# X-ray laser spectroscopy of Li-like heavy ions in the reinjection channel


B. Zielbauer[1,2,3], T. Kühl[2,3], D. Ursescu[2], V. Bagnoud[2], D. Javorkova[2], O. Rosmej[2], D. Zimmer[2], K. Cassou[4], S. Kazamias[4], A. Klisnick[4], D. Ros[4], K. Janulewicz[1], P. Nickles[1], J. Dunn[5], P. Neumayer[5], G. Pert[6], and the PHELIX team[2]

[1]Max Born Institute Berlin

[2]GSI Darmstadt

[3]University of Mainz

[4]Université Paris Sud / LIXAM

[5]Lawrence Livermore National Laboratory

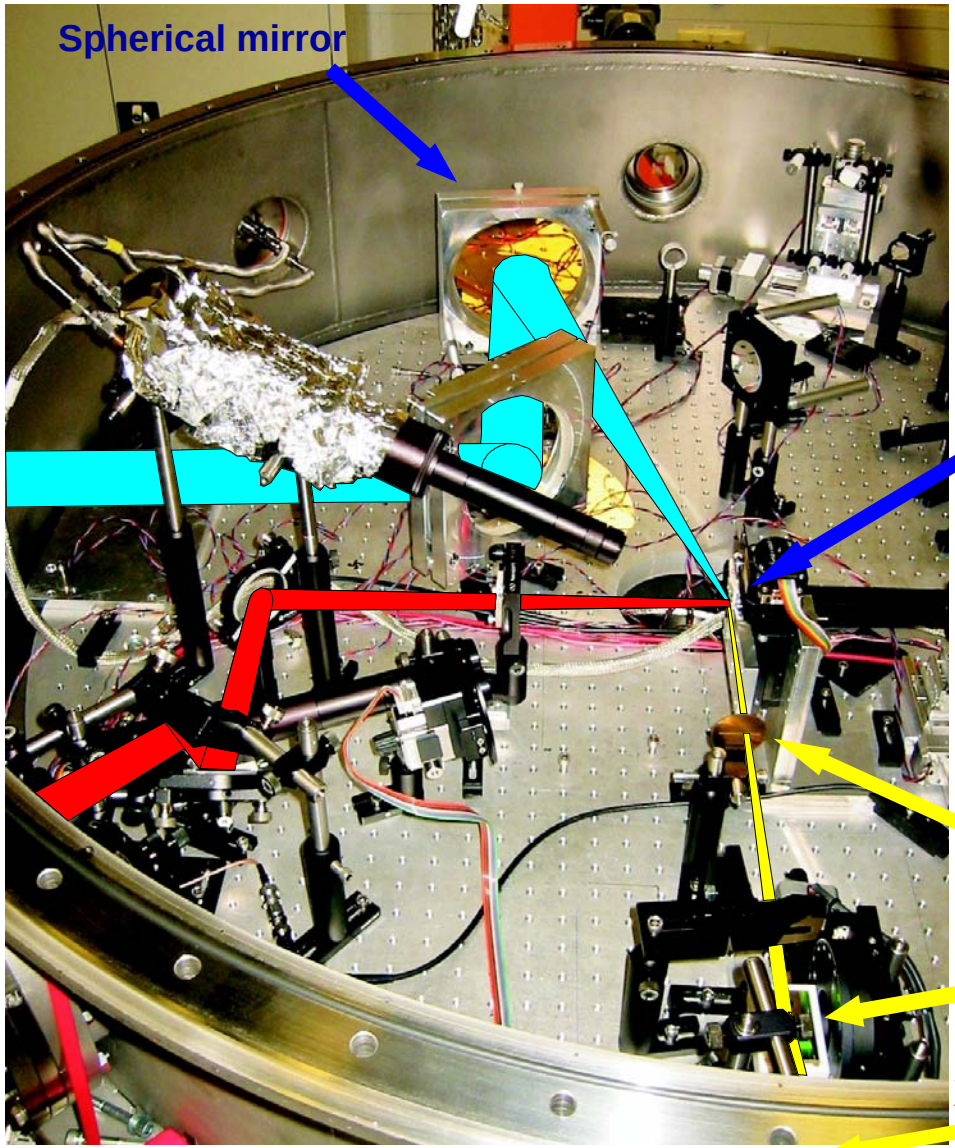
[6]Yorck University

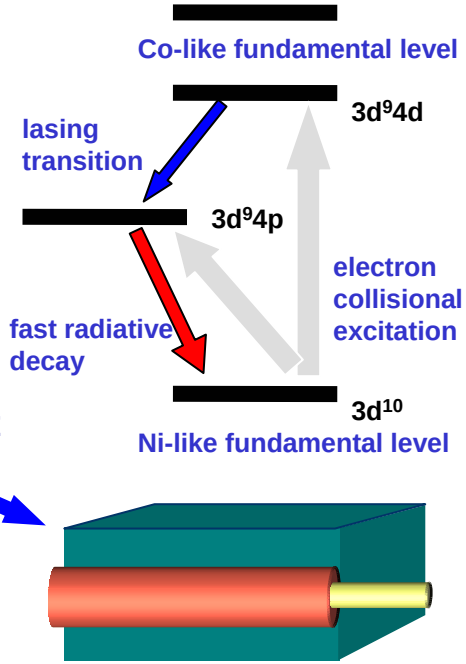
# Outline of the talk:

- Brief introduction on Ni-like x-ray laser scheme
- Motivation for XRL work at GSI
- Overview of the spectroscopy setup
- XRL performance

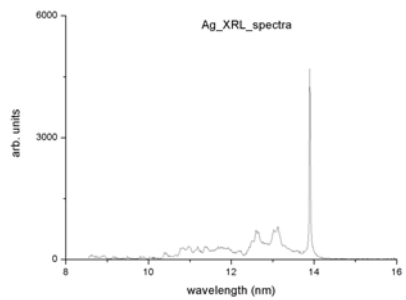
# Experimental setup

## Pump Laser: PHELIX Preamplifier (10 TW Nd:glass)

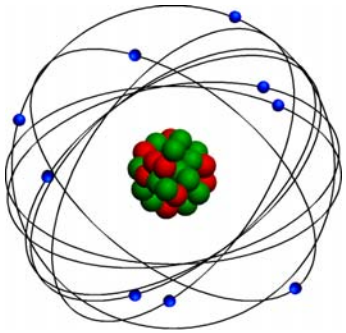


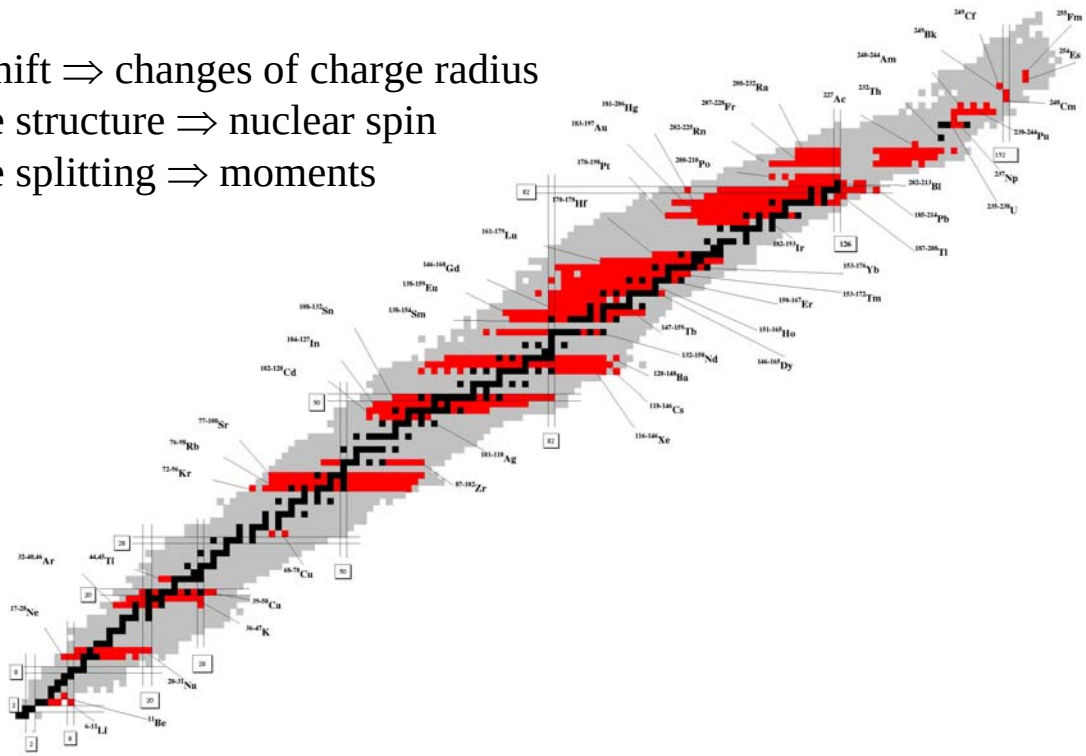


# Laser spectroscopy to measure nuclear properties



isotope shift ⇒ changes of charge radius
hyperfine structure ⇒ nuclear spin
hyperfine splitting ⇒ moments

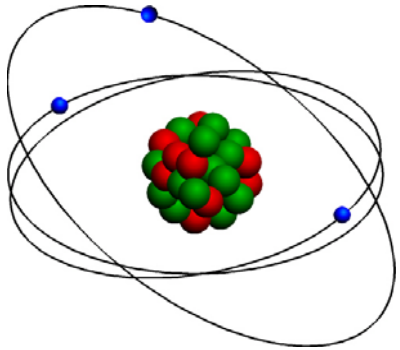


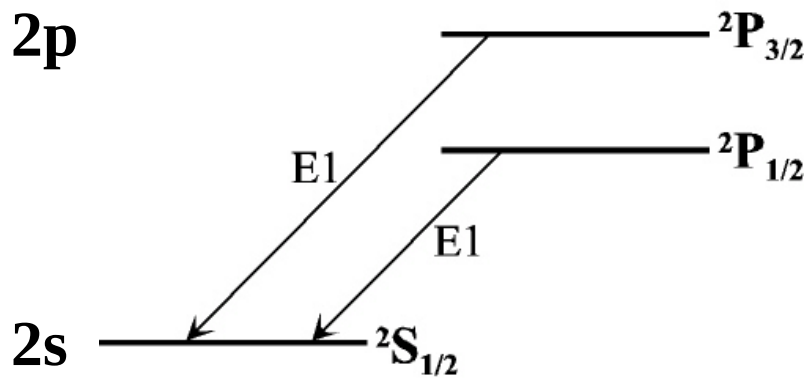
Problem: too many electrons

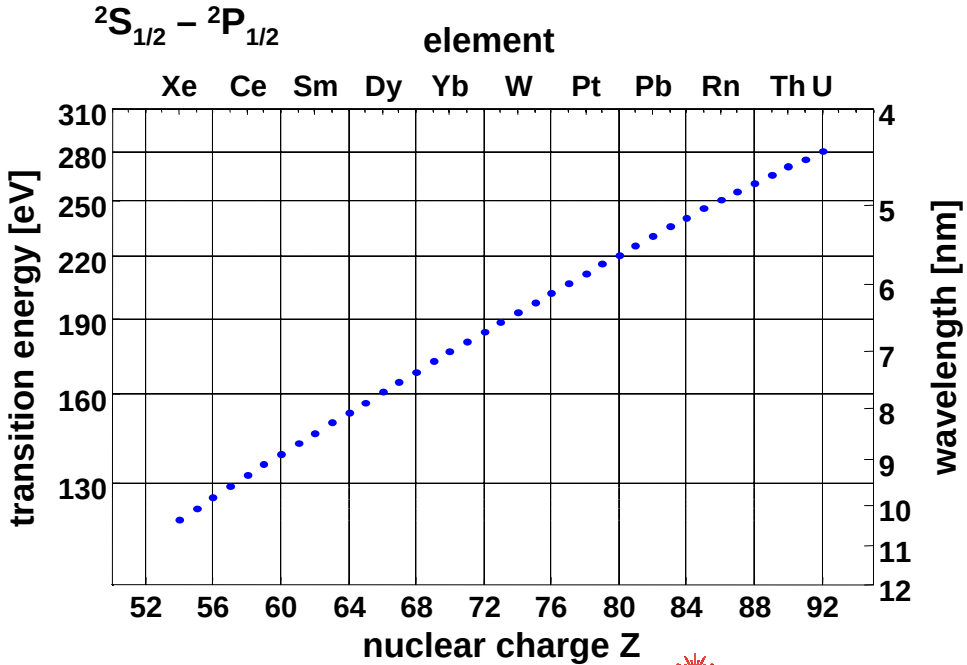
go to few-electron systems:
• H-like: very simple, but excitation energies too high, nuclear size effect small
• He-like: same

⇒ how about **Li-like** ??

# Lithium-like ions: very precise calculations

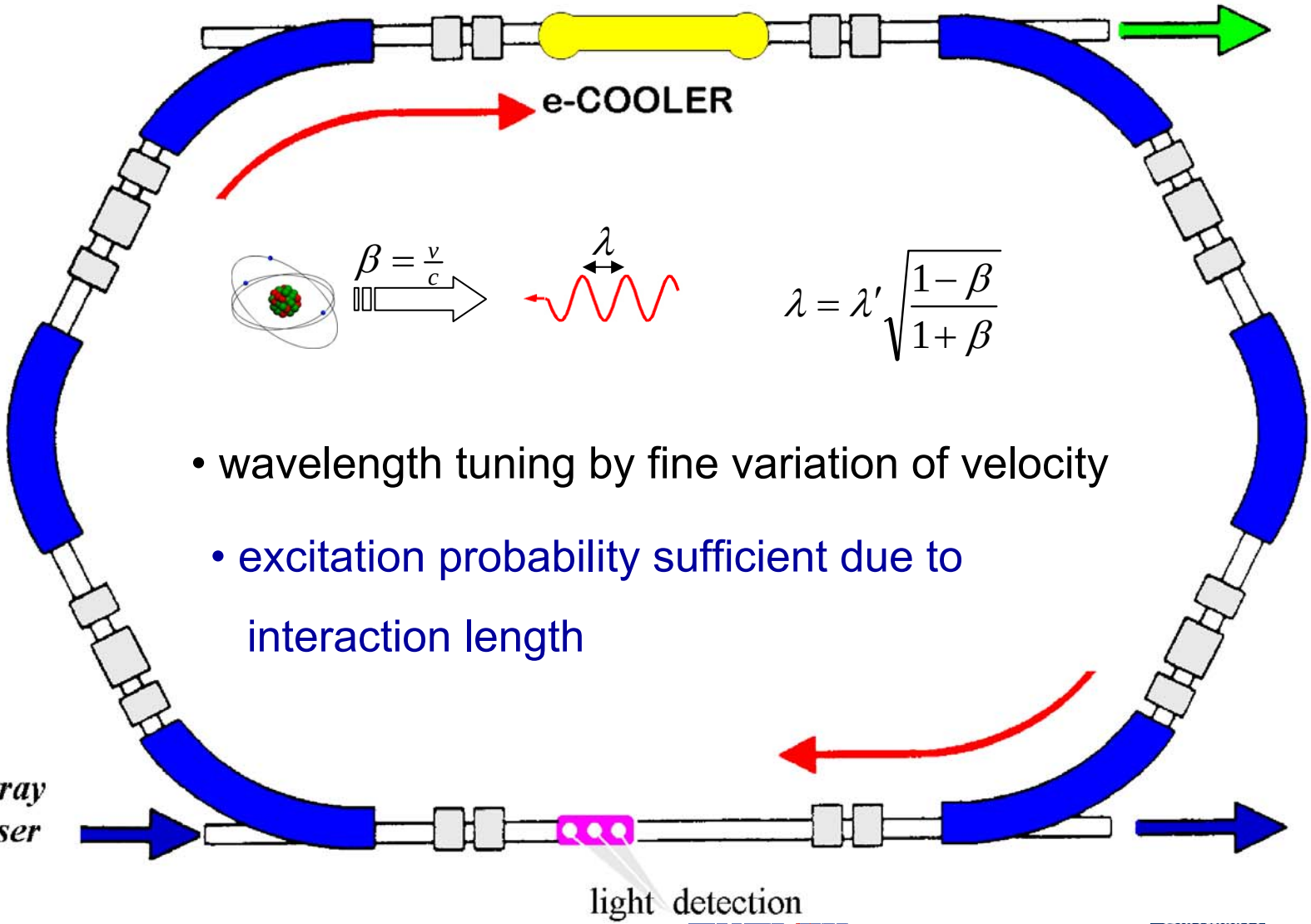




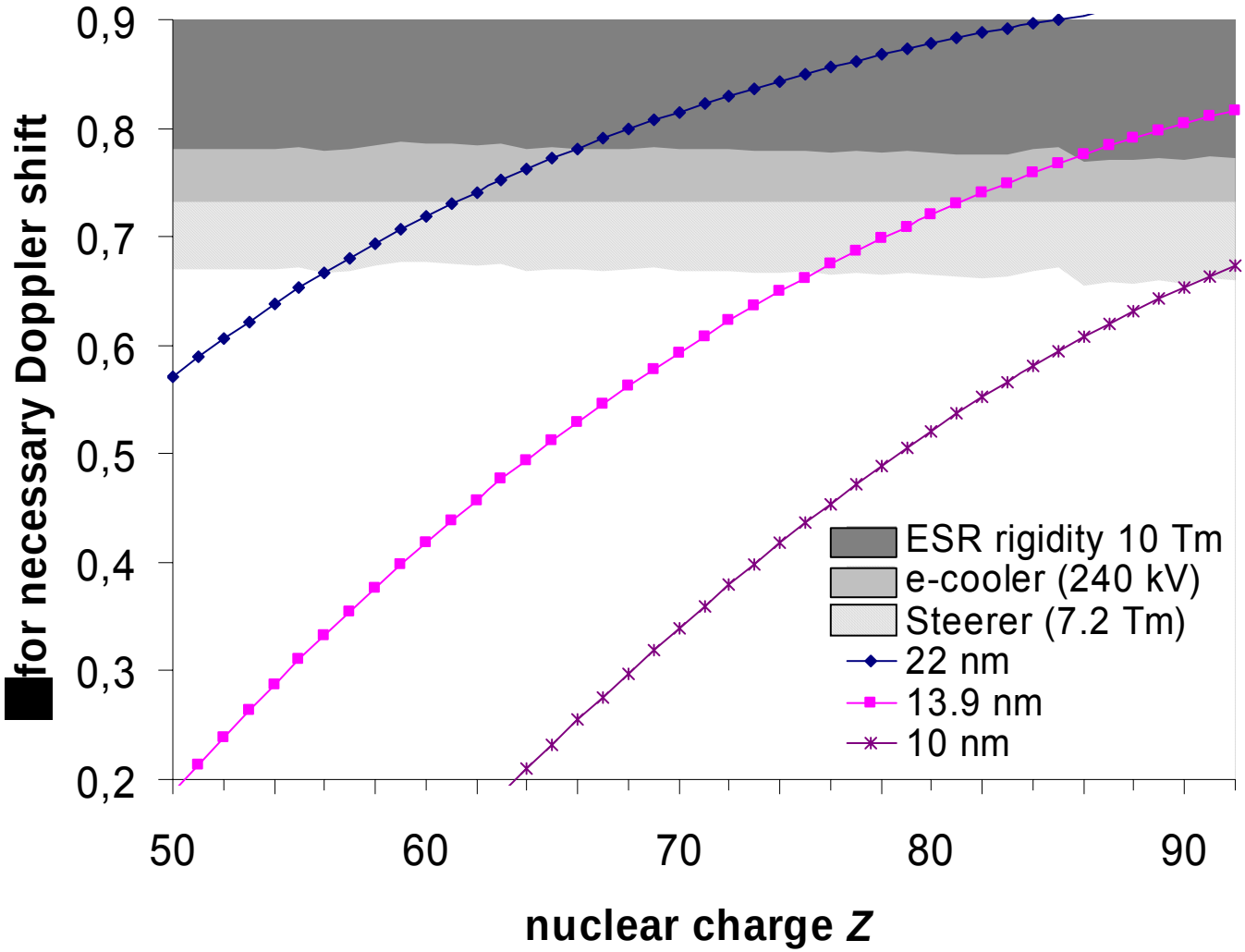

Kim et. al., PRA 44, 1, (1991), 148-166

# Tuning via Doppler-shift

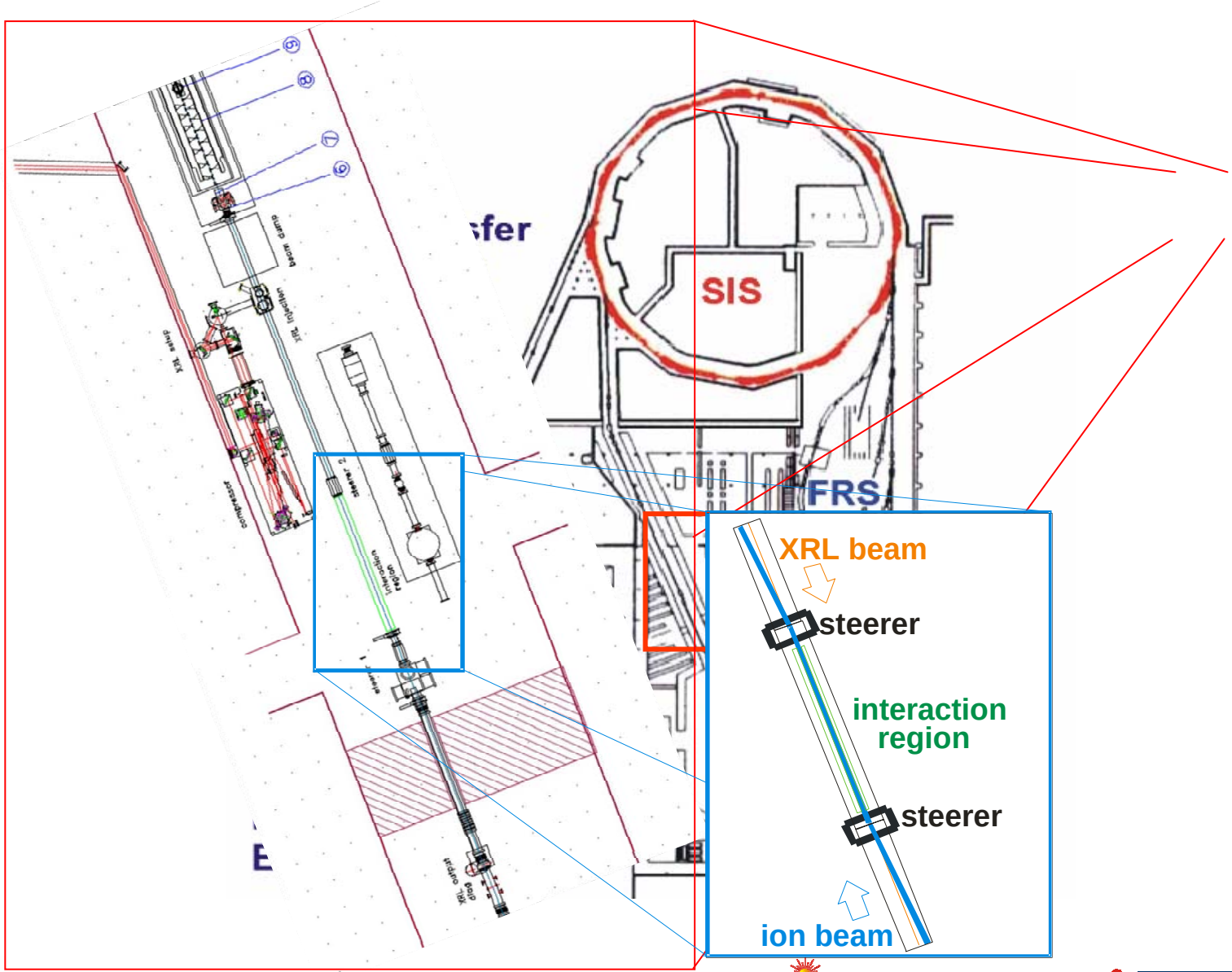



- wavelength tuning by fine variation of velocity
- excitation probability sufficient due to interaction length

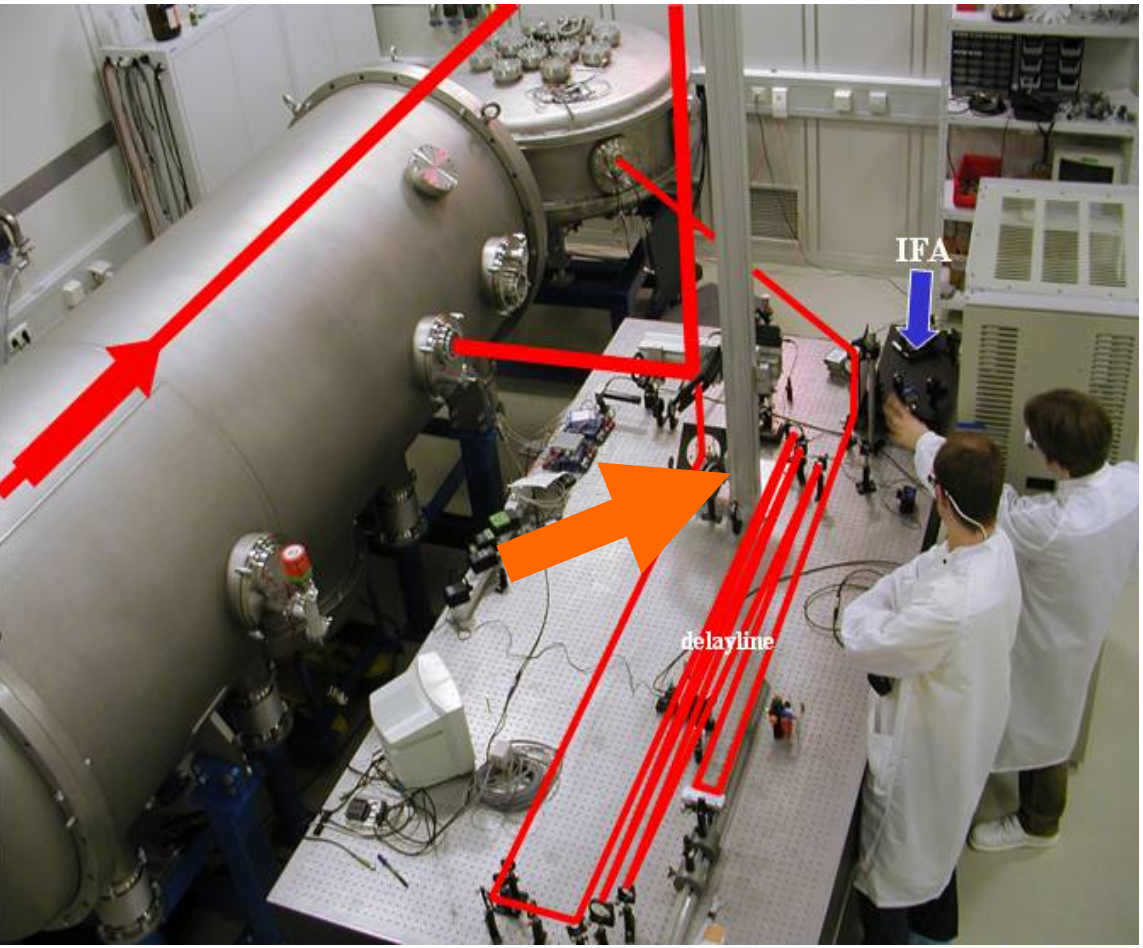
# Nearly all elements in reach of x-ray laser !



# Setup overview



# Compact Compressor Setup

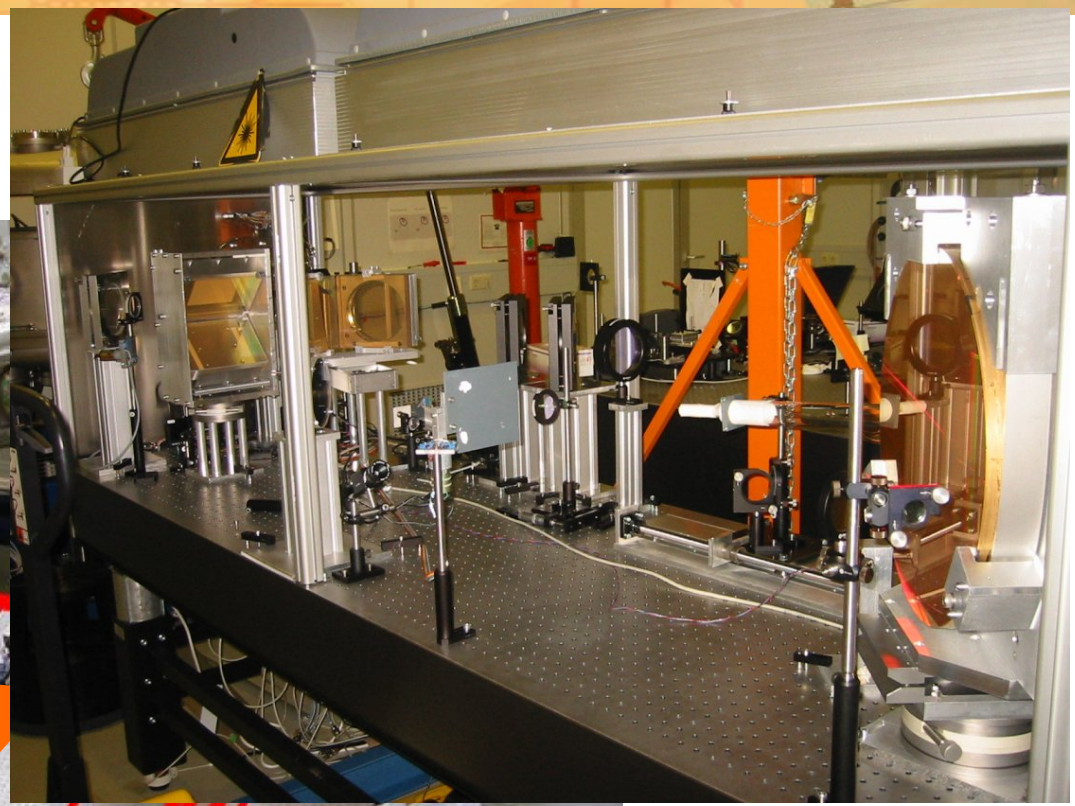


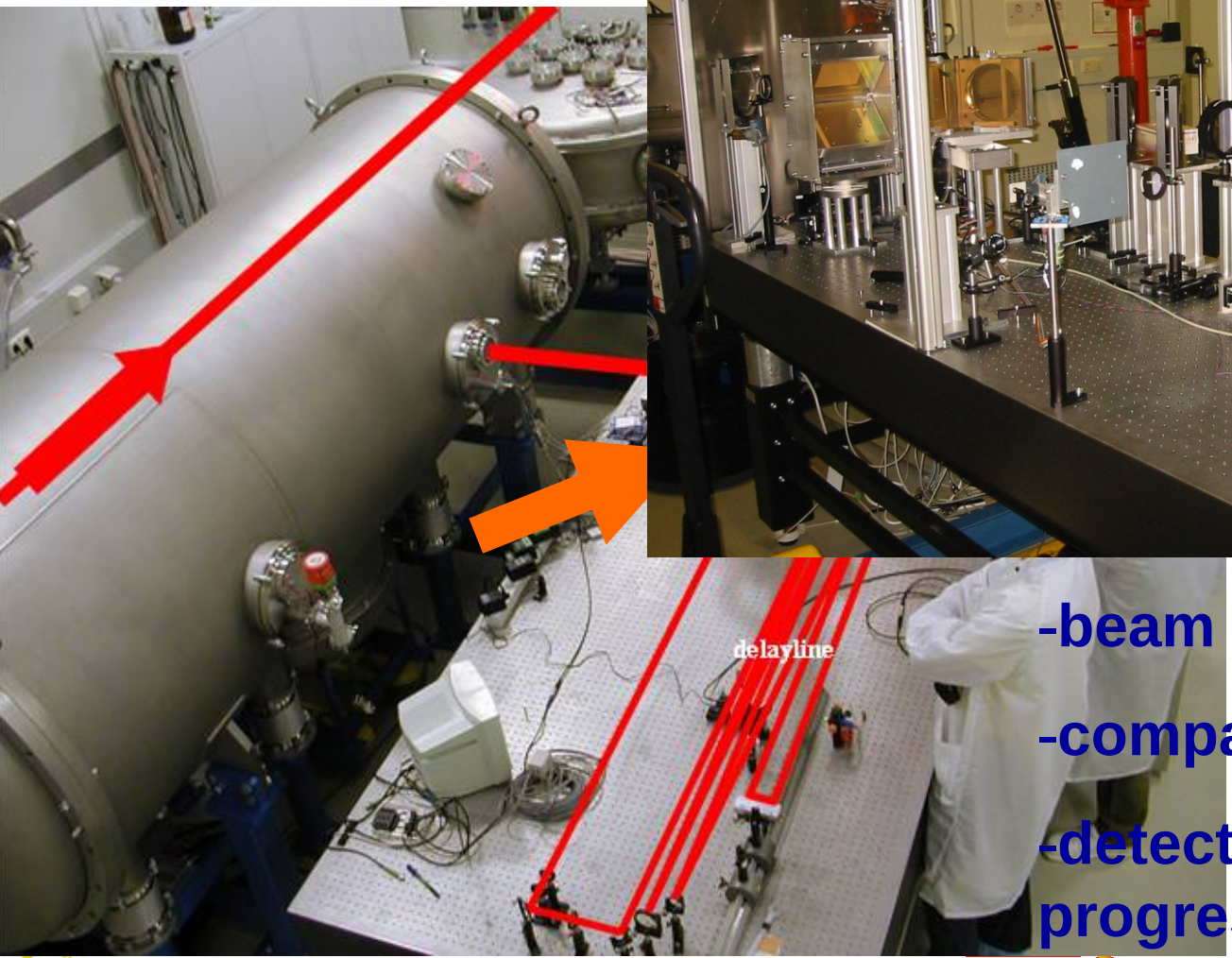

-beam transport

-compact XRL setup

-detector development progressing

# Compact Compressor Setup





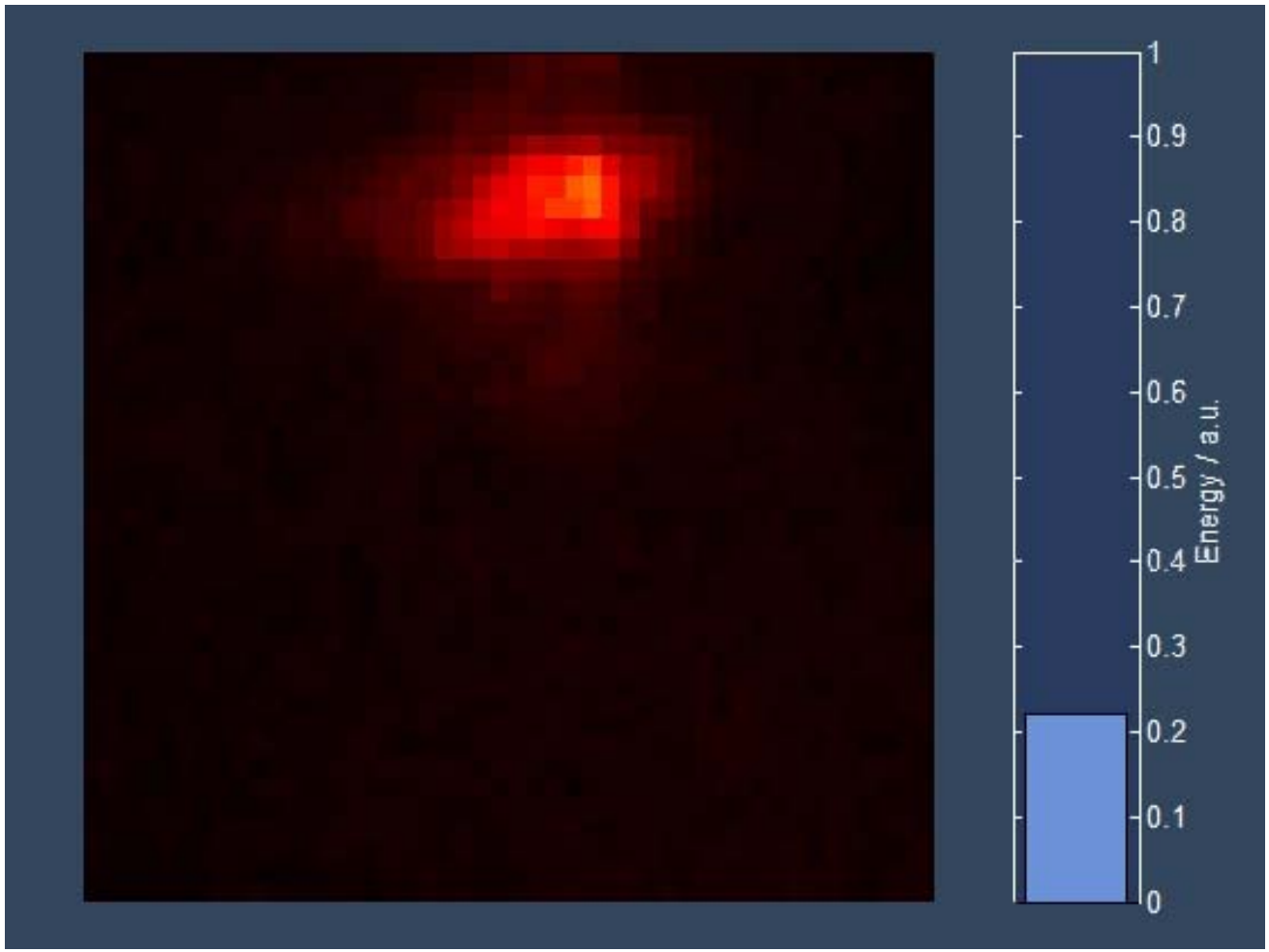

-beam transport

-compact XRL setup

-detector development progressing

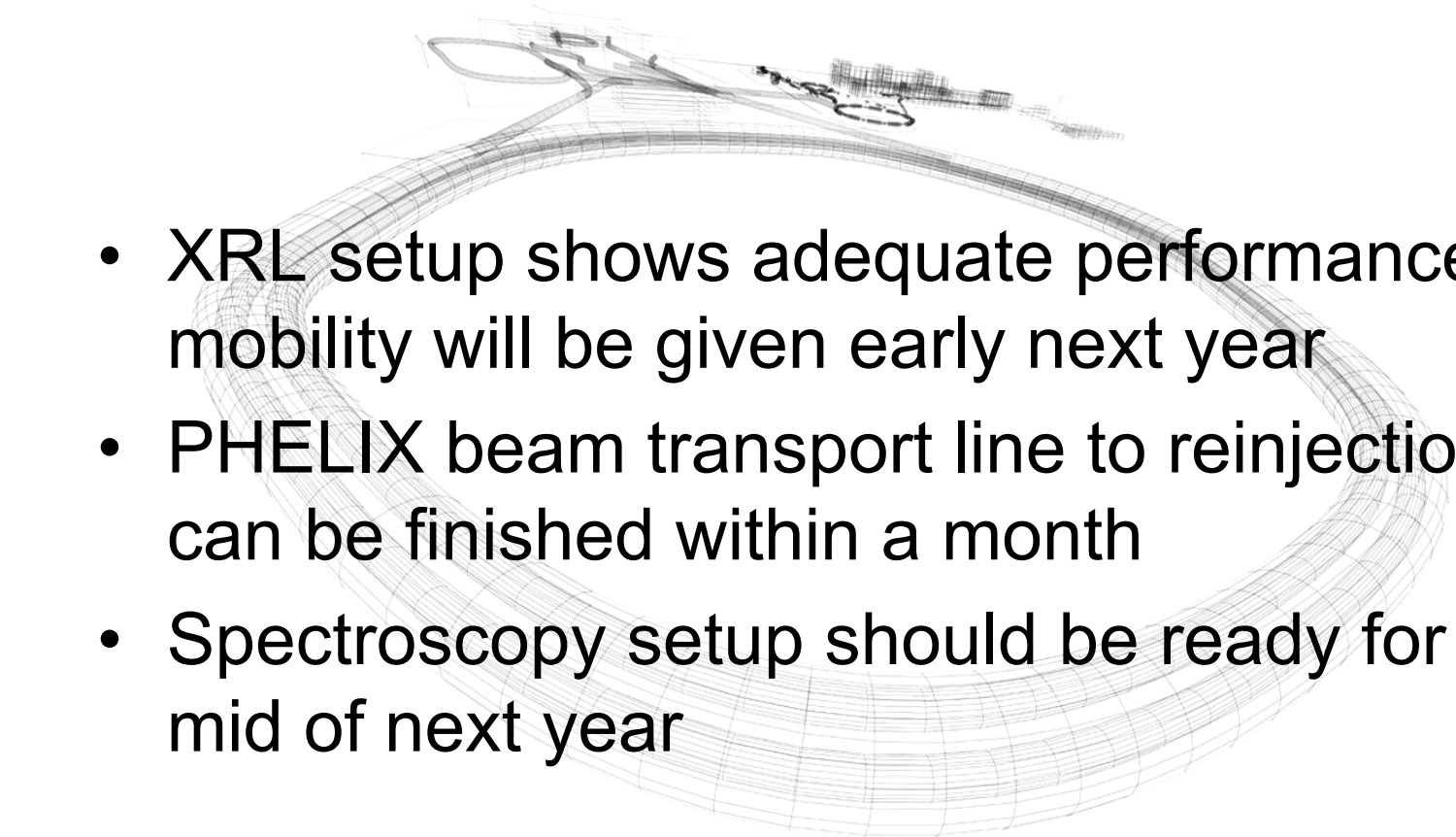
# 10 Hz XRL operation and beam stability

## (XRL campaign at Lund Laser Center, Sweden)




C. Cassou et al., Optics Letters, in print

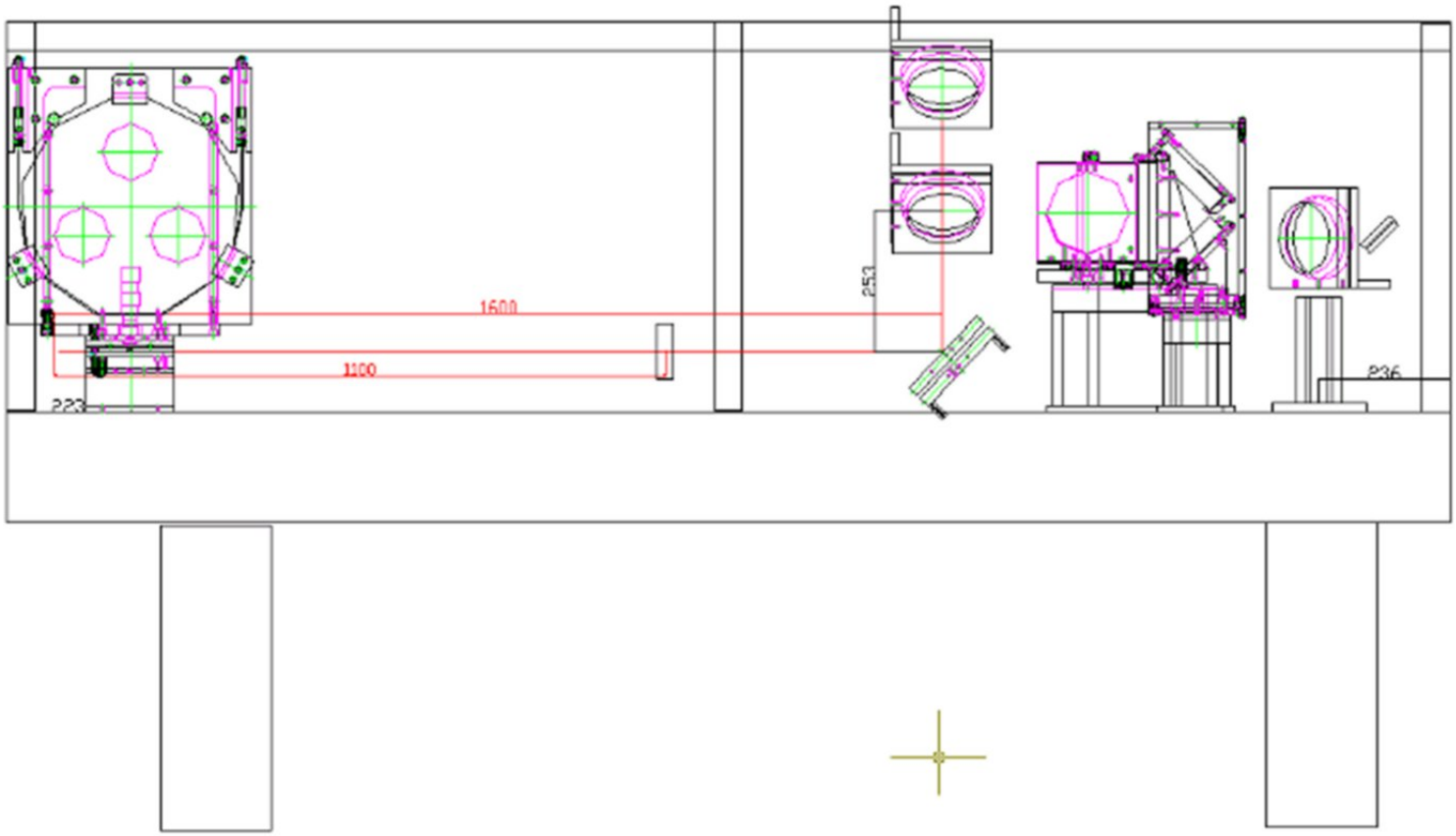
# Outlook / Conclusion



- XRL setup shows adequate performance, full mobility will be given early next year
- PHELIX beam transport line to reinjection channel can be finished within a month
- Spectroscopy setup should be ready for testing mid of next year

# XRL plasma snapshot

# Schematic View



# Non-normal line focusing using a single spherical mirror

Neumayer, P.; Seelig, W.; Cassou, K.; Klisnick, A.; Ros, D.; Ursescu, D.; Kuehl, T.; Borneis, S.; Gaul, E.; Geithner, W.; Haefner, C. & Wiewior, P.
Transient collisionally excited X-ray laser in nickel-like zirconium pumped with the PHELIX laser facility
*Applied Physics B,* **2004**, *78*, 957-959