Program to improve the ion beam formation and transmission at JYFL

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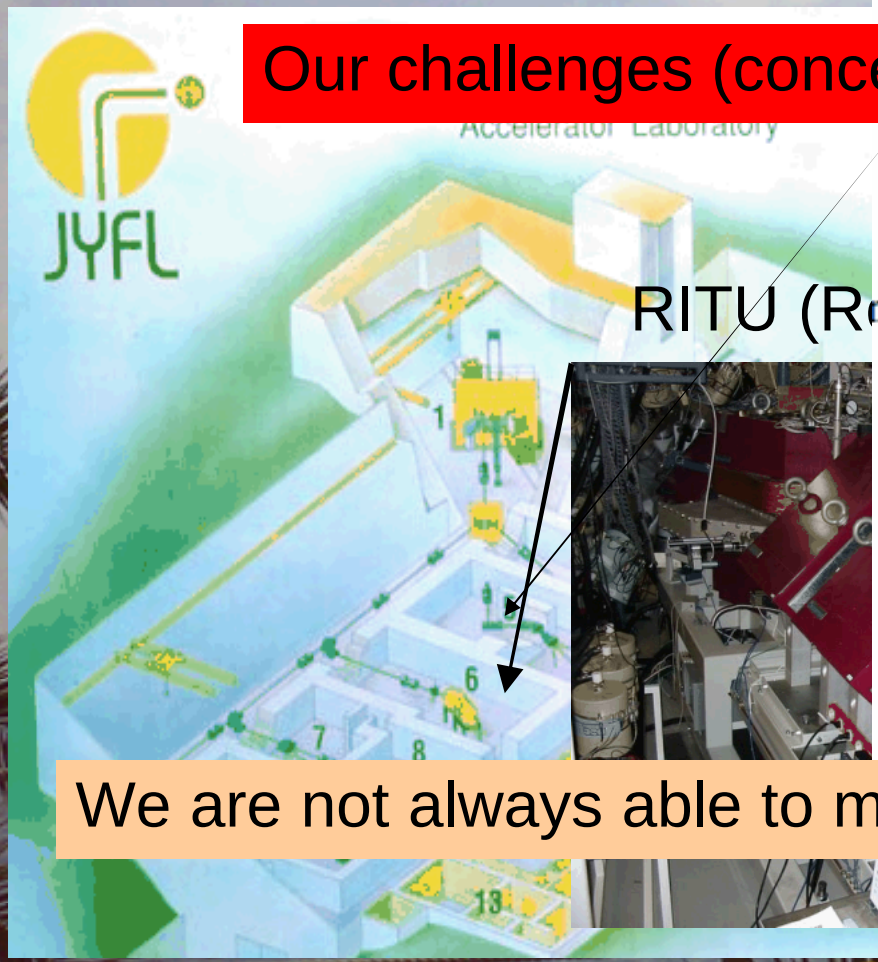
IGISOL (Ion Guide Isotope Separator On-Line)

Our challenges (concerning the beam intensity):



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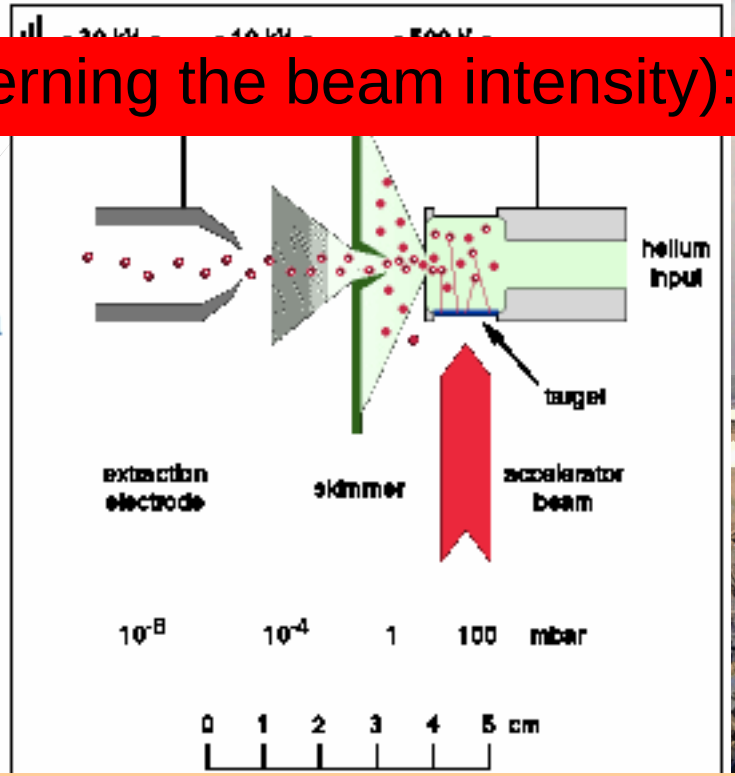
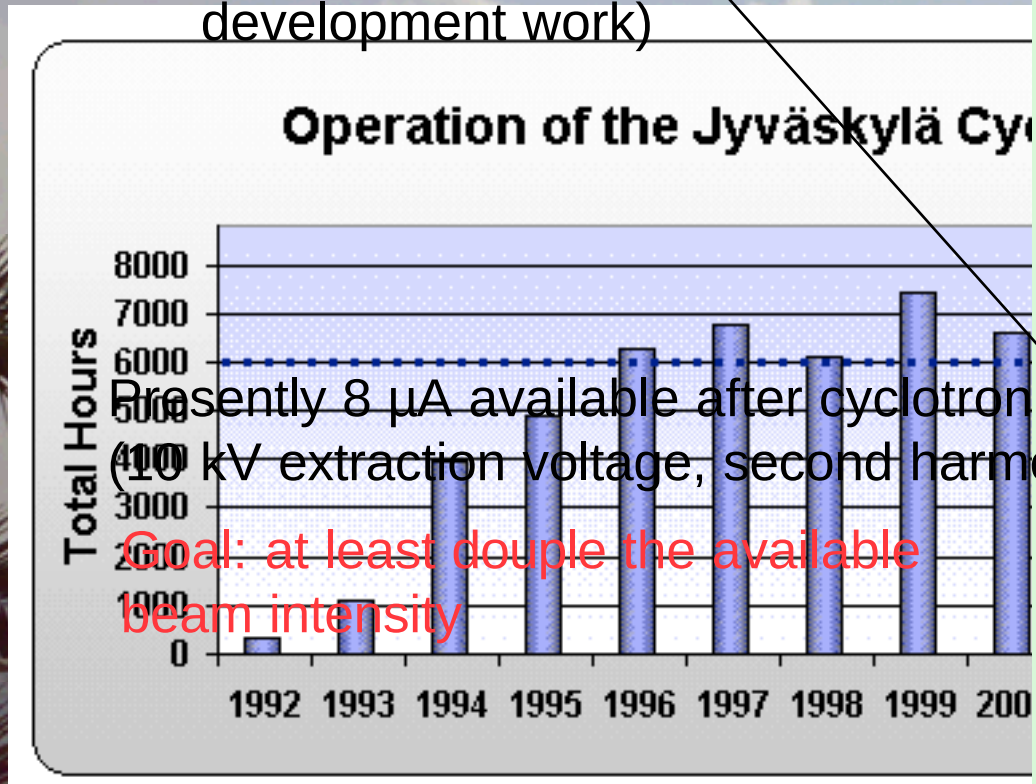


We are not always able to meet the intensity requirement

Background

Reference beam
(concerning beam transmission development work)



Presently 8 μA available after cyclotron
(10 kV extraction voltage, second harmonic)

Goal: at least douple the available beam intensity

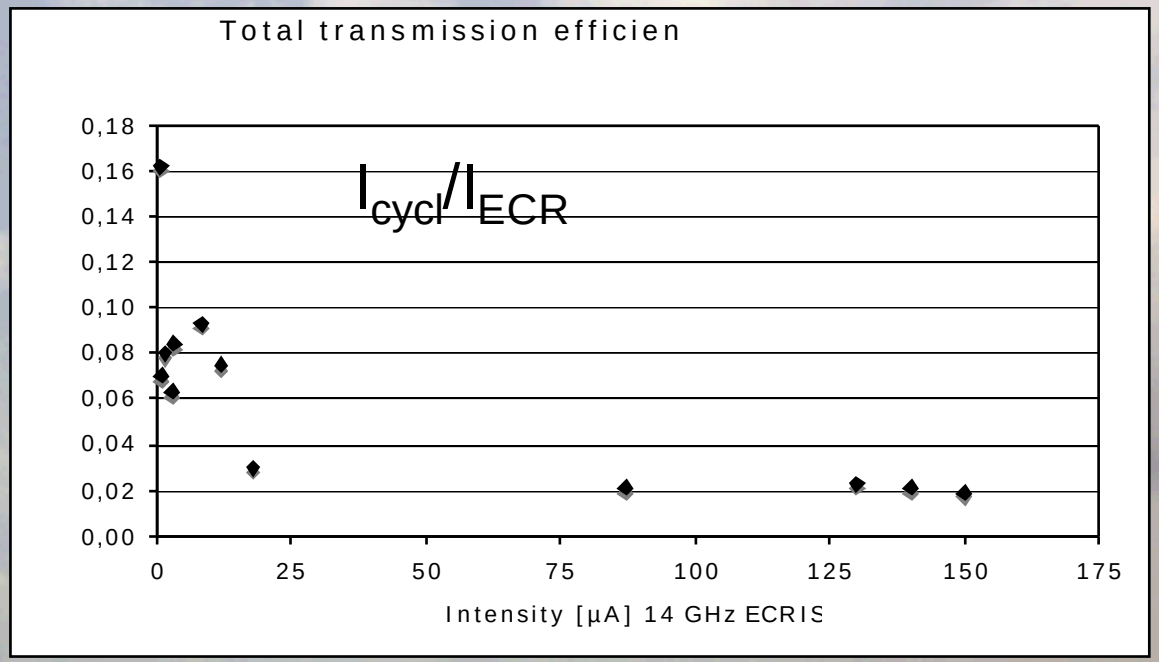
Accelerated ions 2005

Ion	hours	%
PROTONS	2817	38,8
48 Ca	714	9,9
COCKTAIL	471	6,5
32 S	421	5,8
54 Fe	328	4,5
36 Ar	270	3,7
78 Kr	233	3,2
58 Ni	206	2,8
DEUTERIUM	191	2,6
4 He	190	2,6
84 Sr	186	2,6
83 Kr	154	2,1
60 Ni	151	2,1
28 Si	148	2,0
82 Kr	139	1,9
20 Ne	98	1,3
40 Ar	93	1,3
64 Ni	82	1,1
65 Cu	76	1,0
16 O	73	1,0
64 Zn	41	0,6
3 He	31	0,4
136 Xe	25	0,3
86 Kr	10	0,1

Statistics (2004)

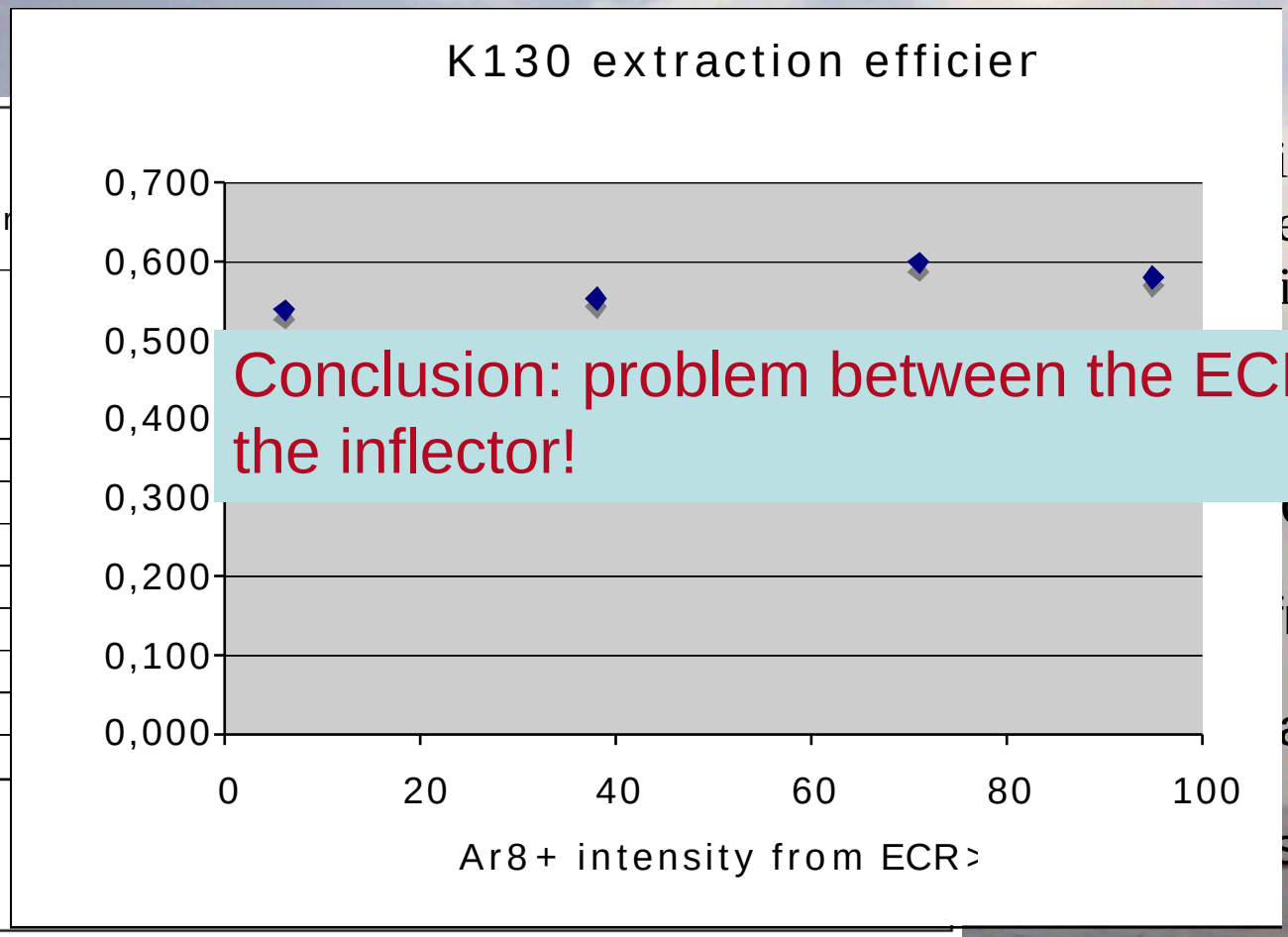
JYFL 14 GHz ECRIS

2nd harmonic



Transmission efficiency decreases when the beam intensity from the ECRIS increases!

Measured transmission efficiency of K130



Conclusion: problem between the ECRIS and the inflector!

ion beam
efficiency as
intensity
ong?
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Beam line

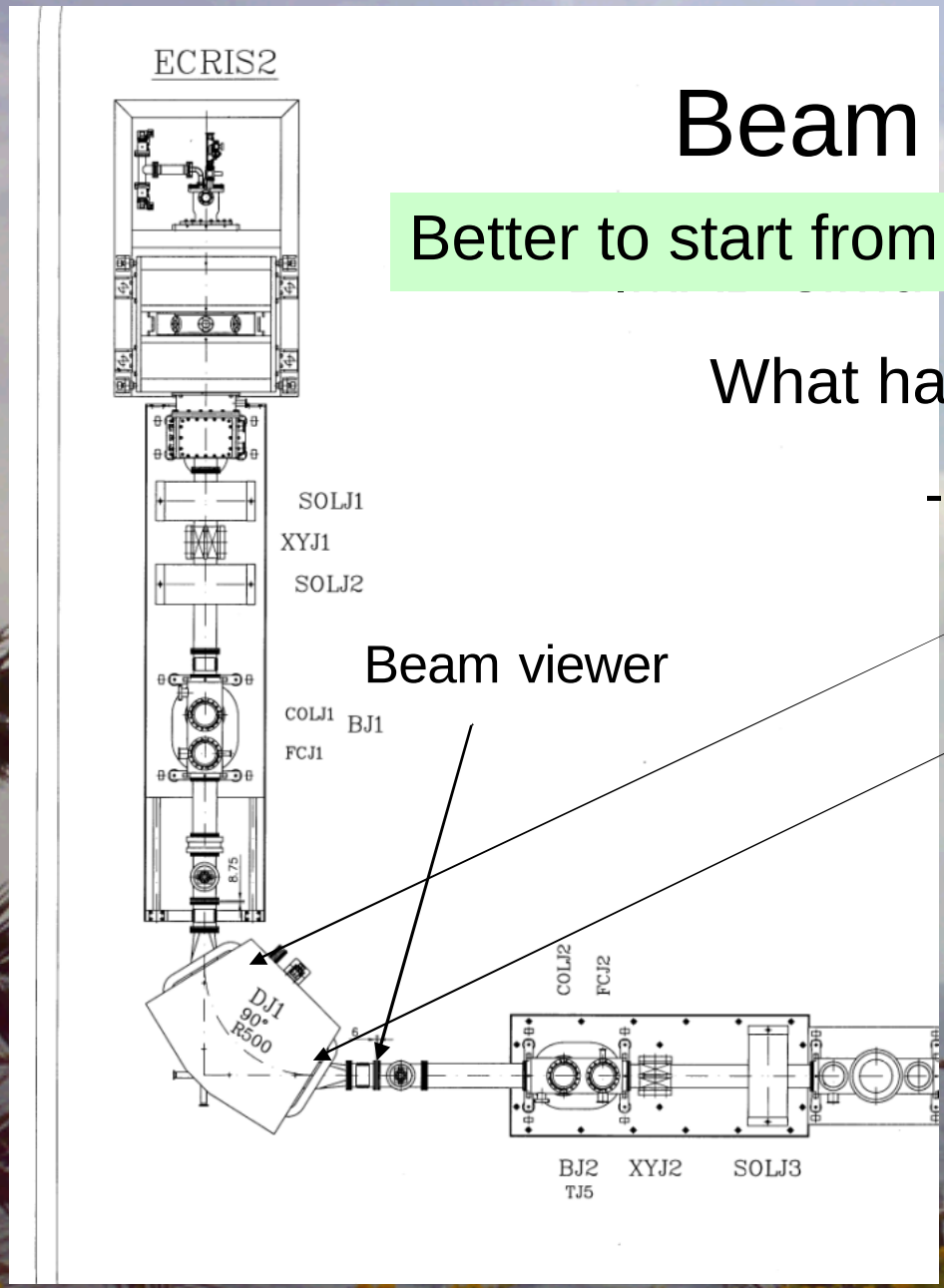
Better to start from beam transport!

Wu/NSCL):

What has been found (for example)?

- Wrong entrance/exit angle of dipole

⇨ Asymmetric beam



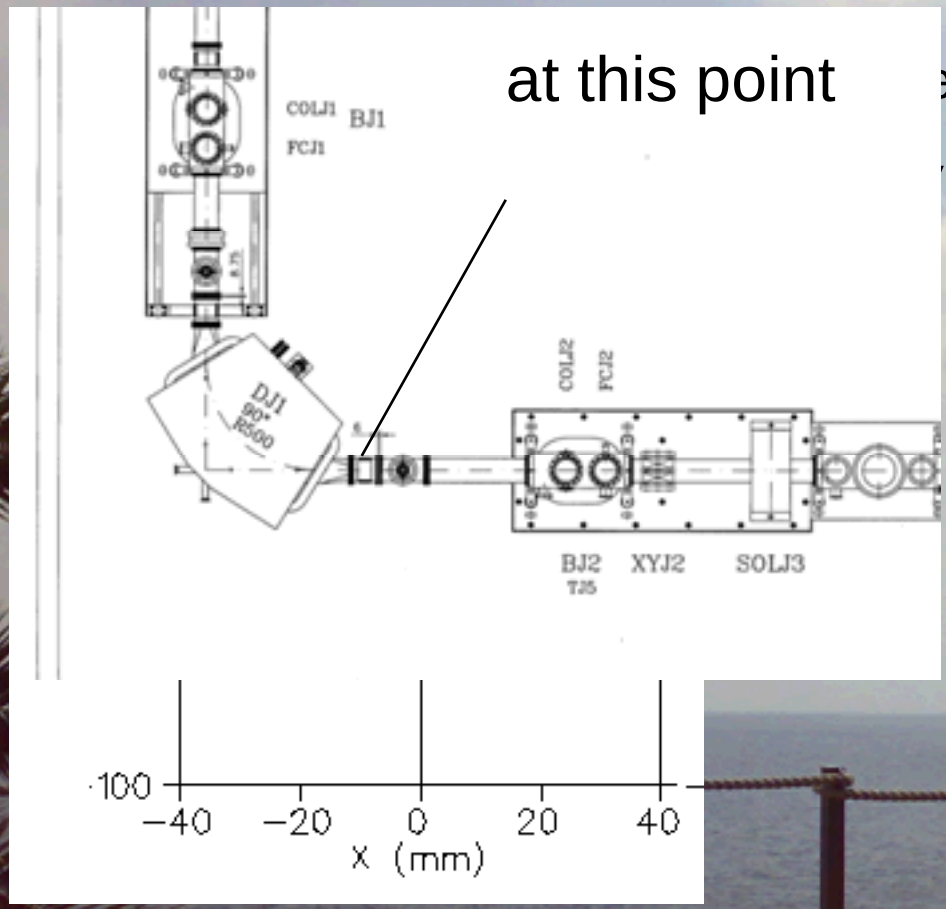
Beam viewer

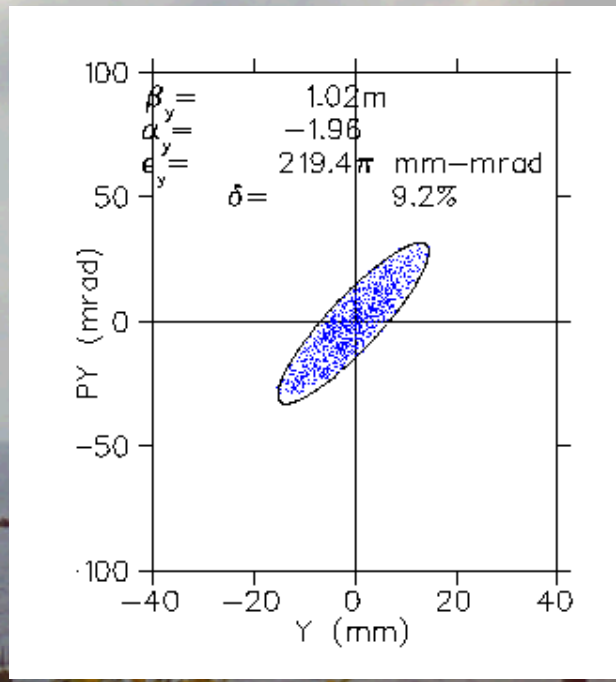
DIMAD simulations (by X. Wu)

at this point

el beam)

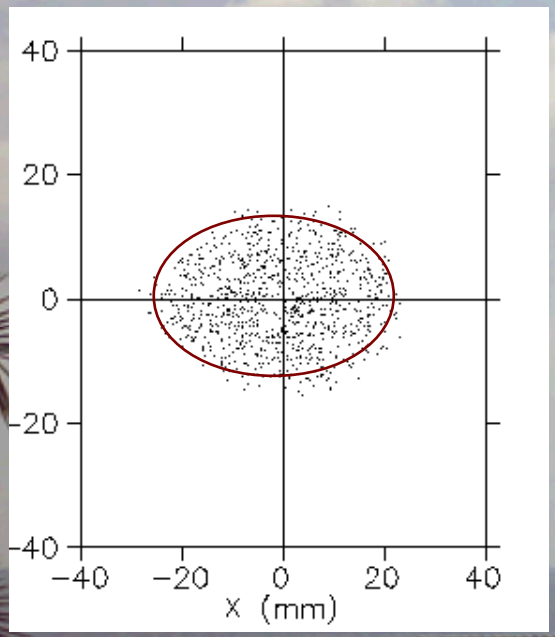
ertical plane (diverging beam)



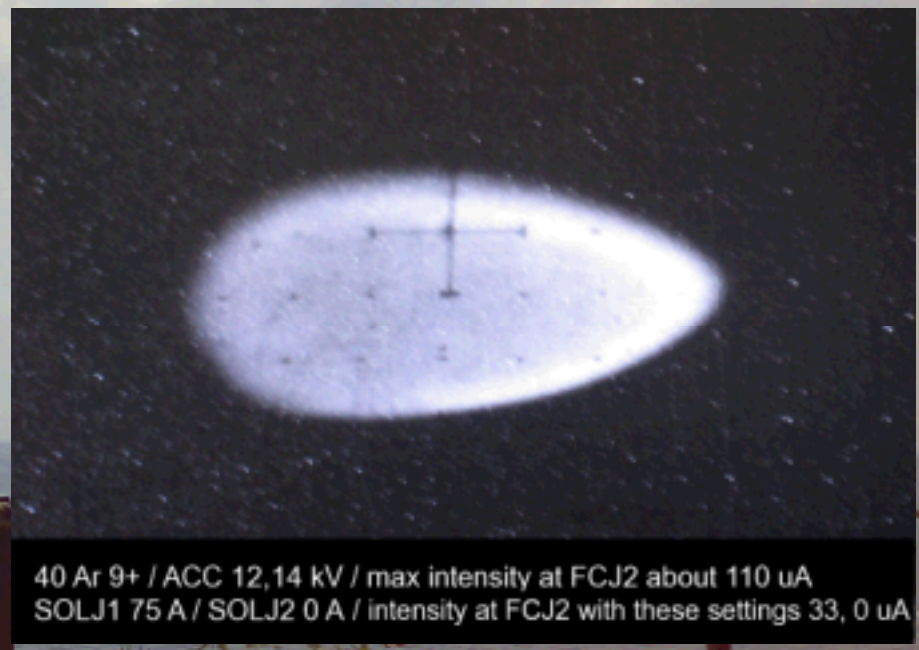


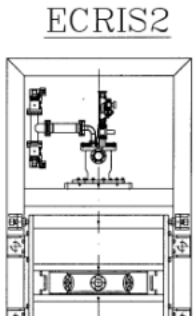
DIMAD simulations (by X. Wu)

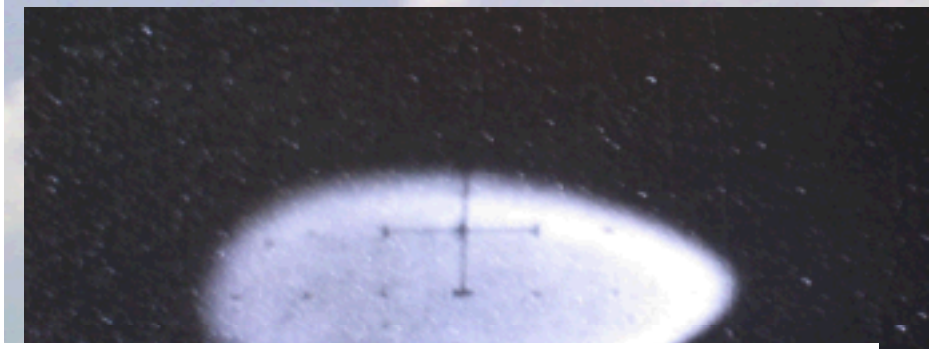
Beam spot in viewer according to DIMAD-simulations



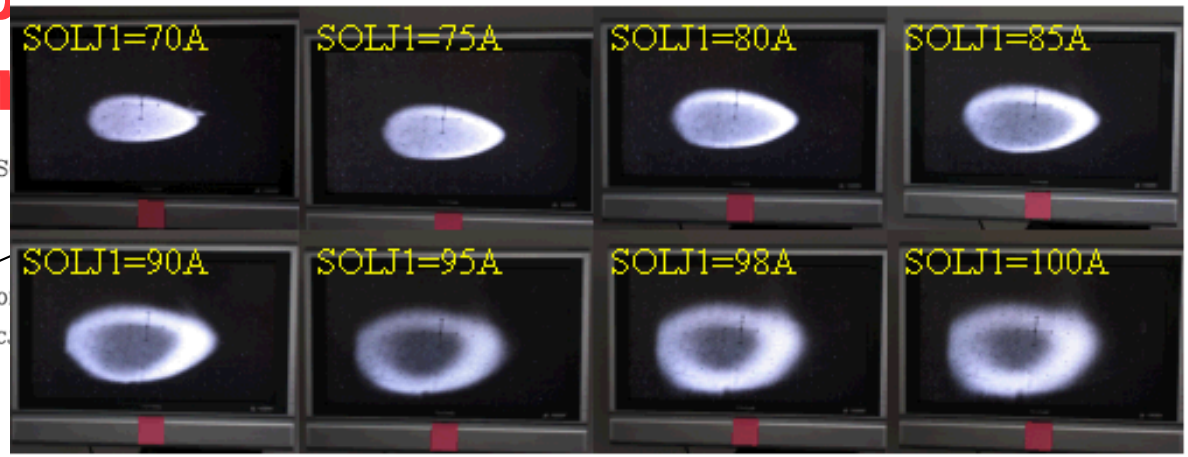
Beam spot in viewer (just after dipole)







Comprehensive experiments have to be perfo ansport!!

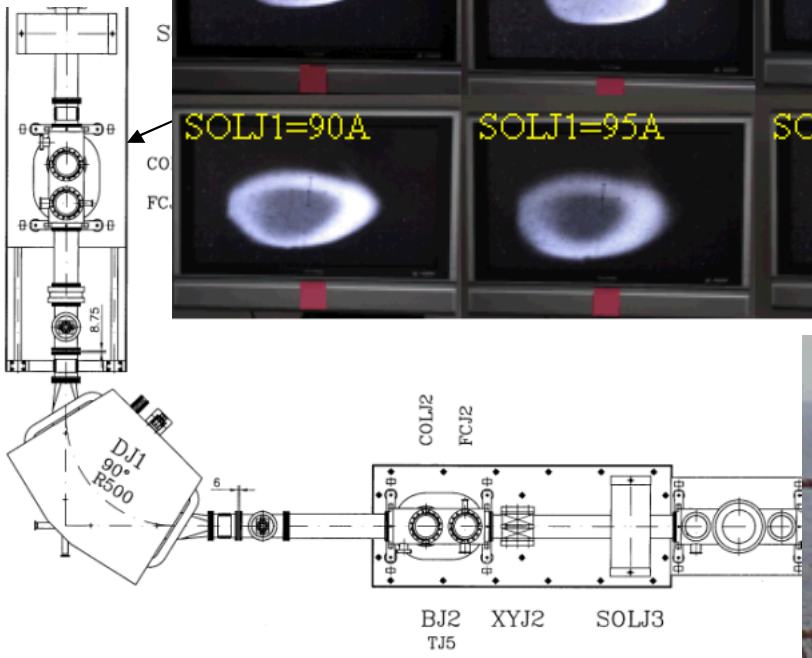


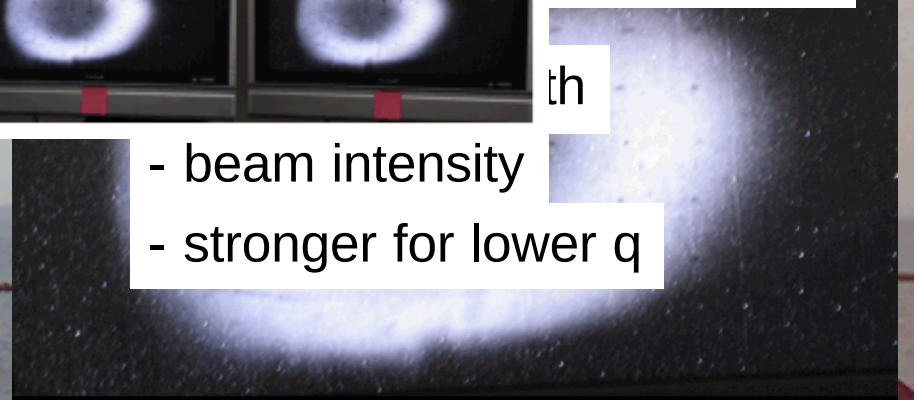
t FCJ2 about 110 uA
2 with these settings 33, 0 uA

ases with:

th

- beam intensity
- stronger for lower q





40 Ar 9+ / ACC 12,14 kV / max intensity at FCJ2 about 110 uA
SOLJ1 98 A / SOLJ2 0 A / This is the beam shape with maximum intensity

Conclusion so far: it seems to us that two reasons for the transmission behavior has been found!

1) Asymmetric beam

- wrong entrance/exit angle of dipole

2) Hollow beam

- space charge effect?
- hollow beam is formed in the ECRIS (proposed by P. Spädtke)?

In addition: Transport efficiency in the case of third harmonic acceleration is poor (50 % compared to 2nd harmonic)

How to improve the beam transmission?

1) Make the beam symmetric!

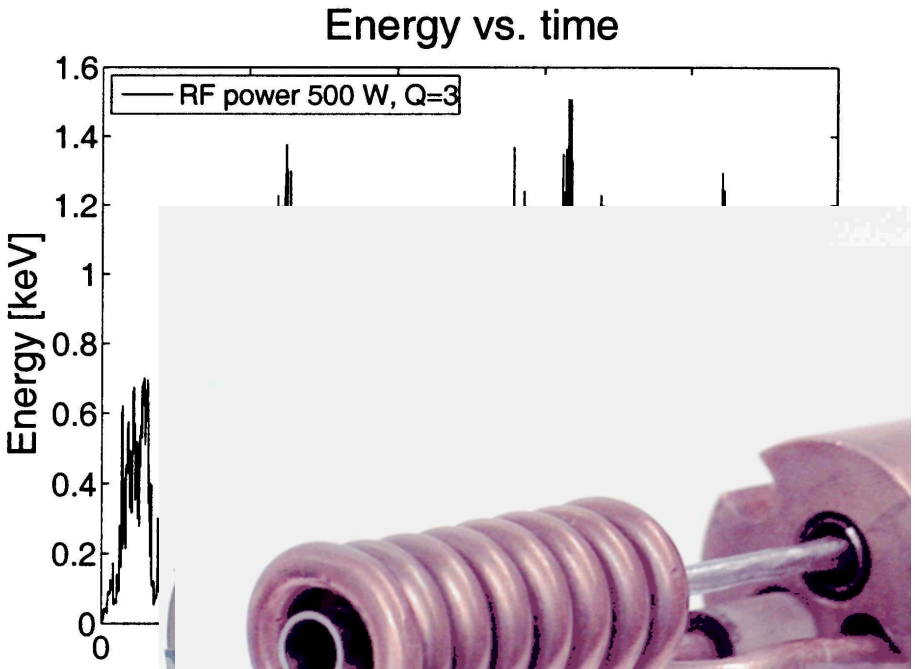
- new dipole with correct entrance/exit angle or
- add quadrupoles to correct the beam

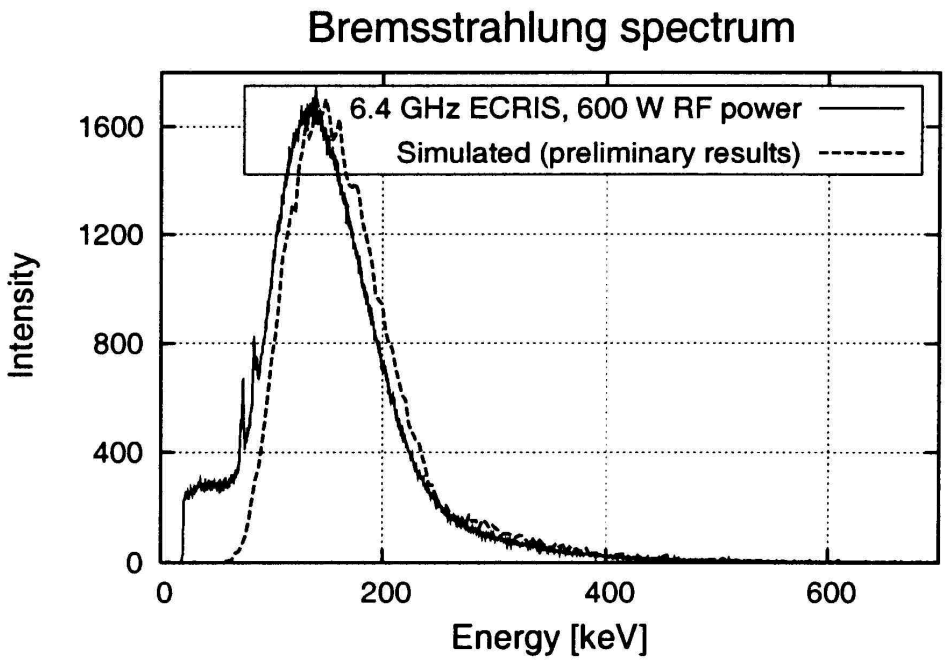
2) Make uniformly distributed beam

- understand how the hollow beam is formed?

3) Add beam viewers and beam profile instruments into the beam line

Next step: the beam formation in ECRIS extraction!!





take care of
nission!!

Development of metal ion beams

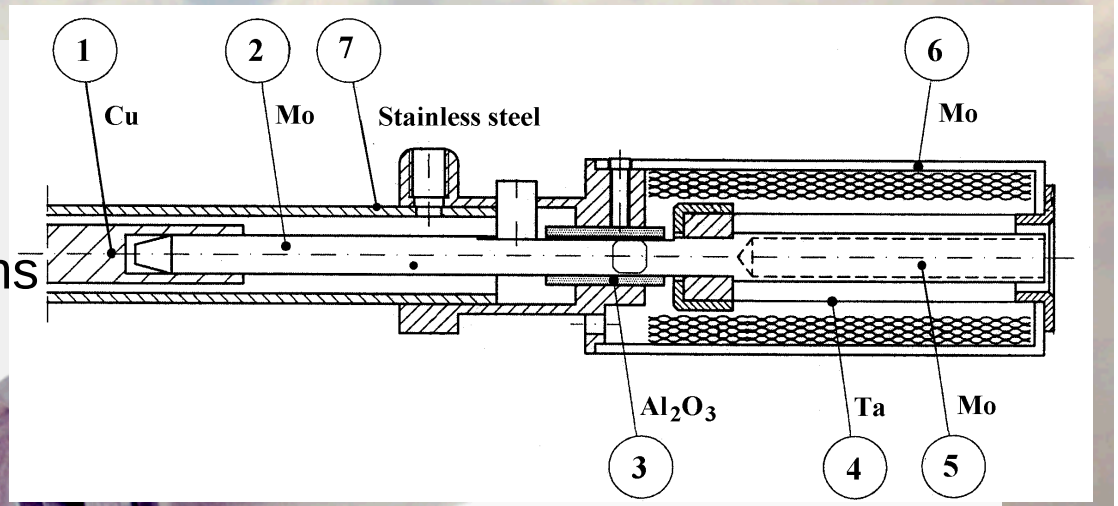
Several ion beams which require temperature above 1500•C have been asked! -> technique has to be improved

1. Resistively heated foil oven

- Above 2000•C

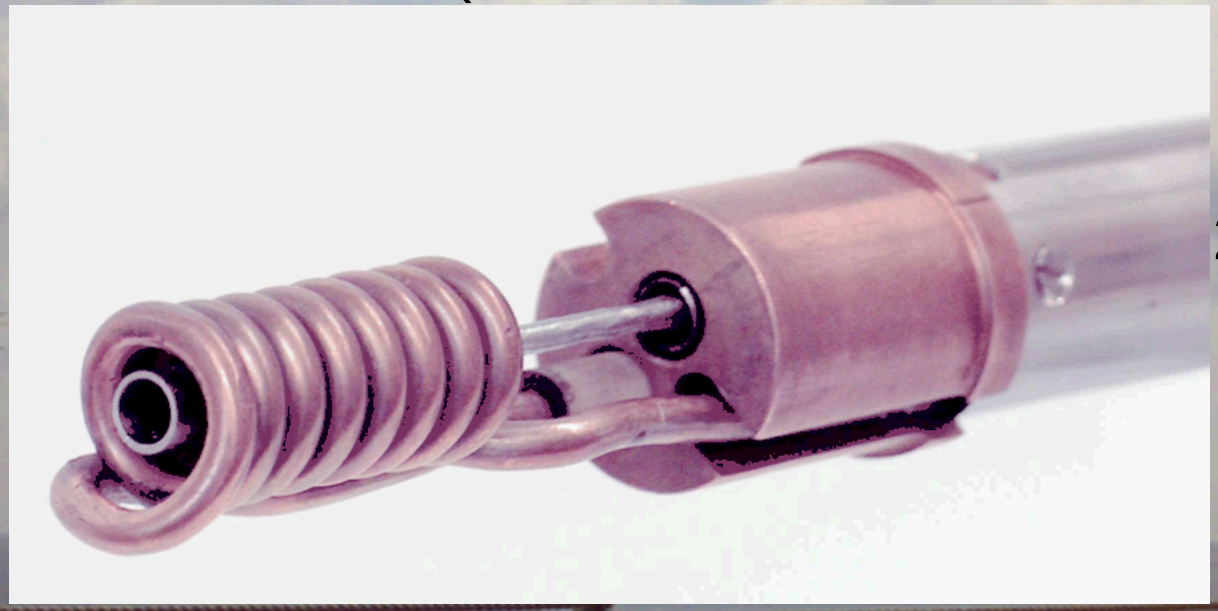
Reliability has to be improved:

-mechanical connections seem to be a problem -> temperature fluctuation from run to run)



Inductively heated oven

2000•C has been reached with the home made resonant circuit (P. Suominen and M. Savonen)



Life time and durability tests have been started

Very stable in the test bench (1820•C ± 2 for several days)