

Status of collinear resonance ionization developments:
Ion optics and beam transport simulations for the CRIS
beam line at ISOLDE

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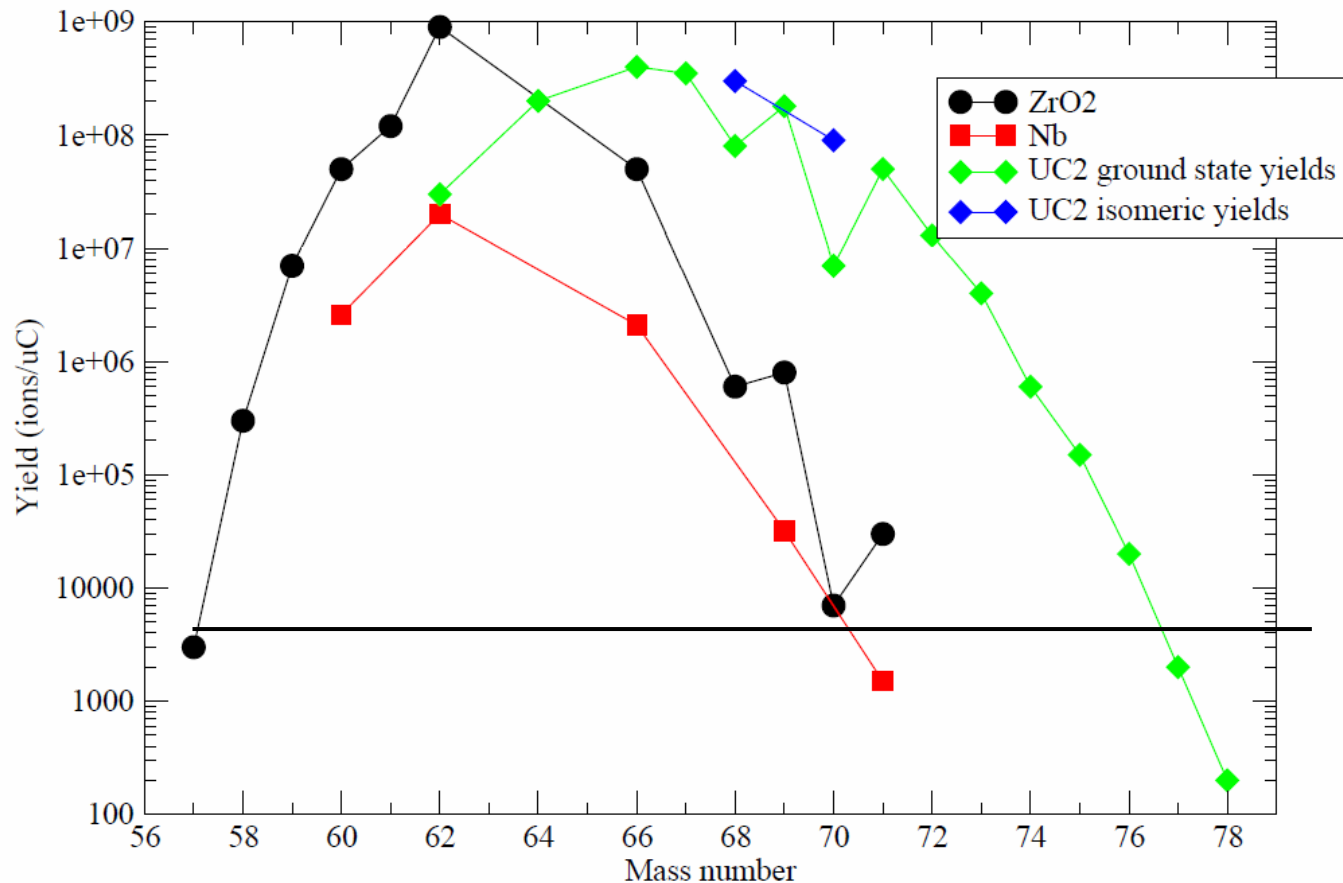
Motivation

32		58Ge	59Ge	60Ge	61Ge	62Ge	63Ge	64Ge	65Ge	66Ge	67Ge	68Ge	69Ge	70Ge	71Ge	72Ge	73Ge	74Ge	75Ge	76Ge	77Ge	78Ge	79Ge	80Ge	81Ge	82Ge	83Ge	84Ge	
		56Ga	57Ga	58Ga	59Ga	60Ga	61Ga	62Ga	63Ga	64Ga	65Ga	66Ga	67Ga	68Ga	69Ga	70Ga	71Ga	72Ga	73Ga	74Ga	75Ga	76Ga	77Ga	78Ga	79Ga	80Ga	81Ga	82Ga	83Ga
30	54Zn	55Zn	56Zn	57Zn	58Zn	59Zn	60Zn	61Zn	62Zn	63Zn	64Zn	65Zn	66Zn	67Zn	68Zn	69Zn	70Zn	71Zn	72Zn	73Zn	74Zn	75Zn	76Zn	77Zn	78Zn	79Zn	80Zn	81Zn	82Zn
	53Cu	54Cu	55Cu	56Cu	57Cu	58Cu	59Cu	60Cu	61Cu	62Cu	63Cu	64Cu	65Cu	66Cu	67Cu	68Cu	69Cu	70Cu	71Cu	72Cu	73Cu	74Cu	75Cu	76Cu	77Cu	78Cu	79Cu	80Cu	
28	52Ni	53Ni	54Ni	55Ni	56Ni	57Ni	58Ni	59Ni	60Ni	61Ni	62Ni	63Ni	64Ni	65Ni	66Ni	67Ni	68Ni	69Ni	70Ni	71Ni	72Ni	73Ni	74Ni	75Ni	76Ni	77Ni	78Ni		
	51Co	52Co	53Co	54Co	55Co	56Co	57Co	58Co	59Co	60Co	61Co	62Co	63Co	64Co	65Co	66Co	67Co	68Co	69Co	70Co	71Co	72Co	73Co	74Co	75Co				
26	50Fe	51Fe	52Fe	53Fe	54Fe	55Fe	56Fe	57Fe	58Fe	59Fe	60Fe	61Fe	62Fe	63Fe	64Fe	65Fe	66Fe	67Fe	68Fe	69Fe	70Fe	71Fe	72Fe						
	24	26	28	30	32	34	36	38	40	42	44	46	48	50	N														

- Research nuclear properties far from valley of stability
- Measure dipole and quadrupole moments of exotic nuclei by using hyperfine interactions
- Production yields drop orders of magnitude

Motivation

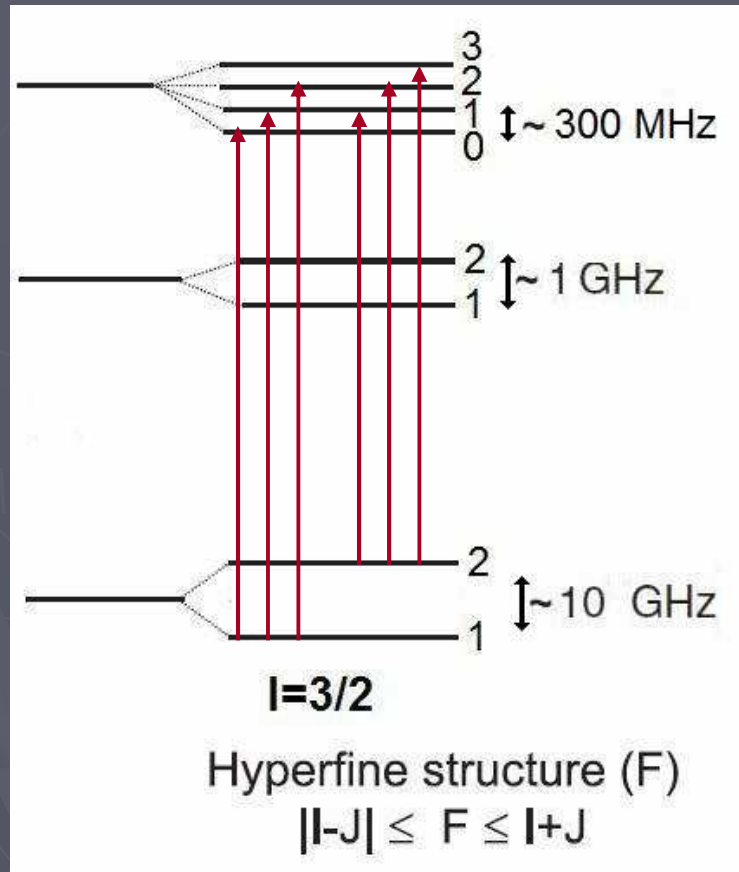
Copper isotopes yields at ISOLDE for different targets



→ Current limit with bunched-beam collinear spectroscopy

→ Need a more sensitive collinear laser method to study the most exotic cases (< 58Cu, > 75Cu) with high resolution

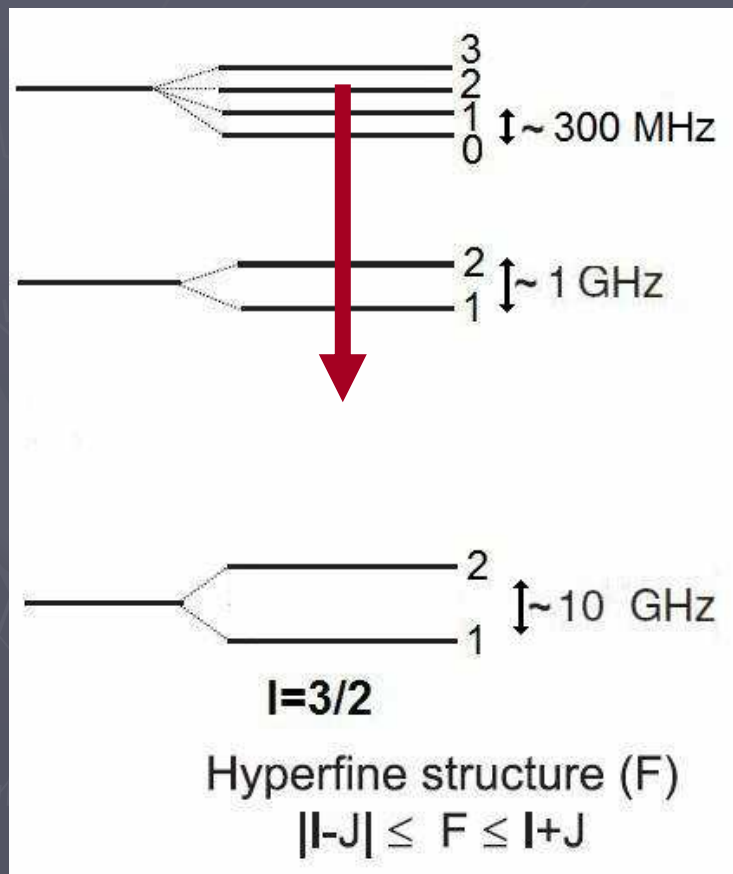
Collinear Laser Spectroscopy



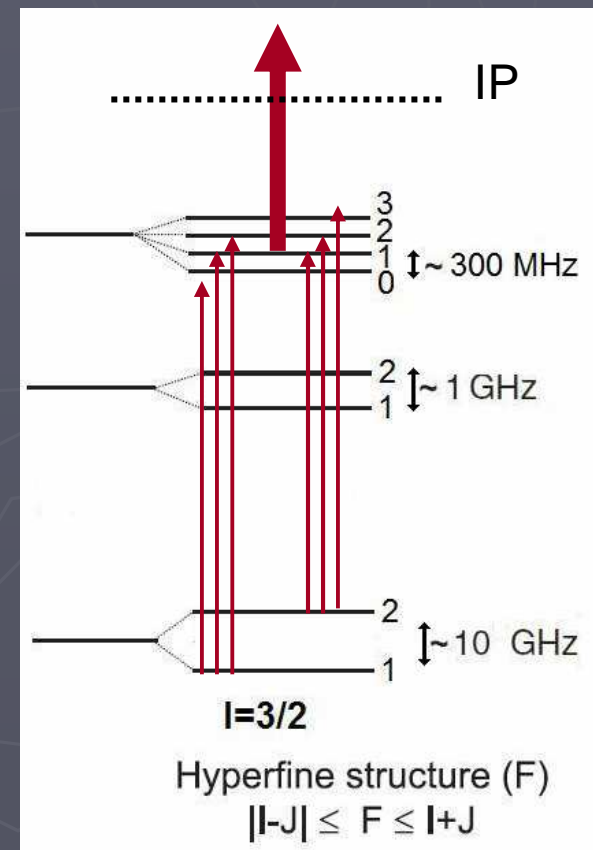
- Overlap the atom beam with a laser beam
- Scan the laser frequency
- Resonantly excite hyperfine levels

Detection of HFS signal

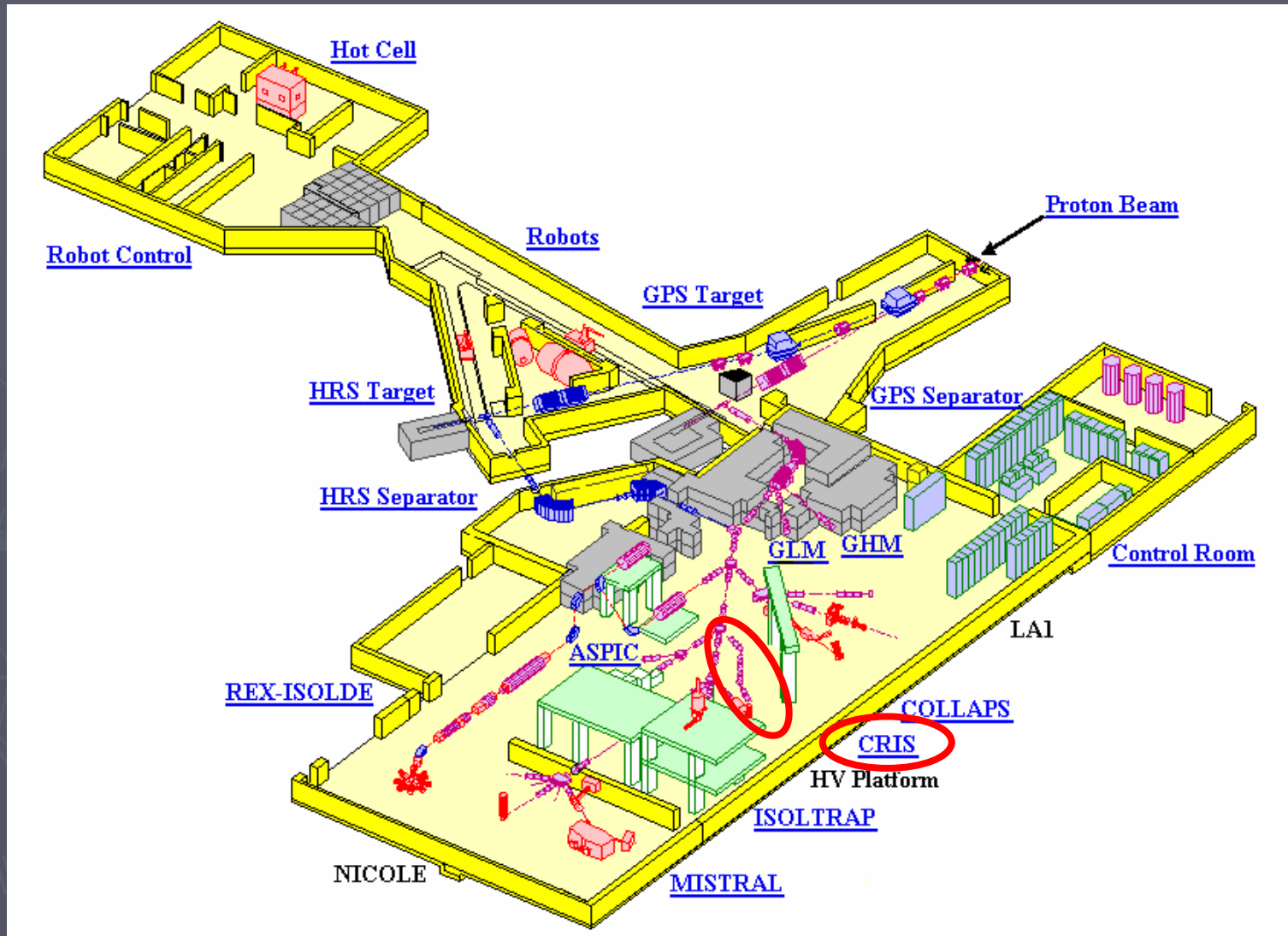
Fluorescent decay



Resonant re-ionisation and ion detection

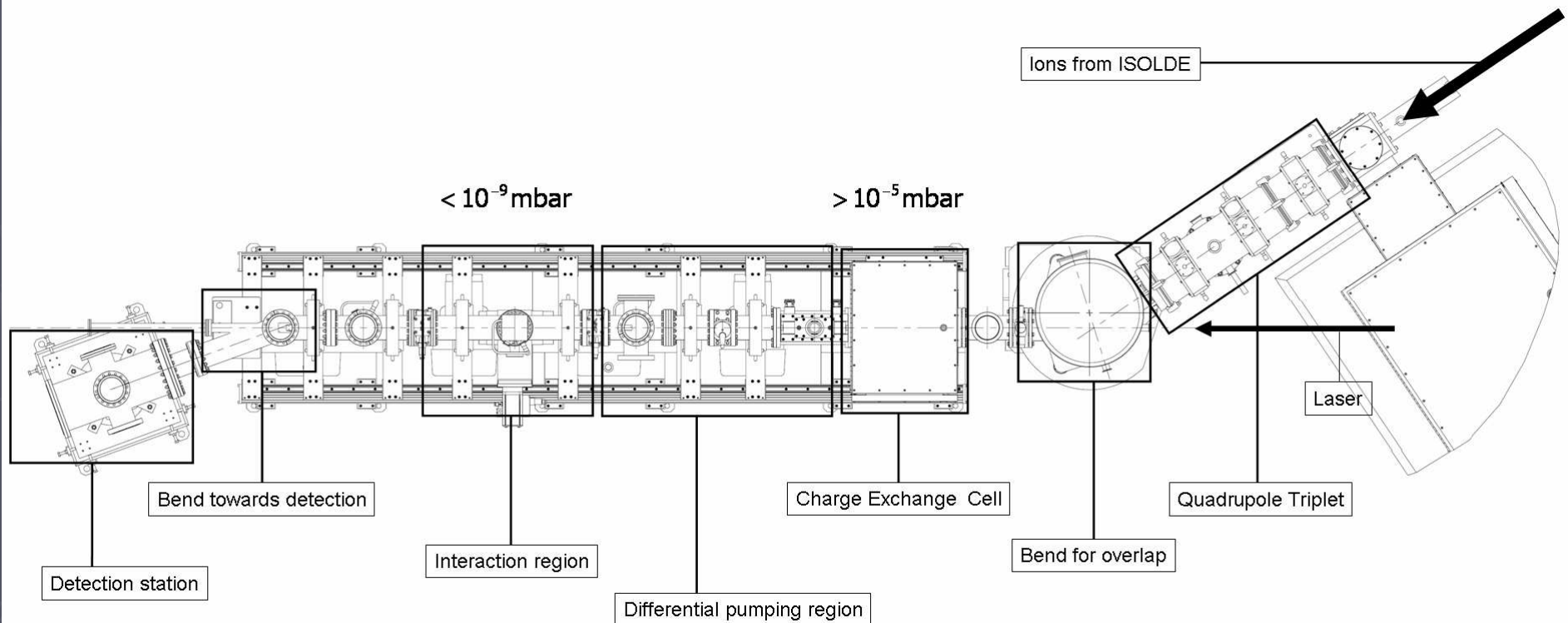


ISOLDE



Collinear Resonant Ionisation laser Spectroscopy

- Neutralize pulsed ion beam in charge exchange cell
- resonantly excite and re-ionize with overlapping pulse-amplified CW laser beam (laser pulses synchronized to ion pulses → high efficiency)
- deflect the ions towards a detection station → background free signal detection !

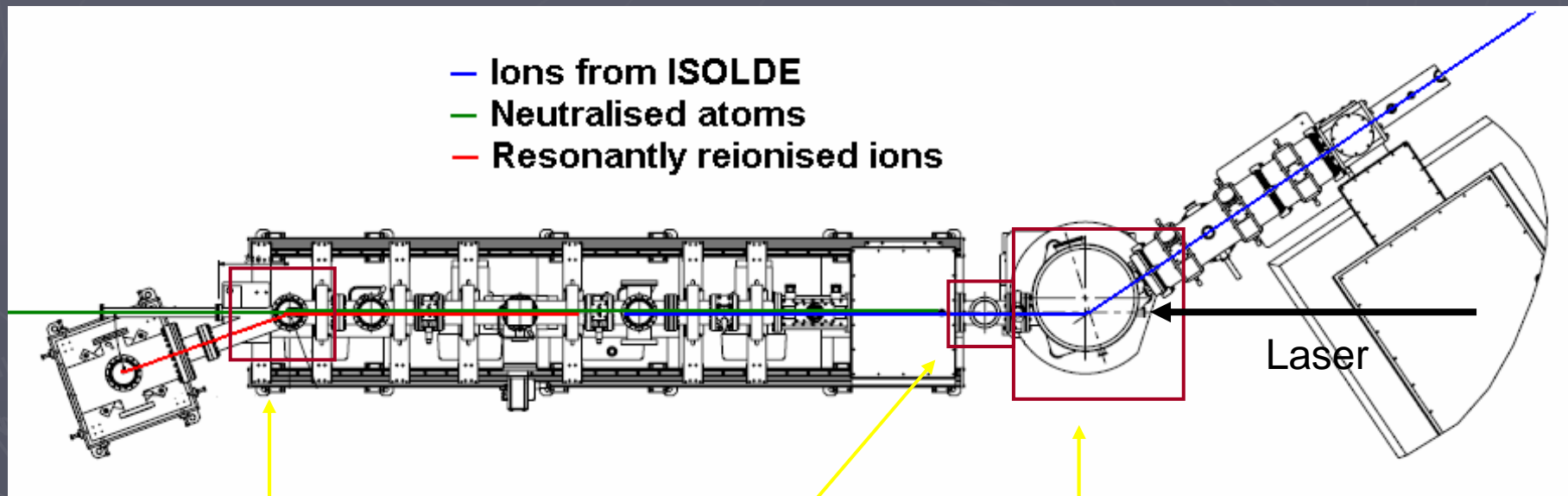


Simulations for ion optics and beam transport

- Start from the original design
- Minimize the loss of ions
- Pumping apertures are bottlenecks
- Keep the ion beam small and aligned

CRIS @ ISOLDE

Top view of the beamline

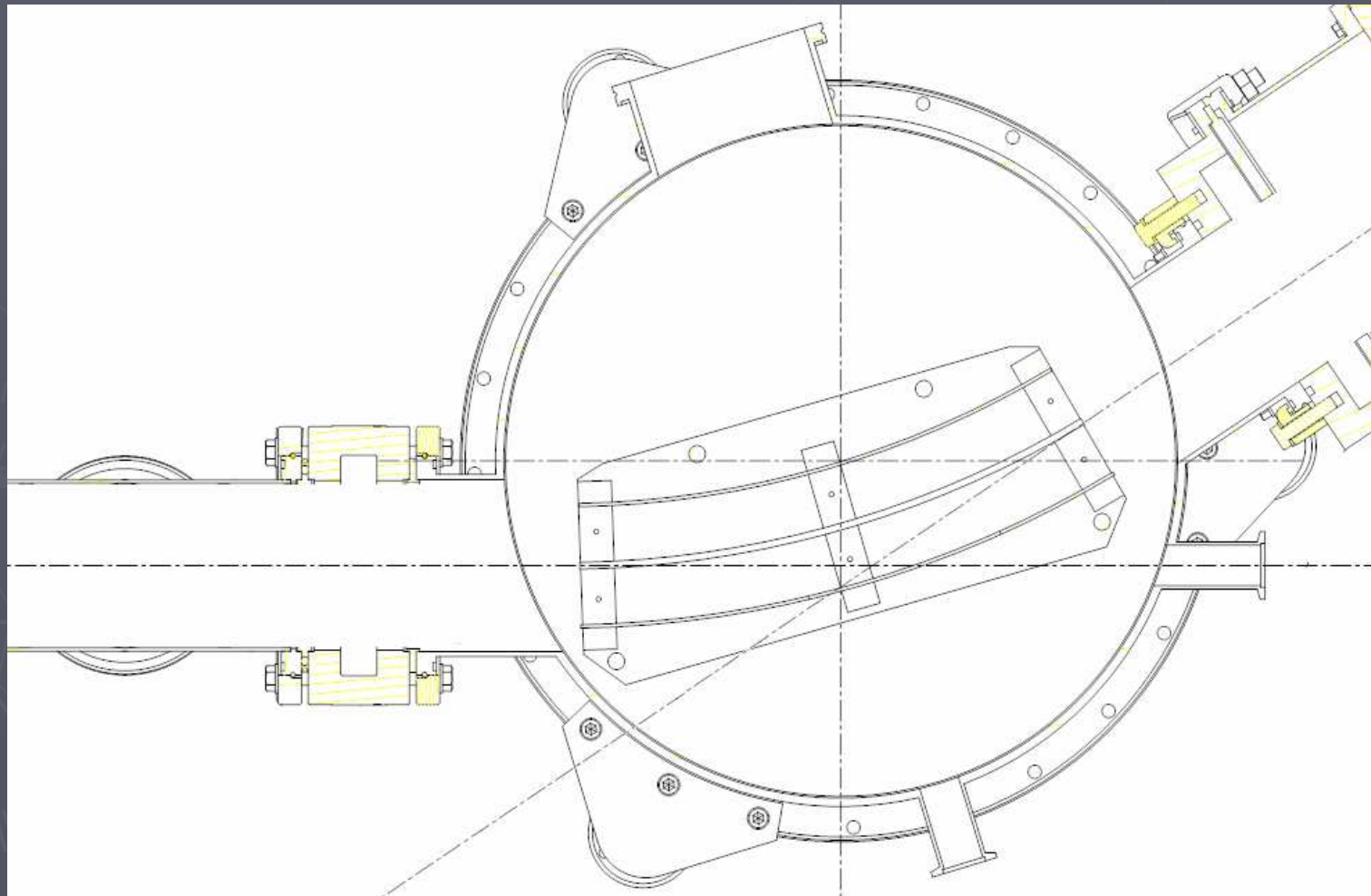


Bend towards detection

Additional focussing

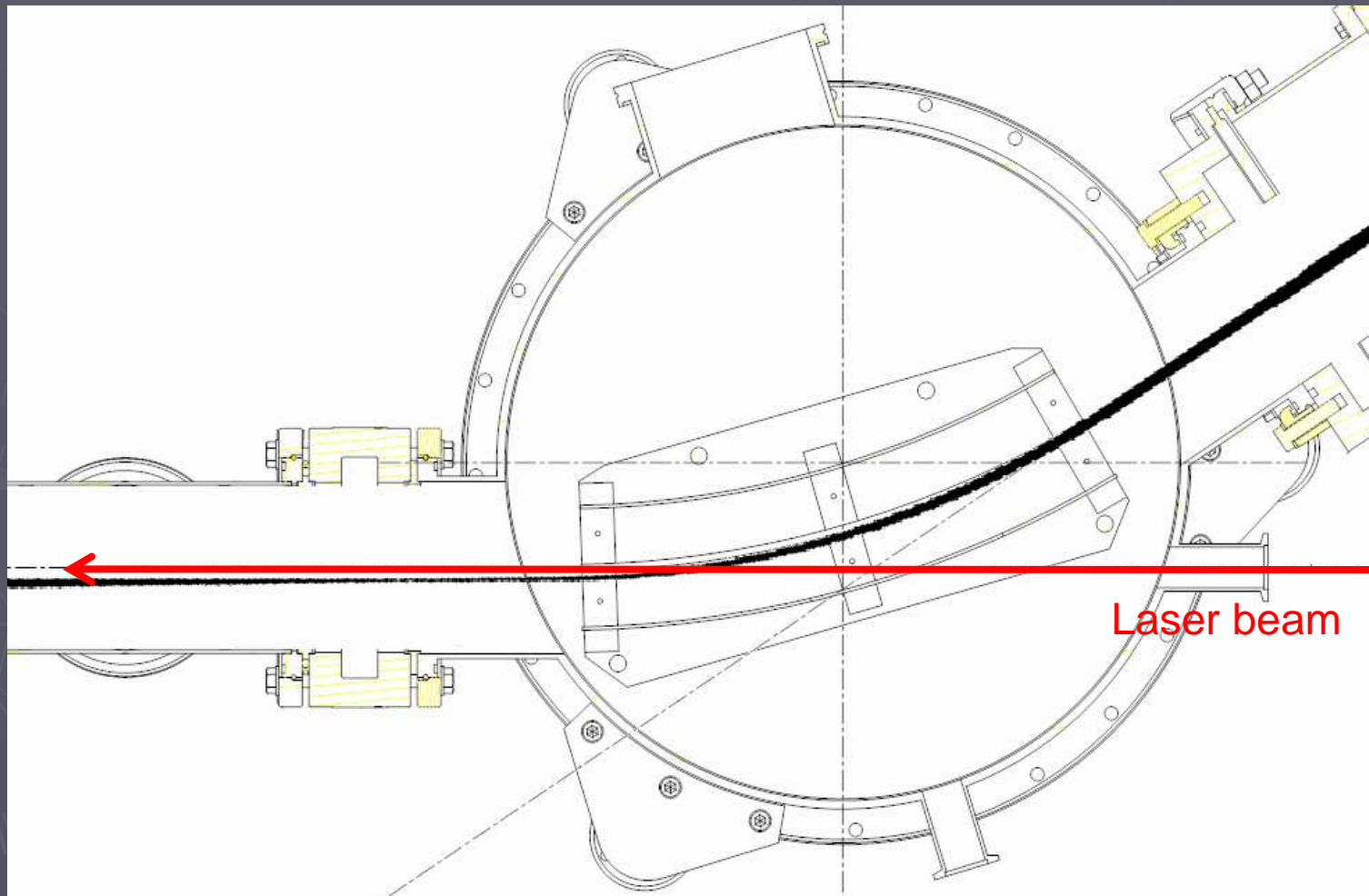
Bend for overlap
with the laser

Ion-bend for overlap with laser



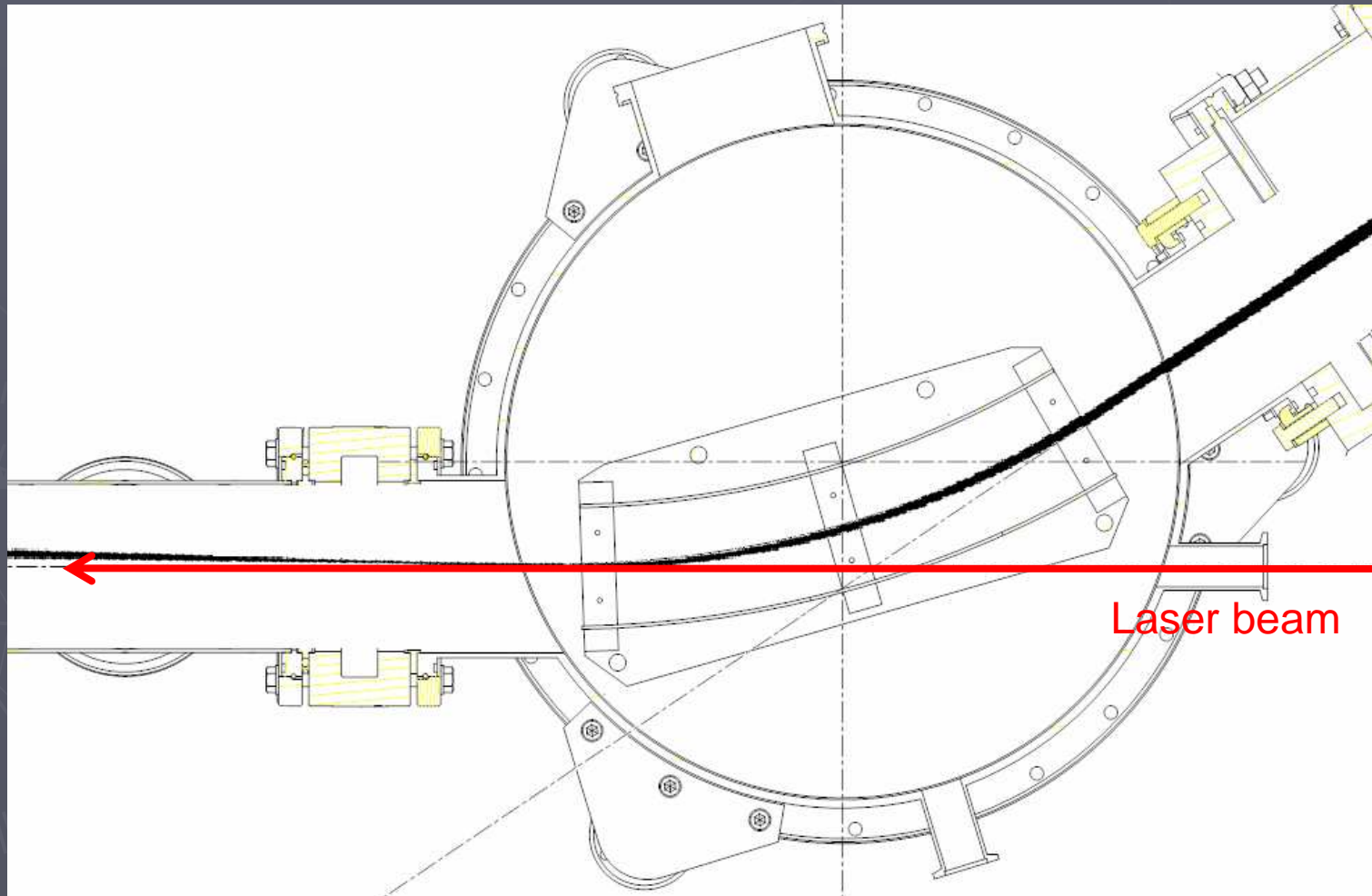
Bend for overlap with laser

Deflection over de bend angle of 34° → beam not aligned with laser beam



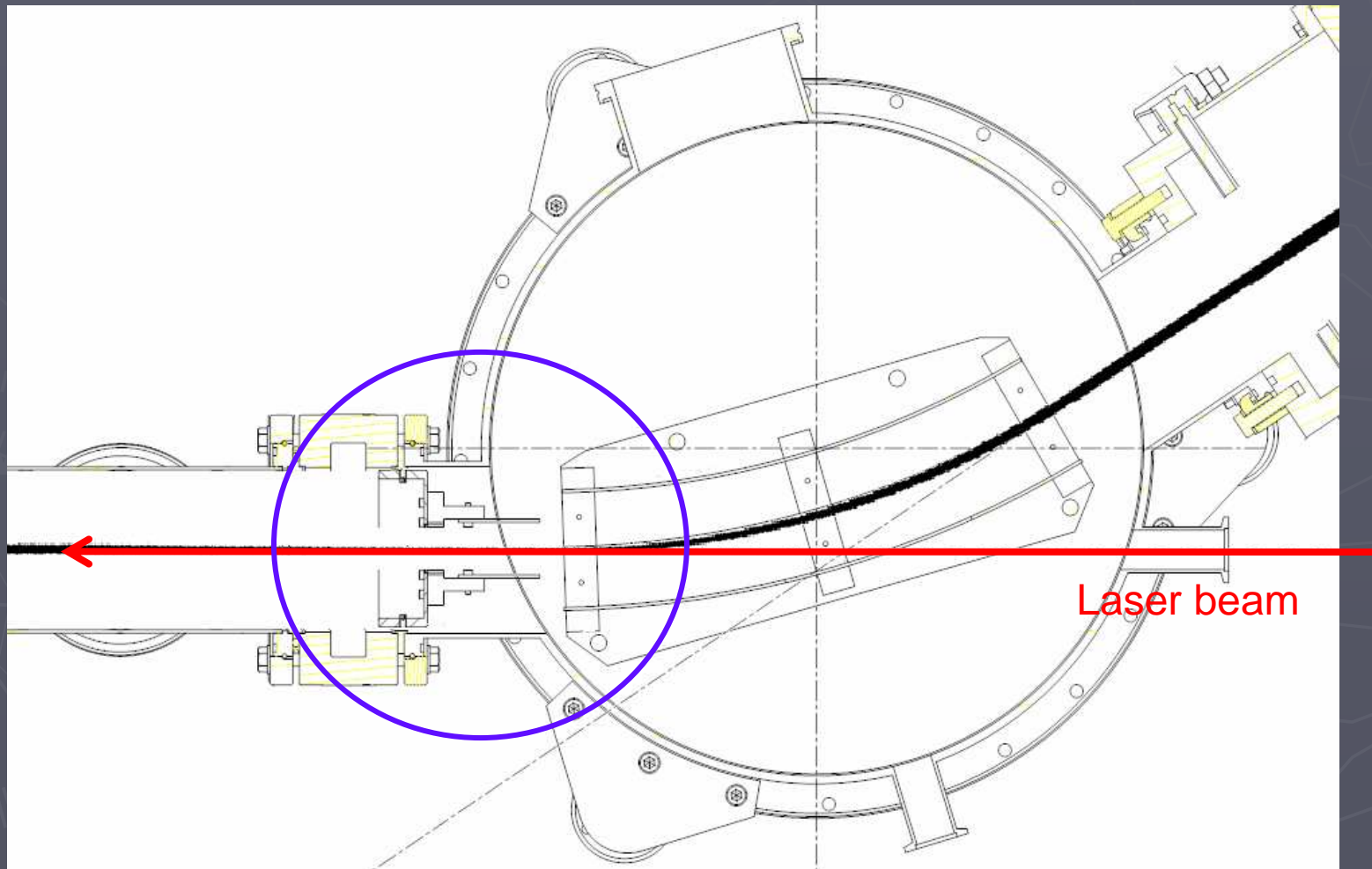
Bend for overlap with laser

Deflection to arrive at beam center \rightarrow beam deflected too much, no overlap

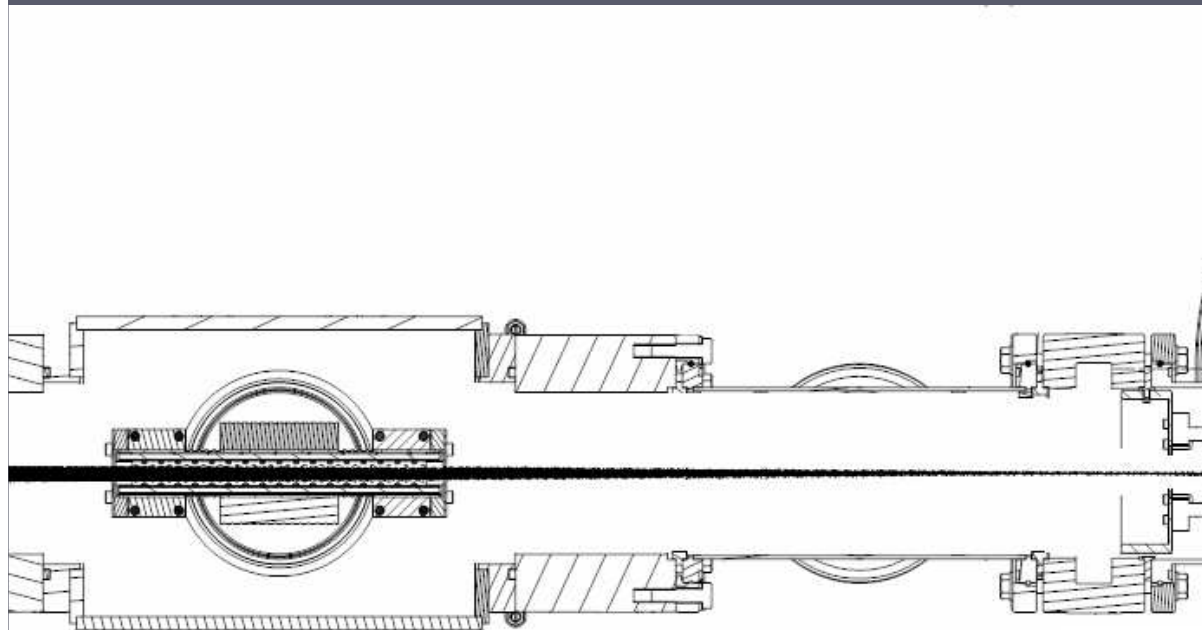


Bend for overlap with laser

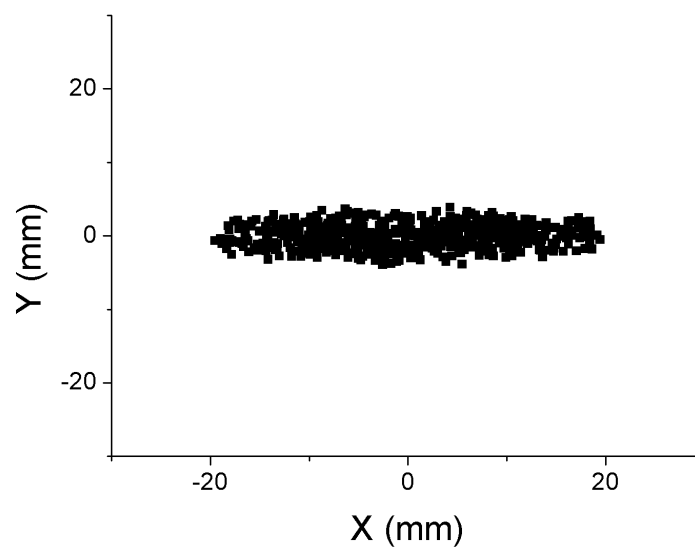
ADD additional deflection plates → beam aligned with laser beam



Beam divergence after deflection



Size of the beam spot after charge exchange cell

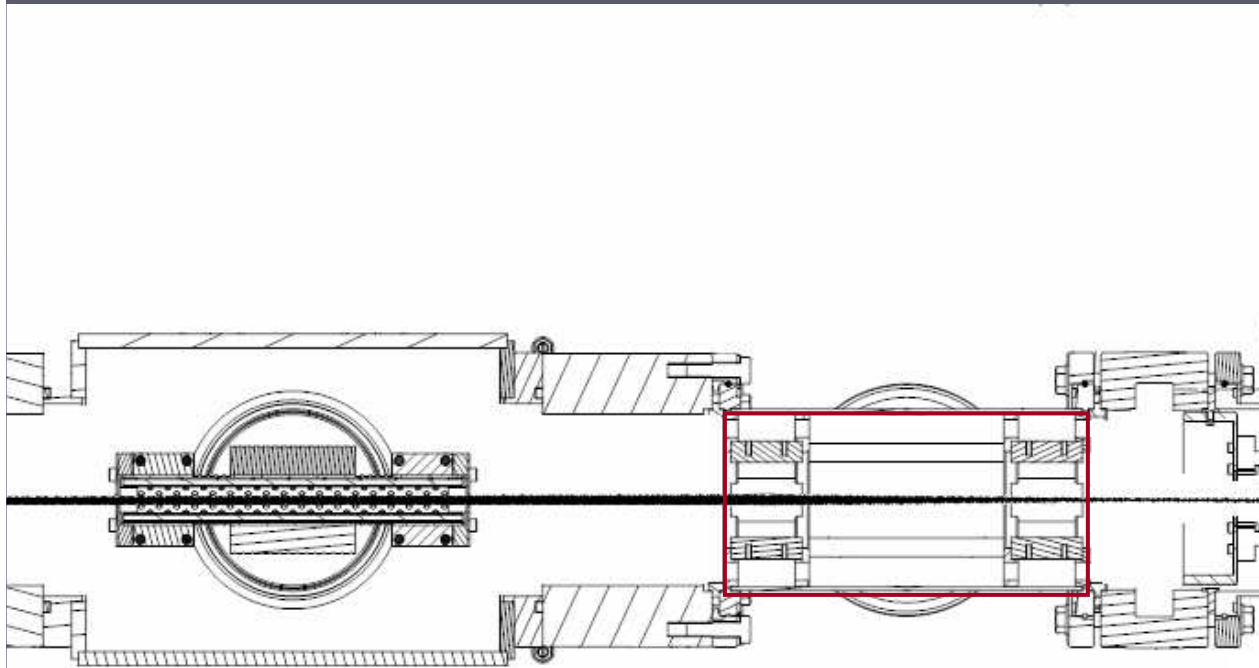


Add a Quadrupole doublet

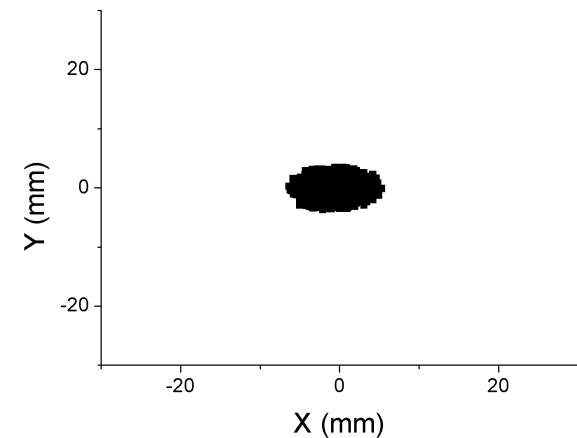
- Ion beam diverges and ions are lost
- Need for extra focussing just after bend
- Quadrupole doublet designed to fit in the beam line



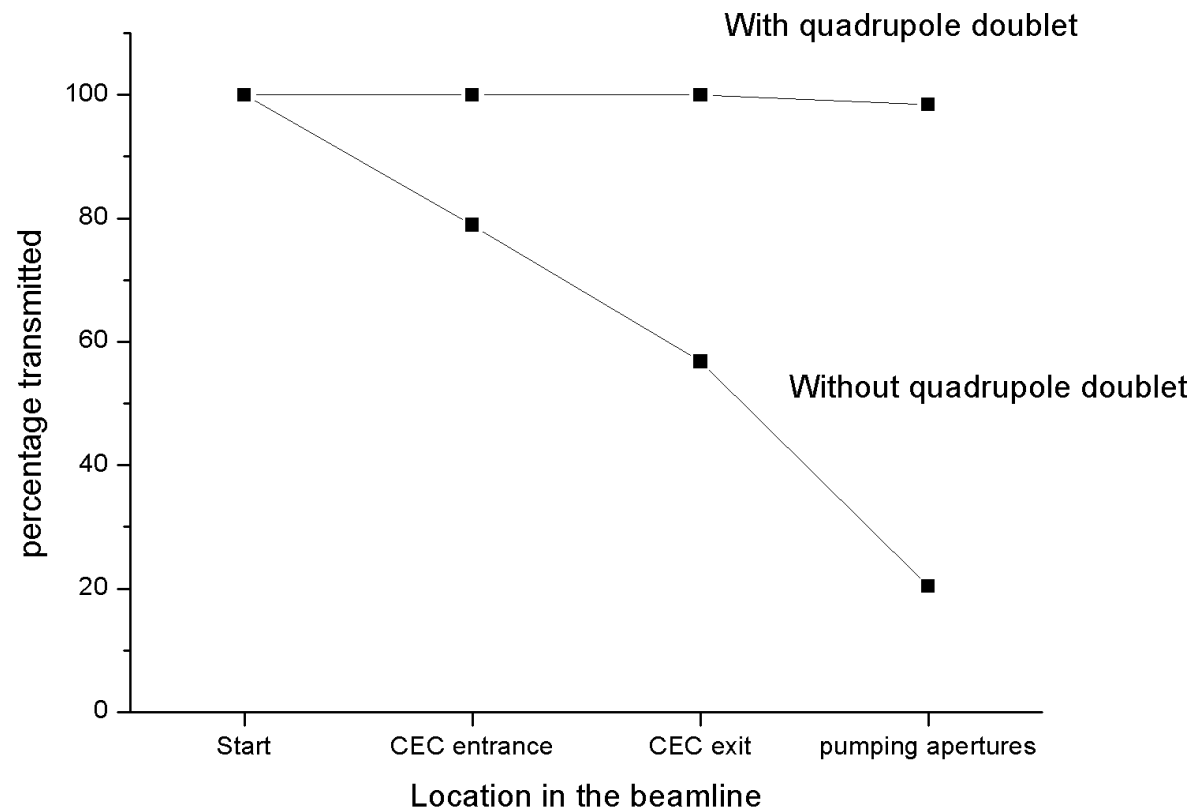
Focussing with new Quadrupole doublet



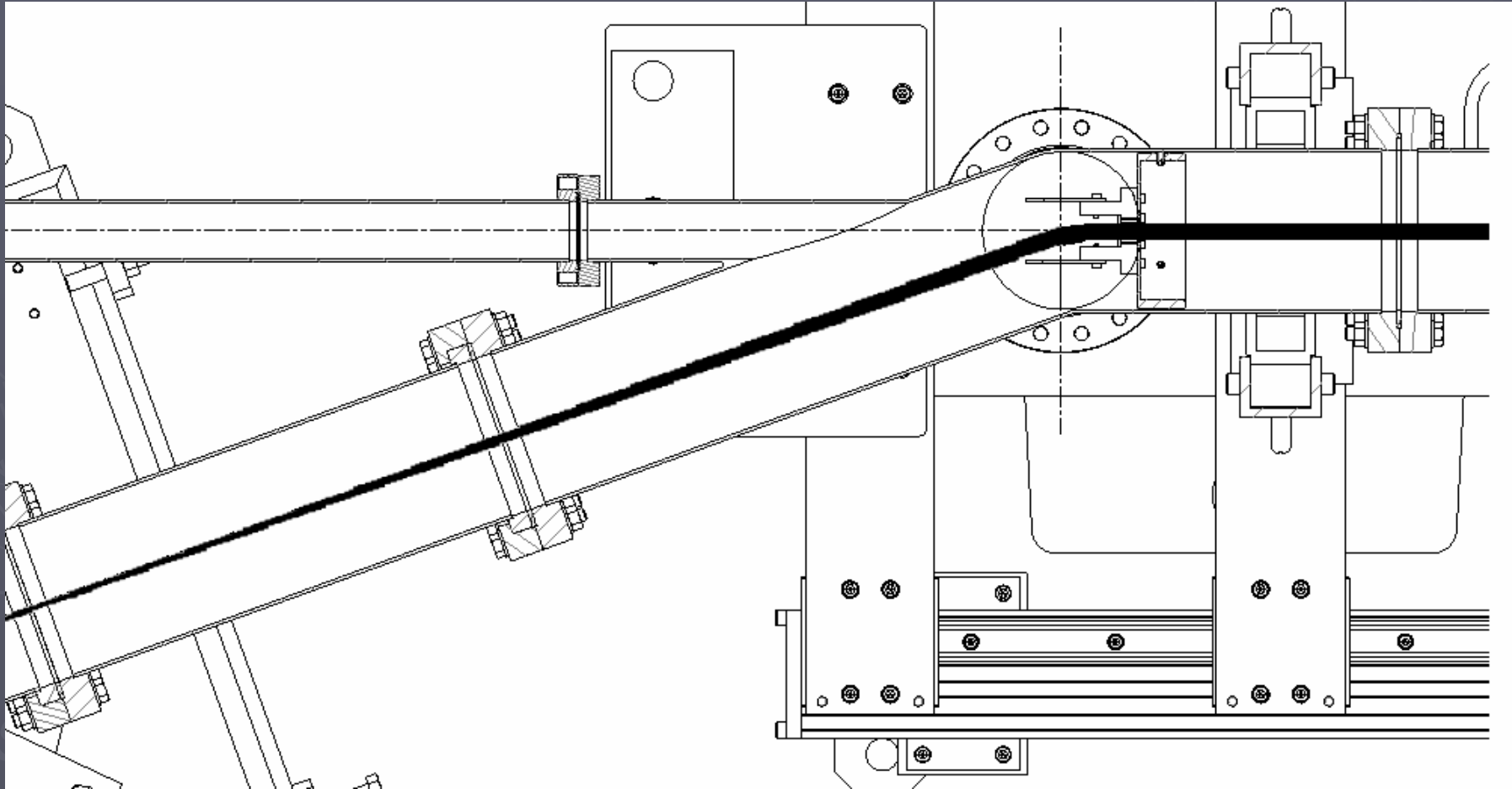
Beam spot using
additional quadrupole
lens



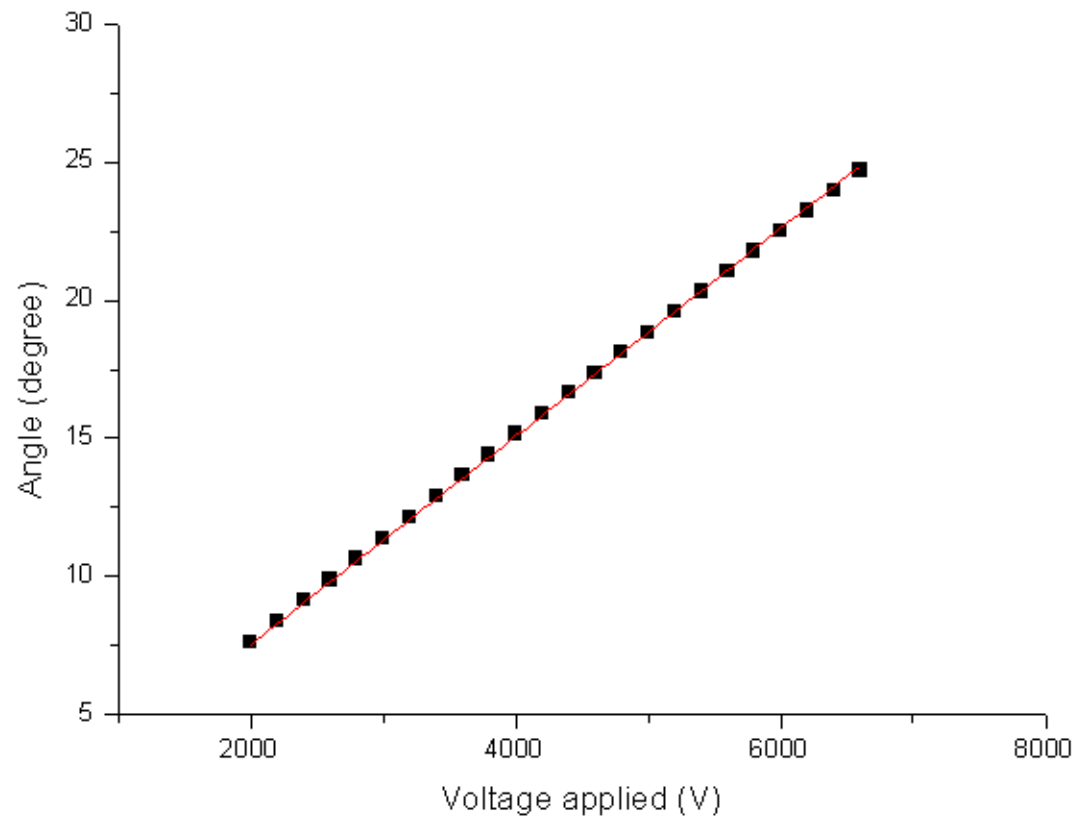
Transmission



Bend towards detection



Voltages needed to bend the beam



Summary of the simulations

- With extra bending plates the beam was aligned
- Quadrupole doublet keeps the beam small enough so there are almost no losses in the beam line
- Voltages on electrodes determined

Conclusions

- Ion optic simulations proved to be necessary
- Extra bending plates and quadrupole doublet were added for correction
- Offline tests this month with stable ions
- First online experiment in November