PK-ISIS: A NEW SUPERCONDUCTING ECR ION SOURCE AT PANTECHNIK

A. C. Villari#, C. Bieth, W. Bougy, N. Brionne, X. Donzel, G. Gaubert, R. Leroy, A. Sineau, O. Tasset, C. Vallerand, Pantechnik, Bayeux, France,
T. Thuillier, LPSC UJF CNRS/IN2P3 INPG, Grenoble, France

Abstract

The new ECR ion source PK-ISIS was recently commissioned at Pantechnik. Three superconducting coils generate the axial magnetic field configuration while the radial magnetic field is done with multi-layer permanent magnets. Special care was devoted in the design of the hexapolar structure, allowing a maximum magnetic field of 1.32 T at the wall of the 82 mm diameter plasma chamber. The three superconducting coils using Low Temperature Superconducting wires are cooled by a single double stage cryo-cooler (4.2 K). Cryogen-free technology is used, providing reliability, easy maintenance at low cost. The maximum installed RF power (18.0 GHz) is of 2 kW. Metallic beams can be produced with an oven (Tmax = 1400 °C) installed with an angle of 5° with respect to the source axis or a sputtering system, mounted in the axis of the source. The beam extraction system is constituted of three electrodes in accel-decel configuration.

Pantechnik has developed and improved its family of ECRIS in collaboration with research laboratories like GANIL and LPSC in France and IUAC in India. From this collaboration, the first ECRIS using He-free High Temperature Superconducting wire technology (HTS) was born in 2002: PK-DELIS.

The goals of that development were to reduce the power consumption of the coils from 200 kW to 15 kW, for avoiding liquid He in the superconducting coils and to demonstrate the feasibility of such hybrid HTS - permanent magnet (for the radial magnetic field) source. PK-DELIS works since then successfully at New Delhi.

The new source of Pantechnik is conceived for reaching optimum performances at 18 GHz RF frequencies. Moving to this direction, PK-ISIS, our new source, has much higher axial and radial magnetic fields (2.1 T axial B_{inj} and 1.32 T radial field in the wall), a larger plasma volume, variable B_{min} via an independent coil and a large and opened extraction region. Moreover, PK-ISIS integrates modern design concepts, like RF direct injection (2.5 kW availability), DC-bias moving disk, out-of-axis oven and axial sputtering facility for metal beams.

PK-ISIS delivers 5 to 10 times more beam intensity than the original PK-DELIS and/or shifting the charge state distribution to higher values.

PK-ISIS is built with Low Temperature Superconducting wire technology (LTS), but keeps the He-free concept, extremely important for a reliable and easy operation. The radial field circuit is permanent magnet made. Finally, PK-ISIS is also conceived for using in a High-Voltage platform with minor power consumption.

The intensities already obtained by PK-ISIS are listed in the Table 1 below. Please, note that these values were obtained during commissioning in the Pantechnik premises. *The intensities – mainly for metallic beams – should be taken as lower limits. Not all intensities were obtained after reaching the maximum magnetic field in the Superconducting coils.*

The problems we faced with the superconducting coils during the first commissioning were recently solved. PK-ISIS is running within the designed specifications.

Table 1: Beam intensities measured with PK-ISIS

Ion	Intensity (μA – electrical)
^{4}He (2+)	2,400
^{13}C (4+)	>500
^{13}C (6+)	50
^{14}N (5+)	>1,000
^{16}O (6+)	1,500
^{16}O (7+)	230
^{40}Ar (12+)	200
^{40}Ar (14+)	100
^{84}Kr (17+)	100
^{129}Xe (26+)	100
^{181}Ta (26+)	20
^{181}Ta (30+)	13
^{181}Ta (32+)	6
^{209}Bi (29+)	35
^{209}Bi (31+)	25
^{209}Bi (33+)	15

#antonio.villari@pantechnik.com