HIAT 2009

STATUS REPORT and FUTURE DEVELOPMENT of FLNR JINR HEAVY ION ACCELERATOR COMPLEX

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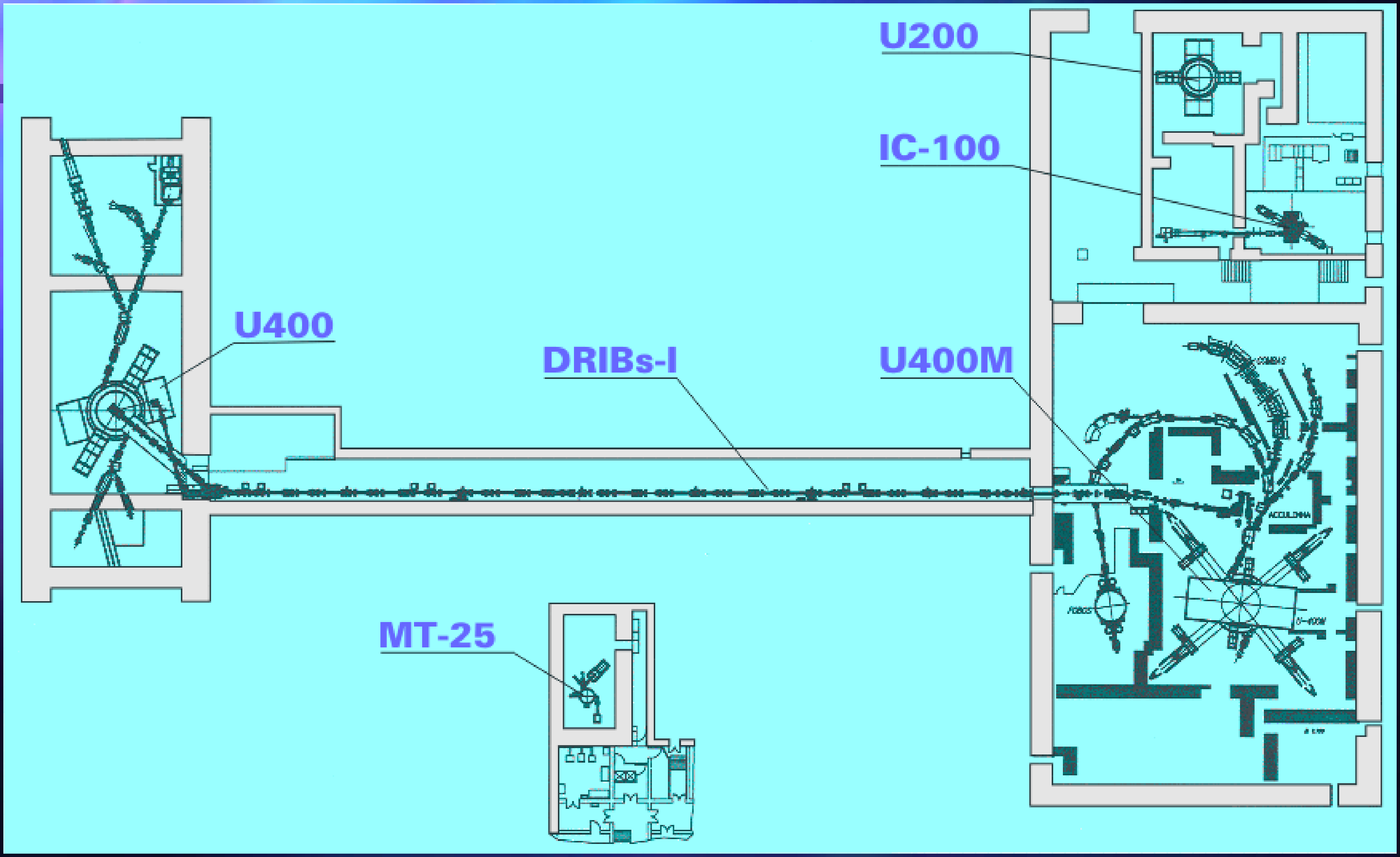
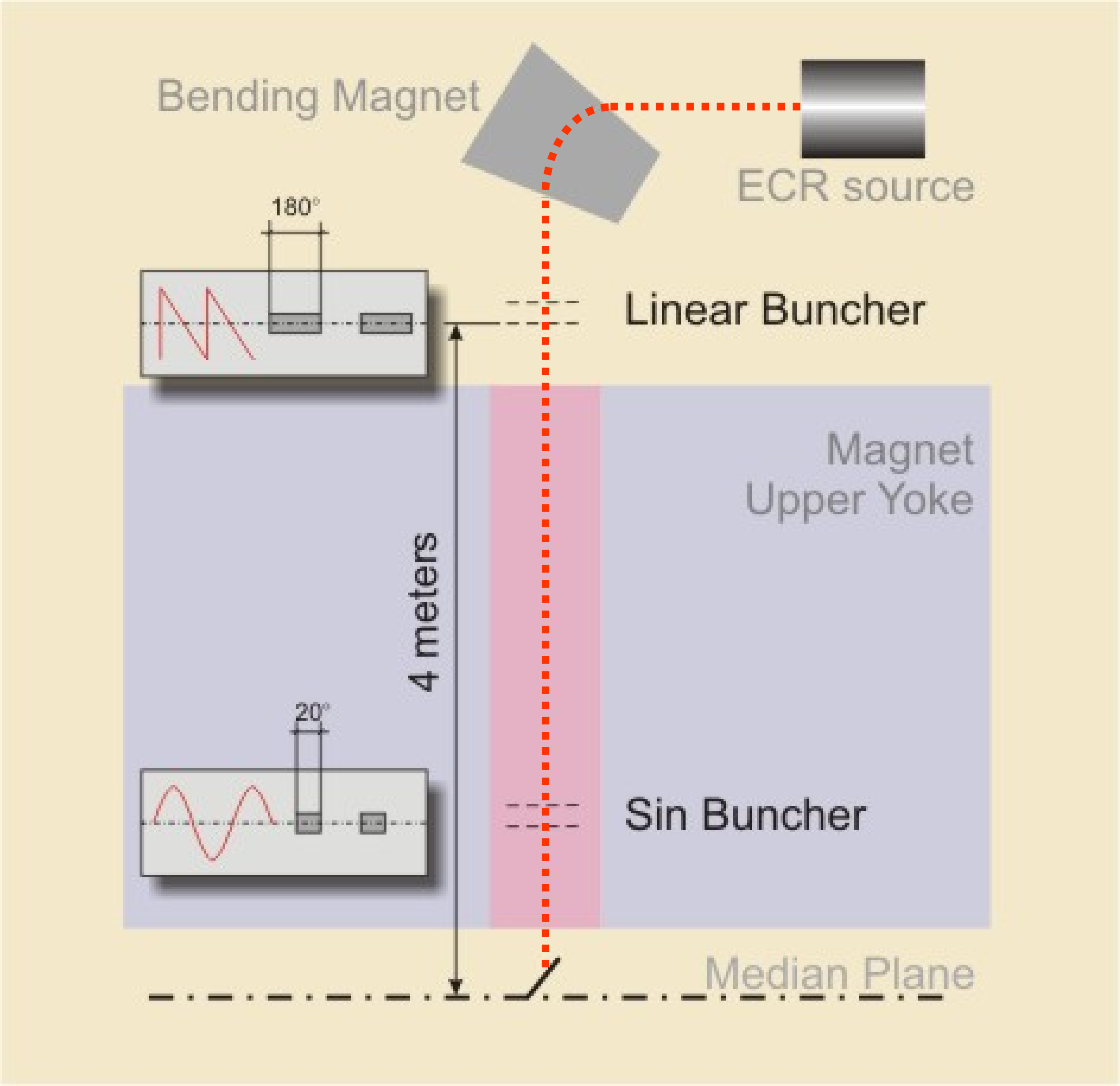
FLEROVLAB ACCELERATORS

View from Above on Accelerator Placement



U400 Cyclotron
Buncher System



U400 cyclotron operation time in 1997-2009

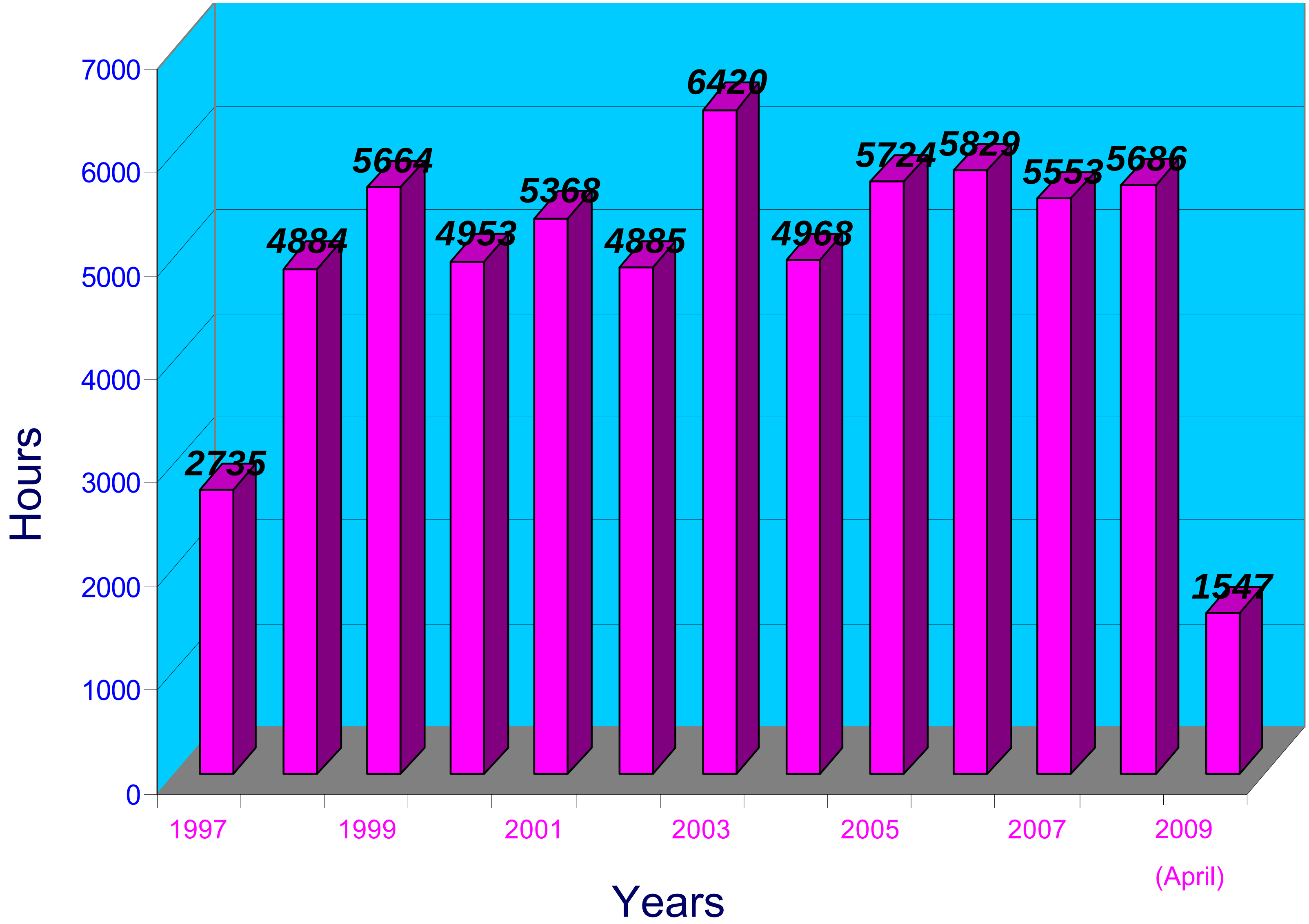
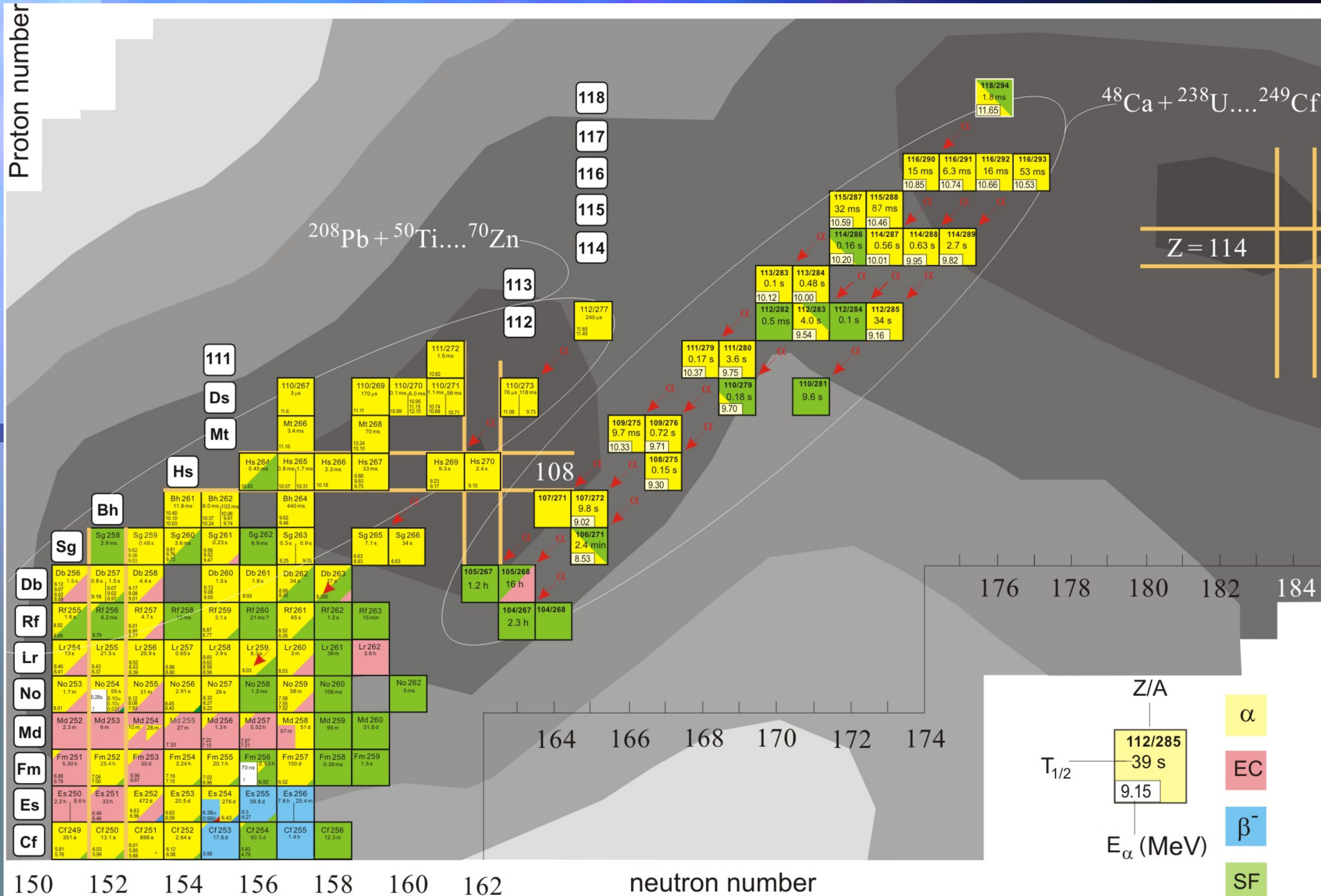


CHART of the NUCLIDES



Comparative parameters of U400 and U400R

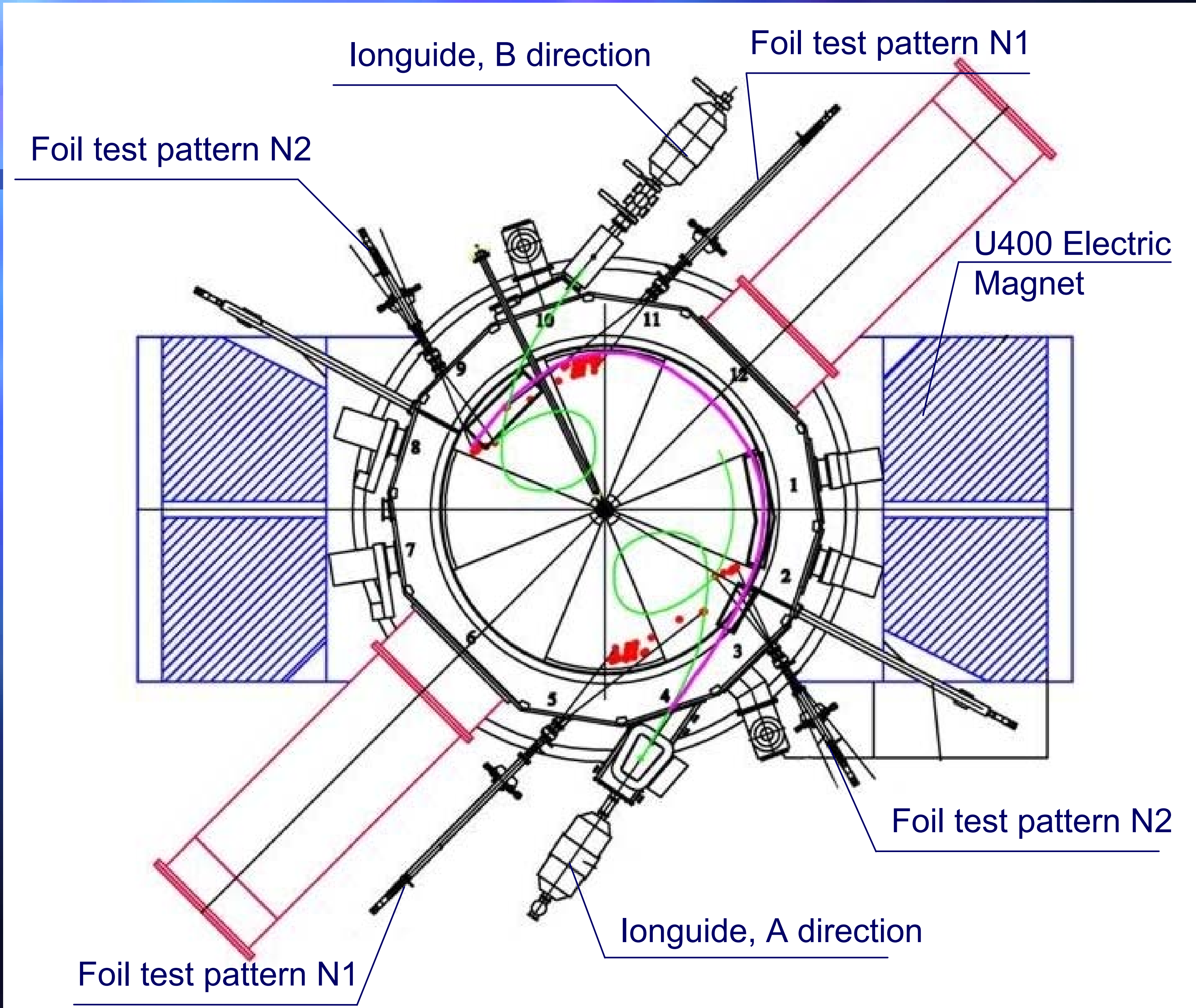
Parameters	U400	U400R
A/z range	5÷12	4÷12
Magnetic field	1.93÷2.1 T	0.8÷1.8 T
K factor	530÷625	100÷500
RF modes	2	2, 3, 4, 5, 6
Injection potential	10÷20 kV	10÷50 kV
Ion energy range	3÷20 MeV/n	0.8÷27 MeV/n
Number of sectors	4	4
Number of dees	2	2
Flat – top system	-	+
Beam extraction	stripping	Stripping, deflector
Power consuption	~1 MW	~0.4 MW

Parameters of U400 and U400R typical ion

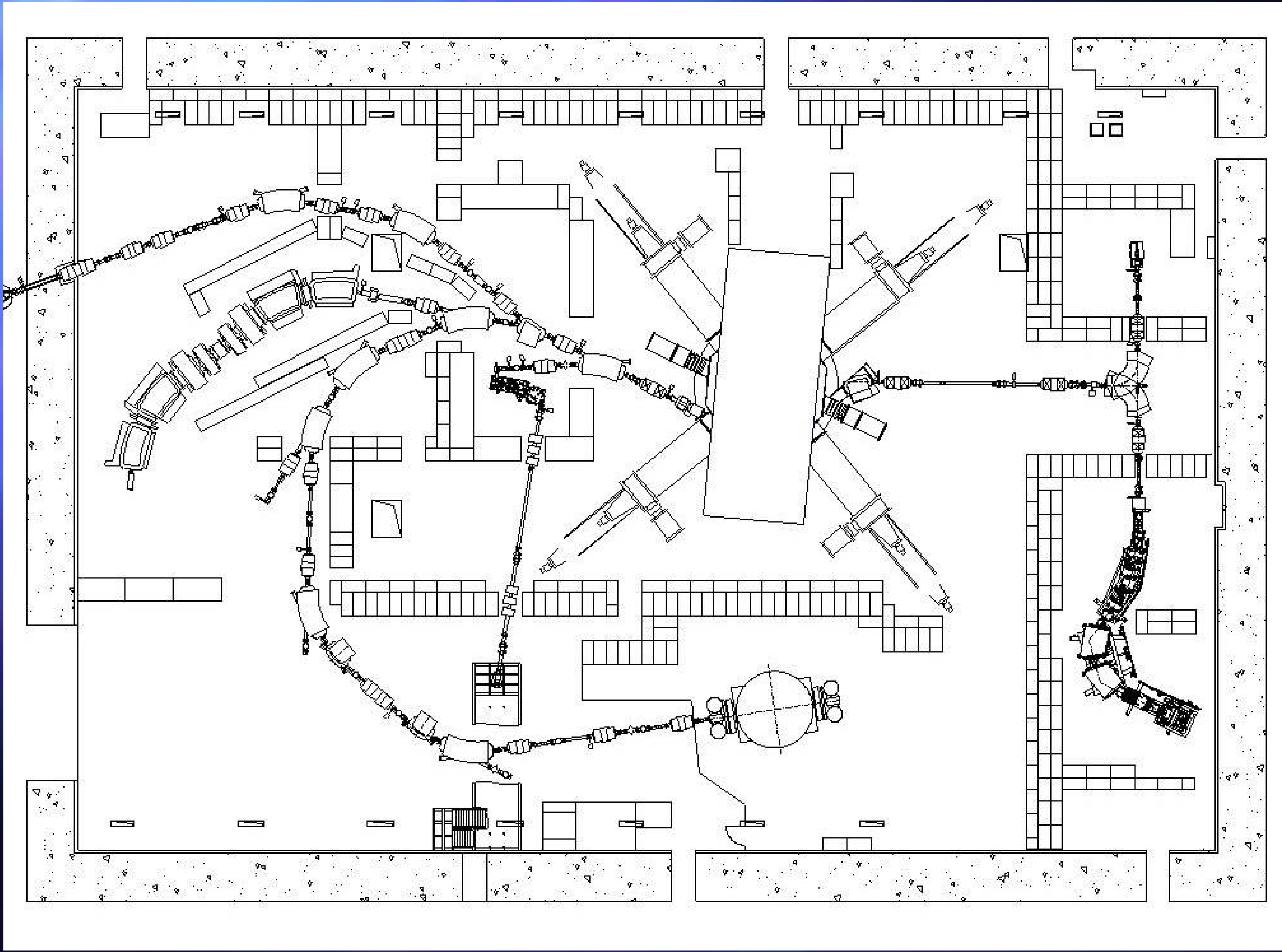
U400		
Ion	Ion energy [MeV/u]	Output intensity
$^{4}He^{1+}$	-	-
$^{6}He^{1+}$	11	$3\cdot10^{7}$ pps
$^{8}He^{1+}$	7.9	-
$^{16}O^{2+}$	5.7; 7.9	5 pμA
$^{18}O^{3+}$	7.8; 10.5; 15.8	4.4 pμA
$^{40}Ar^{4+}$	3.8; 5.1 *	1.7 pμA
$^{48}Ca^{5+}$	3.7; 5.3 *	1.2 pμA
$^{48}Ca^{9+}$	8.9; 11; 17.7 *	1 pμA
$^{50}Ti^{5+}$	3.6; 5.1 *	0.4 pμA
$^{58}Fe^{6+}$	3.8; 5.4 *	0.7 pμA
$^{84}Kr^{8+}$	3.1; 4.4 *	0.3 pμA
$^{136}Xe^{14+}$	3.3; 4.6; 6.9 *	0.08 pμA

U400R (expected)		
Ion	Ion energy [MeV/u]	Output intensity
$^{4}He^{1+}$	6.4 ÷ 27	23 pμA **
$^{6}He^{1+}$	2.8 ÷ 14.4	10^{8} pps
$^{8}He^{1+}$	1.6 ÷ 8	10^{5} pps
$^{16}O^{2+}$	1.6 ÷ 8	19.5 pμA **
$^{16}O^{4+}$	6.4 ÷ 27	5.8 pμA **
$^{40}Ar^{4+}$	1 ÷ 5.1	10 pμA
$^{48}Ca^{6+}$	1.6 ÷ 8	2.5 pμA
$^{48}Ca^{7+}$	2.1 ÷ 11	2.1 pμA
$^{50}Ti^{10+}$	4.1 ÷ 21	1 pμA
$^{58}Fe^{7+}$	1.2 ÷ 7.5	1 pμA
$^{84}Kr^{7+}$	0.8 ÷ 3.5	1.4 pμA
$^{132}Xe^{11+}$	0.8 ÷ 3.5	0.9 pμA

Scheme of the beam extraction in two selected directions

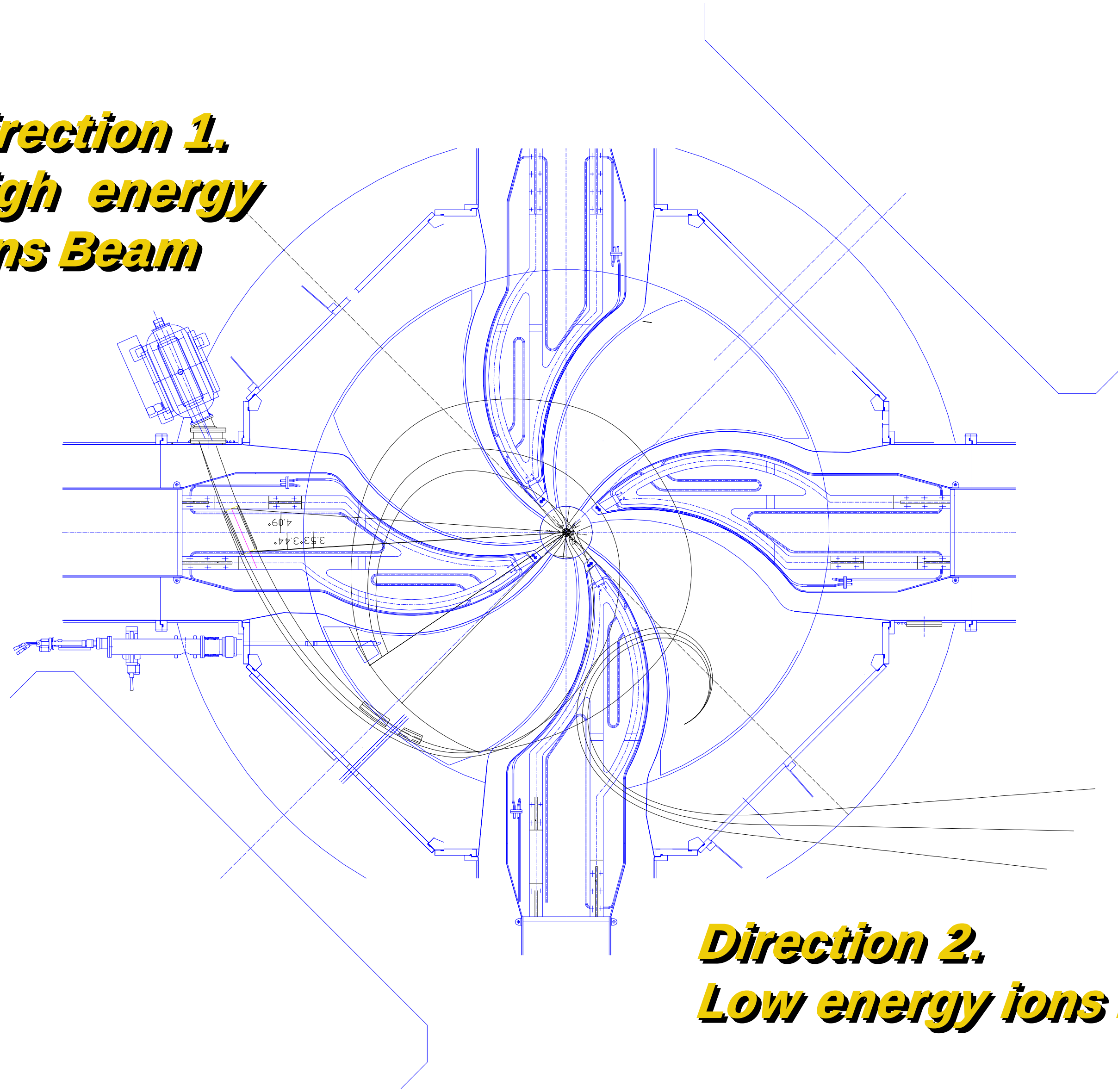


Plan View of the U400M Hall



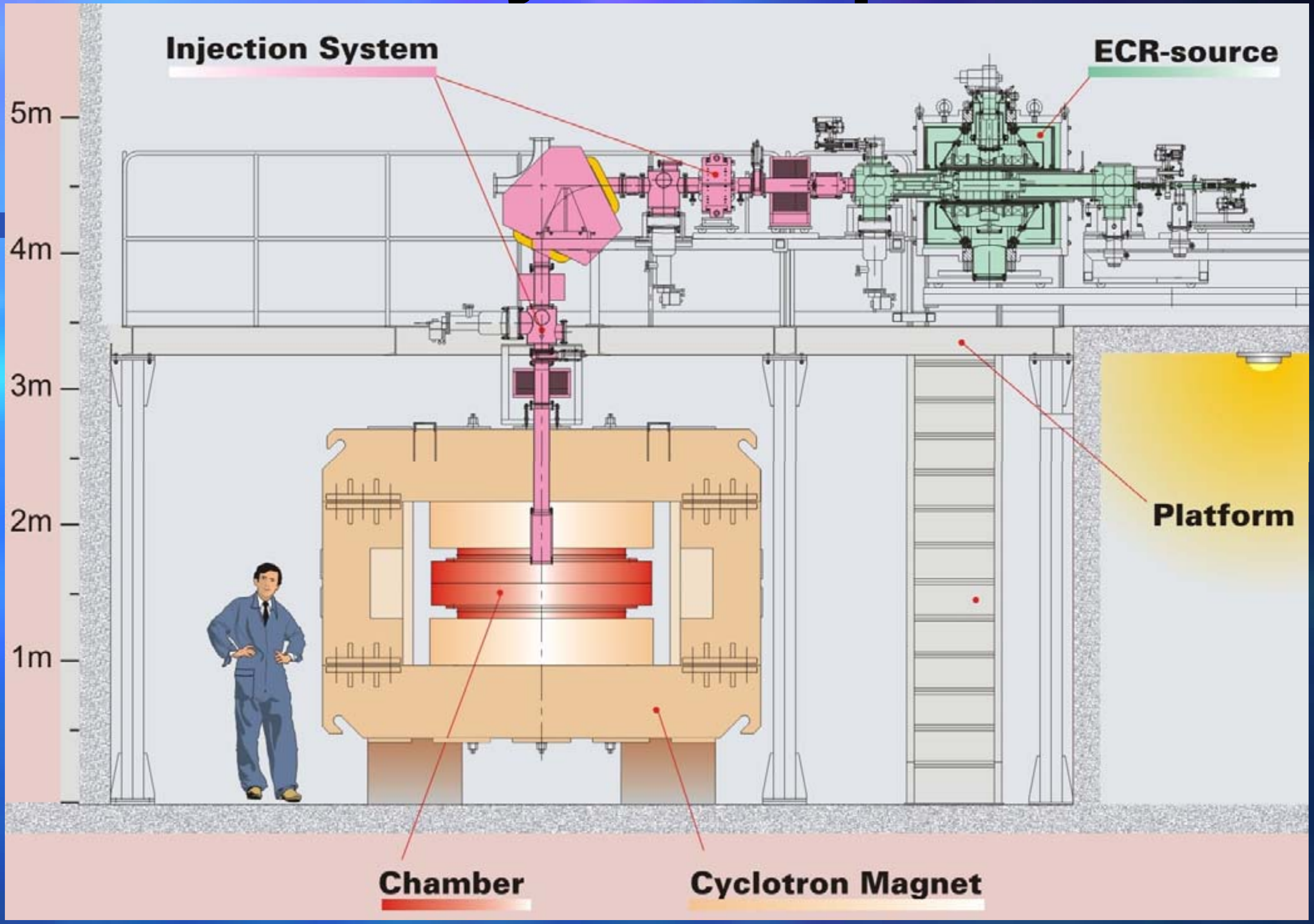
U400M. Ion beam extraction by charge exchange method

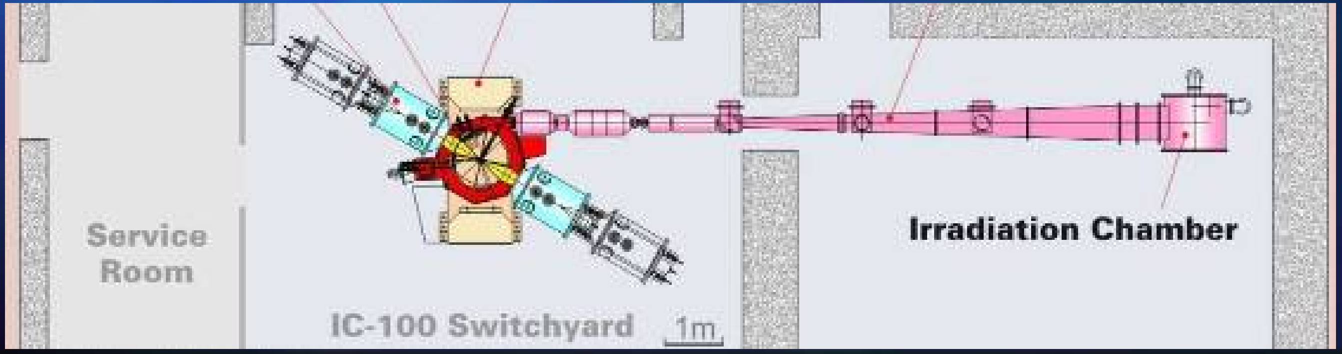
Direction 1.
High energy ions Beam



Direction 2.
Low energy ions Beam

IC-100 cyclic implanter





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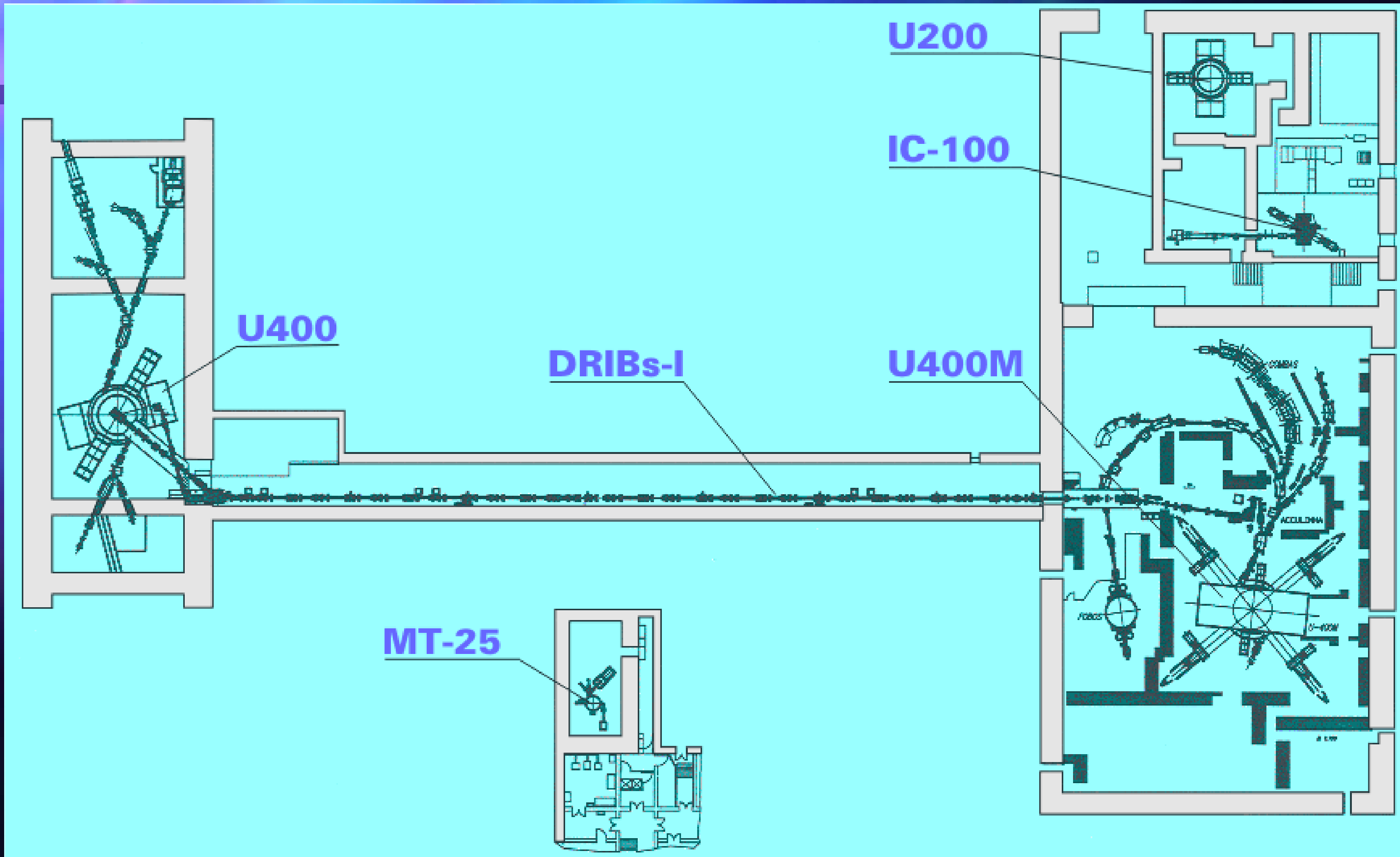
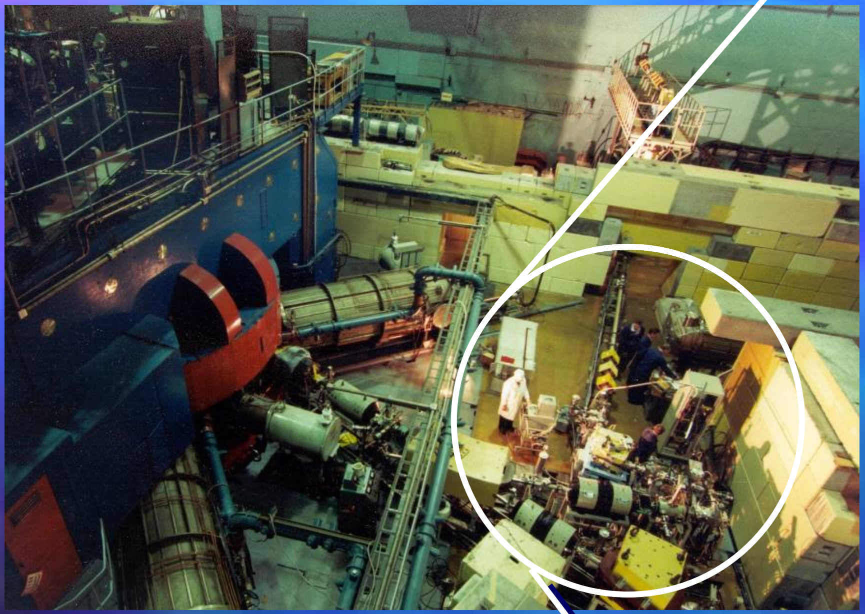
View from Above on Accelerator Placement

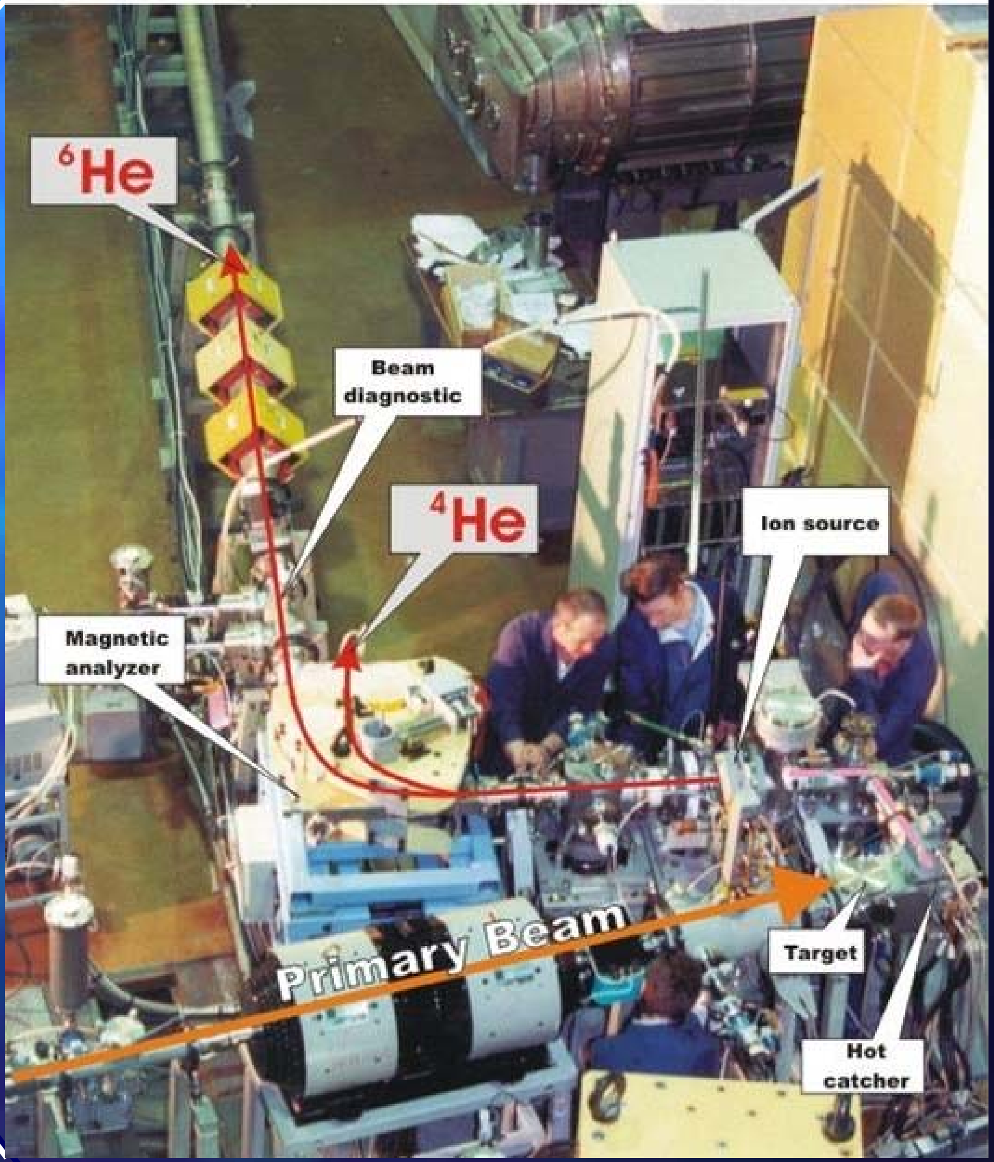


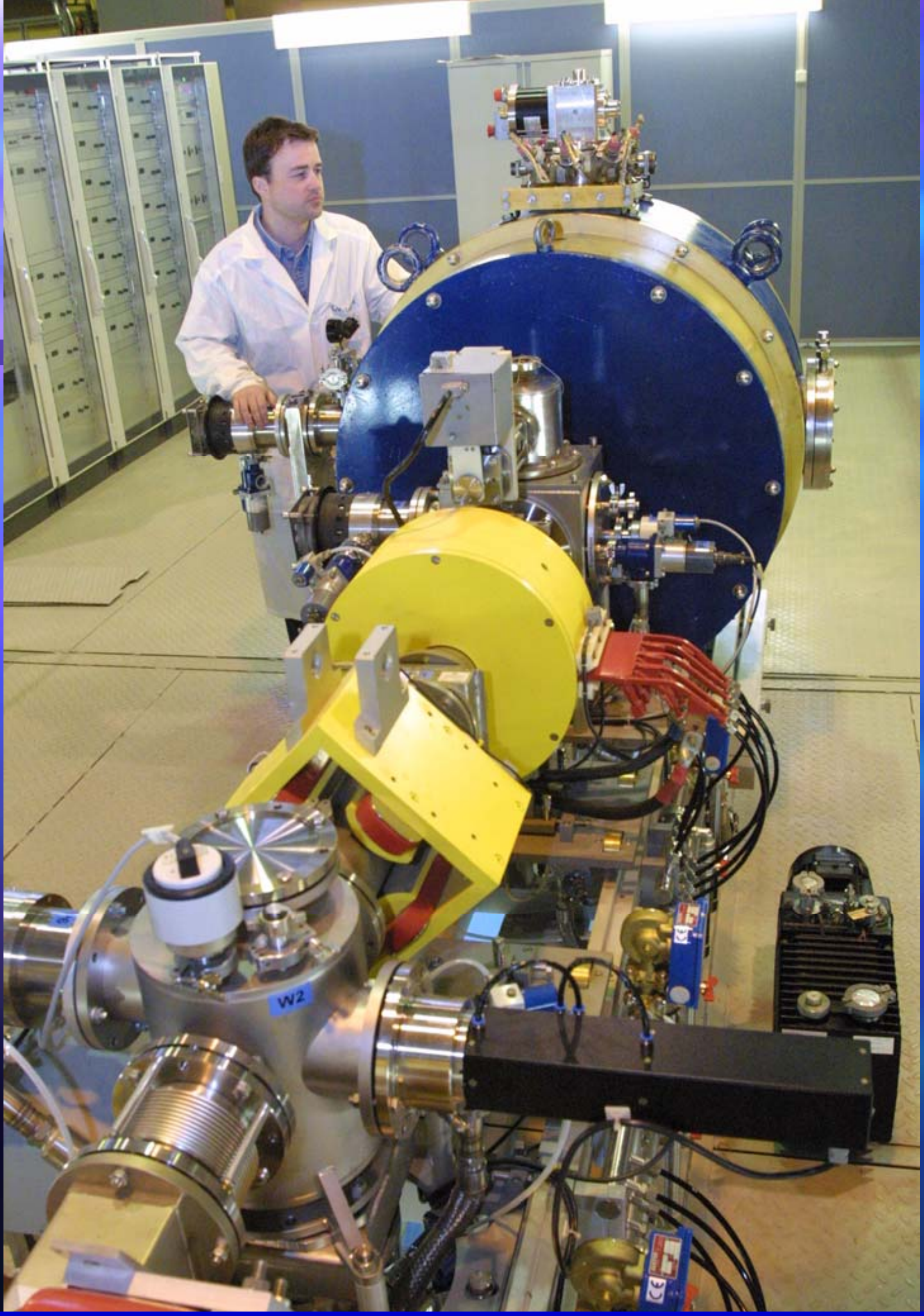
U400M Cyclotron with DRIBs Complex

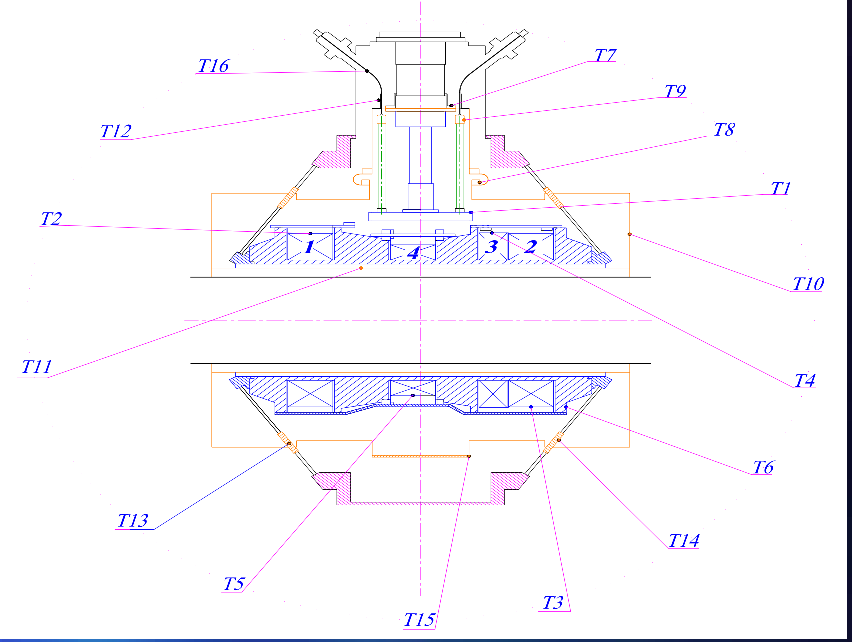


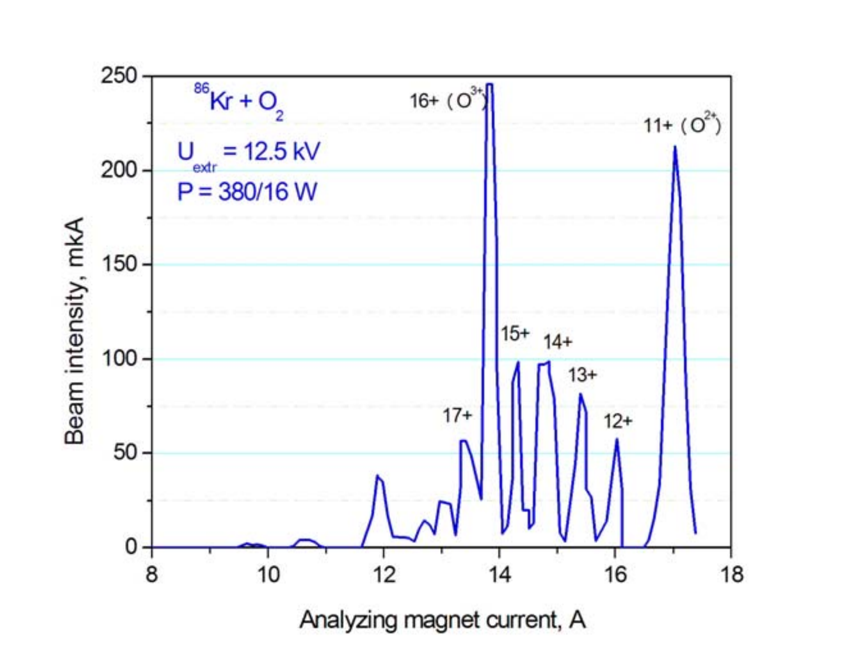
DRIBs - Project

Transformation of the primary beam into a low energy radioactive ion beam



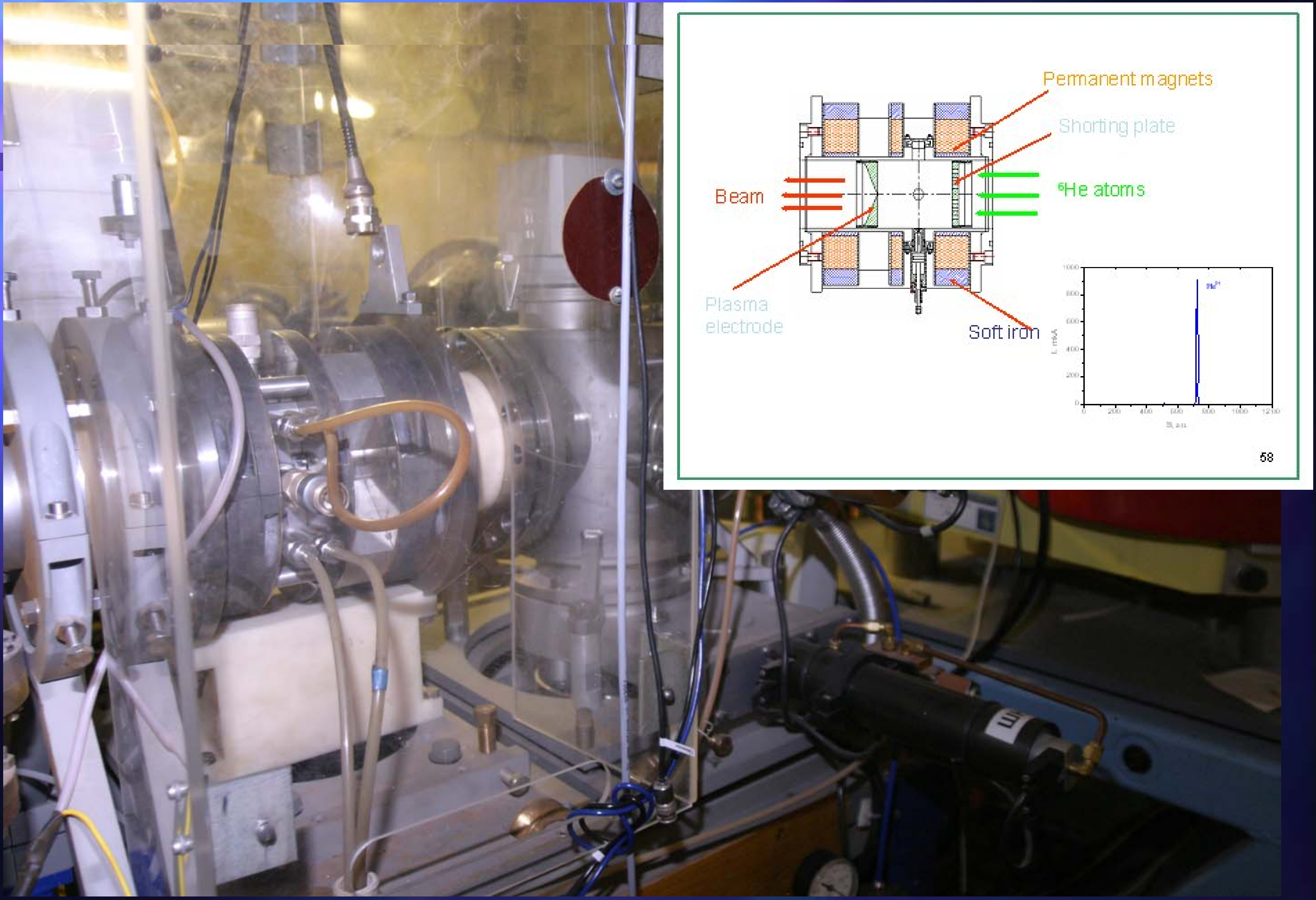




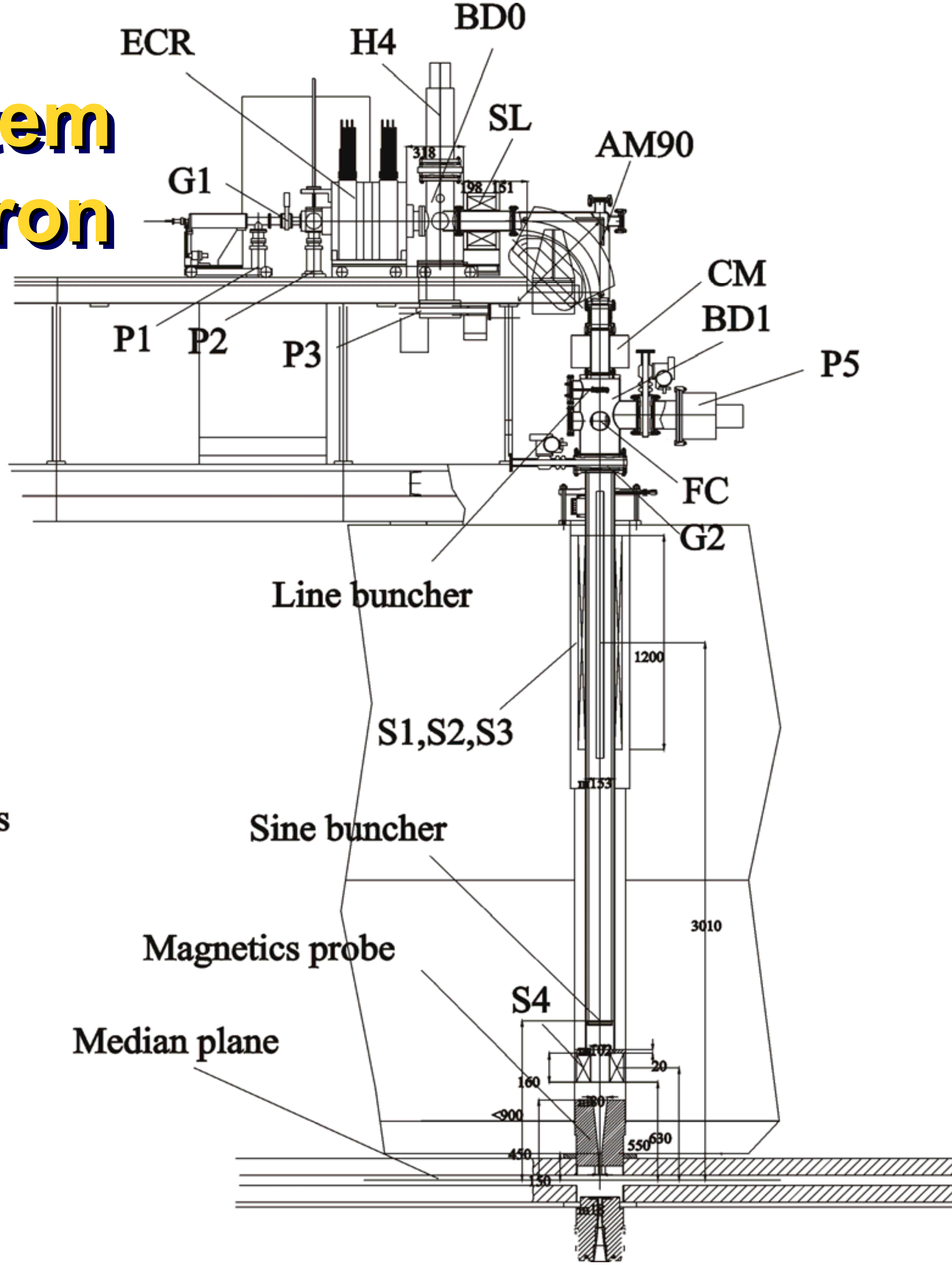


SUPERCONDUCTING ECR ION SOURCE at IC-100

DRIBs-I ECR Ion Source



Axial injection system of U400 Cyclotron



AM90- bending magnet

DB- diagnostics box

P- vacuum pump

SL- solenoidal lens

S1-S4-focussing solenoids

CM- stirring magnet

FC- Faradey cup

G- gate valve

NEW FLNR ACCELERATOR

In order to improve efficiency of the experiments for the next 7 years it is necessary to obtain the accelerated ion beams with following parameters.

Energy	4÷8 MeV/n
Masses	10÷100
Intensity (up to 48Ca)	10 pμA

Beam emittance less 30 π mm·mrad

Efficiency of beam transfer >50%

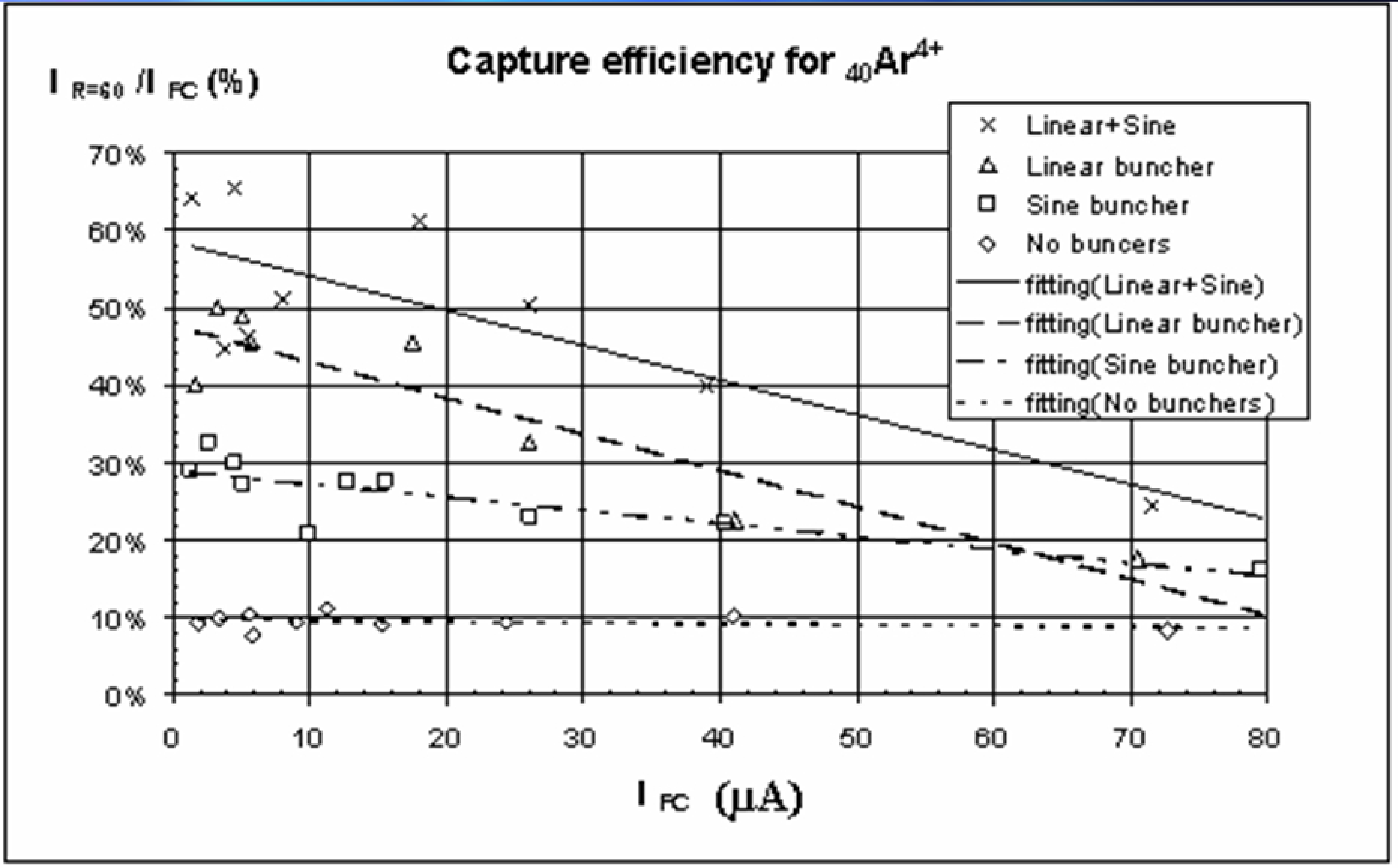
ECR frequency 18÷28 GHz

Under consideration here are two variants now: SC linac or specialized cyclotron.

Variant 1 – SC LINAC

The proposed superconducting linac structure includes RFQ and 26 QuaterWave Resonators (QWR). The total length is near 46 m, total power consumption is 350 kW, and average accelerating gradient (along all QWR) is near 1.5 MV/m.

The efficiency of capture versus injecting beam current and bunchers



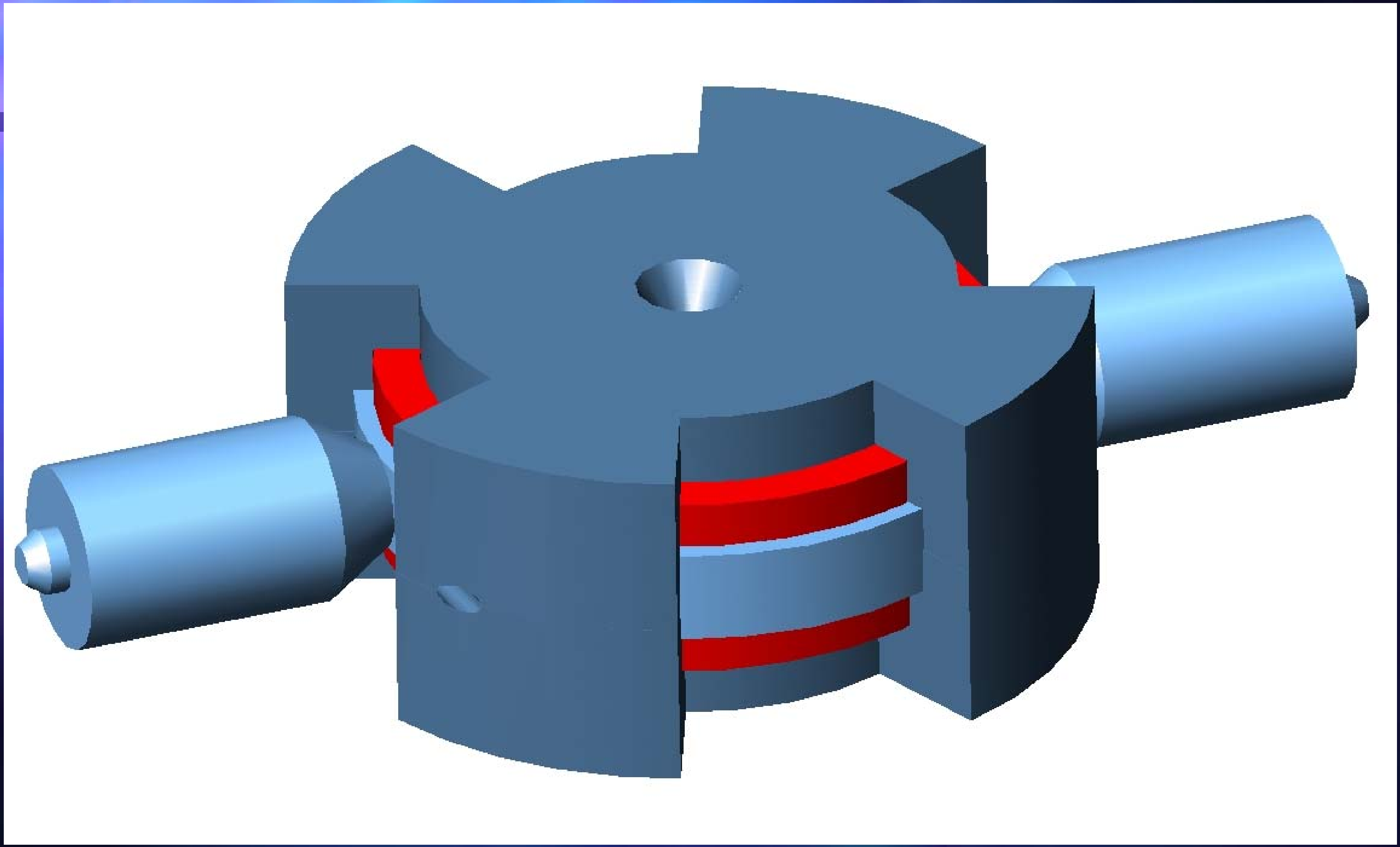
DC200. Parameters and Goals

	DC200 Parameter	Goals
1.	High injecting beam energy (up to 100 kV)	Shift of space charge limits for factor 30
2.	High gap in the center	Space for long spiral inflector
3.	Low magnetic field	High starting radius. High turns separation. Low deflector voltage
4.	High acceleration rate	High turns separation.
5.	Flat-top system	High capture. Single turn extraction. Beam quality.

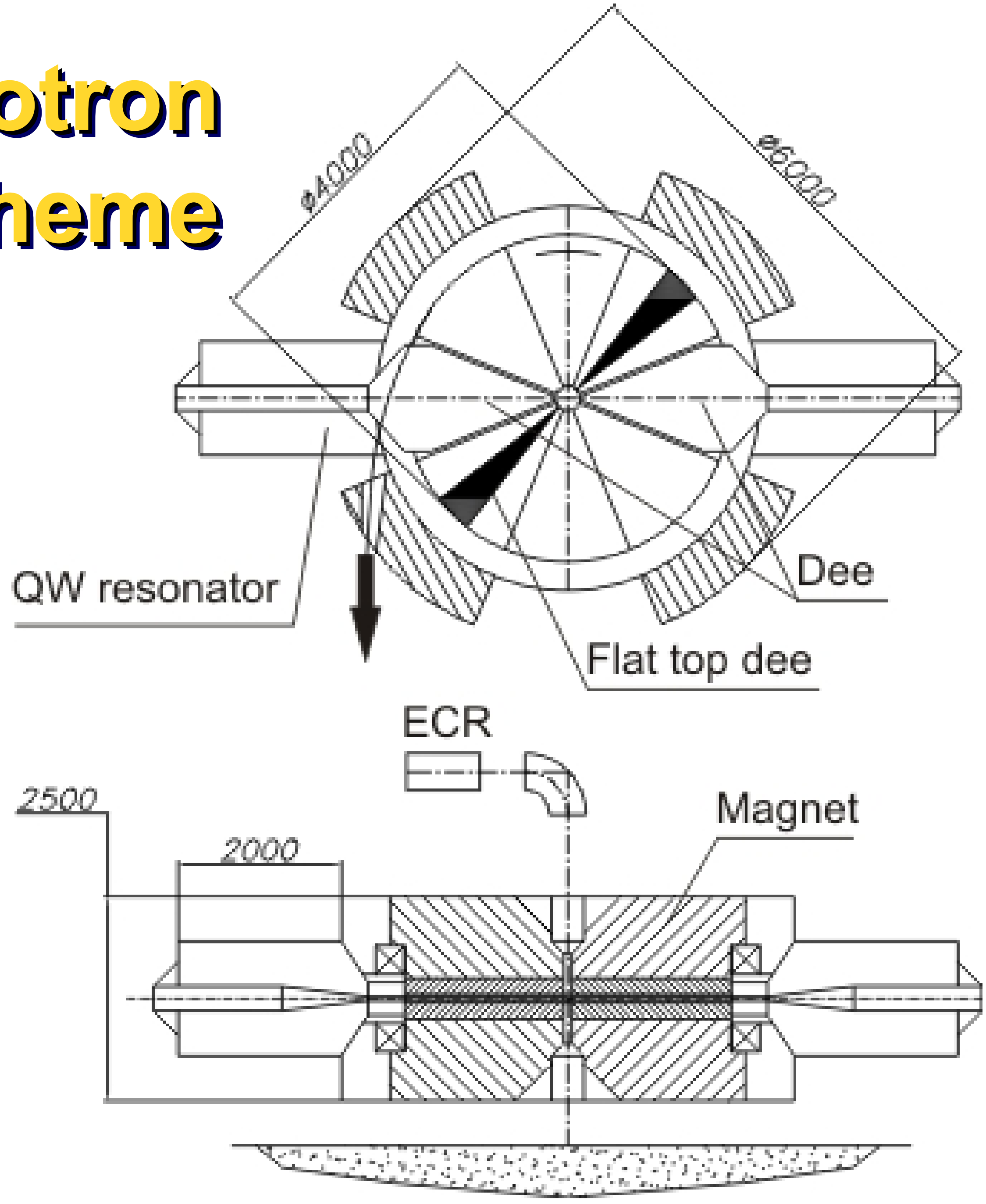
DC200. Main Parameters

Injecting beam potential	Up to 100 kV
A/Z range	4÷7
Magnetic field level	0.65÷1.15 T
K factor	200
Gap between plugs	250 mm
Valley/hill gap	350/240 mm/mm
Magnet weight	470 t
Magnet power	170 kW
Dee voltage	2x130 kV
RF power consumption	2x30 kW
Flat-top dee voltage	2x14 kV
Beam turns separation	10 mm
Radial beam bunch size	3 mm
Efficiency of beam transferring	60%
Total accelerating potential	up to ~ 40 MV

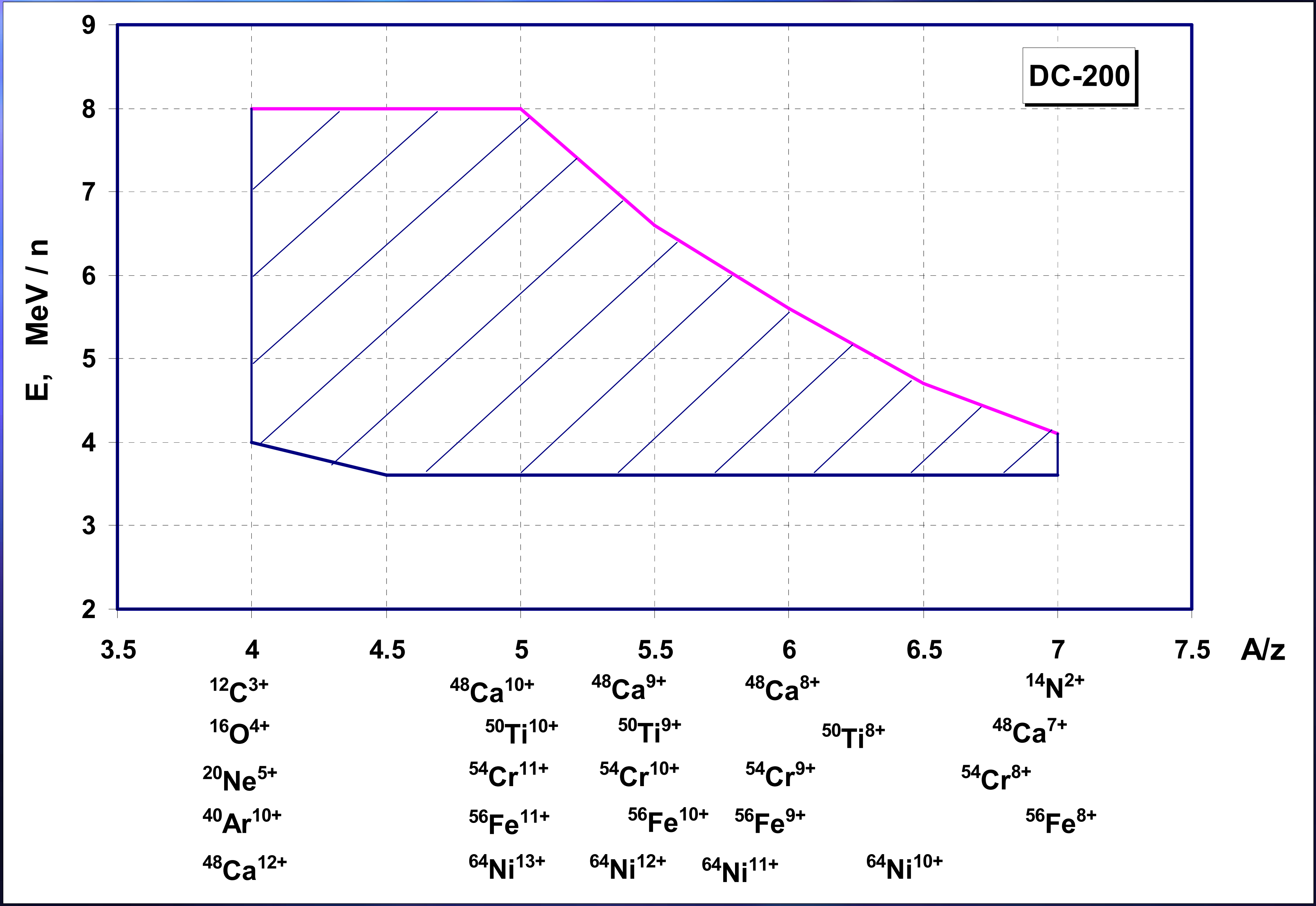
3D design of DC200 Cyclotron



DC200 Cyclotron Scheme



DC200 Working Diagram



Thanks for your attention!