

Ion intensities

Mariusz Sapinski, GSI & SEEIIST Joint NIMMS-SEEIIST weekly meeting CERN, November 29, 2019

Ion intensity table

element	Z	A	Intensity required	Source charge state	Ion source current [uA]
С	6	12	2.00E+10	4	478
Li	3	6	5.02E+10	3	900
Не	2	4	8.23E+10	2	984
н	1	1	2.63E+11	1	1574
0	8	16	1.40E+10	6	501
Ar	16	36	4.98E+09	12	357

table from Elena, intensity requirements come from multiturn injection process characteristics

High current ECR ion sources

Here we consider two which are still reasonably small, commercially (almost) available and providing higher current then SUPERNANOGUN:

Pantechnik ISIS



THE MOST POWERFUL ECR ion source produced by Pantechnik

 Catania ECR source (AISHA - Advanced Ion Source for Hadrontherapy): Hybrid ECRIS with helium-free superconducting system. Unfortunately the whole system has not been fully tested yet, so I could not find data on final performance.

Pantechnik ISIS

A / q	2+	4+	6+	7+	12+	14+	26+	30+	33+
⁴He	2400								
¹² C		>500	50						
¹⁶ O			1500	230					
⁴⁰ Ar					200	100			
¹²⁹ Xe							100		
¹⁸¹ Ta				not opti	mized			13	4
²⁰⁹ Bi				not opti	mized			25	15

PK-ISIS measured beam intensities for selected ions (electric µA).

Pantechnik SUPERNANOGAN

(reference source)

ion / Q	1	2	4	6	8	9	20	27
н	2000							
He	2000	1000						
С			200	2,5				
Ar	1000		250	200	200	90		
Хе	500				220		15	1
Au							20	6
Pb							10	1

Beam intensity for various charge states given in electric µA. This table indicates typical intensities for selected charge states.

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Ar	16	36	4.98E+09	12	357	Missing factor 2

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Summary

- Pantechnik ISIS source fulfills ion intensity requirements except Argon.
- Data on lithium has not been not found yet, email send to Matthieu Cavellier, director of Pantechnik.
- Lithium beam is used to probe plasma in tokamaks. Some papers found, but no report of 900 μ A current potential problem? To be investigated...

AN ECR SOURCE FOR Li³⁺ IONS R. ERNST, L. FRIEDRICH, E. HUTTEL and F. SCHULZ Kernforschungszentrum Karlsruhe GmbH, Institut für Kernphysik III/Zyklotron, Postfach 3640, D-7500 Karlsruhe, FRG

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A two-stage ECR ion source for Li^{3+} ions has been built for the Karlsruhe cyclotron. The $2\omega_{CE}$ mode is used in the first stage. In order to obtain the optimum Li vapor pressure the complete plasma chamber is heated to about 400 °C. Microwaves of 7.5 GHz frequency and 100 W power are used. The source currently delivers 60 e μ A Li³⁺ of which up to 5 e μ A are accelerated to 156 MeV.

PHYSICS AND TECHNIQUE OF ACCELERATORS =

Production of Intense Beams of Lithium, Magnesium, Phosphorus, and Calcium Ions by the ECR Ion Source at the DC-60 Cyclotron

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AISHA source should provide even more intensity (800 μA C⁴⁺)