The AISHa ion source at INFN-LNS

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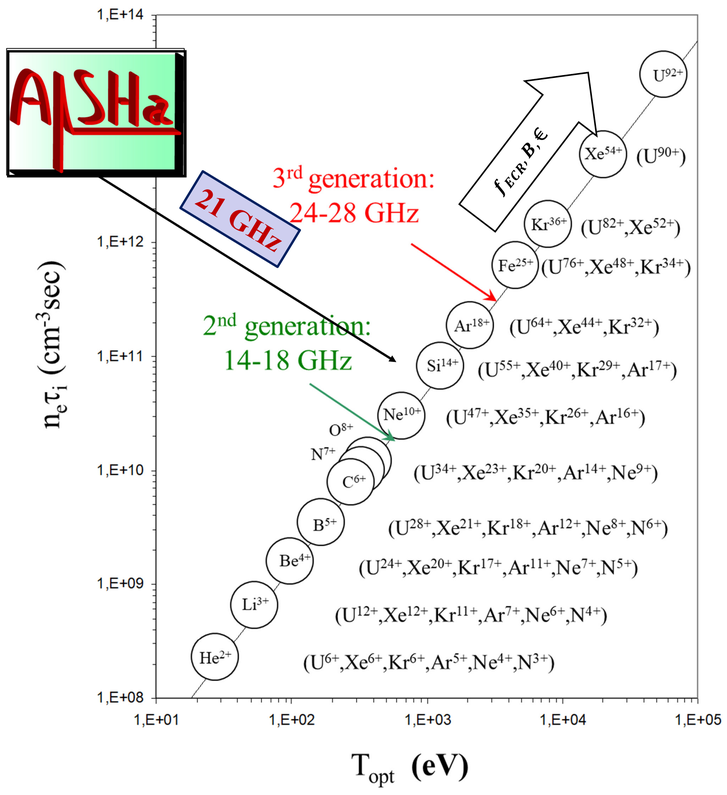
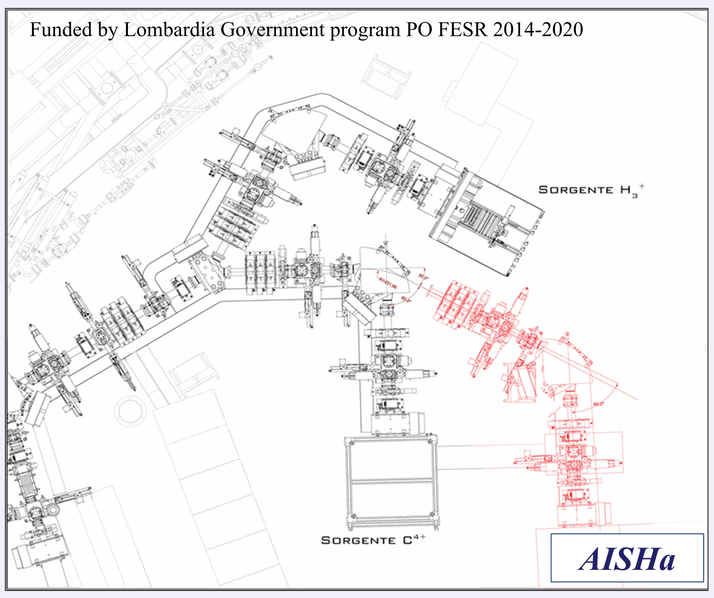
Abstract

The Advanced Ion Source for Hadrontherapy (AISHa) is an ECR ion source operating at 18 GHz, developed with the aim of producing high intensity and low emittance highly charged ion beams for hadrontherapy purposes. Due to its unique peculiarities, AISHa is a suitable choice for industrial and scientific applications. In the framework of the INSpIRIT and IRPT projects, in collaboration with CNAO, new candidates for cancer treatment (including metal ion beams) are being developed. Moreover, within the IONS experiment, AISHa will be the test-bench for the development of an innovative active plasma chamber designed to increase plasma confinement by changing plasma fluxes. OES technique will be also used to refine techniques of non-invasive plasma diagnostics. Finally, a dedicated setup is under realization to provide impinging beams and detection systems for target production in nuclear physics experiments.

AISHa in the Golovanivsky diagram



The INSpIRIT project: AISHa-2 at CNAO



An innovative irradiation facility with an ion source for research and radiation hardness studies with industrial and clinical applications.

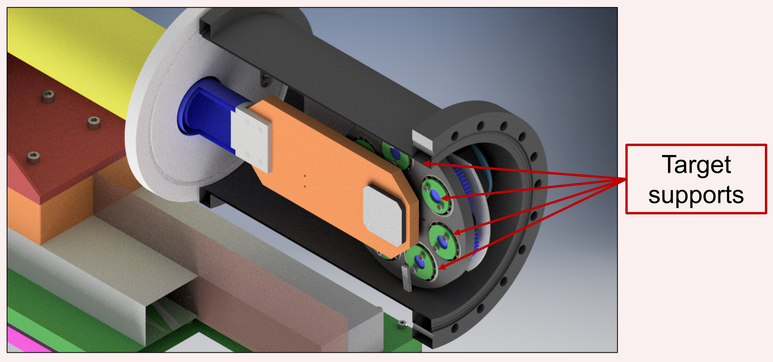
- Integration within synchro room in progress: Commissioning is planned from Spring 2022.
- Metal beams are being developed in collaboration with GSI.

Ion	AISHa Performances [uA]	Requirement CNAO [uA]
C^{4+}	520 uA	110
O^{6+}	1200 uA	64
He^{2+}	5400 uA	344

For more information: L. Celona Monday Talk

Production of solid target of noble gases

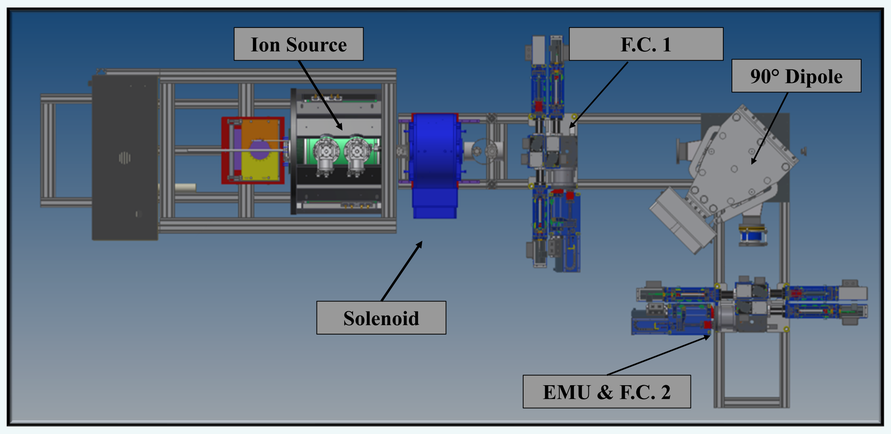
The availability of **high intensity beams** and the scientific interest in **precision nuclear physics** experiments pushes the requests for **demanding targets**.
Ion of interest: ^{136}Xenon, candidate for studies on 0νββ (Numen experiment).



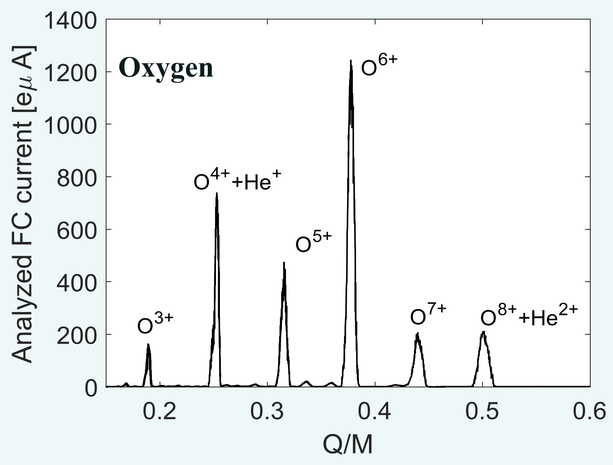
Ion implantation tool designed and ready for manifacturing for the AISHa test-bench.

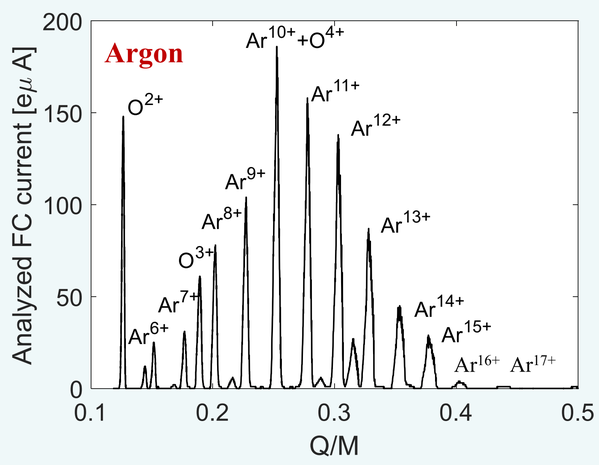
The AISHa Ion source

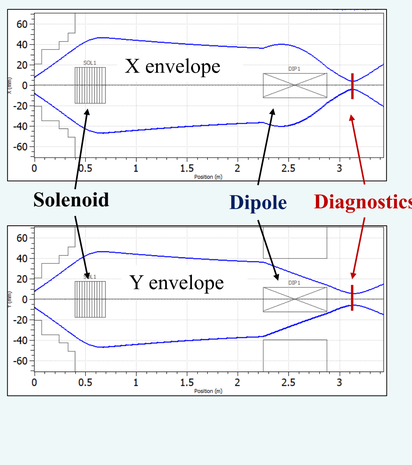
Maximum radial field [T]	1.3
Maximum axial field [T]	2.6/0.4/1.7
Operating frequency [GHz] / Power [kW]	21 GHz / 1.5 + 18 GHz / 1.5
Cryostat length / Diameter [mm]	620 / 5650
Extraction voltage [kV]	Up to 40
Plasma chamber diameter [mm]	92
Length of the resonance zone [mm]	<10
Distance between maxima of the axial field [mm]	365

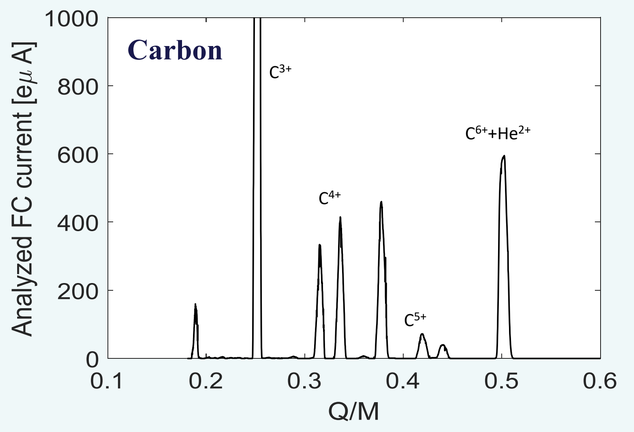


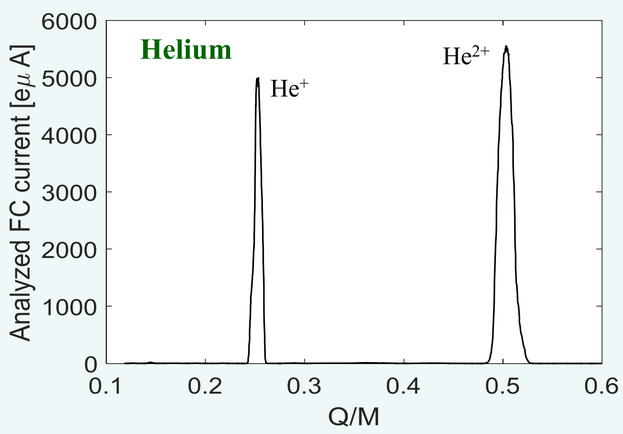
Results from AISHa commissioning









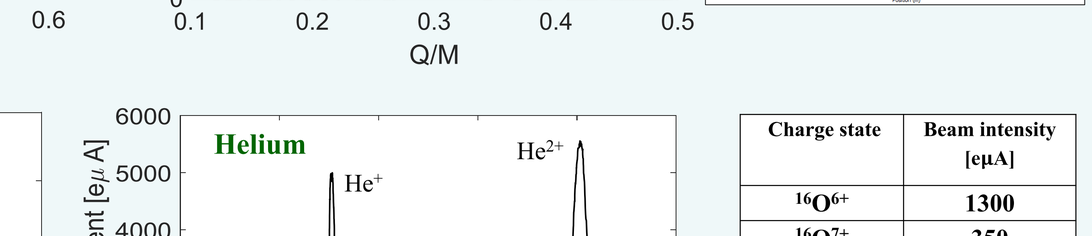


Charge state	Beam intensity [eμA]
$^{16}O^{6+}$	1300
$^{16}O^{7+}$	350
$^{16}O^{8+}$	100
$^{12}C^{4+}$	520
$^{12}C^{5+}$	165
$^{40}Ar^{11+}$	155
$^{40}Ar^{12+}$	140
He^{2+}	5400

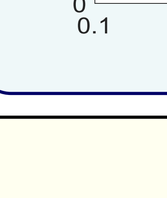
The IONS project: from plasma to beam paramaters

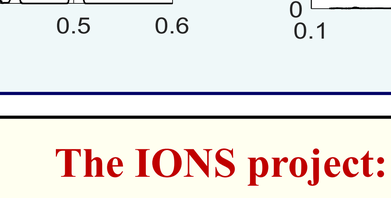
GOALS

1) Evaluation of plasma parameters in a Helium and Neon Plasma by **Optic Emission Spectroscopy**;
2) Modification of plasma losses current by using **active** (multi splitted camera) and **passive methods** (wall covering) to **improve source performances**;
3) Study of **correlation between plasma parameters and beam parameters** by 0-dimensional models;



R&D phase on Active plasma chamber: commissiong foreseen in 2022





A positive bias of lateral walls is expected to reduce ion losses, leading to an increase of plasma confinement times and, consequently, of highly charged ion beams production