RIALTO, the laser ion source at ALTO

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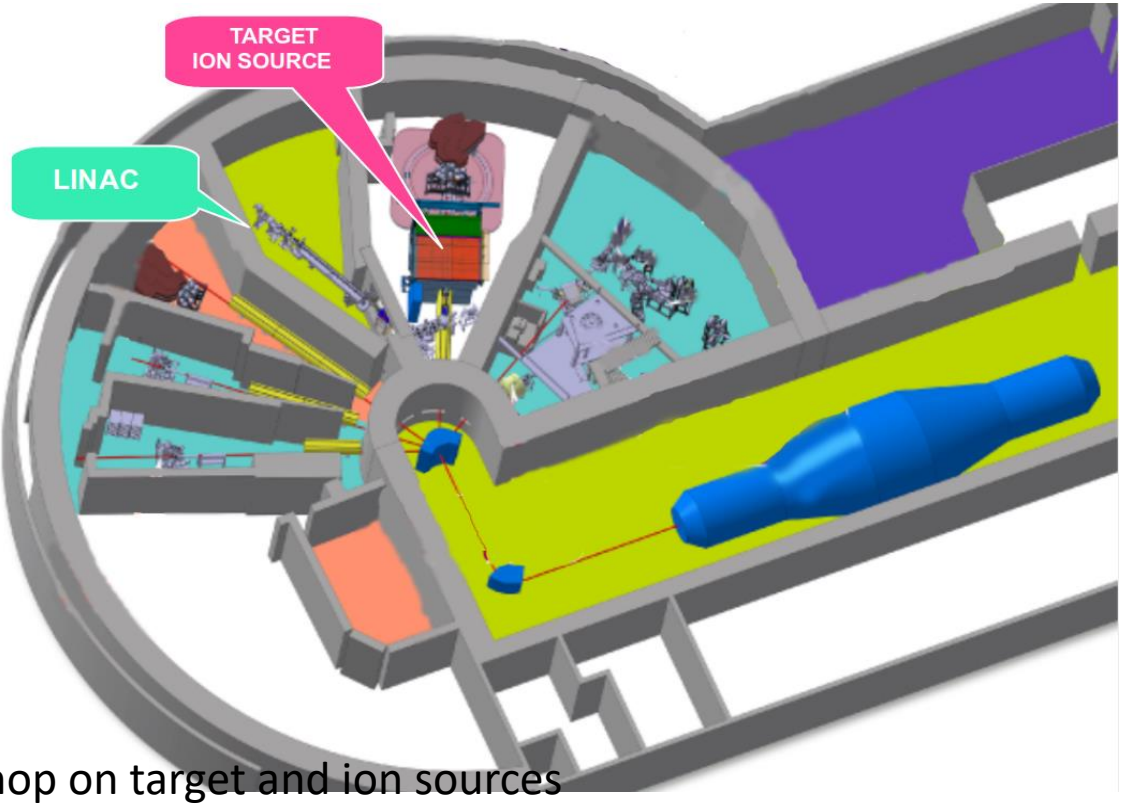
Outline

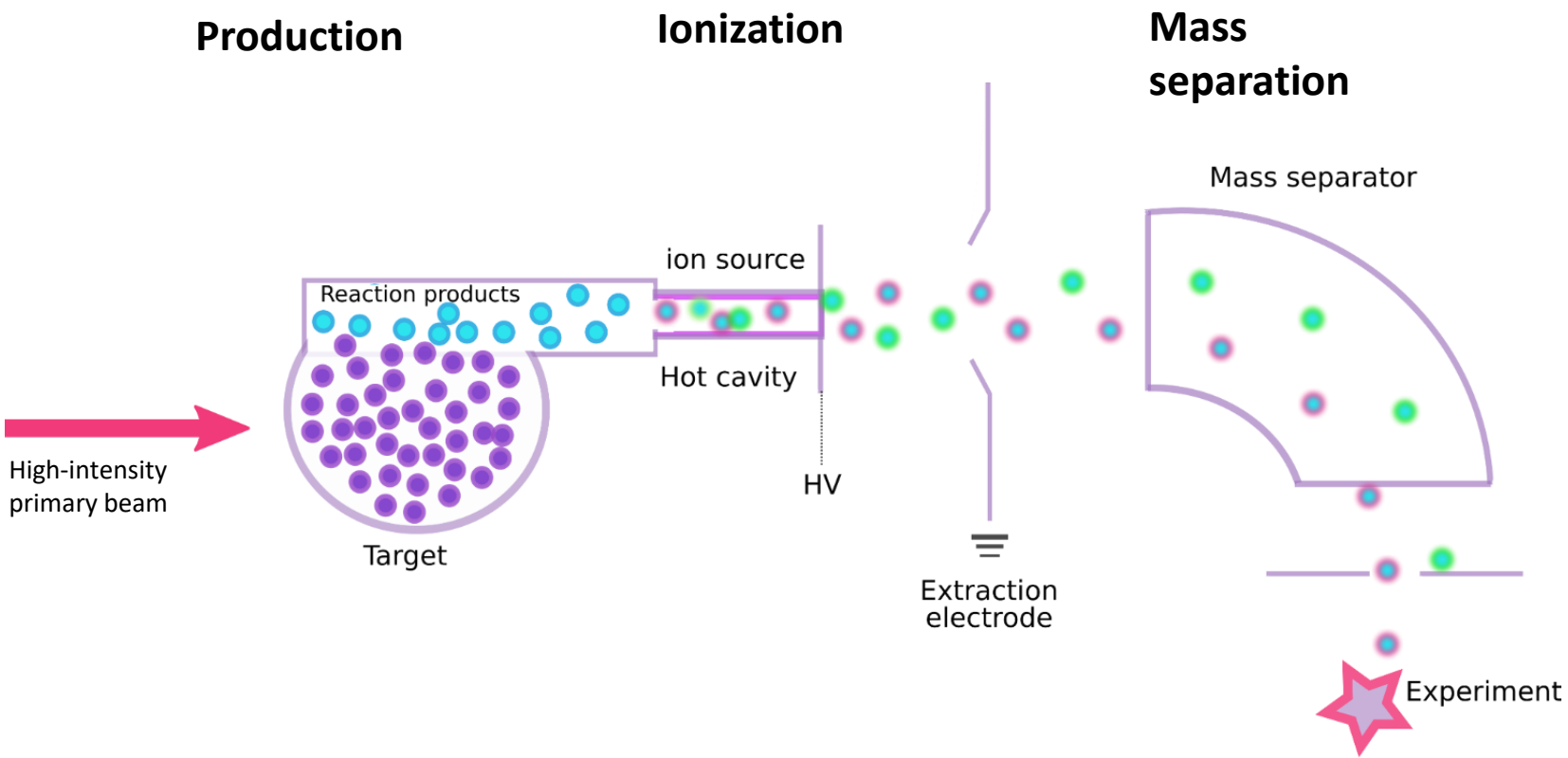
- ALTO-LEB facility
- Laser resonance ionization
- Layout of RIALTO
- RIALTO upgraded system.
- Ag and Ga production
- Outlook: A laser ion source at Spiral1

ALTO Facility
(Accélérateur Linéaire et Tandem d'Orsay)

- 10 μA Electron beam accelerated at 50 MeV on a target of 70g of UCx to produce **neutron-rich** radioactive nuclei by **photofission**.

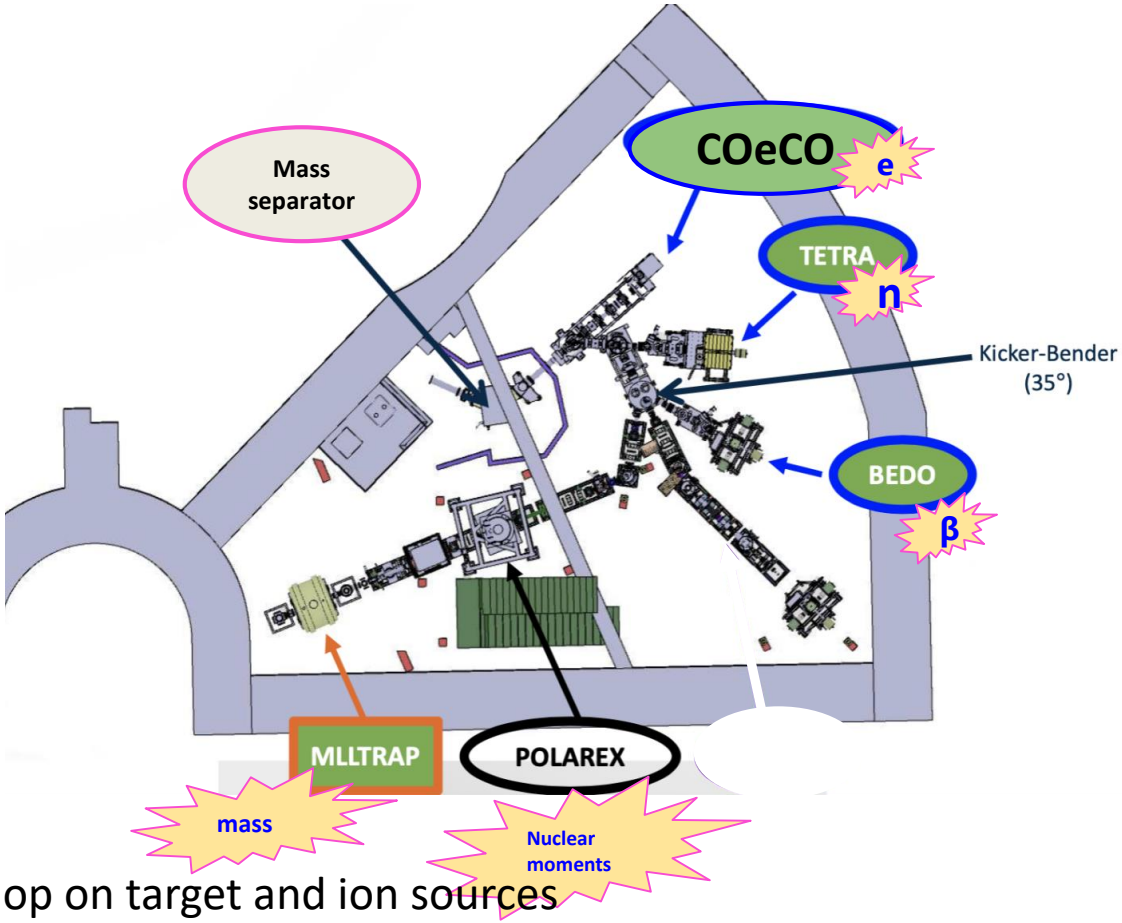


Isotope Separation On Line technique

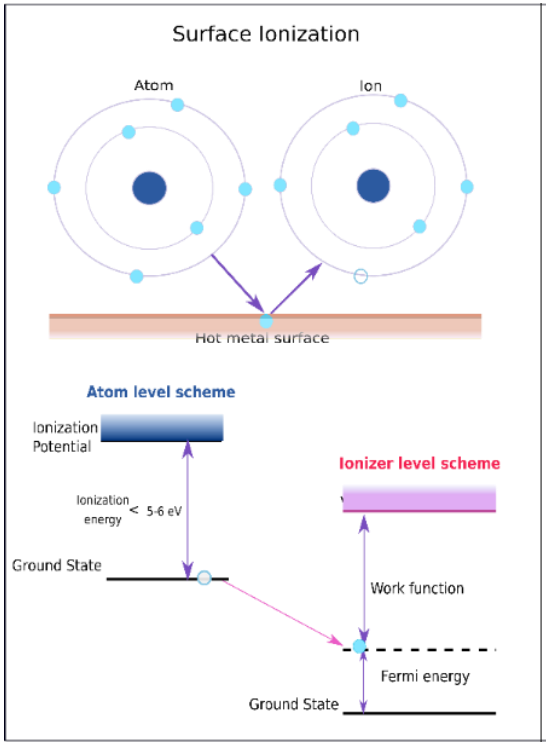


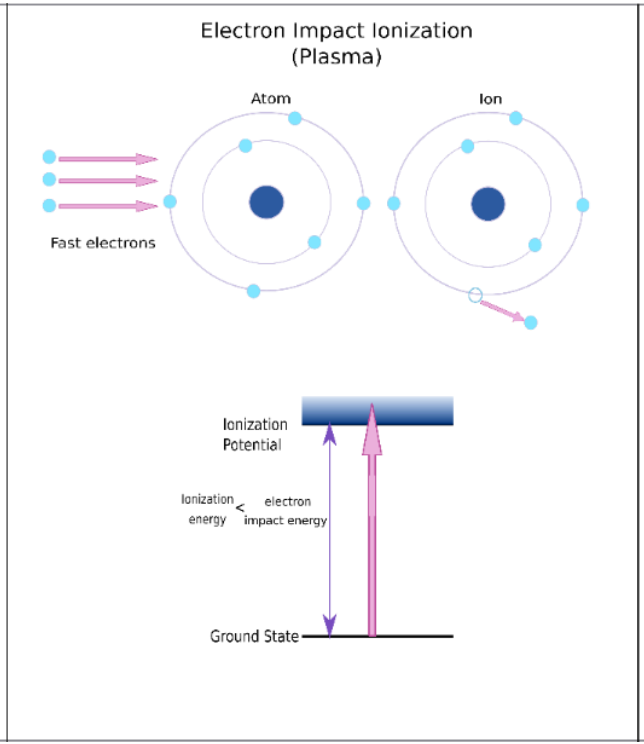
ALTO-LEB Hall

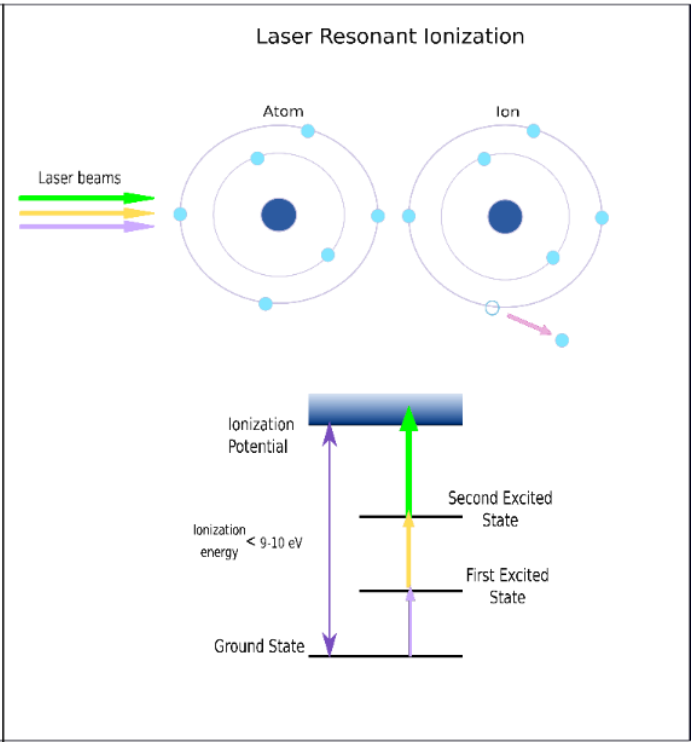
- Hyperfine interaction
  - POLAREX
- Manipulation of ions for mass measurements
  - MLLTRAP
- Radioactive decay
  - COeCO
  - TETRA
  - BEDO



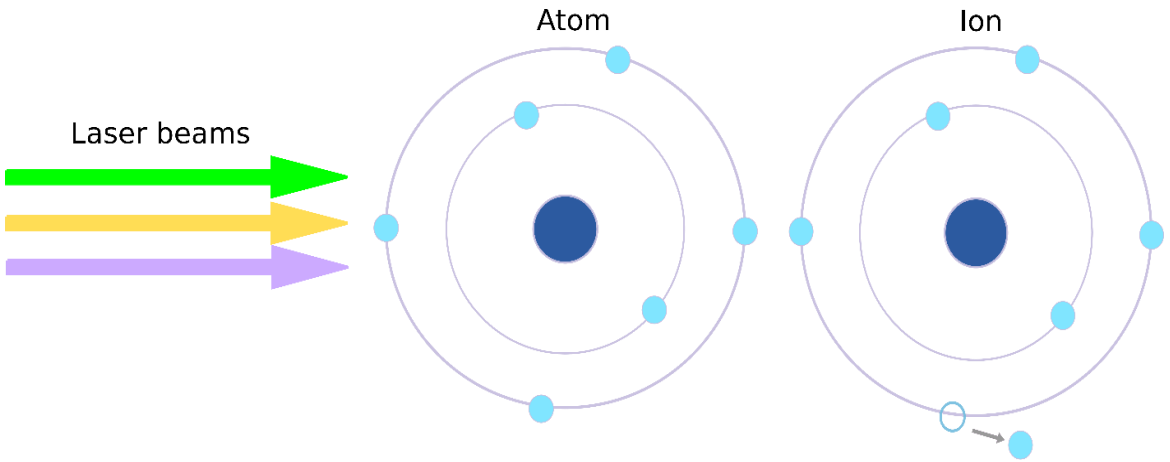
Ionization methods

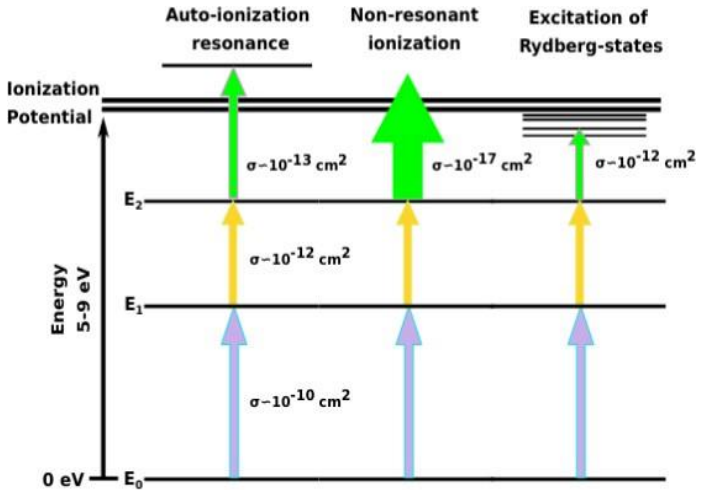




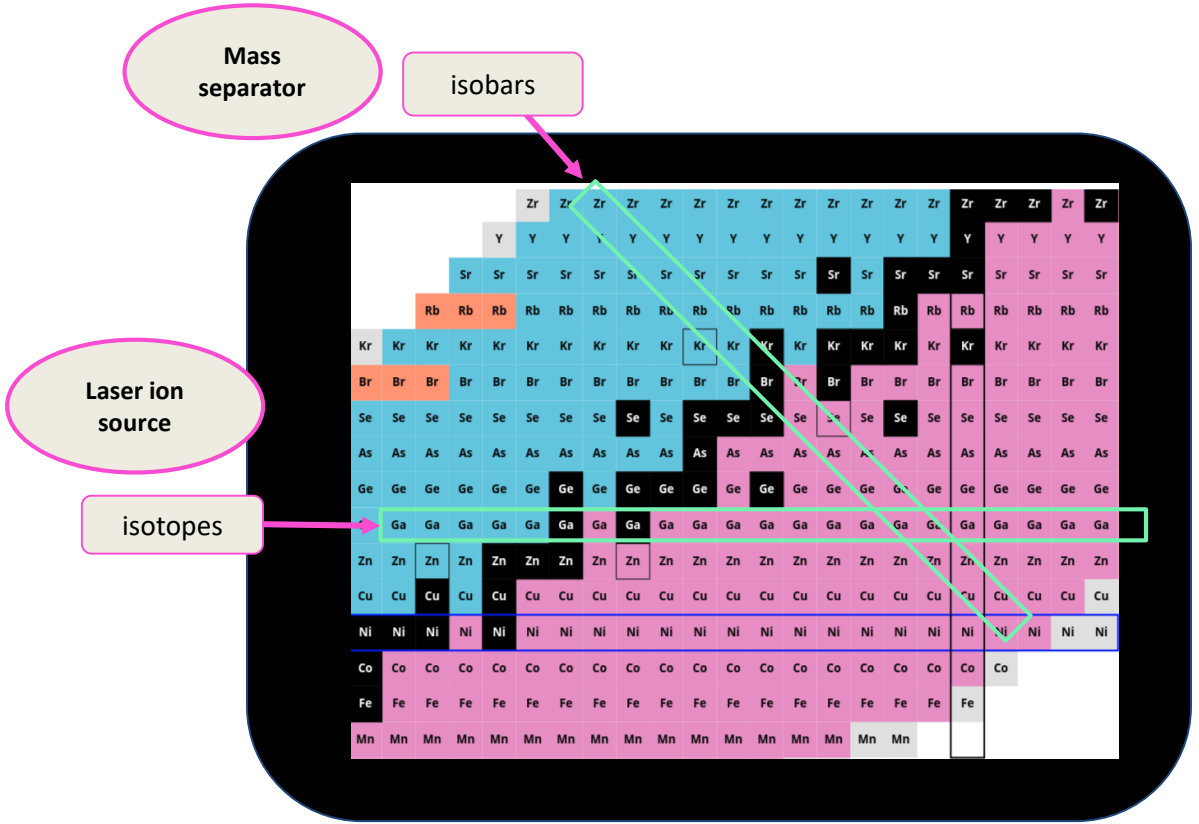


Laser resonance ionization



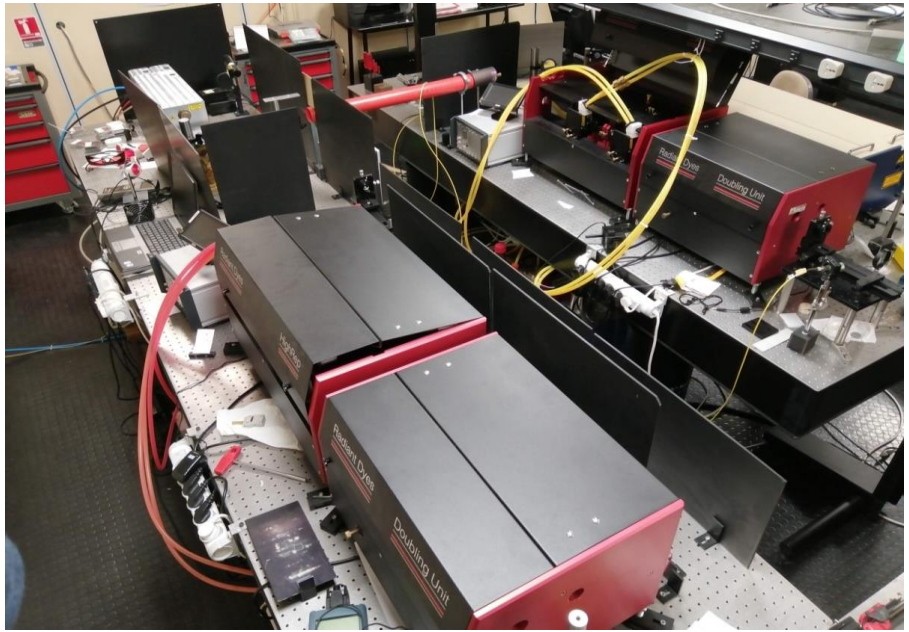


ALTO-LEB selection



Laser ion source:
- high selectivity
- high efficiency

RIALTO facility

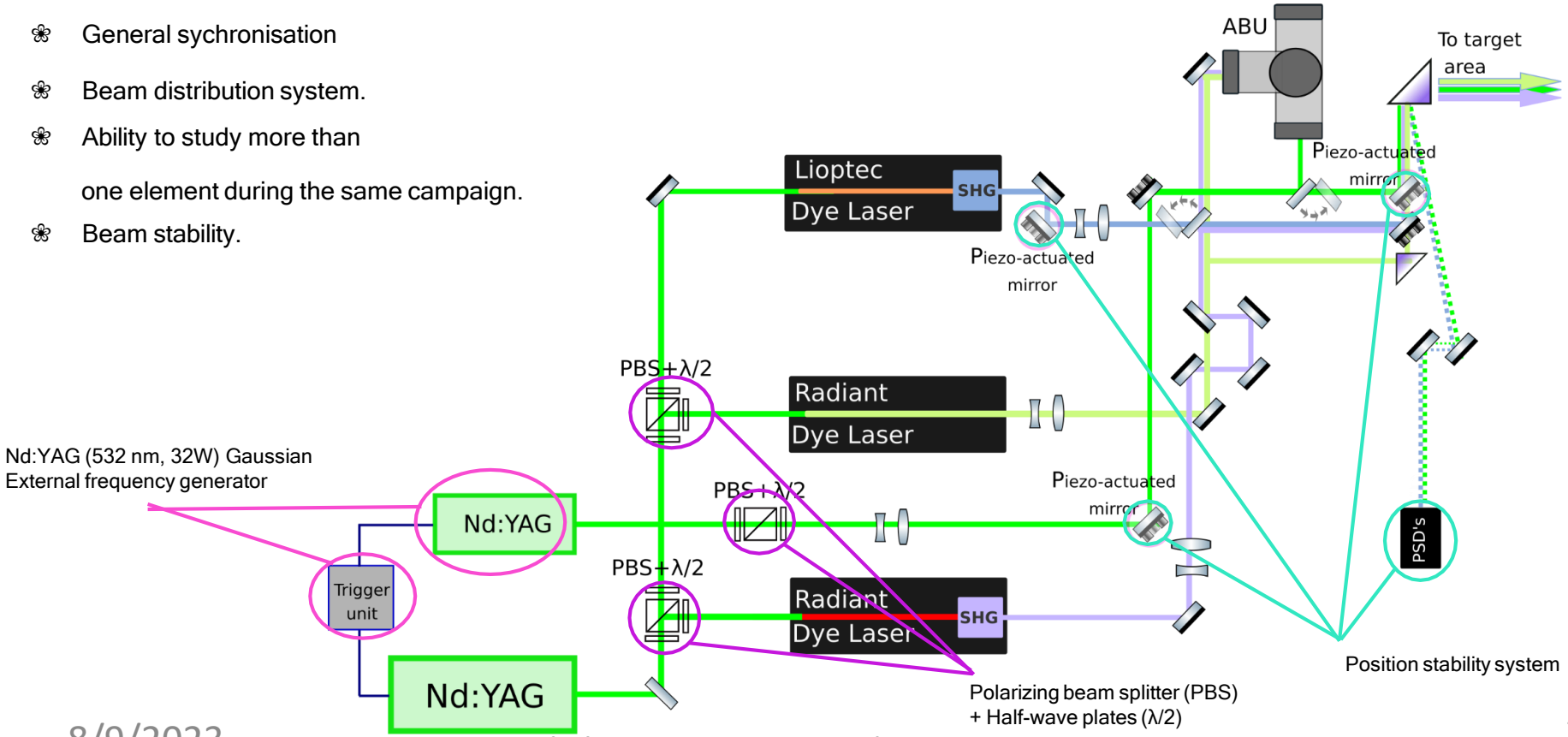


2 high power Nd:YAG: 532 nm, 100W (top hat) and 35W (gaussien)

3 dye lasers (540 – 850nm) with BBO doubling and tripling units (210 – 425nm)

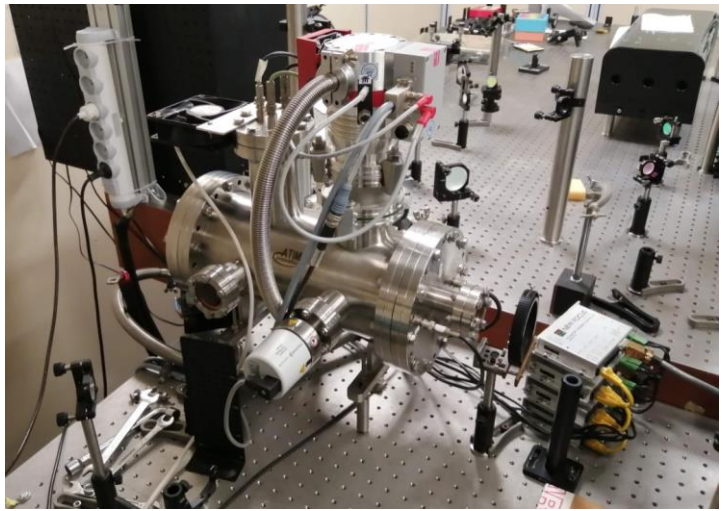
RIALTO layout

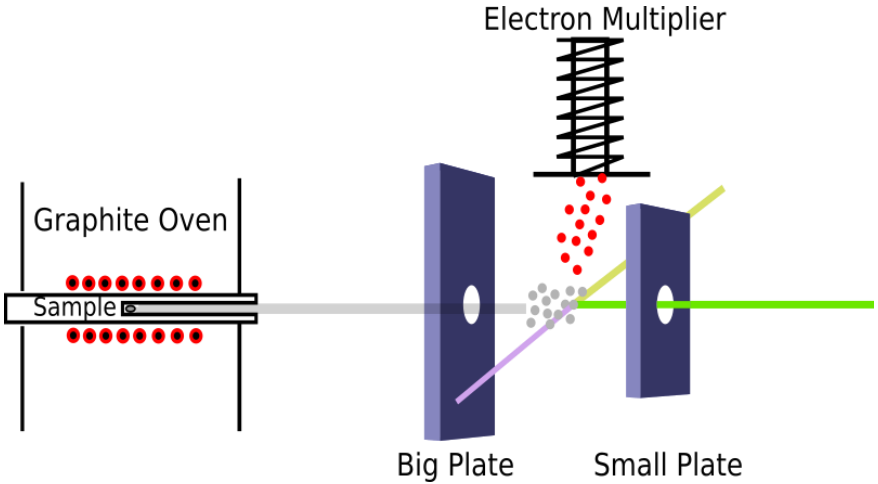
- General sychronisation
- Beam distribution system.
- Ability to study more than one element during the same campaign.
- Beam stability.



Atomic Beam Unit (ABU)

- Allows determining optimal operational parameters for on-line production
- Qualitative validation of ionization schemes.



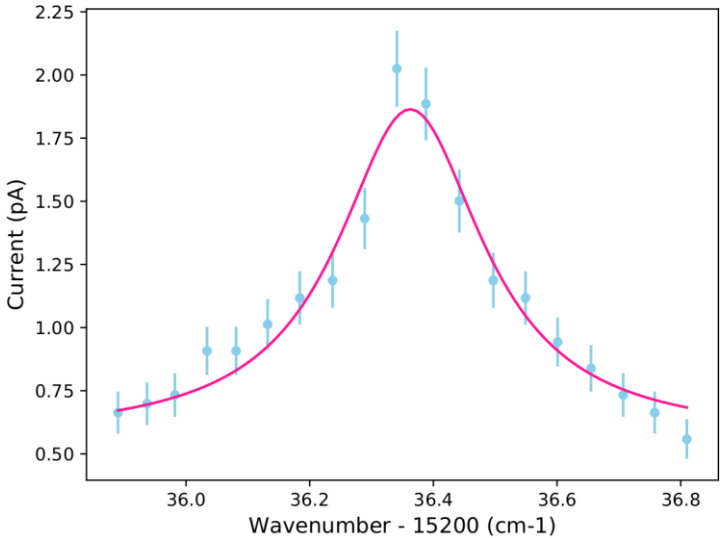


A sample of interest is placed in the graphite oven and heated to produce an atomic flux. The laser beams interact with this flux producing an ion beam.

Wavelength scan

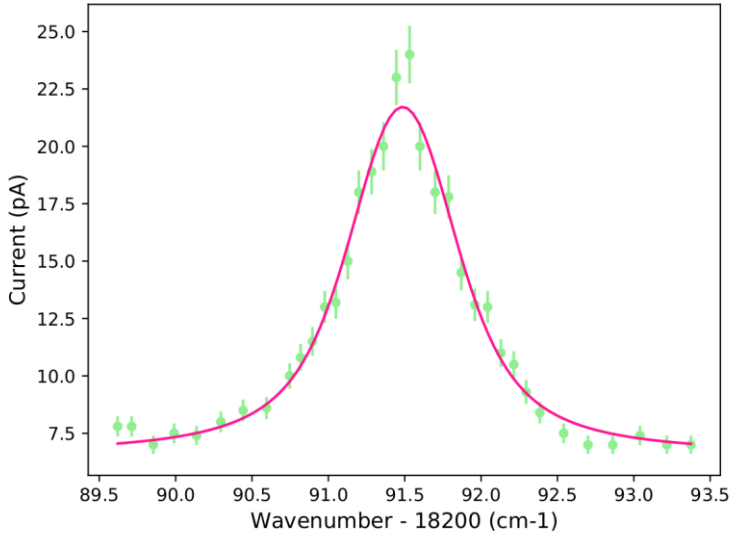
To verify the frequency of the atomic transitions in the Ag ionization scheme

First excitation step



Optimal λ=328.162 nm

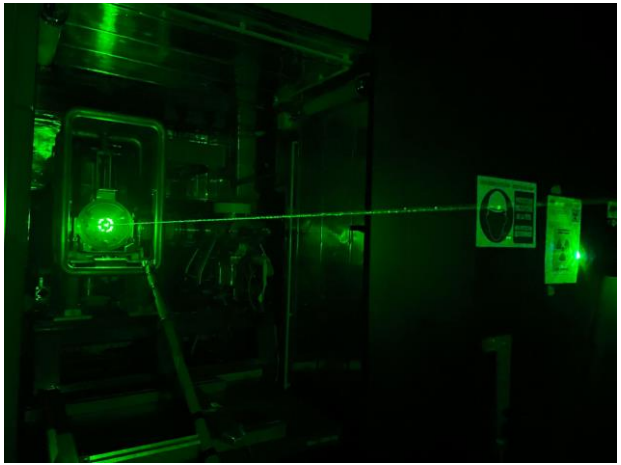
Second excitation step

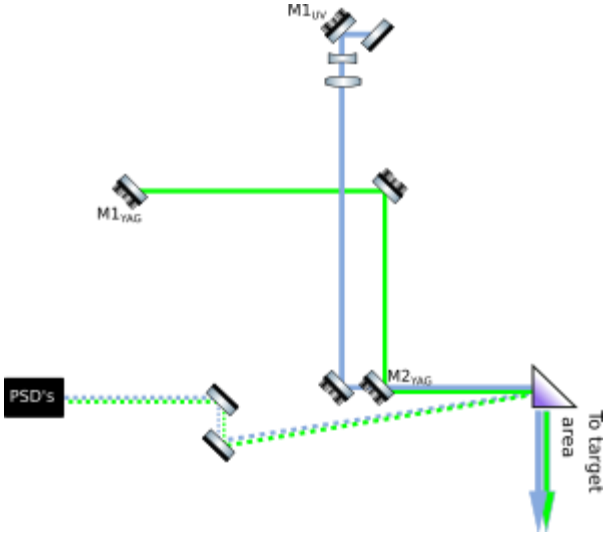


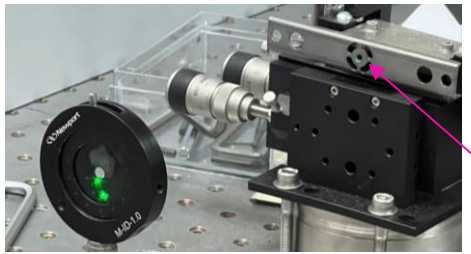
Optimal λ=546.702 nm

Stabilization system

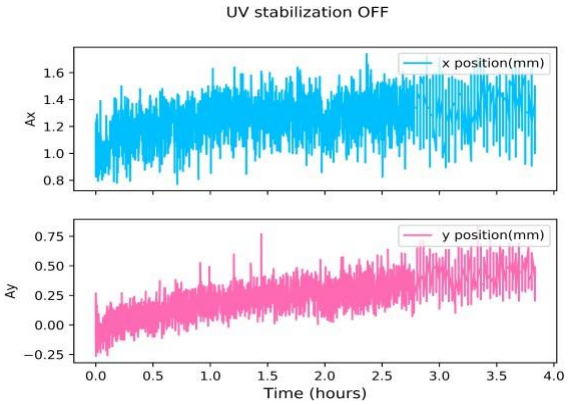
Distance from laser output to ion source 20m



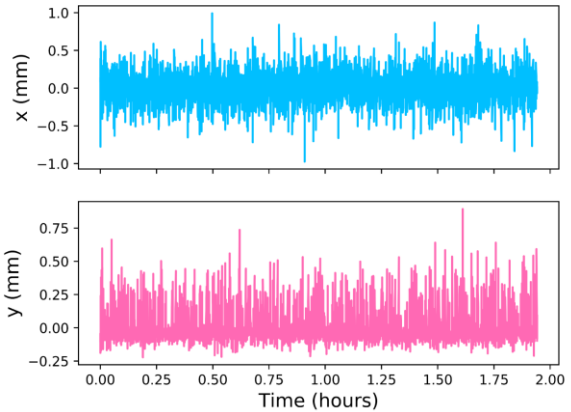




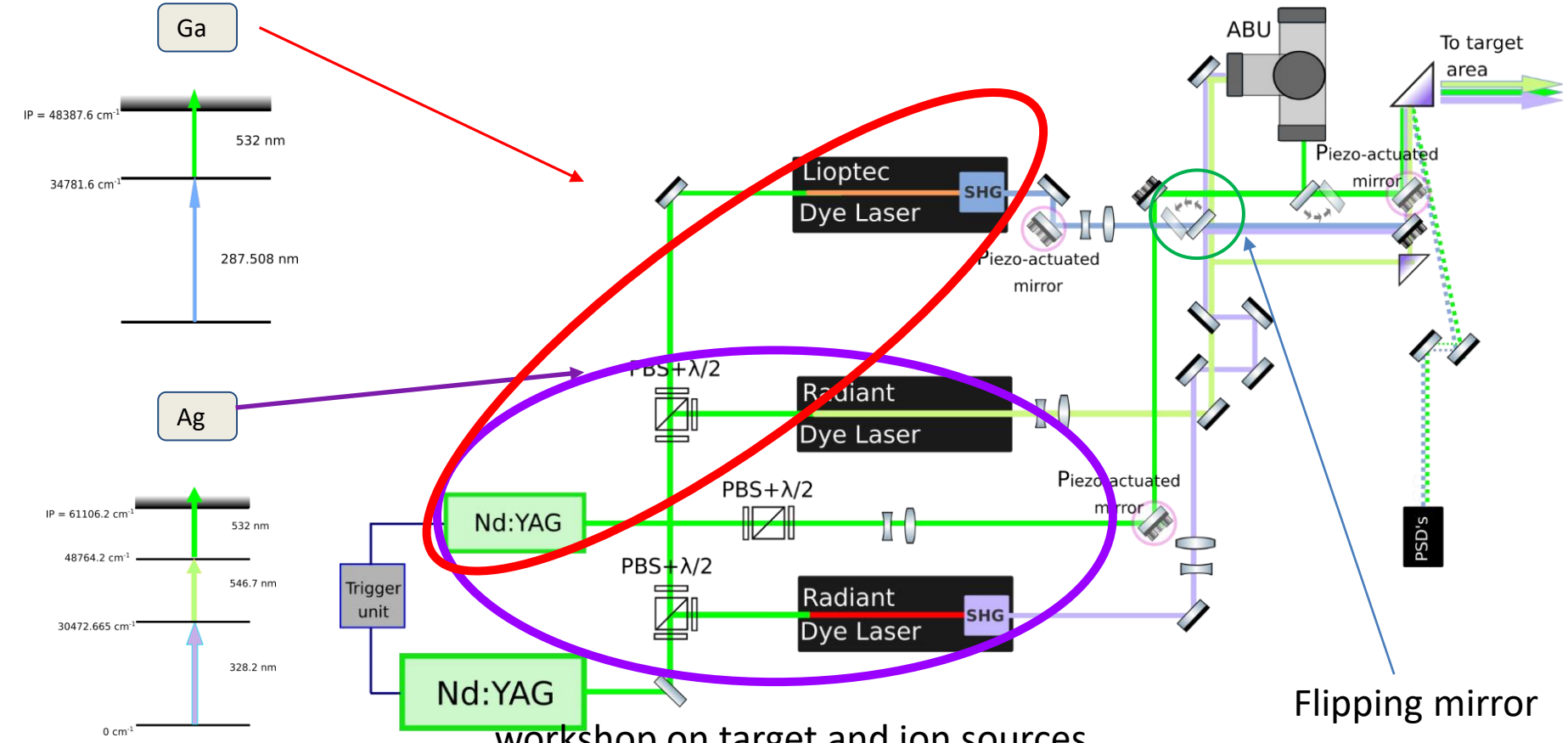
Reference tube



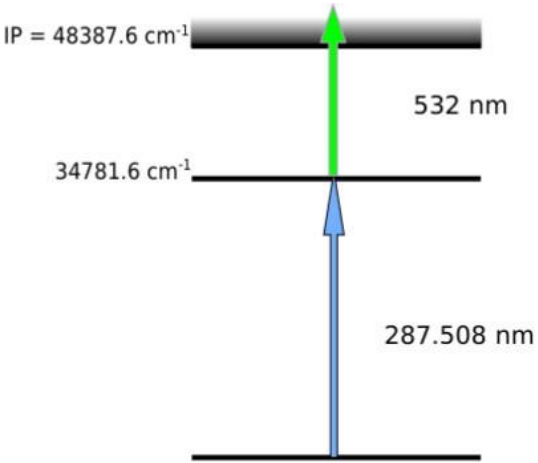
UV stabilization ON

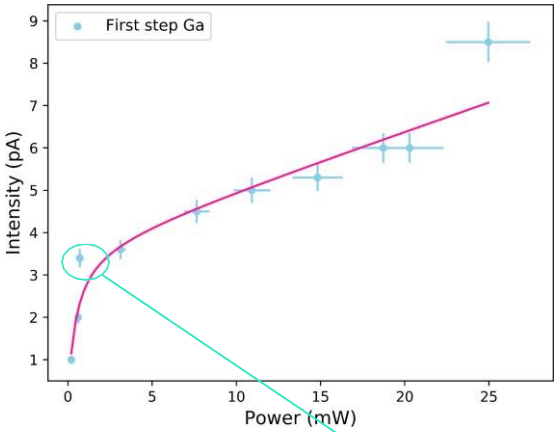


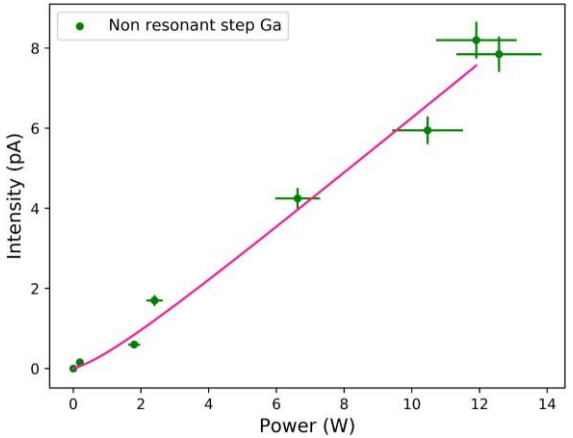
Ionization of two elements



Ga ionization

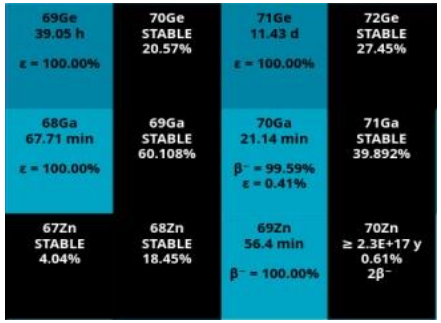


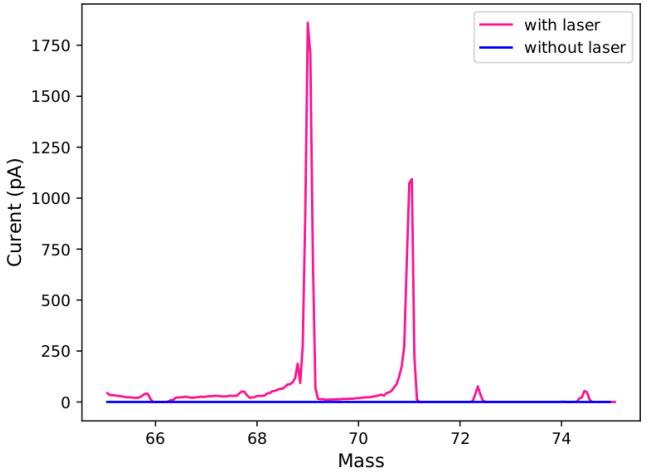


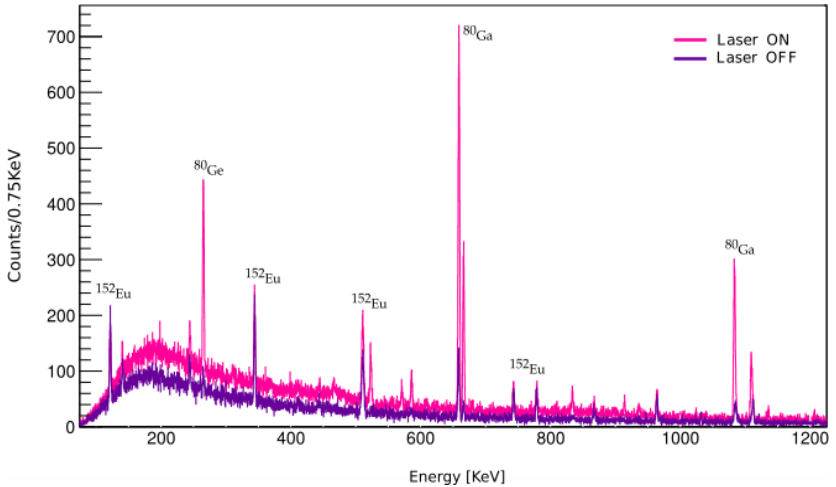


	P_{Sat} [mW]	$P_{Max\ Available}$ [mW]
First step	0.473 ± 0.207	125
non resonant step	n/a	16500

Ga production

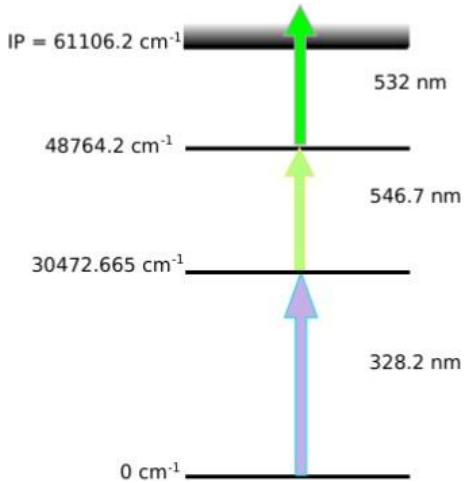


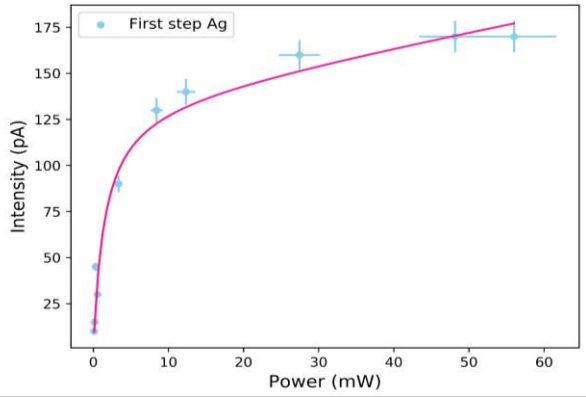


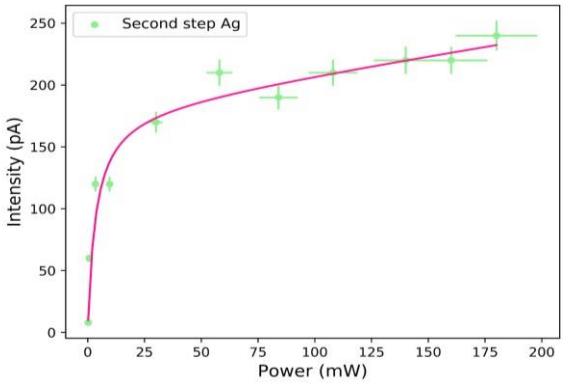


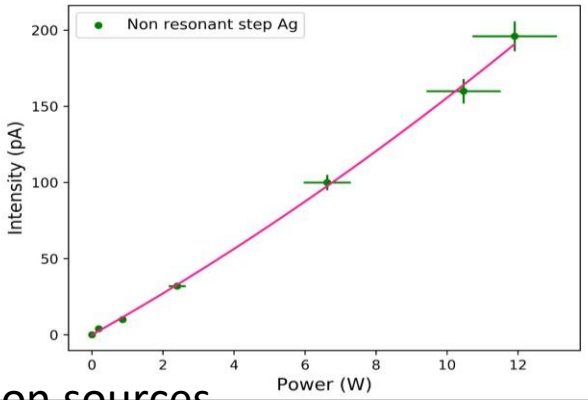
Laser ON-OFF effect. Gamma-ray spectrum recorded with HPGe detectors at the COeCO station for ^{80}Ga with surface ionization ion source (purple) and with the laser ionization (pink). Factor 8 enhancement with lasers.

Ag ionization



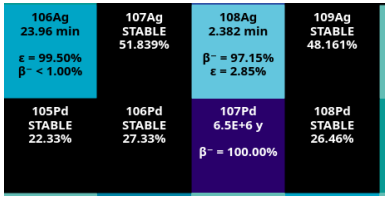


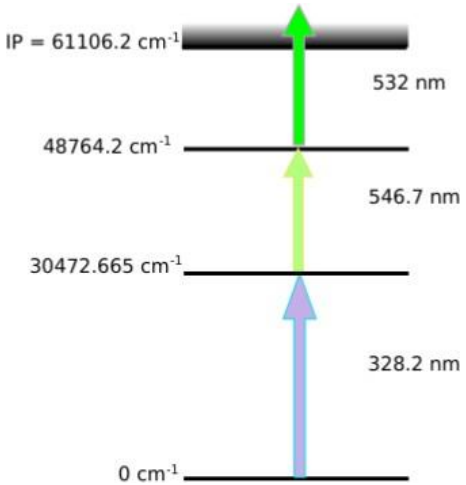


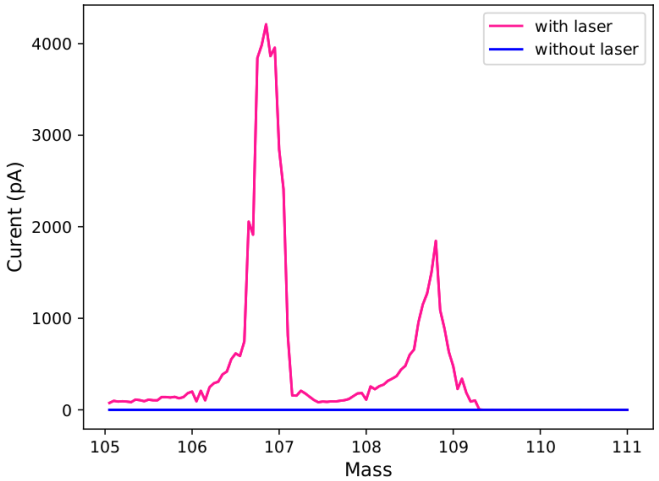


	P_{Sat} [mW]	$P_{\text{Max Available}}$ [mW]
First step	1.48 ±0.44	125
Second step	3.45 ±1.14	30
Non-resonant step	n/a	16500

Silver production

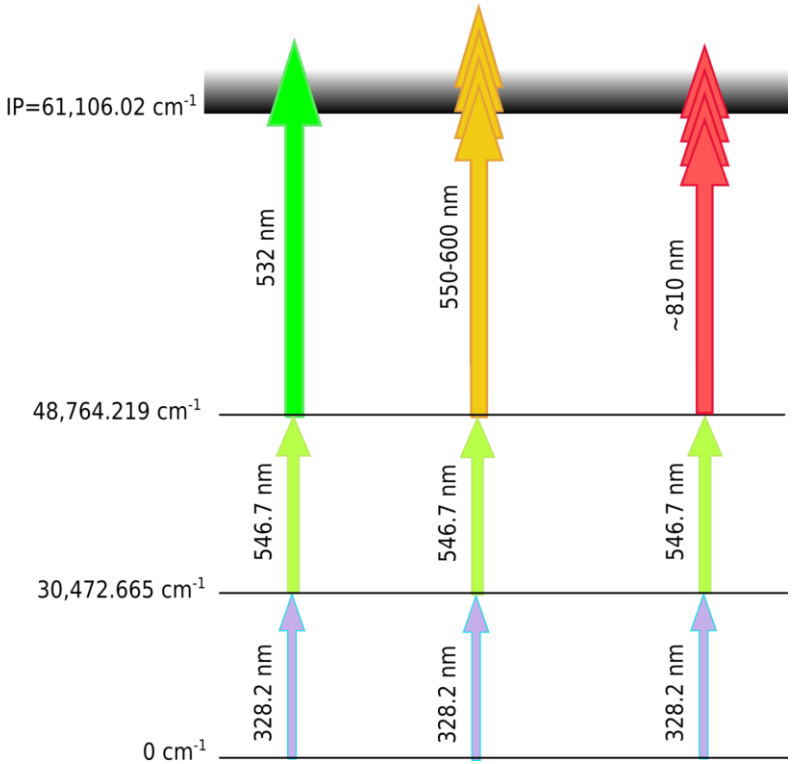




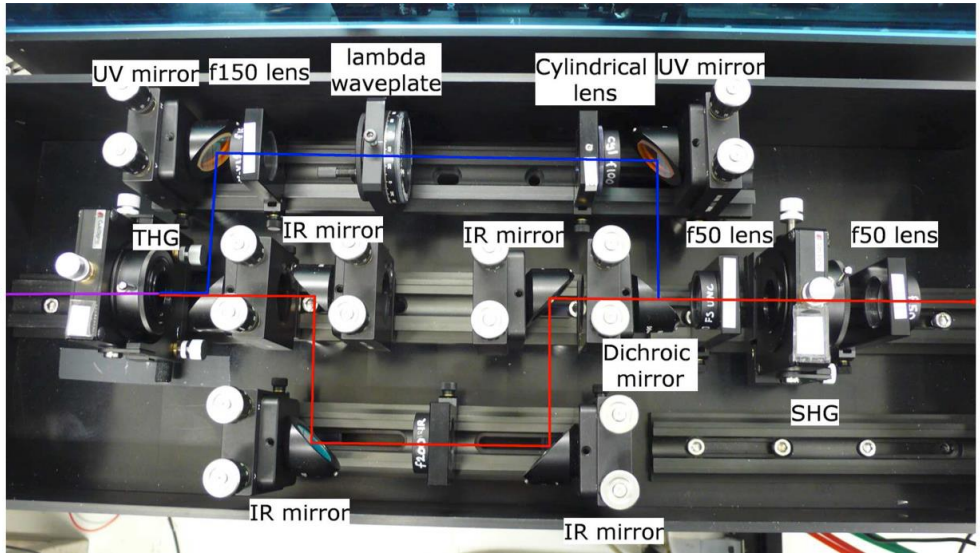


Silver perspectives: looking for AIS

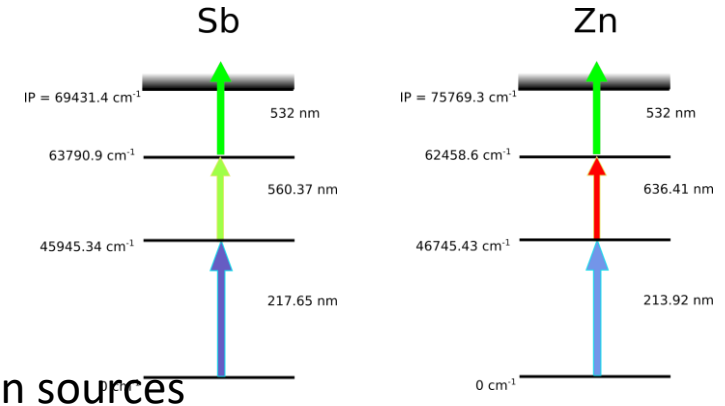
- Use the fundamental wavelength of Ga as third step.
- Change dye (styryl 9M).



Short term perspectives : use of the tripling unit

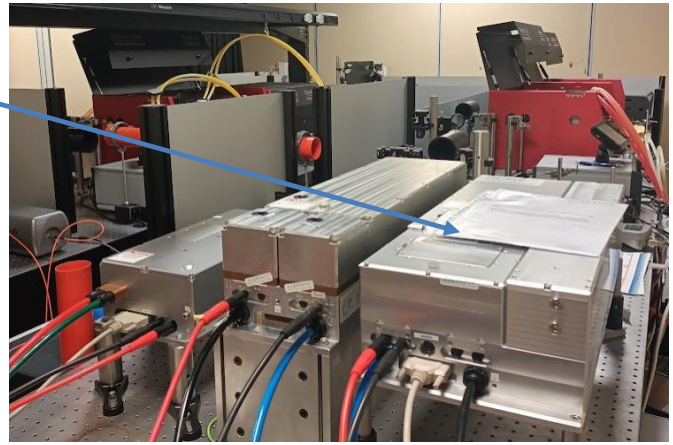


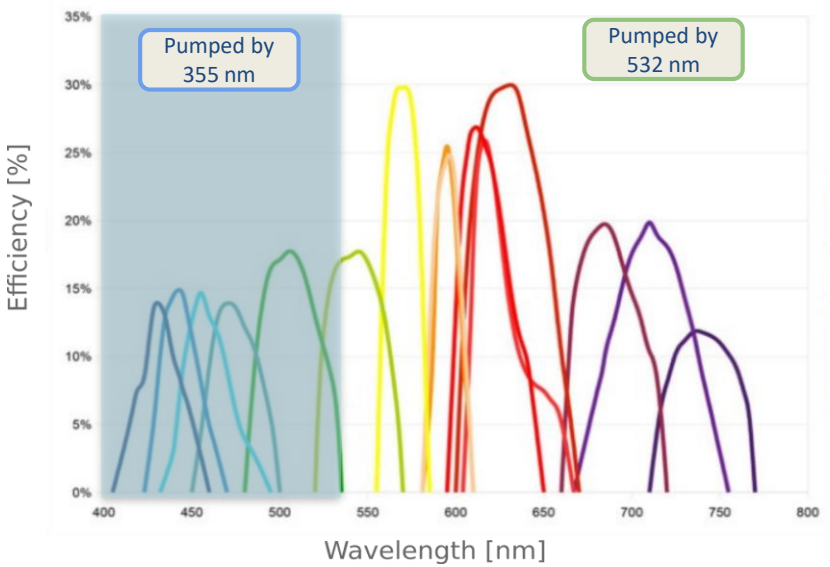
- **Neutron-rich Zn program**
  - BEDO + Monster
- **Neutron-rich Sb program**
  - Magnetic moments and hyperfine field of Sb with POLAREX



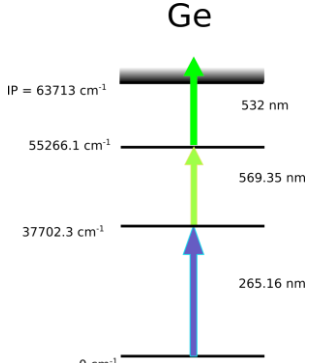
Short term perspectives : New YAG with 2 output

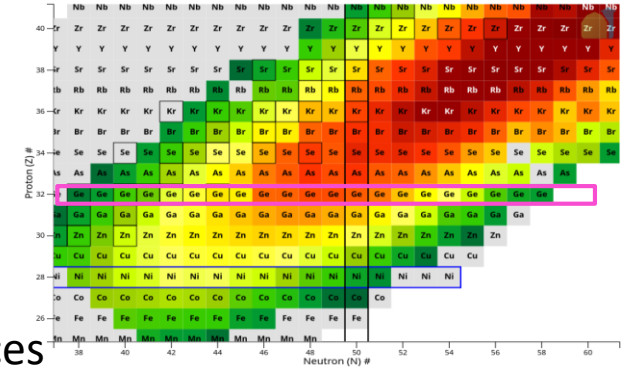
Installation of a new high-power Nd:YAG laser with UV output: 17W@355nm and 55W@532nm





❀ Neutron-rich Ge program

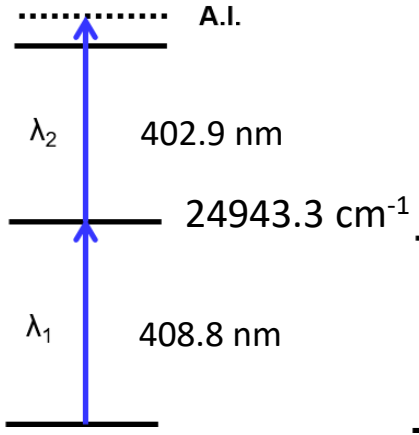


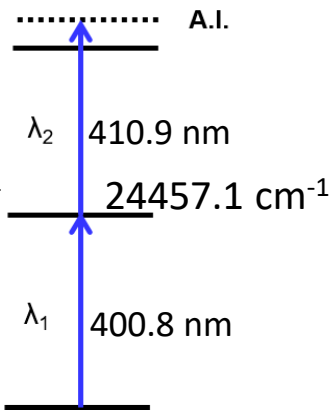


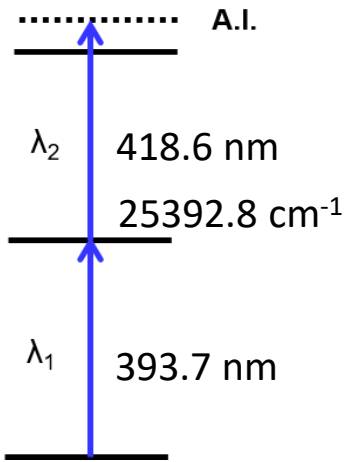
Outlook: R&D for a laser ion source at Spiral1

Developing level scheme: Looking for AIS with GISELE and RIALTO

Example of Erbium with GISELE







Can be done at RIALTO with Ag

Outlook: laser ion source at Spiral1

2 options :

- using GISELE as it is now and send the beam to SPIRAL1

And/or

- Build another laser room close to SPIRAL1, move the lasers of GISELE there and complete them with a set of dye laser to fully cover all the wavelengths

Outlook: laser ion source at Spiral1

Using GISELE as it is

To be operational quickly: using GISELE and transport the laser beam with fibers
Available for resonant transitions (< some watts) i.e. for element with AIS

Qualified manpower : available at GANIL

Delay : 6 months

To be tested with stable element ion source

Outlook: laser ion source at Spiral1

In parallel, building another laser room close to SPIRAL1

- A 30 m2 equipped laser room at some 20m (or less) of the SPIRAL1 ion source
- A GISELE like ion source with 3 TiSa and one 70W long pulse YAG laser
- A RIALTO like ion source with 2 dye laser to fill the gap in yellow-green. With a 10ns and 70 W 532 nm YAG laser (2x36+90 = 162 k€)

Qualified manpower: available at GANIL and IJCLab

Delay : 2 years

FTE SOLAIRE 2020-2025

Nom des personnes	Statut	2020	2021	2022	2023	2024	2025	Total (FTE)
IJCLab pour RIALTO		190%	170%	135%	75%	75%	75%	9,00
François Le Blanc	DR	60%	60%	60%	60%	60%	60%	
Vladimir Manéa	CR	40%	20%	15%	15%	15%	15%	
A. Segovia Miranda	PhD	90%	90%	60%	60%	90%	50%	
IJCLab pour GISELE		30%	20%	30%	30%	30%	20%	1,60
Vladimir Manéa	CR	20%	10%	10%	10%	10%	10%	
Serge Franchoo	CR	10%	10%	10%	10%	10%	10%	
Wenling Dong	PhD			10%	10%	10%		
TOTAL IJCLab (FTE)		2,20	1,90	1,65	1,05	1,05	0,95	10,60
GANIL pour GISELE		15%	35%	65%	45%	35%	35%	2,30
Anjali Ajayakumar	PhD		10%	10%	10%			
Alejandro Ortiz-Cortes	PhD		10%	30%				
Etudiant Master - PhD	M2-PhD				10%	10%	10%	
Nathalie Lecesne	IR	10%	10%	10%	10%	10%	10%	
Sarina Geldhof	IR			10%	10%	10%	10%	
Benoit Osmond	AI	5%	5%	5%	5%	5%	5%	
TOTAL GANIL (FTE)		0,15	0,35	0,65	0,45	0,35	0,35	2,30

Total GISELE : 3,9 FTE

Total RIALTO : 9 FTE (only IJCLab)

Thank you for your attention