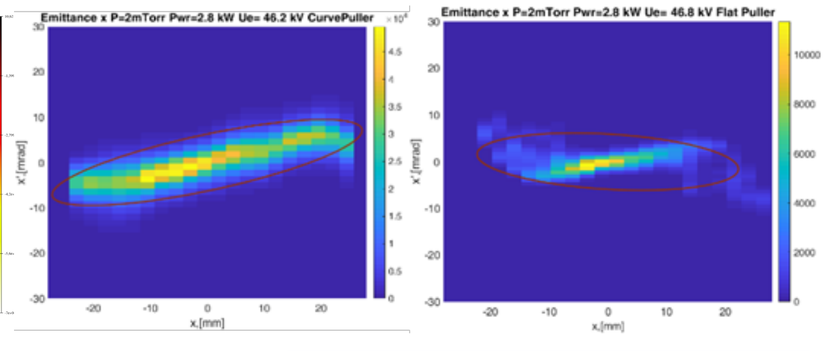
New extraction idea

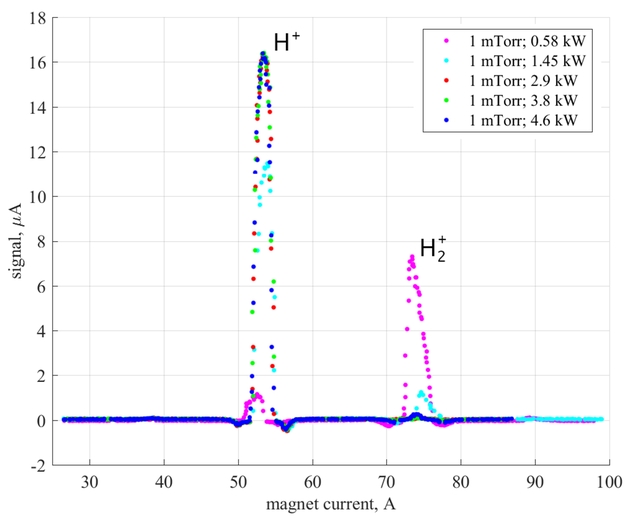


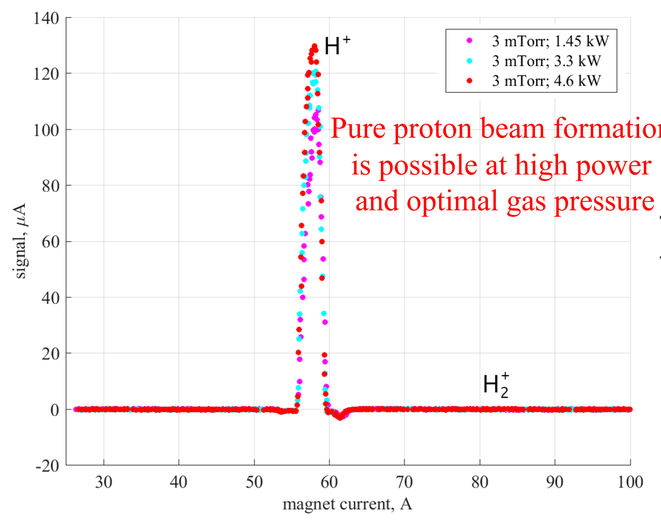
New extraction concept



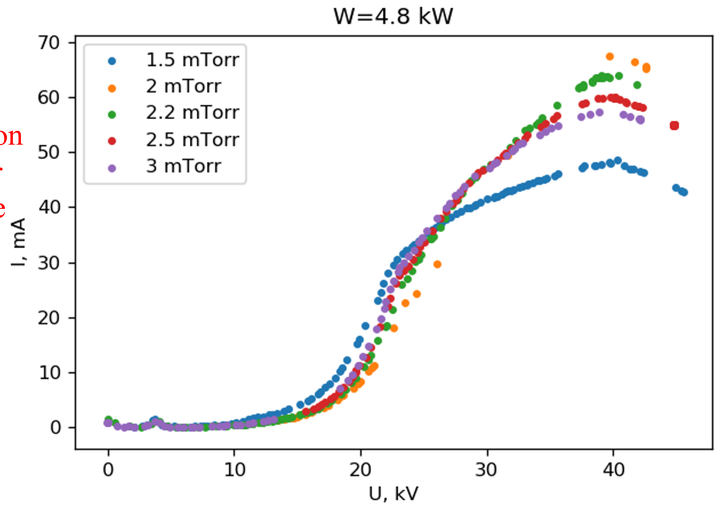
First emittance measurements







Pure proton beam formation is possible at high power and optimal gas pressure



70 mA of pure protons was extracted using 3 mm extraction aperture

(almost 1 A/cm^2 of ion beam current density with high beam quality)

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