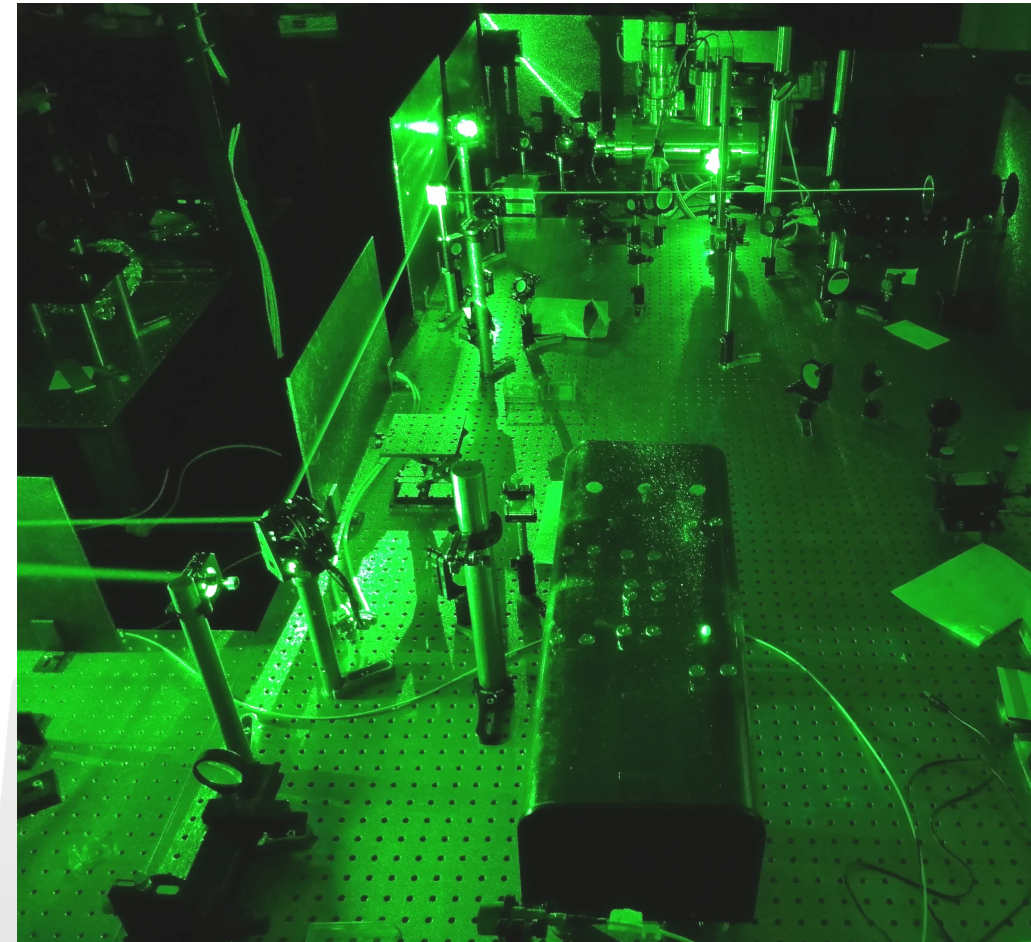


**Development of a laser ion source at  
ALTO: Application to the production of  
silver beams for the study of its magnetic  
properties with the Low Temperature  
Nuclear Orientation Method.**

Anahí Segovia Miranda





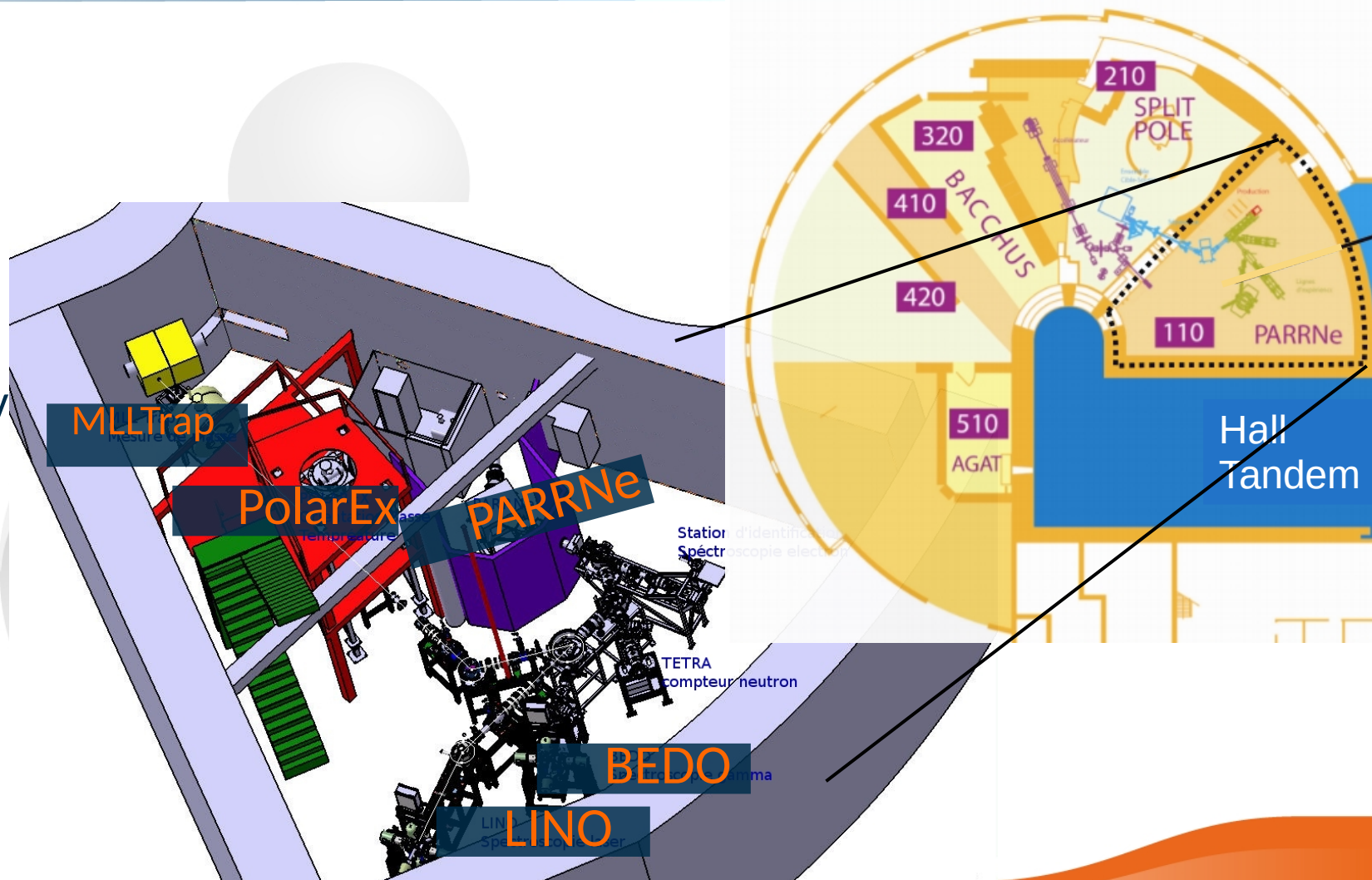
# Outline

- ALTO facility
- Laser Resonance Ionization Technique
- RIALTO facility
- Silver Production
- Summary and outlook



# ALTO (Accélérateur Linéaire et Tandem d'Orsay)

- Neutron-rich RIB's.
- Electron beam 50MeV
- 70g UCx Target



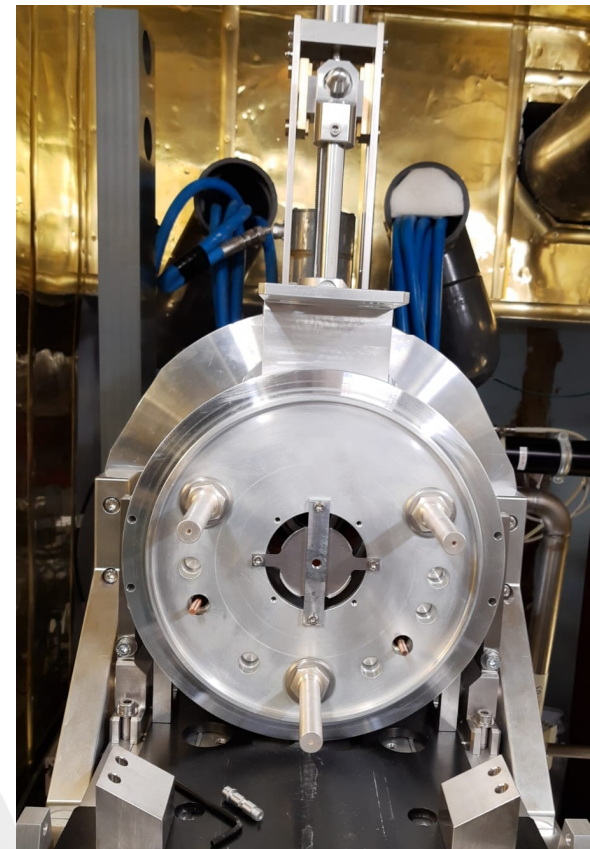
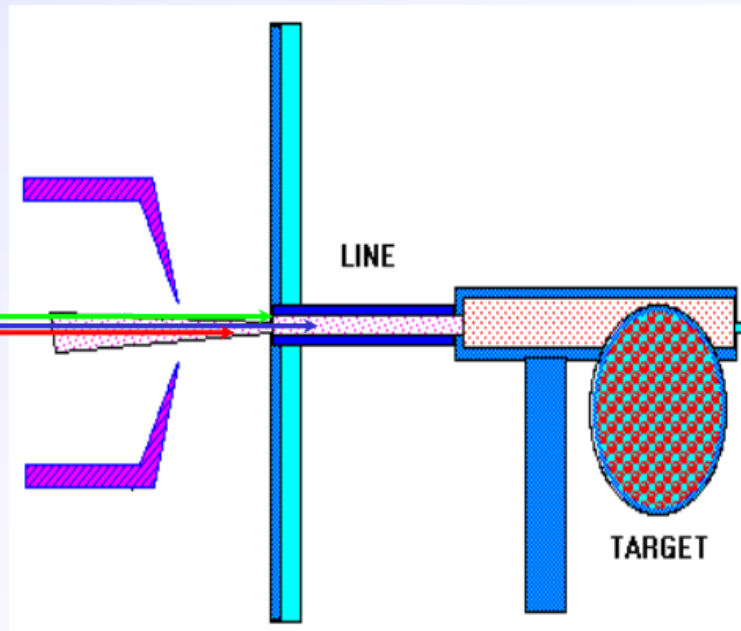


Uranium fission

Neutron rich radioactive nuclei  
beams well separated in mass A

LASER ION  
SOURCE

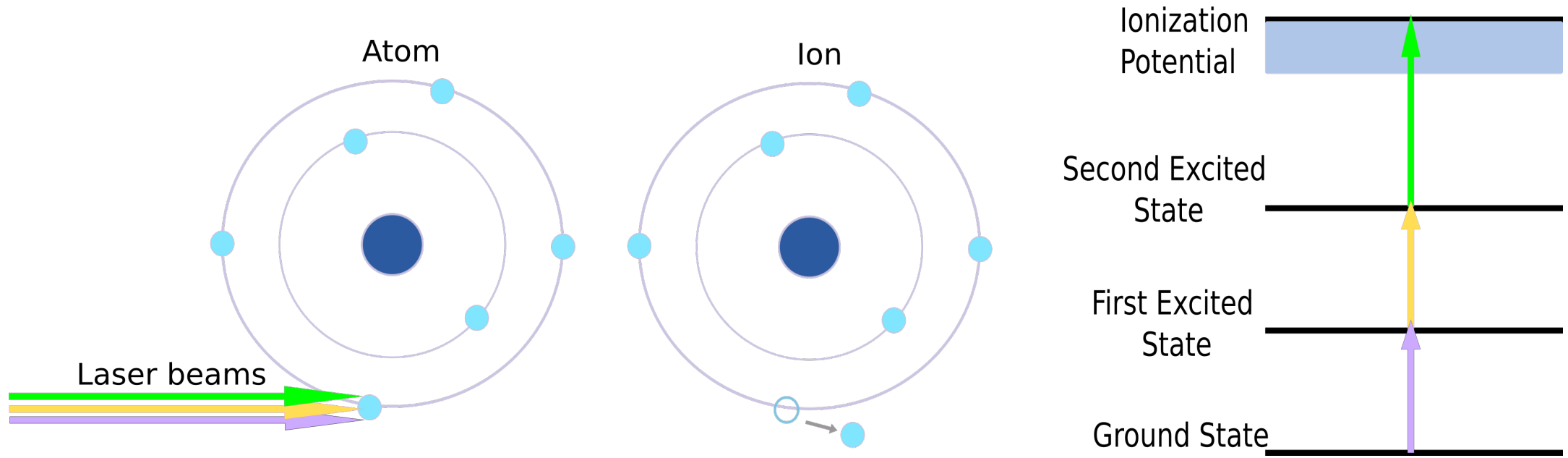
Beams of high purity and high selectivity





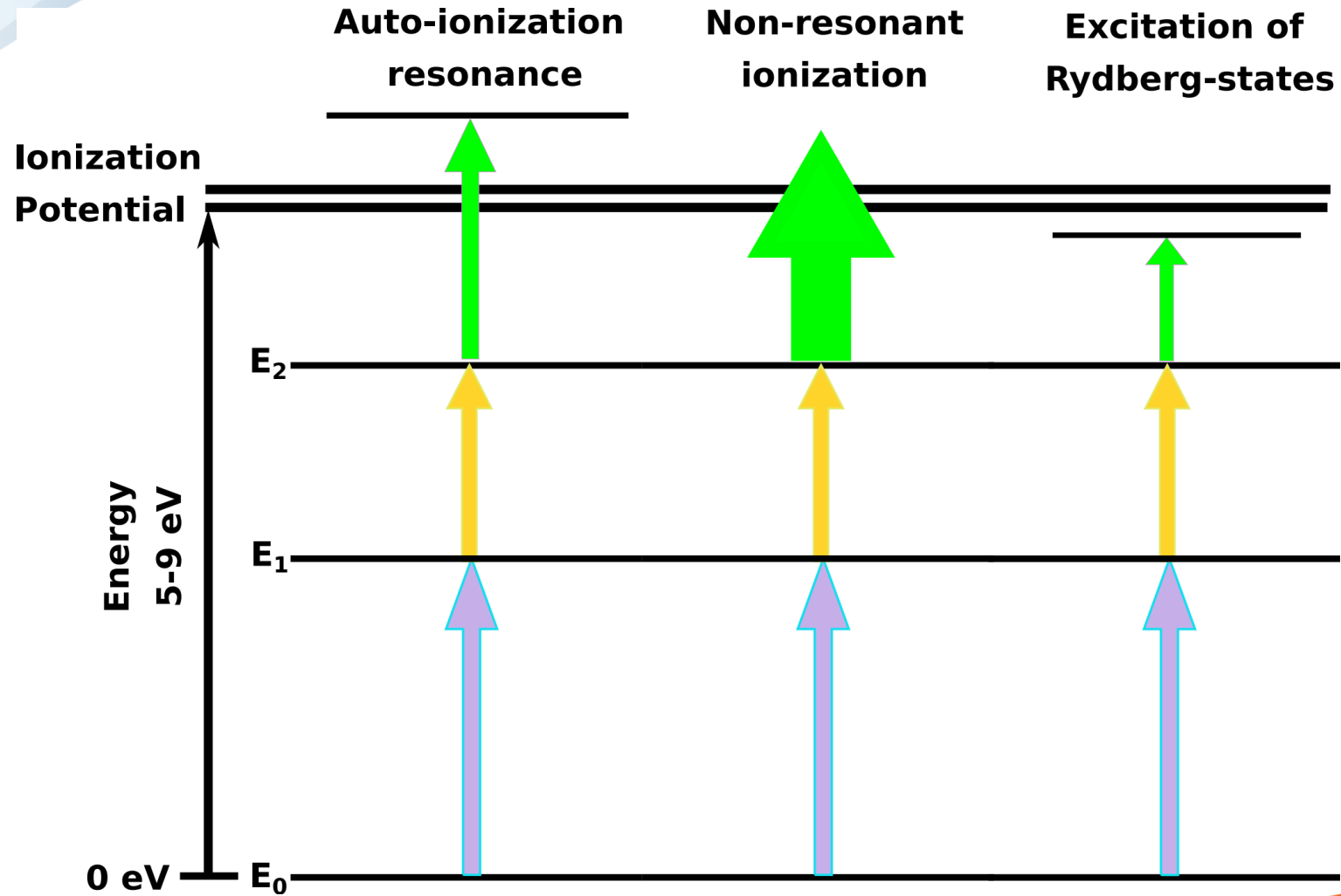


# Laser Resonance Ionization



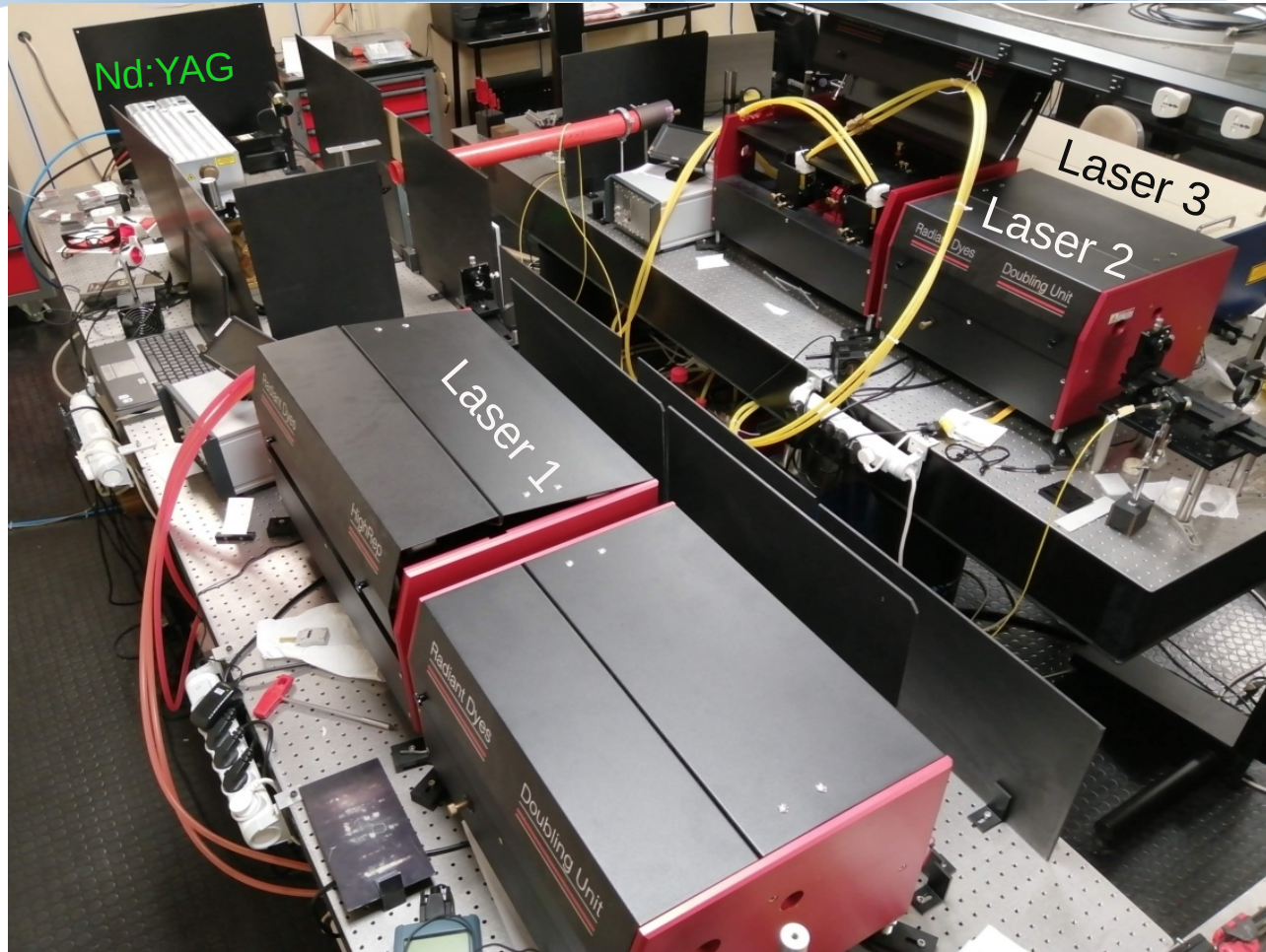


# Laser Resonance Ionization





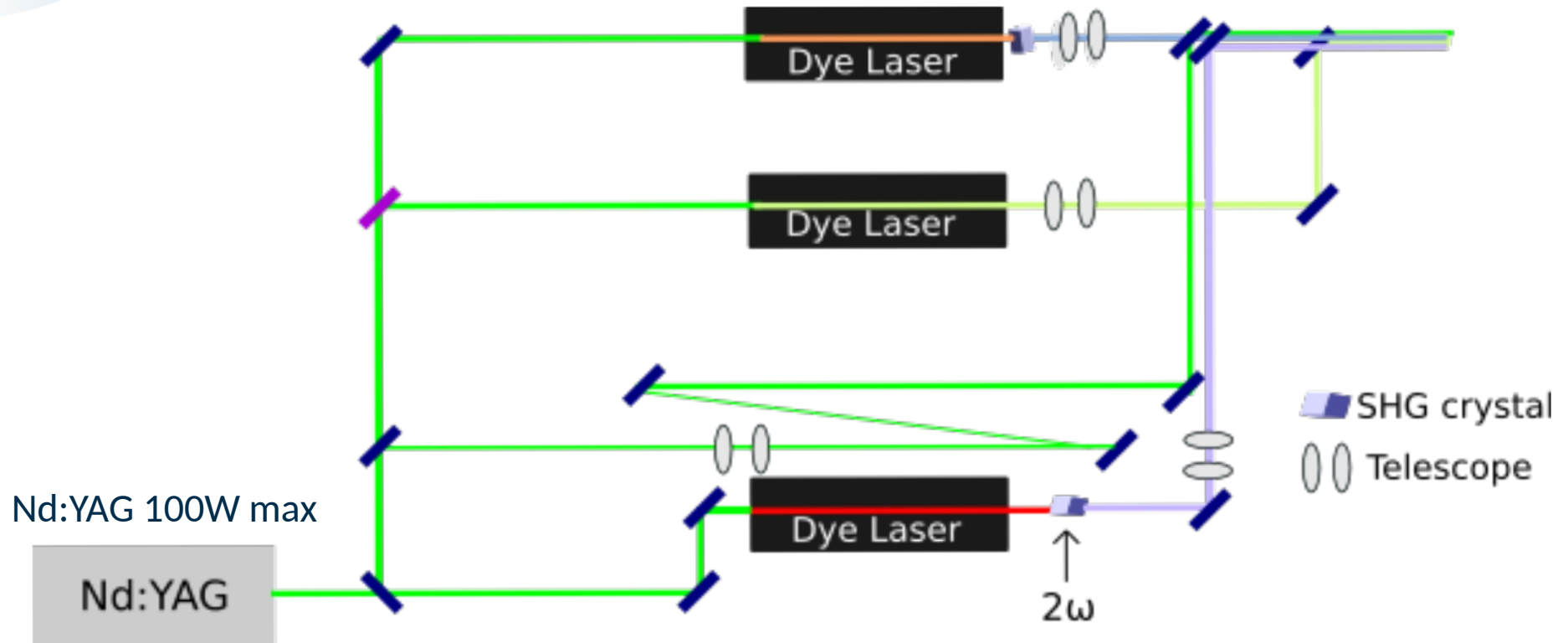
# RIALTO facility



2 high power Nd:YAG (532 nm, 100W and 35W)  
3 dye lasers (540–850nm) with BBO doubling units(270–425nm)



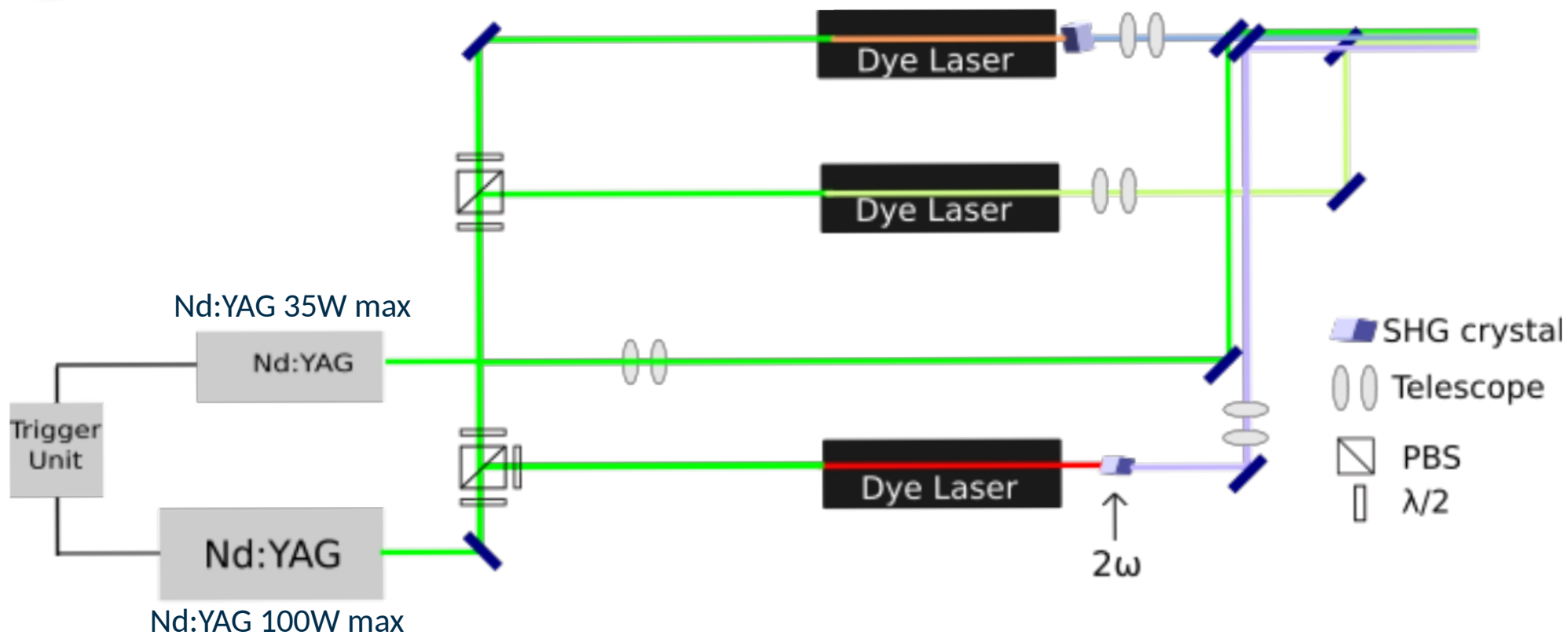
## RIALTO « Old » layout







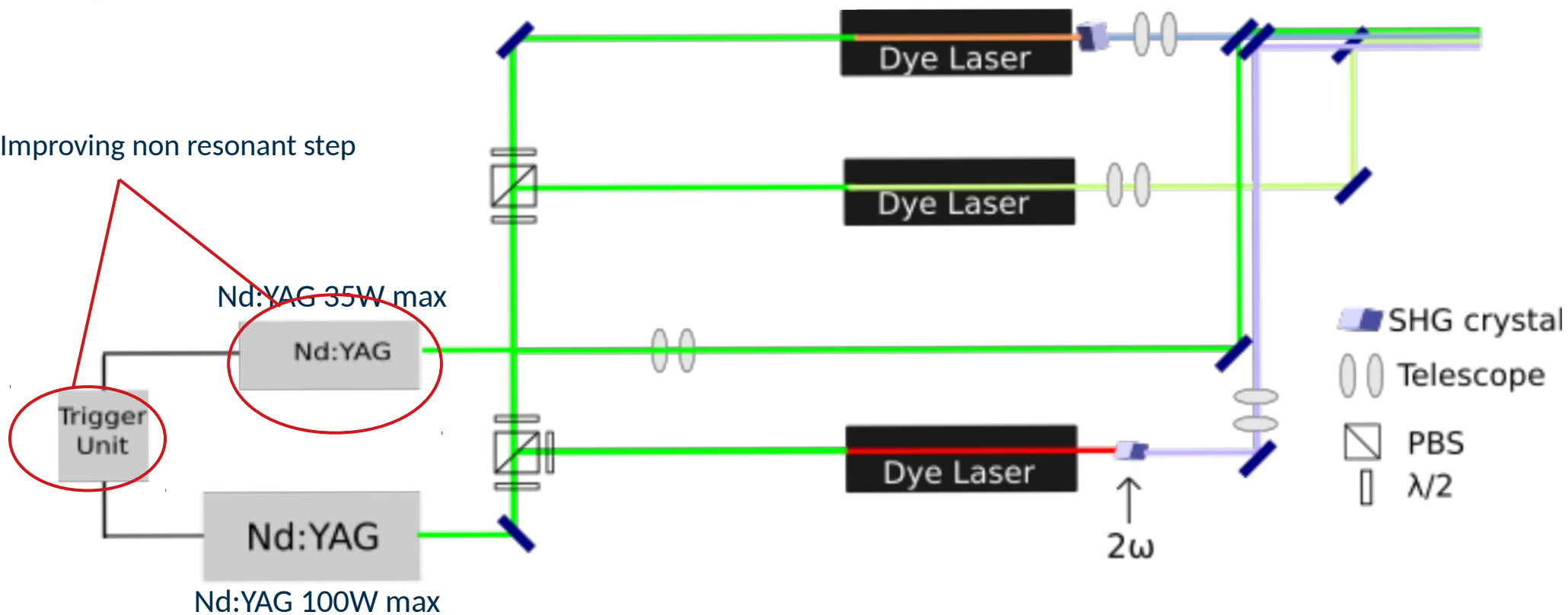
# RIALTO upgraded layout





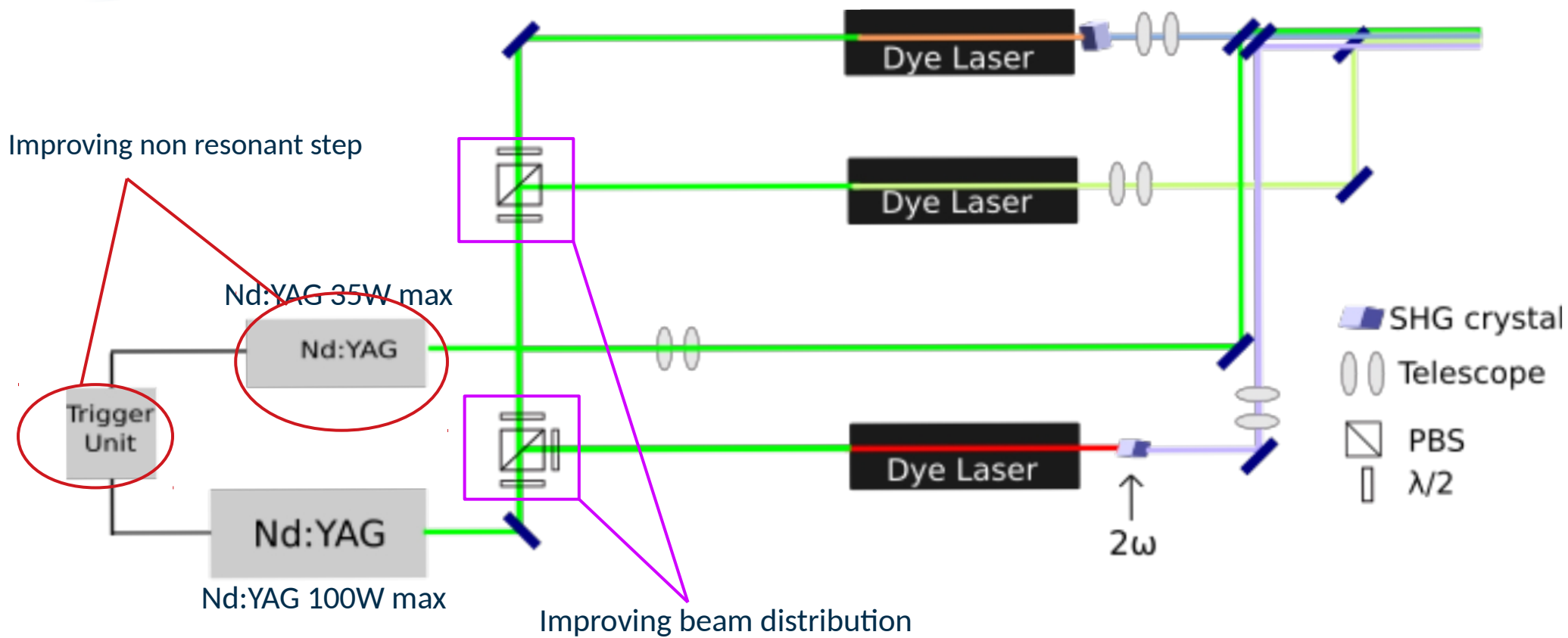
# RIALTO upgraded layout

Improving non resonant step



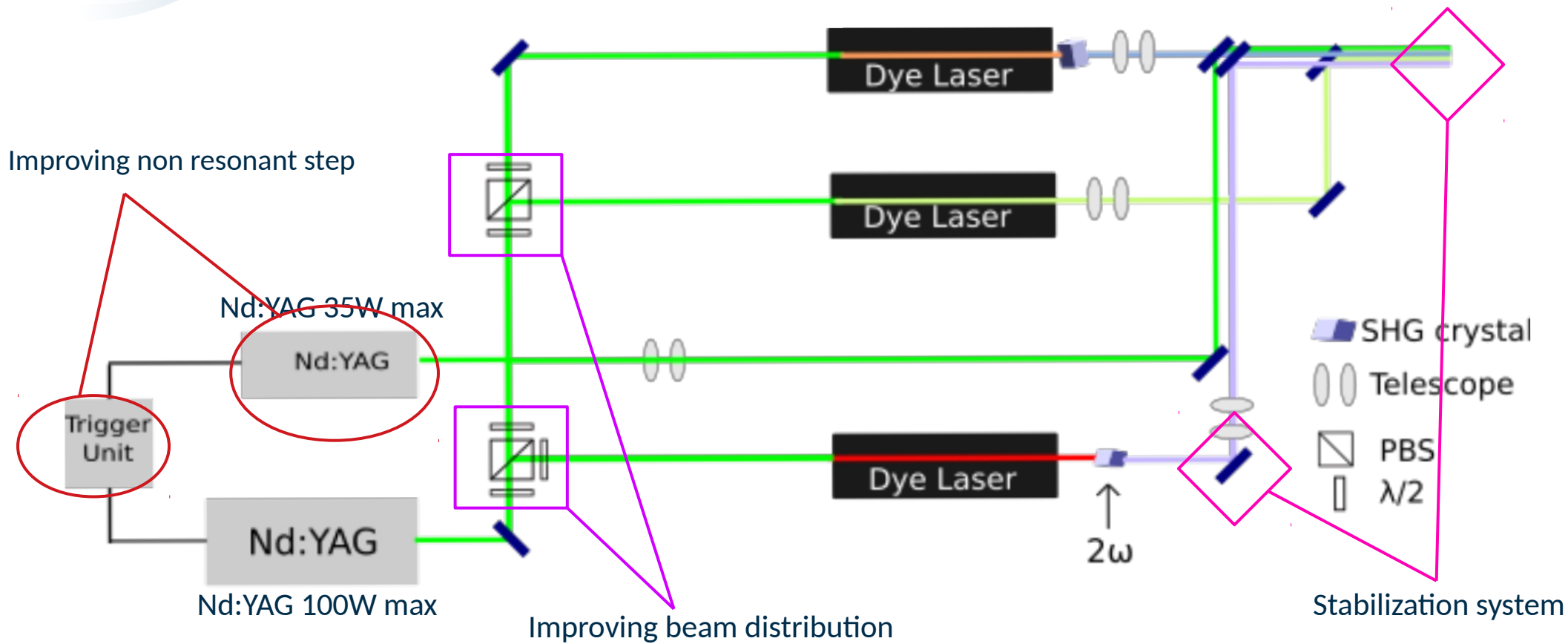


# RIALTO upgraded layout





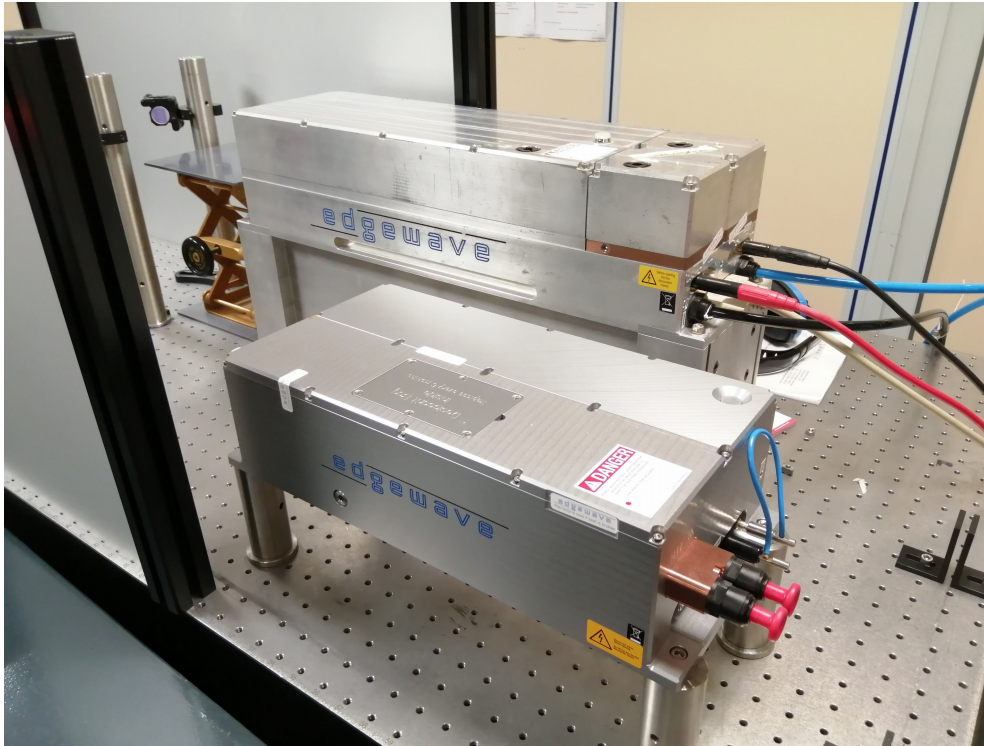
# RIALTO upgraded layout







# RIALTO Upgrades. YAG laser and trigger unit

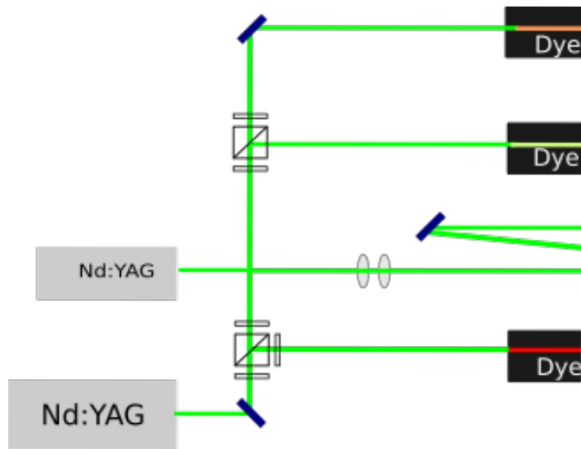


- Up to 35 W (63 A)
- Gaussian profile for ionization step
- Temporal synchronization with new trigger unit

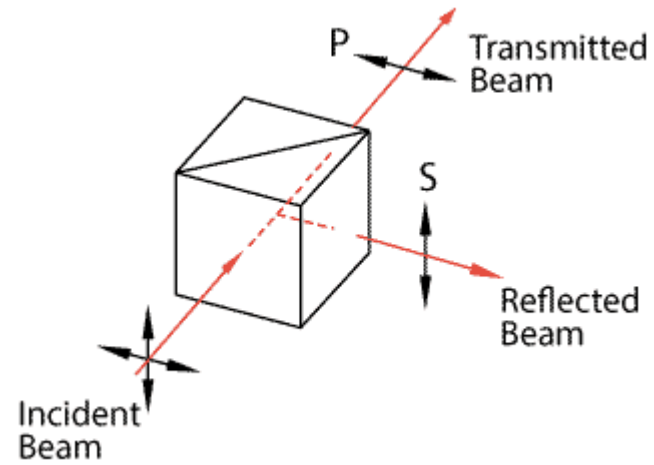




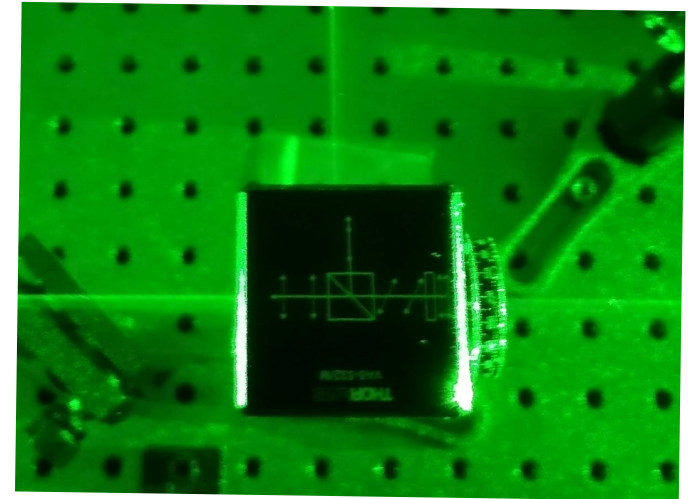
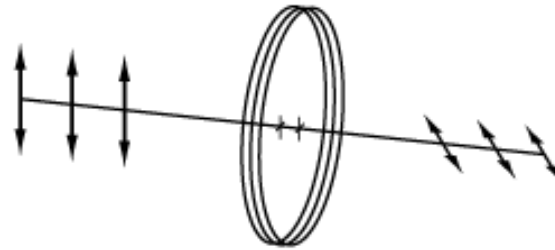
# RIALTO Upgrades. Beam Distribution



Polarizing Beam Splitter (PBS)

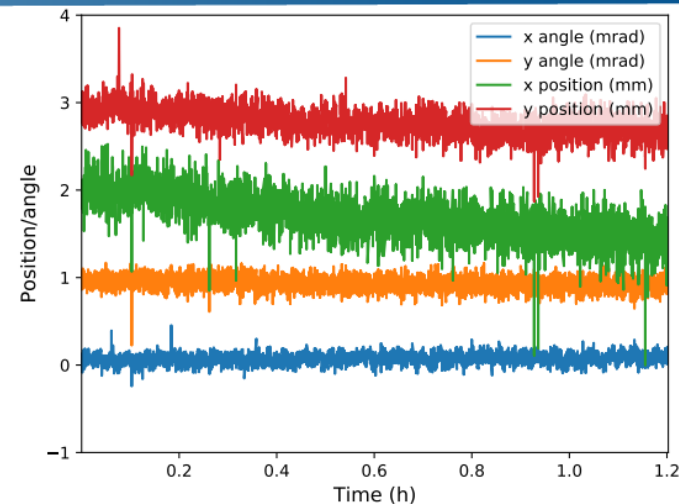
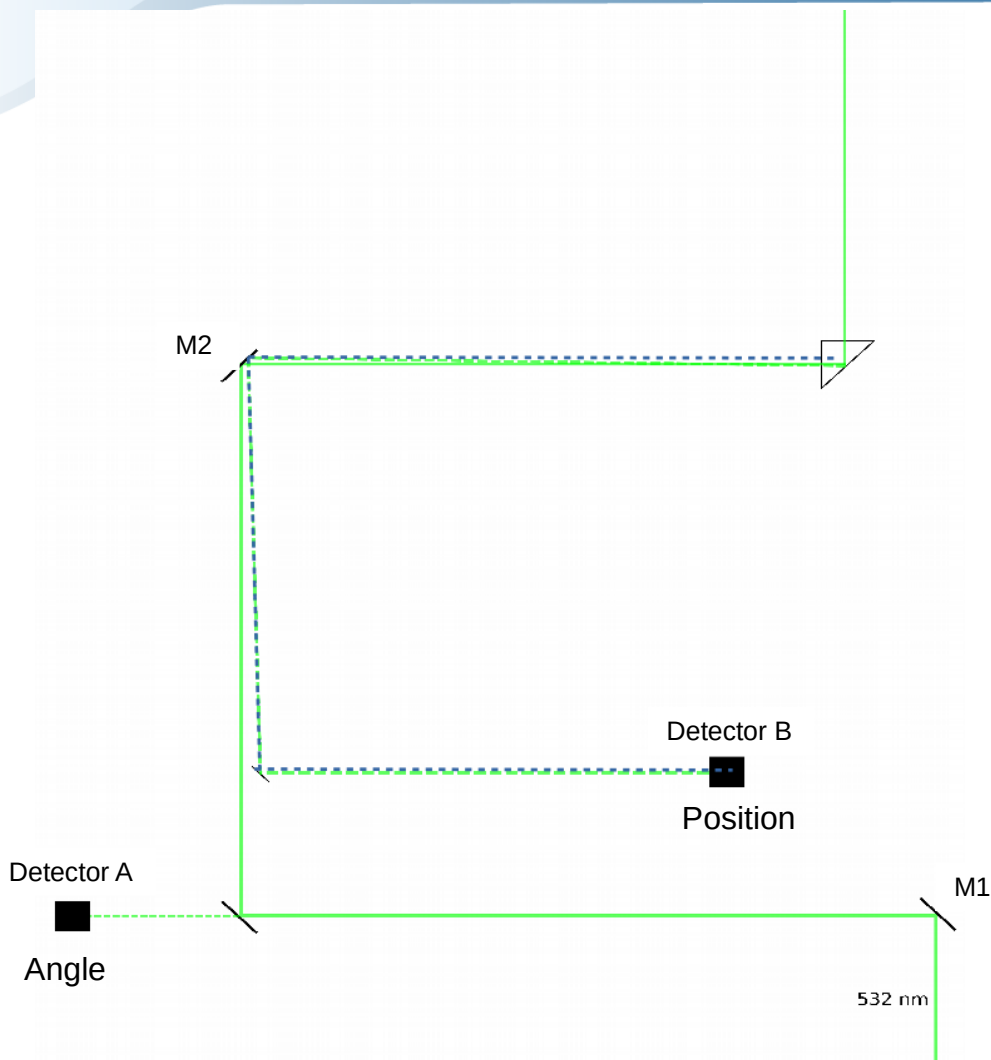


Waveplate

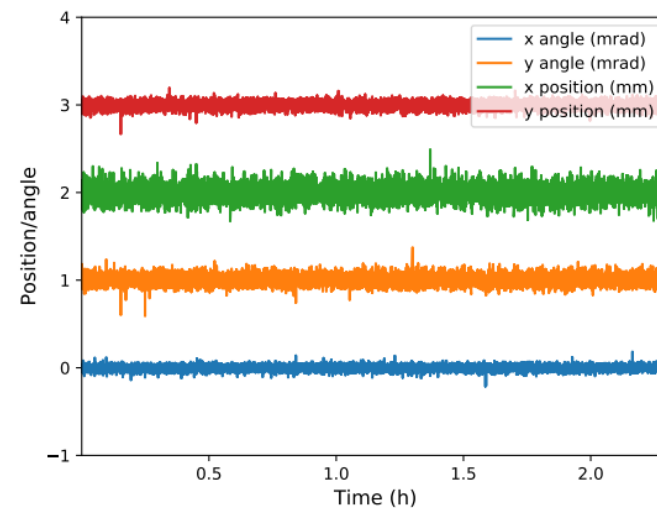




# Beam Stabilization System



YAG position without stabilization system



YAG position with stabilization system



- **Improving the quality of the non resonant step**
  - 2nd YAG laser and external trigger unit
- **Beam Distribution System that allows changing schemes.**
  - Cube beam splitters and waveplates.
- **Beam Stabilization System.**





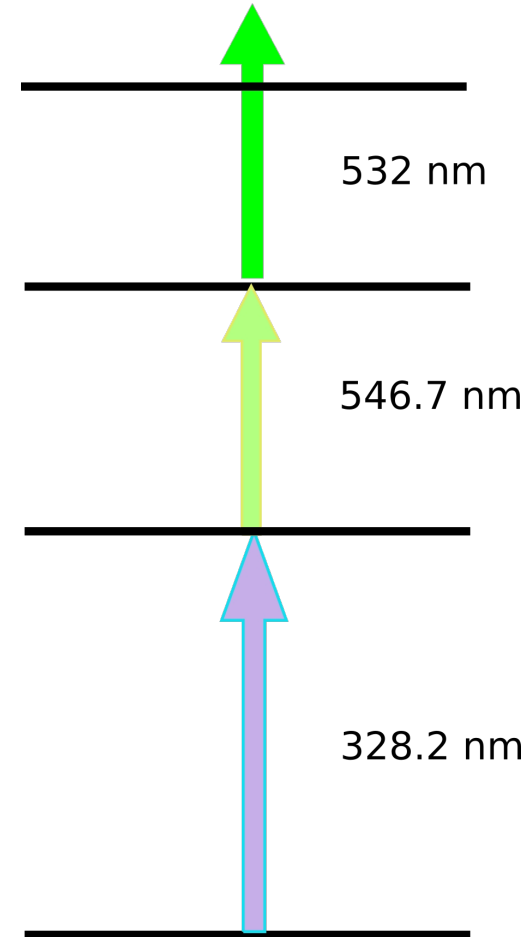
# Silver Ionization Scheme

- **Challenging Scheme**

- ♦ 3 step-3 color scheme  
with no resonant last step
- ♦ Green laser (second step)
- ♦ UV first step

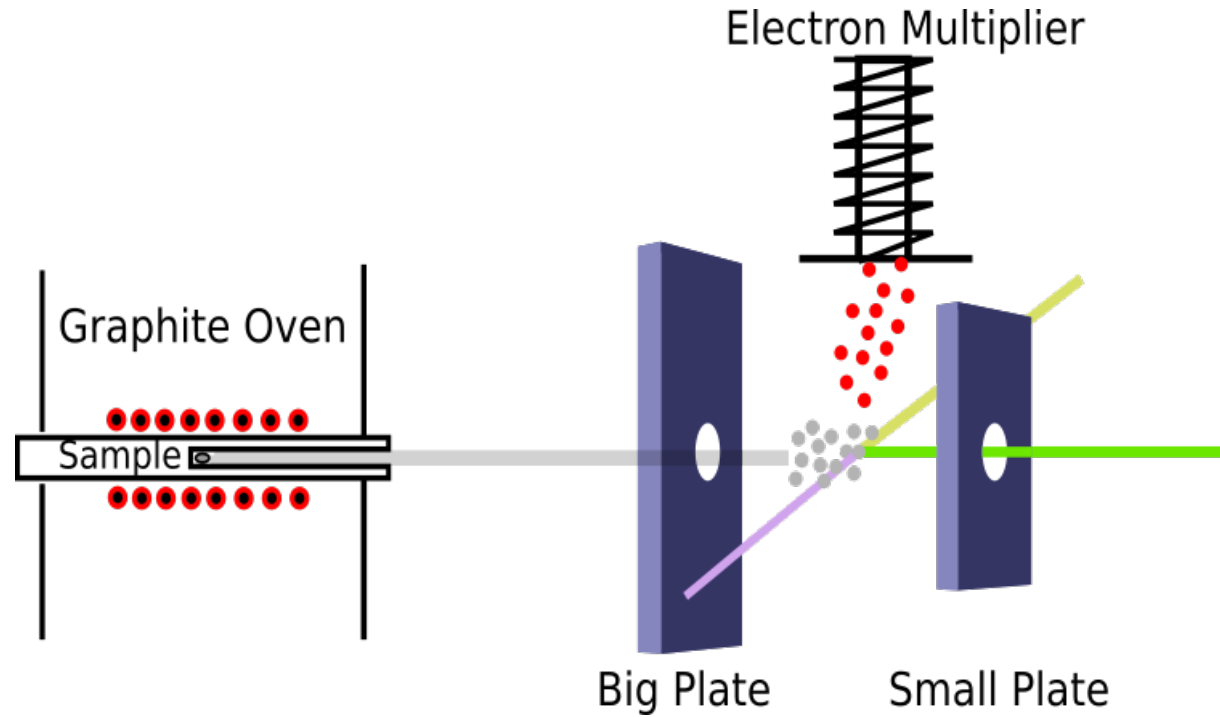
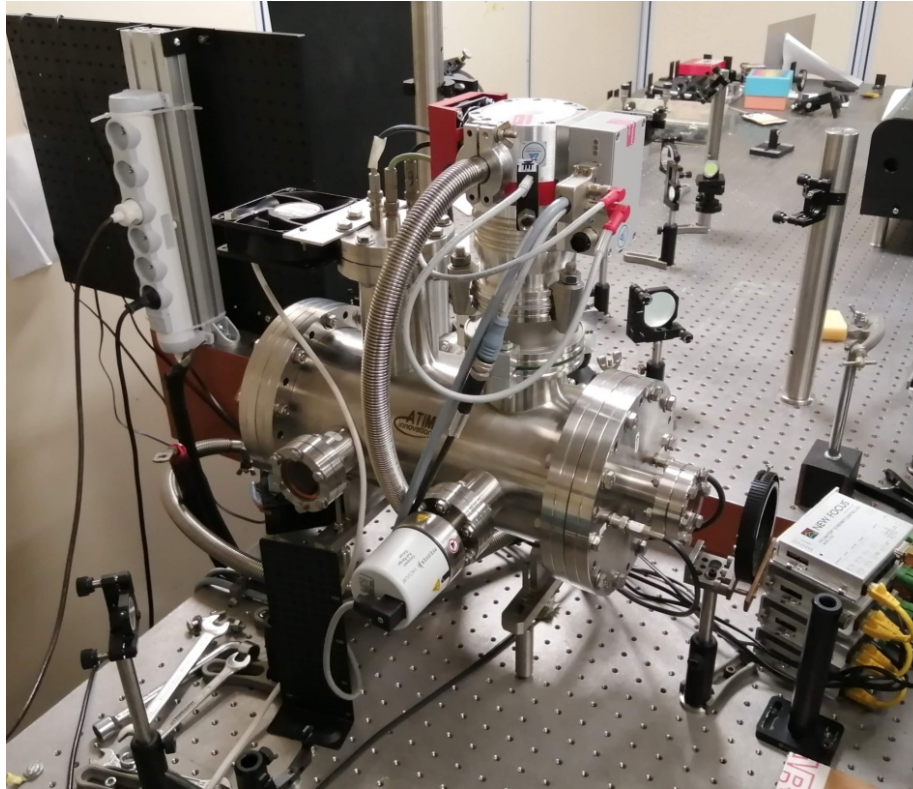
- **Motivation**

- ♦ POLAREX (LTNO)  
POLARization of EXotic nuclei with On-Line Nuclear Orientation
- ♦ MLLTrap
- ♦ LINO
- ♦ BEDO
- ♦ ...



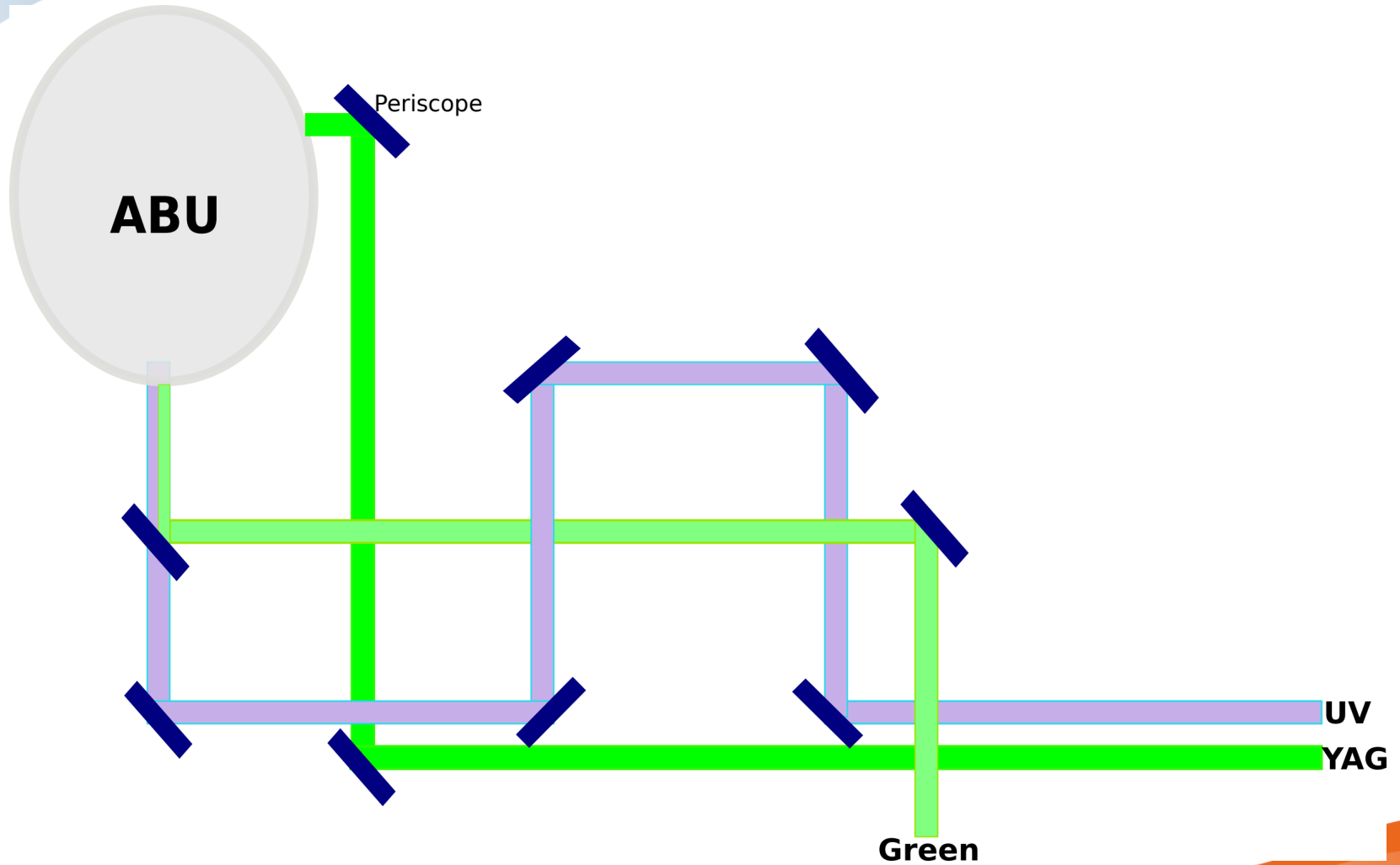


# Atomic Beam Unit (ABU)



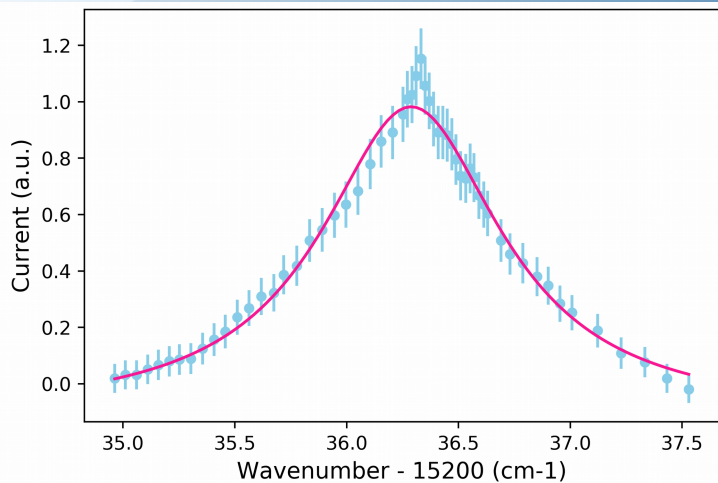


# Ag Test. Transversal configuration

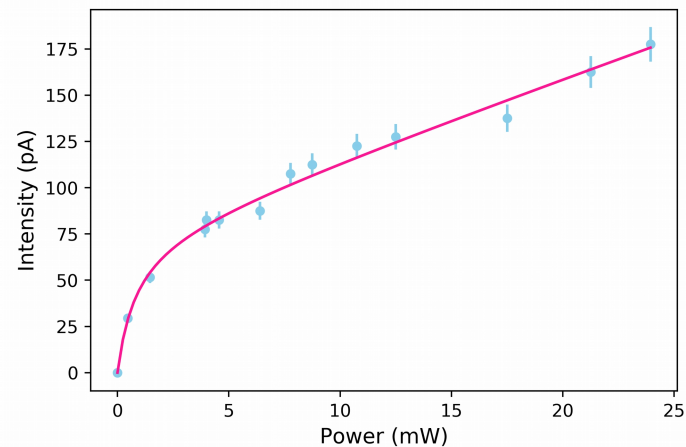




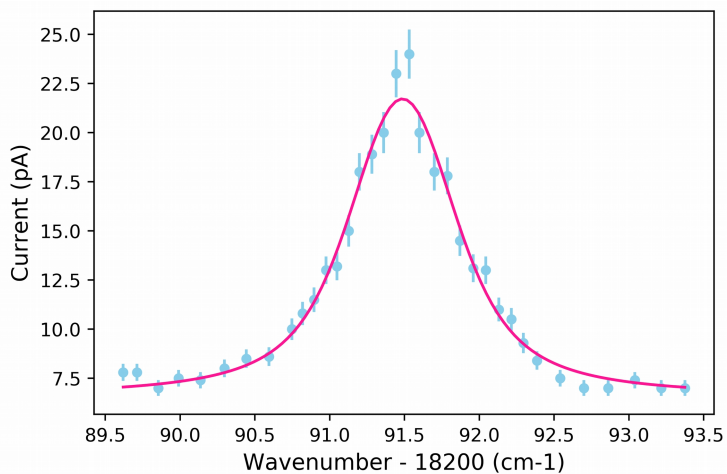
# Wavelength scan and saturation power



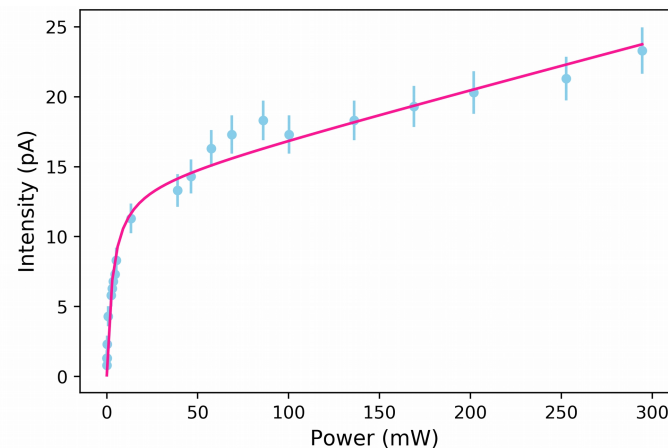
Wavelength scan for the first excitation step.



First step saturation curve. Saturation power  $0.83 \text{ mW} \pm 0.12$



Wavelength scan for the second excitation step.

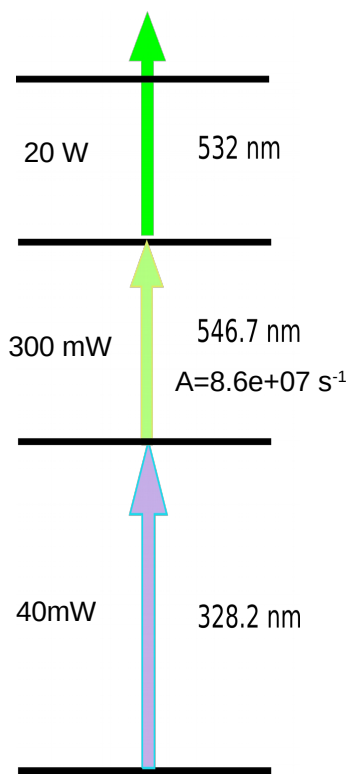


Second step saturation curve. Saturation power  $3.28 \text{ mW} \pm 0.81$



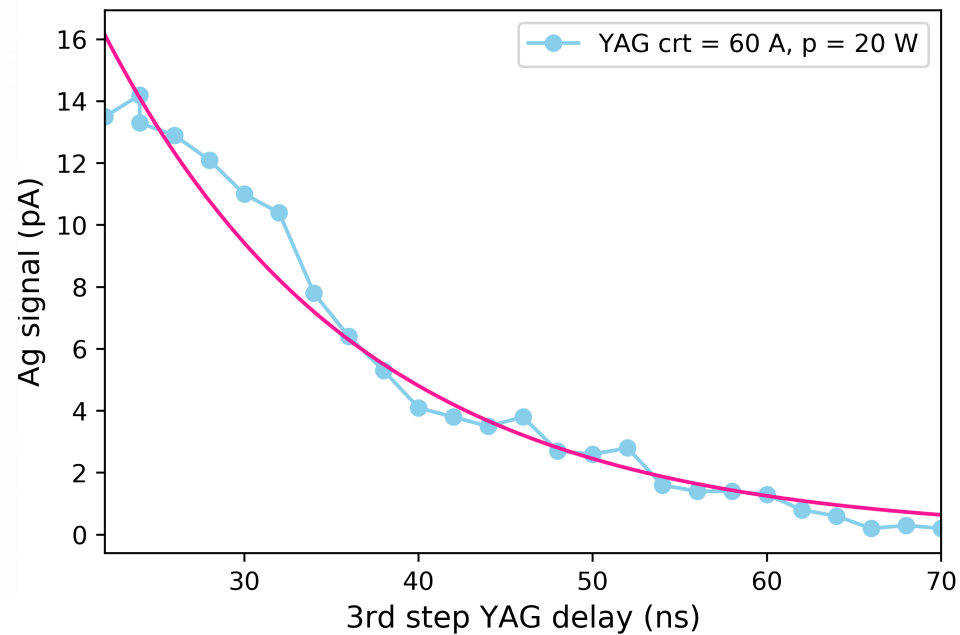
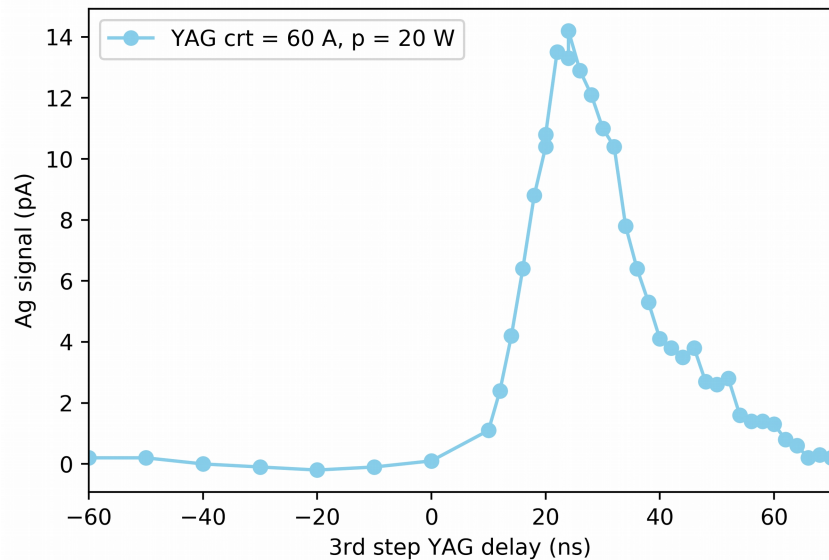


# YAG Delay



$$\frac{1}{A} \approx 11 \text{ ns}$$

YAG Decay time  $\approx 14 \text{ ns}$





# Summary

- Upgrade of RIALTO
  - New YAG with external trigger unit
  - Beam distribution
  - Stabilization System
- Ag off-line production
  - Wavelength scan
  - Saturation curves



# Summary

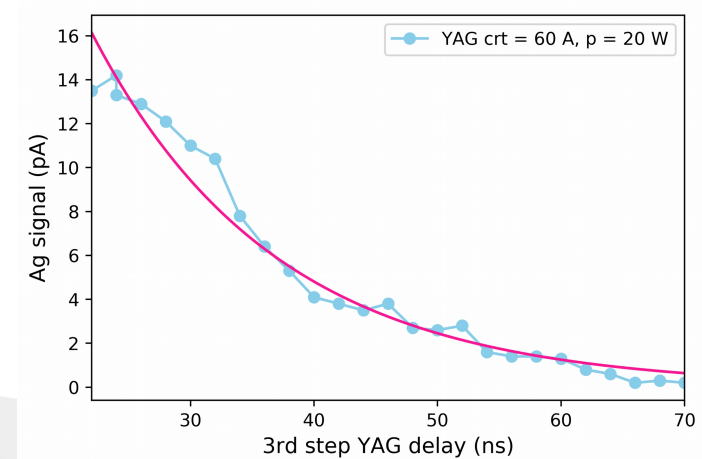
- Upgrade of RIALTO

- New YAG with external trigger unit
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## Temporal overlap





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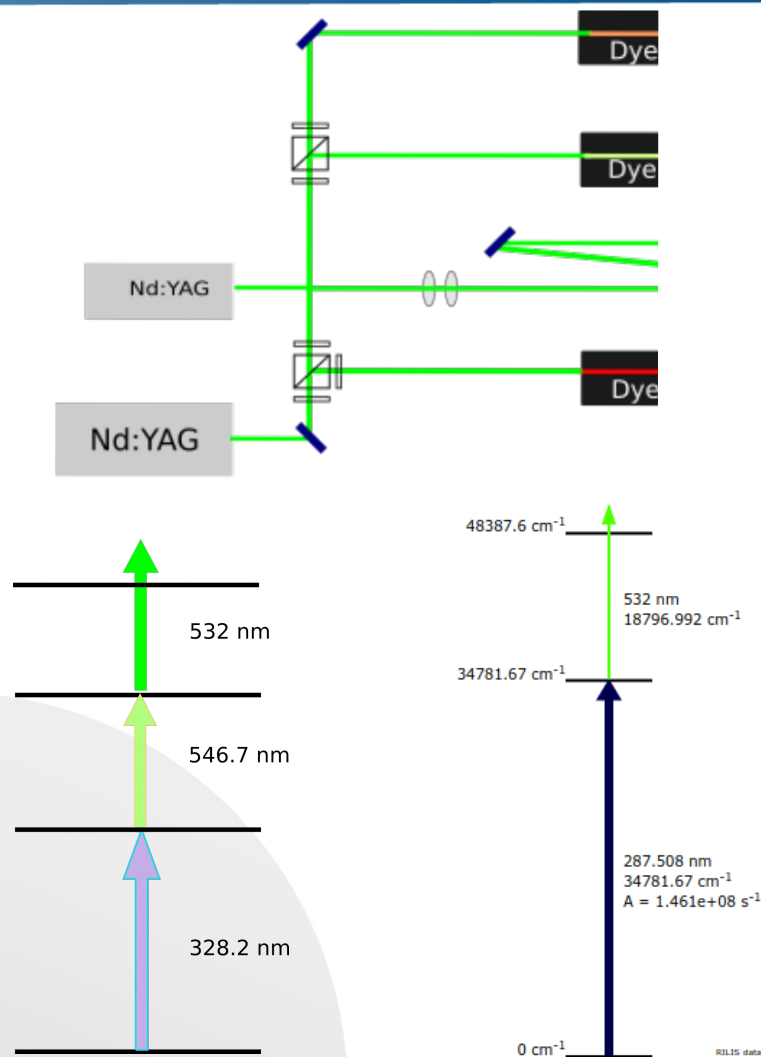
# Summary

- Upgrade of RIALTO

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# Summary

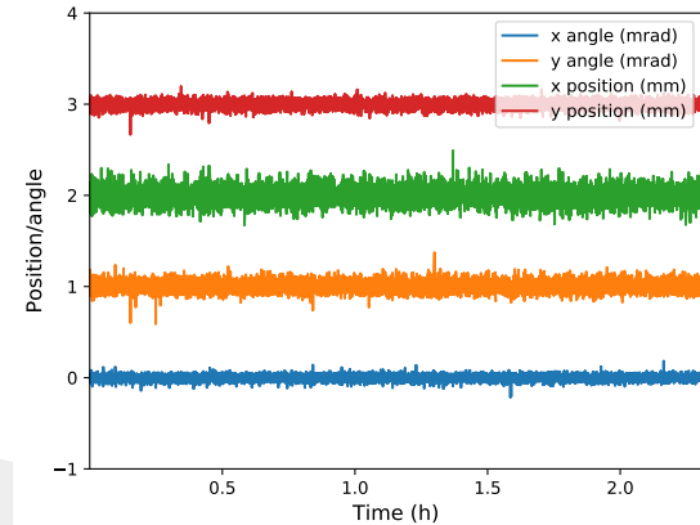
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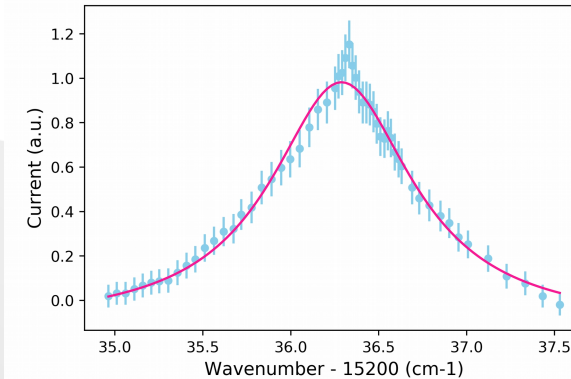
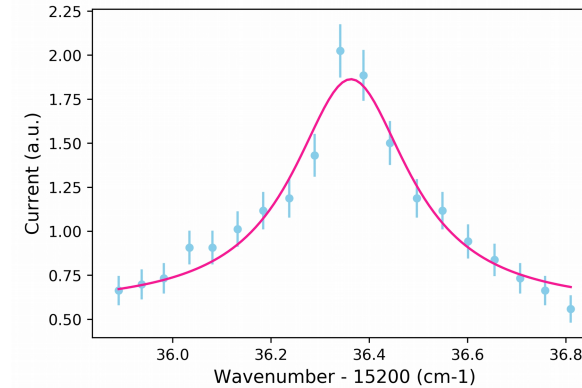


- Upgrade of RIALTO
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# Summary

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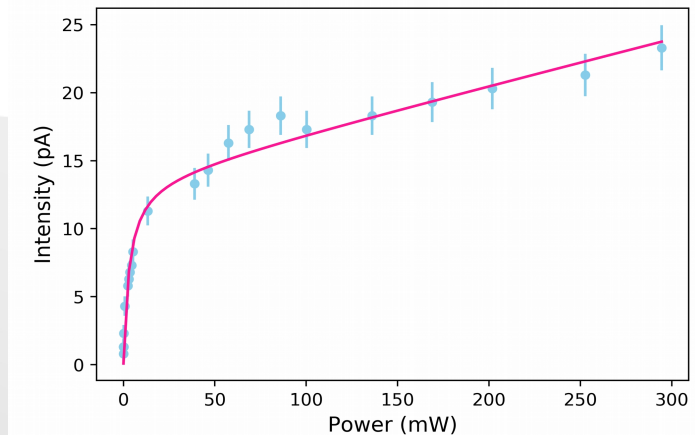
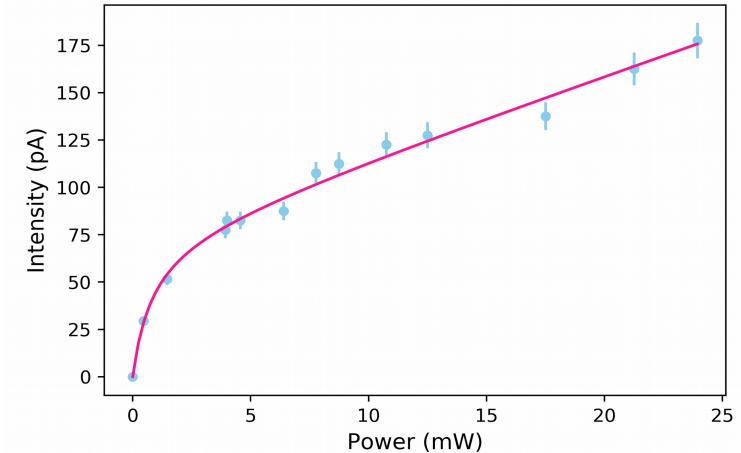
# Summary

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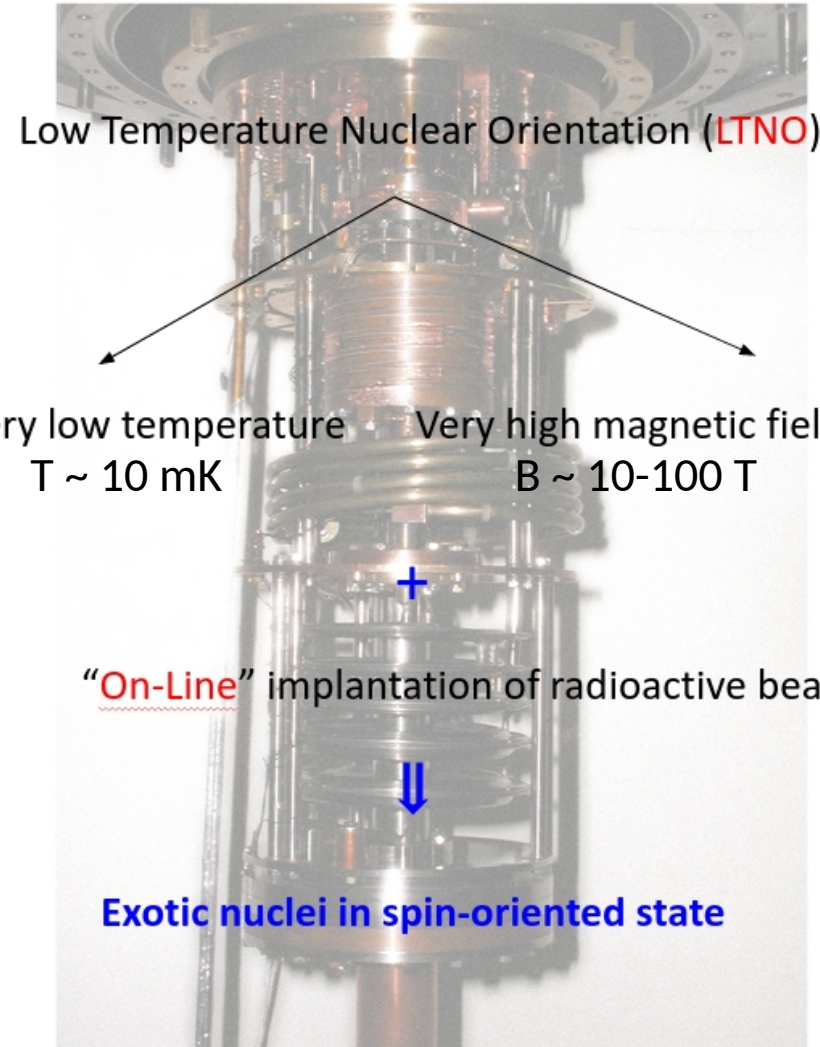
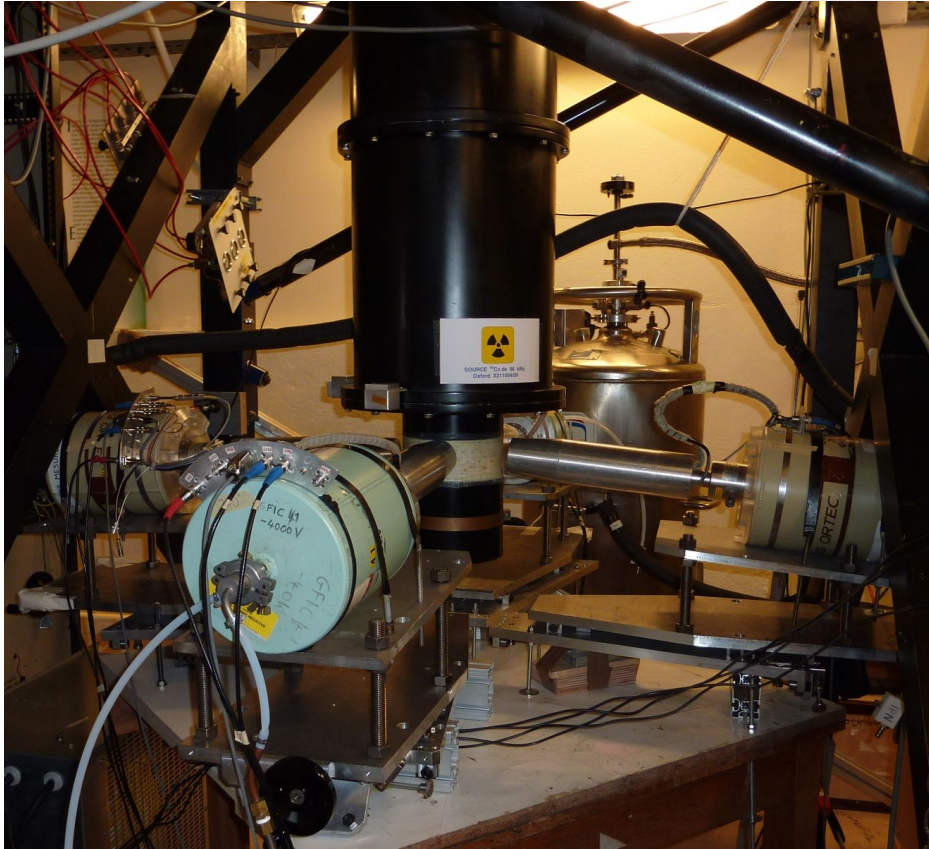


## Outlook

- Online Ag and Ga beams.
- Stabilization system for UV
- Tripling frequency for Sb
- Sb production in ABU
- Zn, Cu, beams...



# POLAREX (POLARized EXotic nuclei)

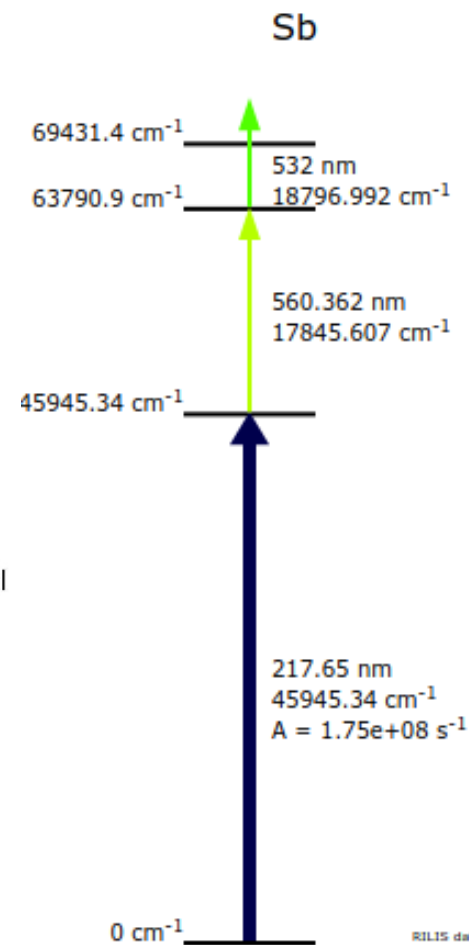
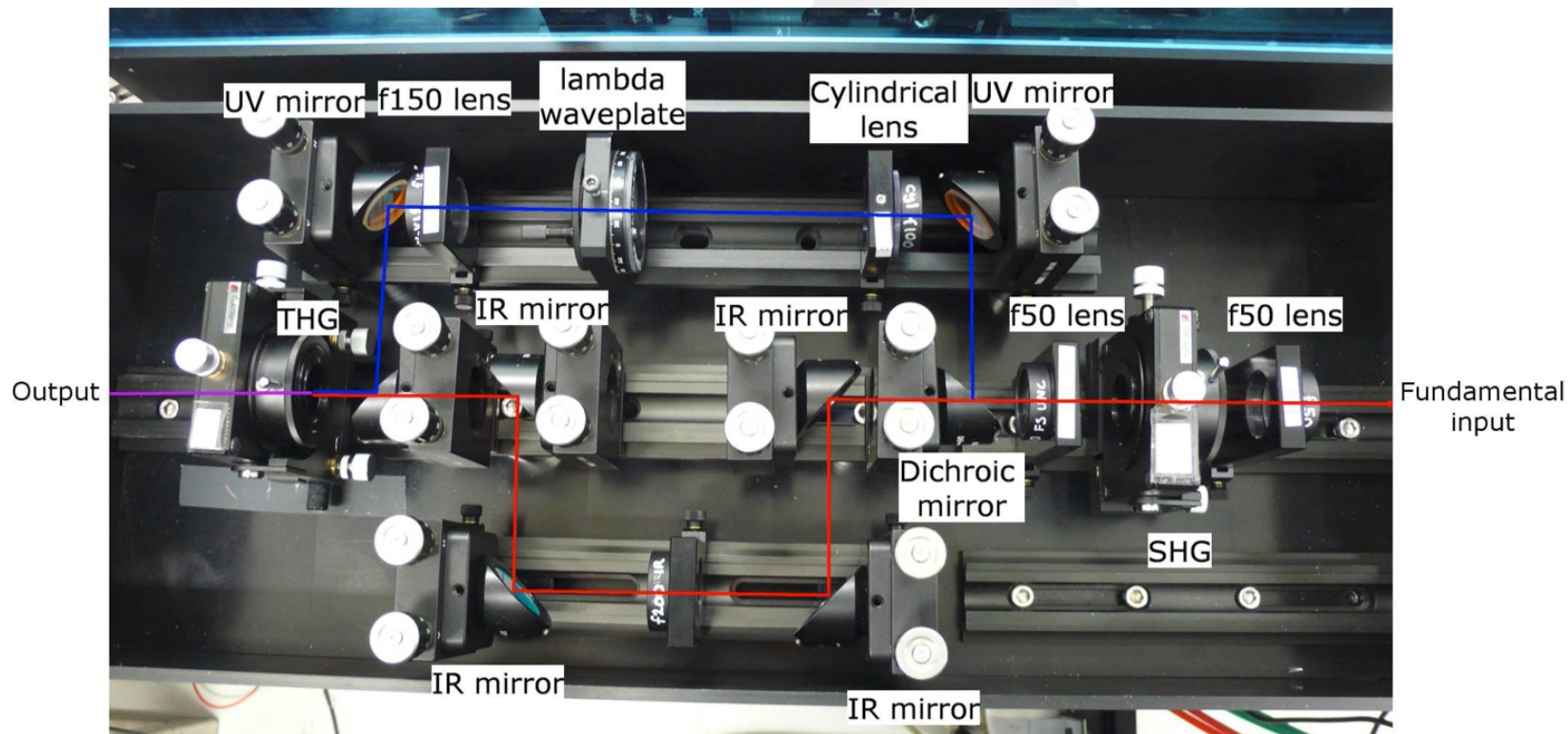




Thank you !



# Back-up



RILIS database

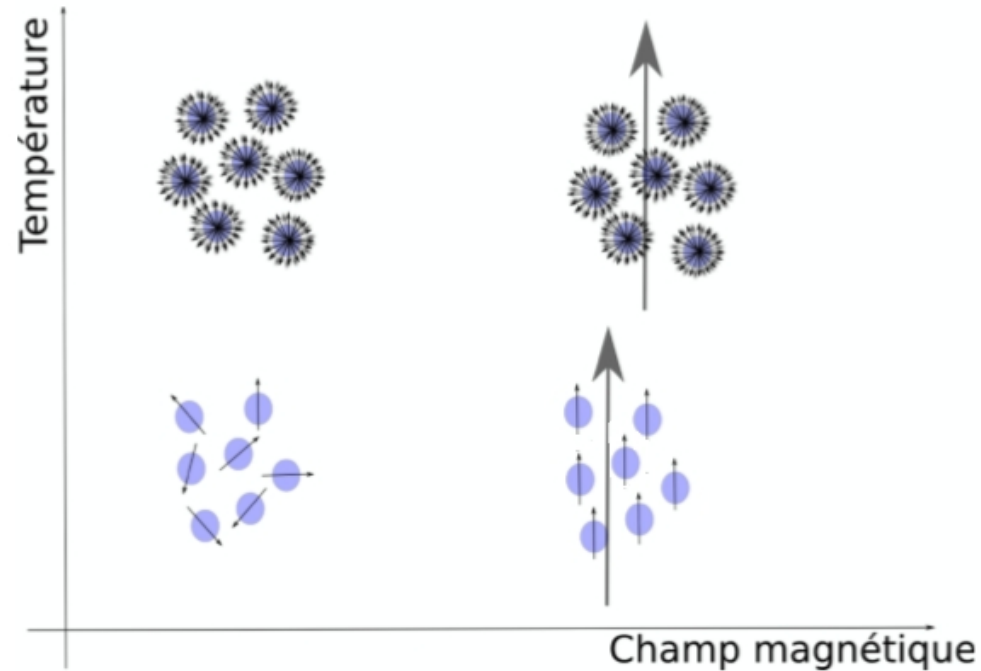


## Low temperature nuclear orientation (LTNO)

Study of magnetic properties of nuclei under extreme conditions of magnetic field and temperature

$T \sim 10 \text{ mK}$

$B \sim 10\text{-}100 \text{ T}$



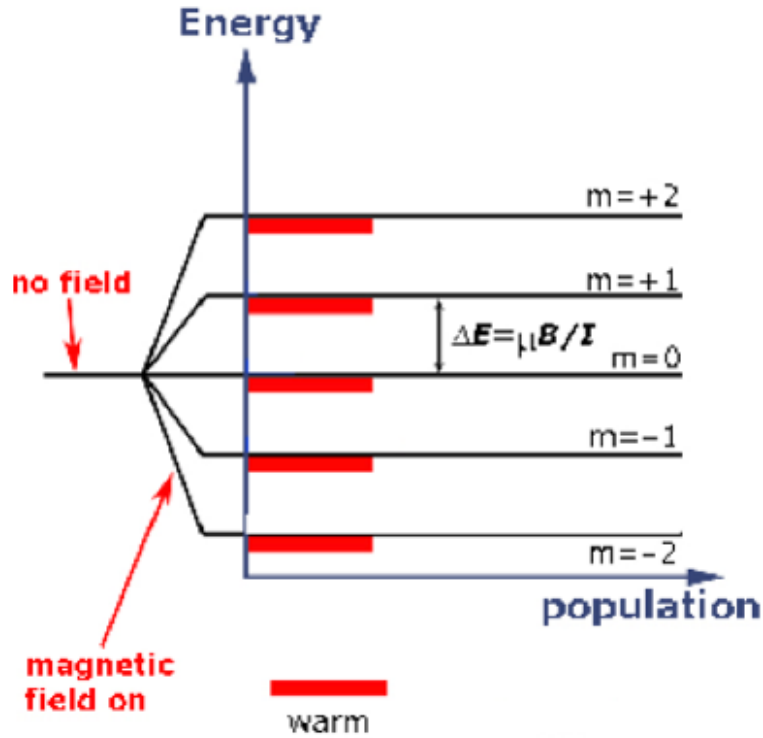




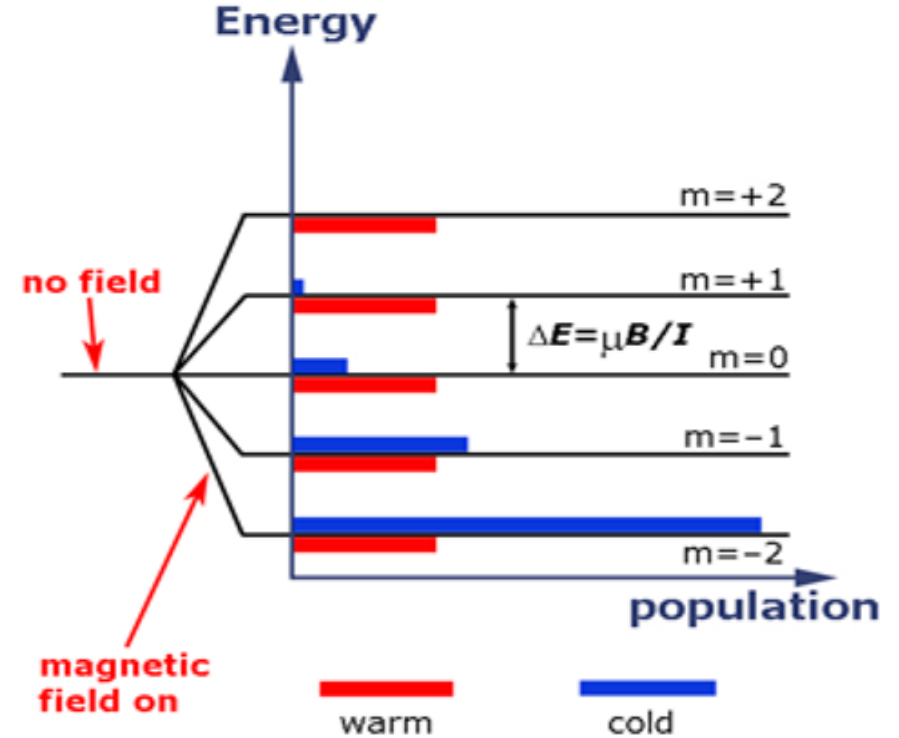
# Principle of LTNO

$$N \propto e^{\frac{\Delta E}{k_b T}}$$

$$B = B_{app} + H_{Hf}$$



Zeeman Splitting

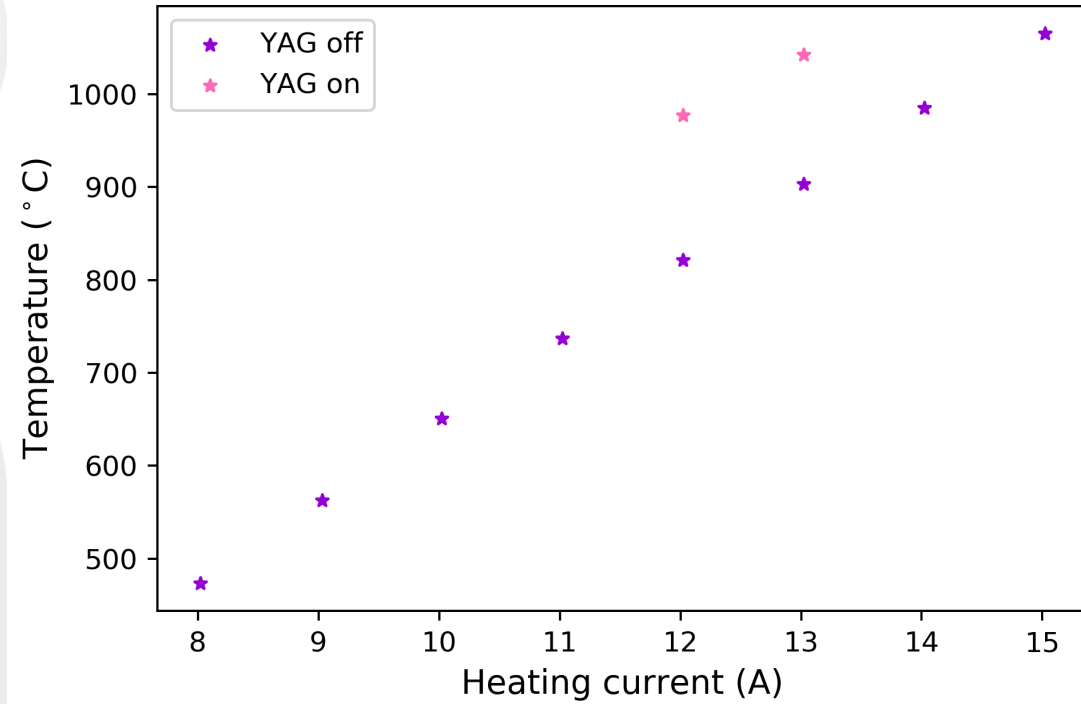
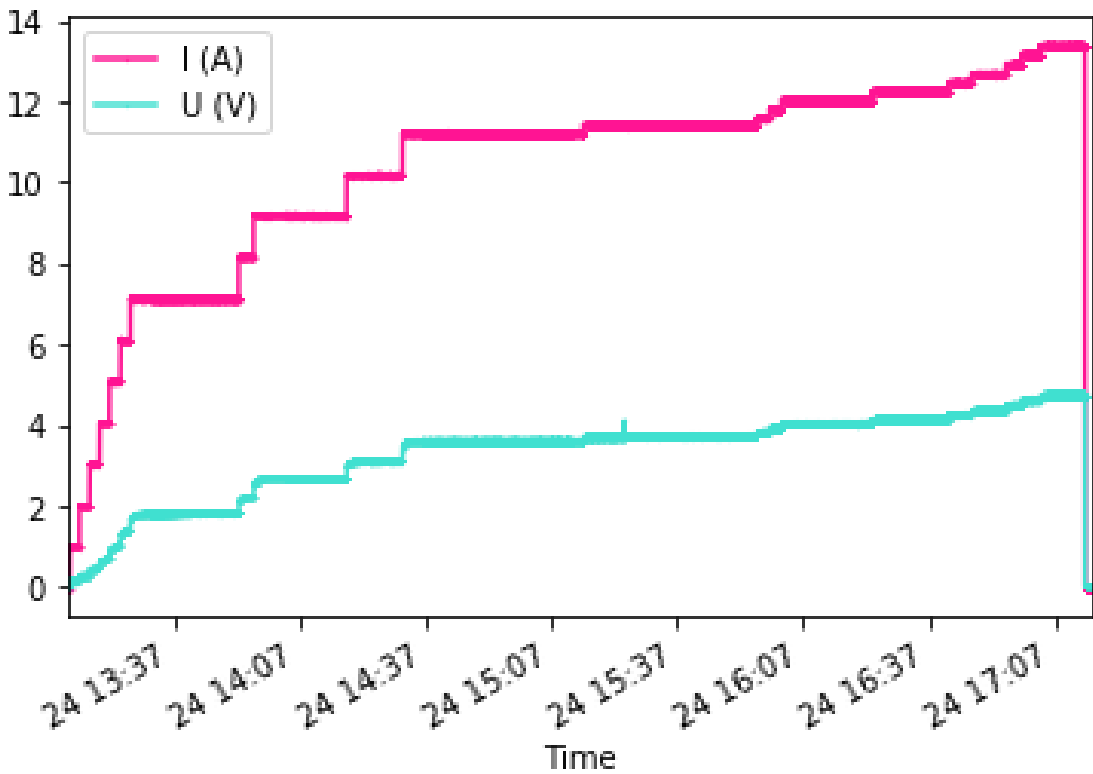


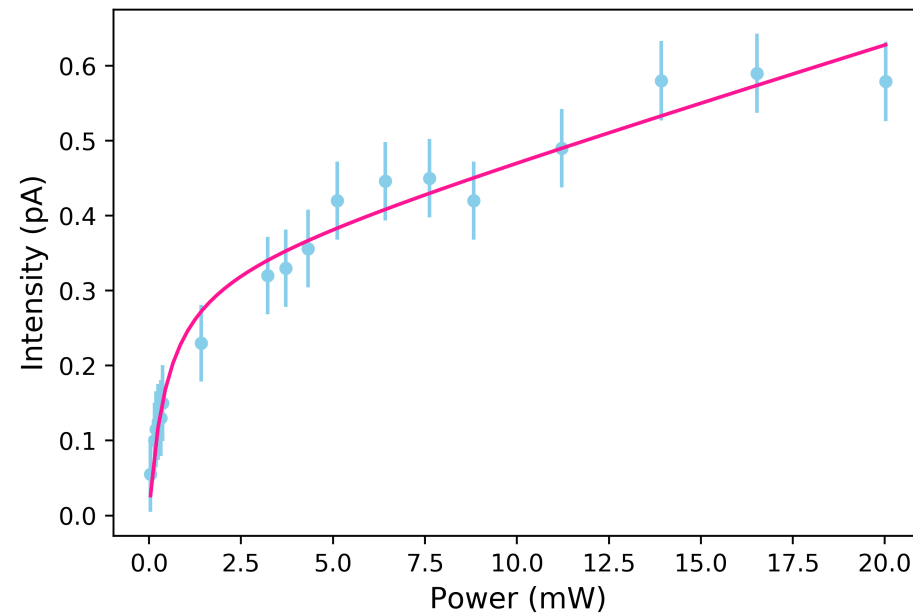
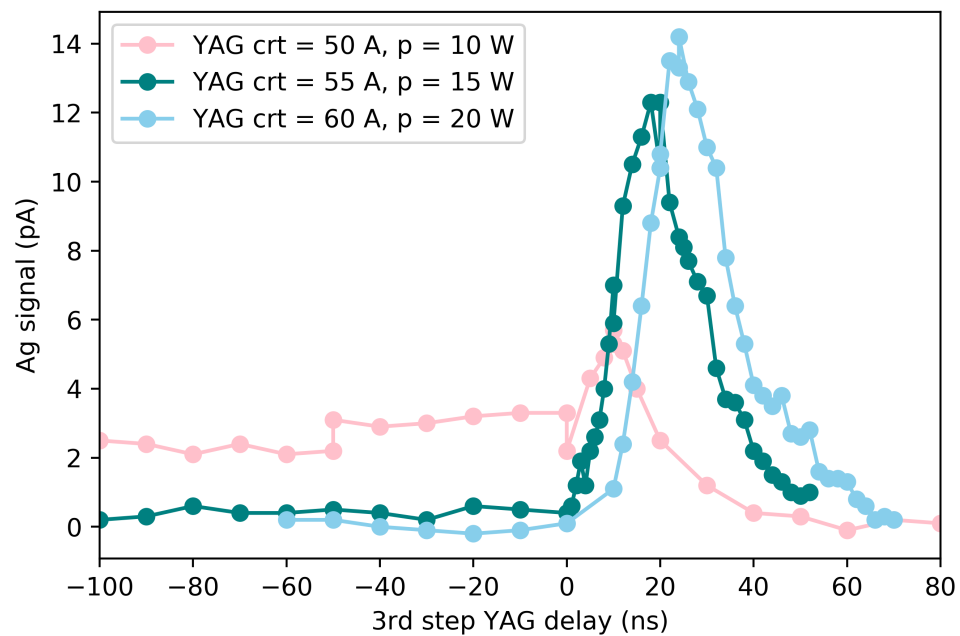
Boltzmann's distribution





# Heating Cycle and YAG heating





**First step saturation curve. Saturation power 4.74 mW**

