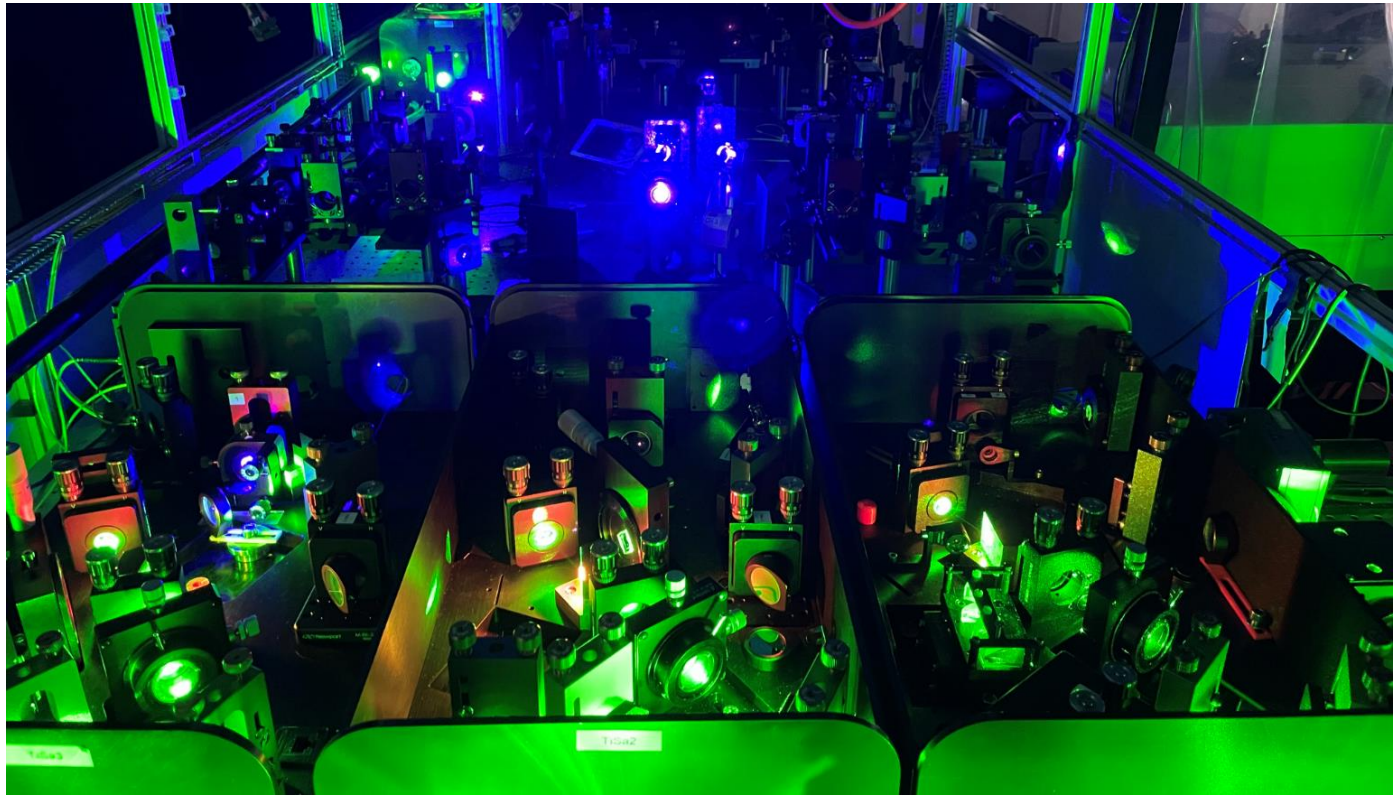
News from RILIS

93rd ISCC - 4th February 2022

Katerina Chrysalidis
On behalf of SY-STI-LP

Agenda

1. Recap of 2021
2. Upgrades 2022
3. Ongoing development
4. The team



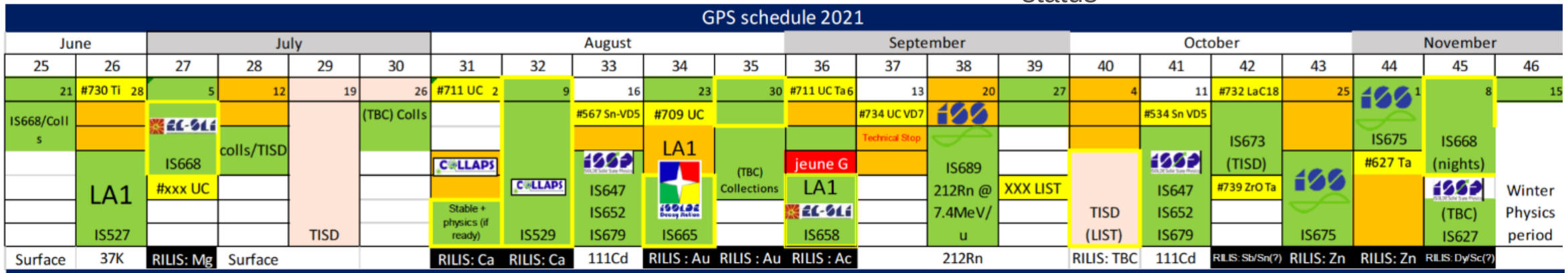
Recap of 2021

A typical RILIS run

Setup of tunable lasers (wavelength, power, stabilization) → setup of optical beam paths to separators → setup of observation system → optimization of laser position, timing and overlap on ion signal → handover → on-call mode starts

1-3 days depending on the wavelengths and lasers used in previous run

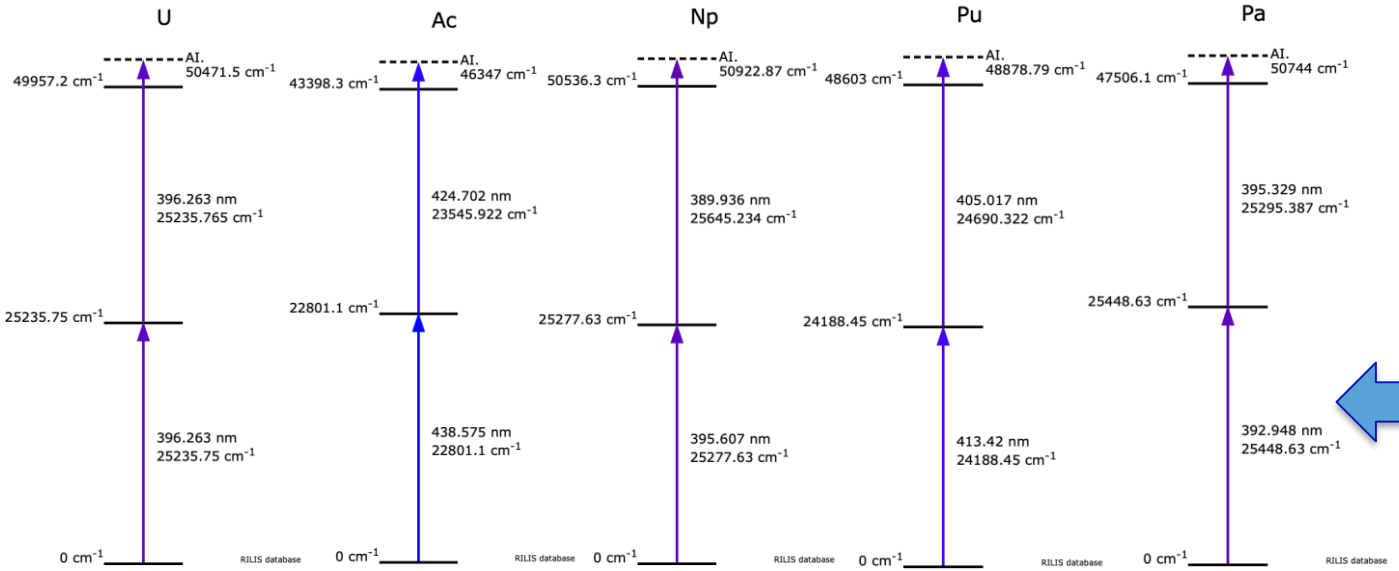
½ -1 day depending on the element and ion beam setup status



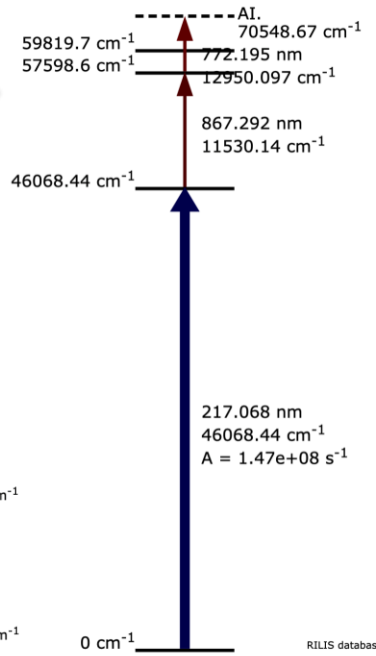
Online statistics

→ Overall **21 weeks out of 23 weeks of ISOLDE operations**

- Elements: Ag, Mg, Cu, Ca, In, Au, Ac, Zn, Pb*, Sb, Dy, Sc, Be
- physics runs: 17
- TISD runs*: 4



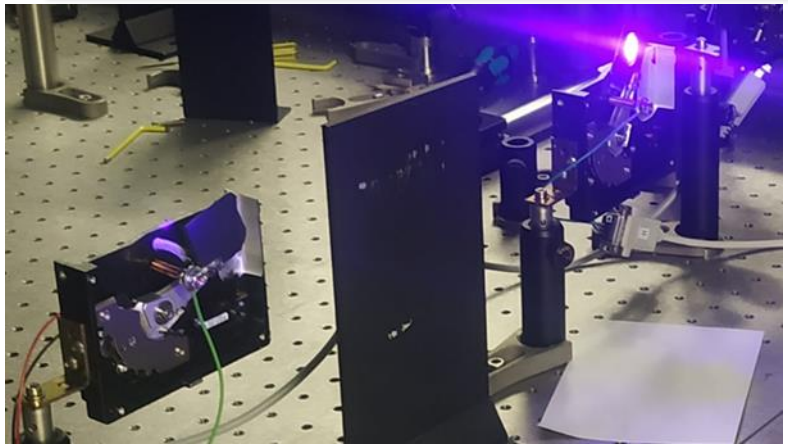
*Pb



- New Pb laser ionization scheme
- Developed Jan 2021 (Master thesis R. Mancheva, Sofia university)
- First used on-line Sep 2021
- Efficiency enhancement by factor 10!

- TISD on Actindes extraction for LISA student projects
- Many actinide schemes tested on-line
- Np, Pu, Ac were seen!
- Additionally molecular extraction tested

Dual separator operation and new laser shutters

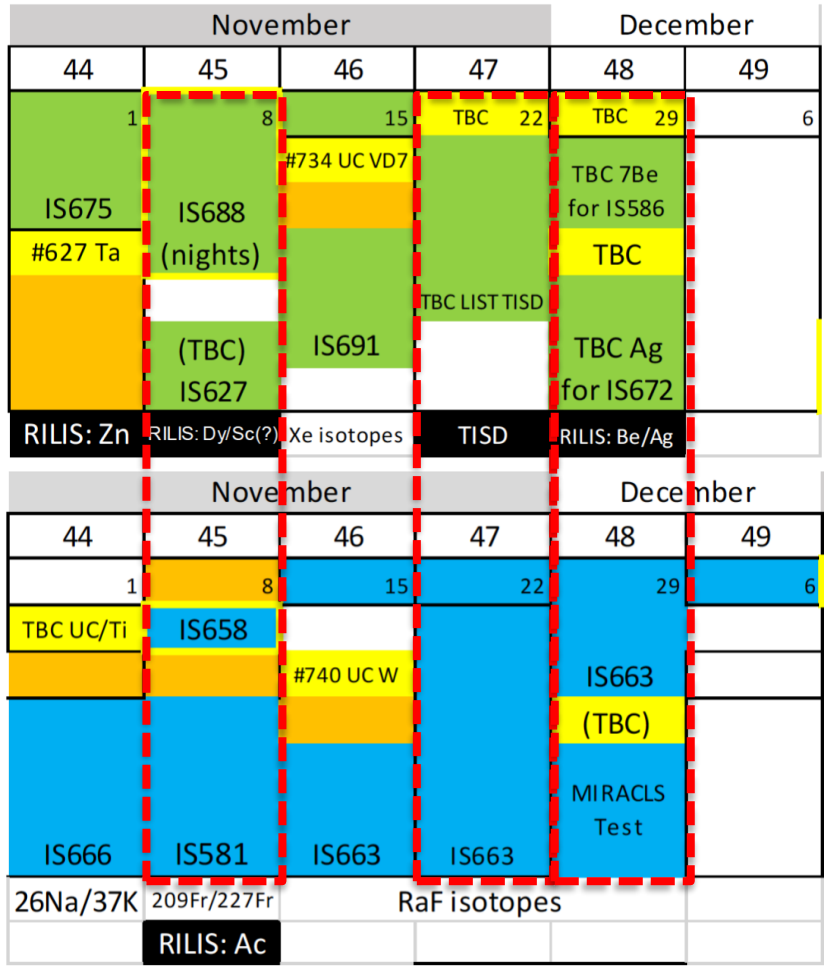


- New design of Laser shutters implemented beginning of 2021
- LabView interface and accessible via ISOLDE control PCs
- Recycled hard drives + Arduino = cheap and reproducible
- Possibility to block multiple lasers
- Useful for dual separator operation!

→ Used throughout 2021 by all RILIS users

Student project G. Stoikos

GPS



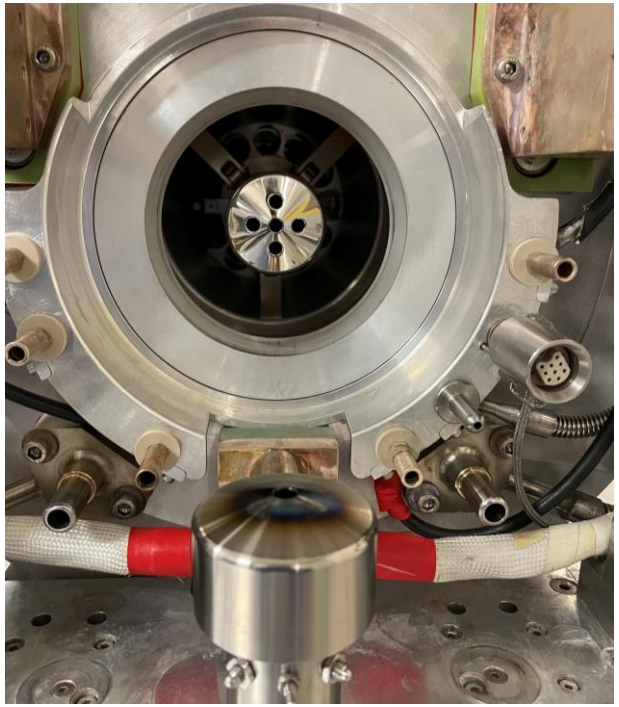
HRS

- Upgraded observation& stabilization System
- Built during LS2 by S. Wilkins and finally tested at the end of 2021
- Delivery of Dy and Ac (day/nights, no time wasted on switching)
- Delivery of 532nm laser beam for RaF in parallel to LIST developments

→ Decreases setup time

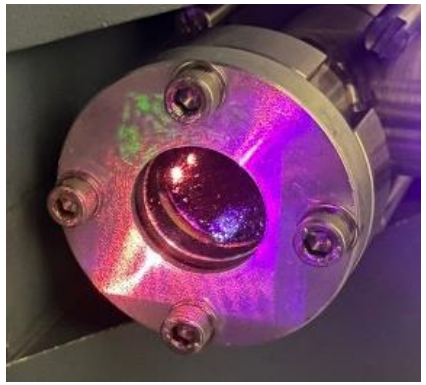
→ opens up possibility of using GHM/GLM whilst taking beam from HRS with RILIS

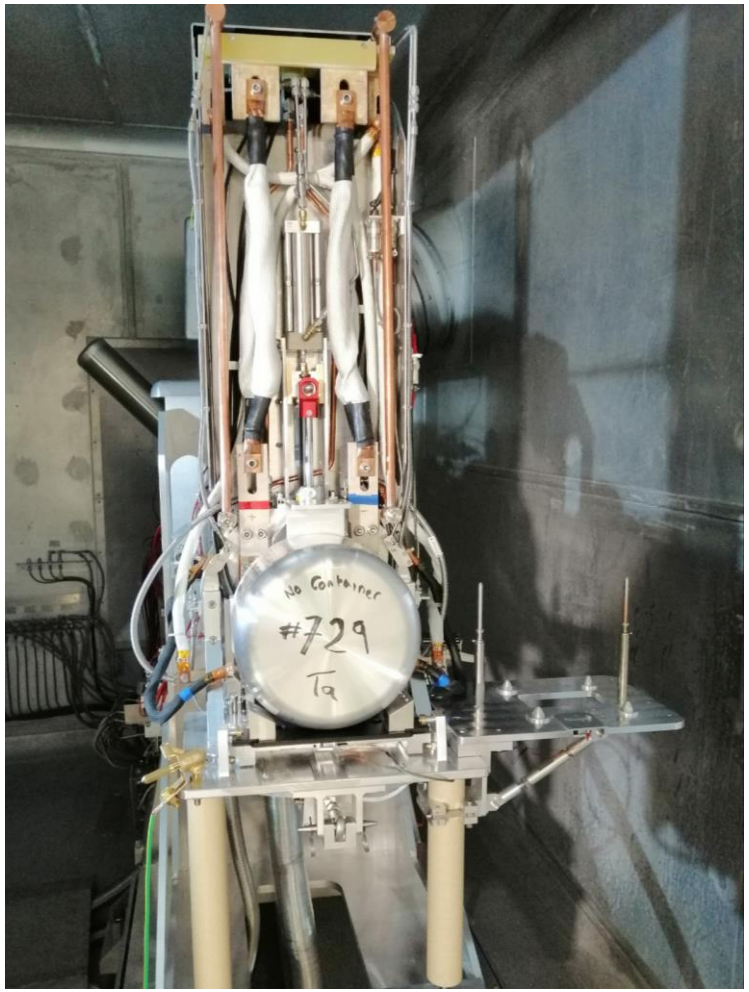
LIST compatibility with ISOLDE FE



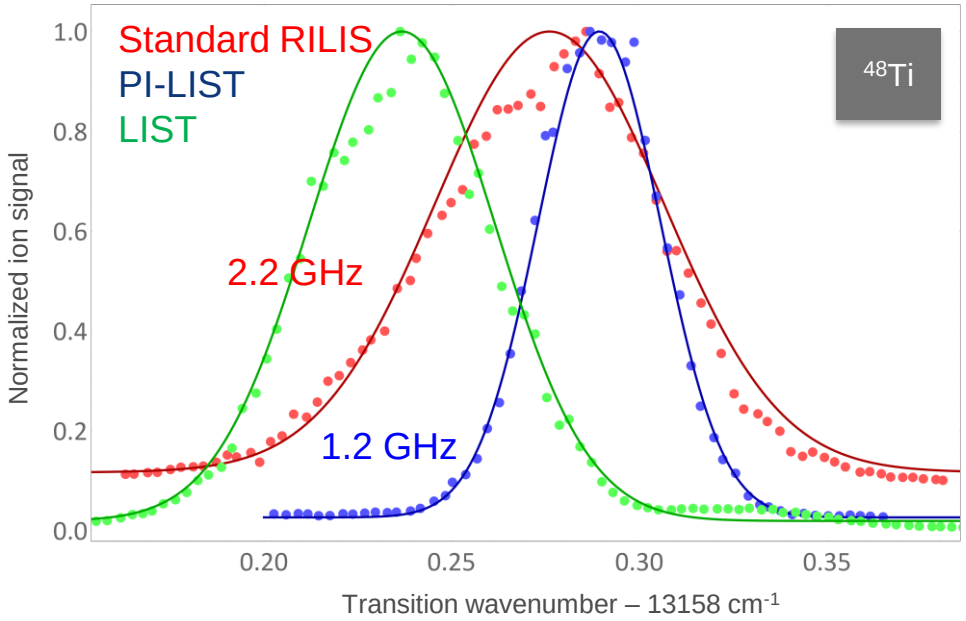
- New extraction electrodes with additional holes for PI-LIST mode
- Tested during 2021 operation → no difference in operation
- New electrodes installed in January 2022 on both HRS and GPS
- Installation of RF guides on GPS → fully tested and working well
- Installation of RF guides on HRS January 2022

→ Ready for LIST on both Front Ends





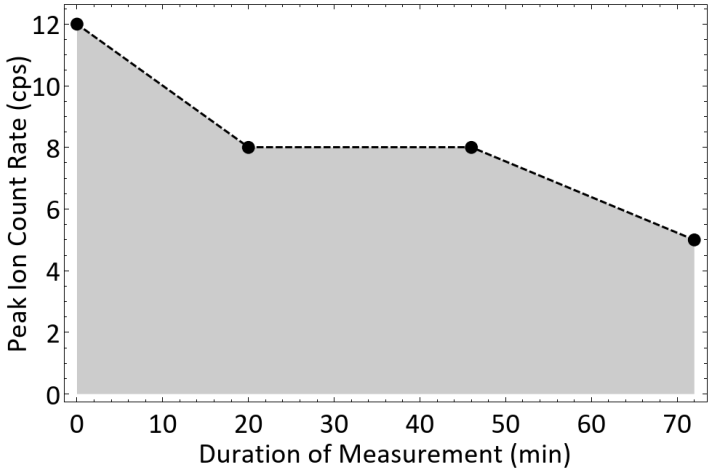
First PI-LIST beam at ISOLDE



- No “real” NB laser available for test
- Doppler broadening at 2000°C: 2GHz
  - ➔ Laser linewidth: 1.2GHz
- PI linewidth laser-limited
- Caution with shift in different modes!

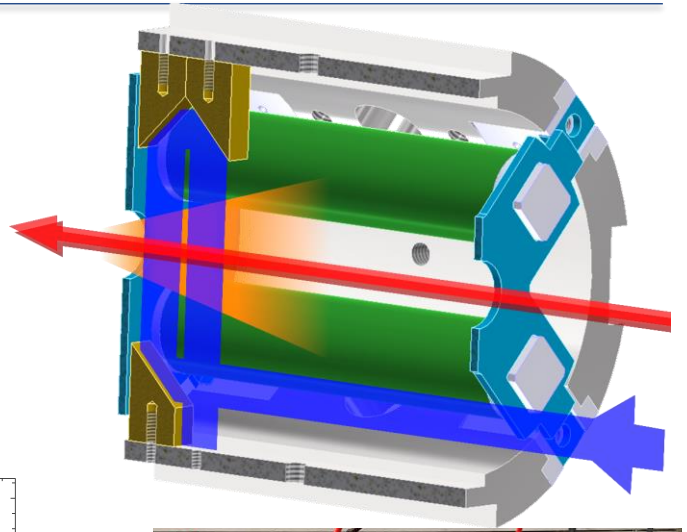
Loss factors

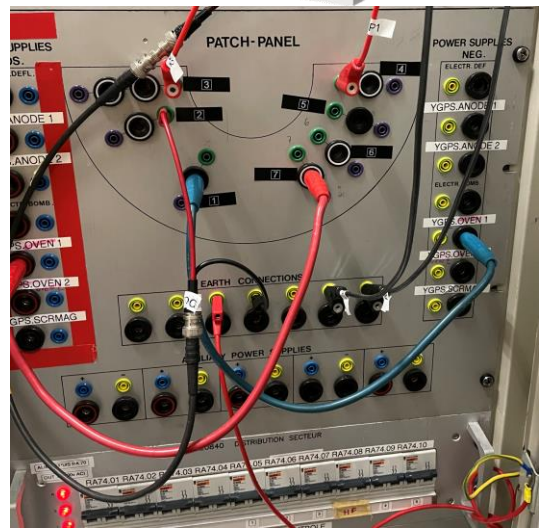
RILIS → LIST	~ 30
LIST → PI-LIST	~ 2
PI-LIST opt.	~ 10
Total:	**~ 500 - 1000**



Efficiency extrapolation with ^{225}Ac:

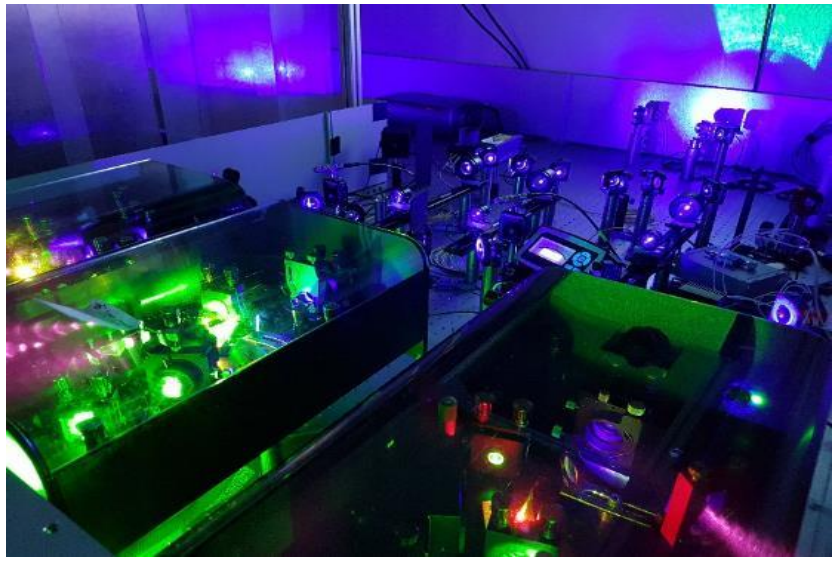
~10^{-4} (RILIS: 10%)

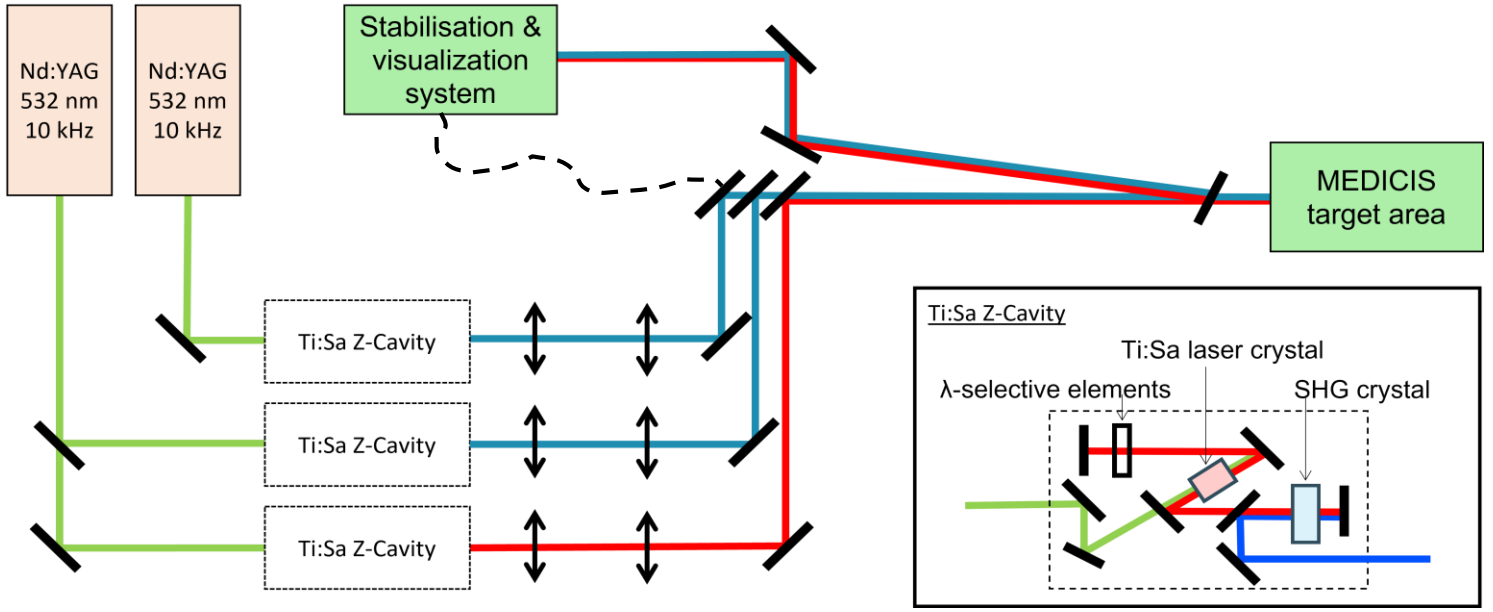




Slide content by R. Heinke

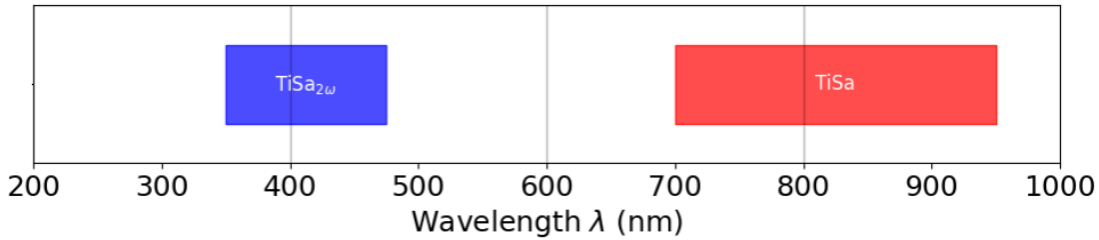
News from MELISSA





- 2 Nd:YAG pump lasers
- 3 Ti:Sa cavities
- Intra-cavity Second-Harmonic Generation system
- Telescope and transport system
- Stabilisation/visualisation system

→ All using same hardware as RILIS: easy to interchange



Slide provided by C. Bernerd

MELISSA in 2021

^{225}Ac*	^{167}Tm**	^{128}Ba*	^{44}Sc*	^{47}Sc*	^{149}Tb*	^{155}Tb*	^{149}Dy*	^{155}Dy*	^{153}Sm***	^{175}Yb****
α	e^-capture	e^-capture	β^+	β^-	β^+	e^-capture	β^+	β^+	β^+	β^-

* ISOLDE target ** Target from PSI *** Target from SCK-CEN (Br-2) **** Target from ILL

MELISSA operation since July 2021

Month	July				August					September				October				November			
Week n°	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Mon	Ac 225		Tm 167	Tm 167		Sc 45	Sc 44 - Sc 47			Tb 155	Sm 153	Sm 153				Sm 153		Sc 44 - Sc 47	Ac 225		
Tue															Ba 128						
Wed								Tb 155	Tb 149												
Thu			Ba 128												Tb 155	Tb 155					
Fri													Yb 175	Yb 175							
Sat																					
Sun																					

2 main operators :
Reinhard Heinke, Cyril Bernerd
+ RILIS team support

85% of isotopes collected using MELISSA (Only Pt-191/Hg-191 not collected with lasers)

New scheme developed for Ba using only TiSa lasers

Slide provided by C. Bernerd

Upgrades 2022

New (Pump) Lasers

Status 2021:

- 3 TiSa pump lasers (+ 1 spare at OL2)

→ 1 out of warranty, 2 refurbished in beginning of 2021 and with new extended warranty until end of 2022

- 1 laser for non-resonant ionization

→ no longer supported by company (we purchased spare parts)

- 1 dye pump laser (+ 2 spare, out of which only one works)

→ Out of warranty, had to be sent back mid 2021, problems with chiller and is again back with company right now

Status 2022:

- Plan to buy new TiSa pump lasers

→ Surveying the market and ongoing discussions with other institutes

- 1 single mode laser for non-resonant ionization, frequency mixing and PDA

→ Blaze replacement, arrived 2 weeks ago after some covid-related delays

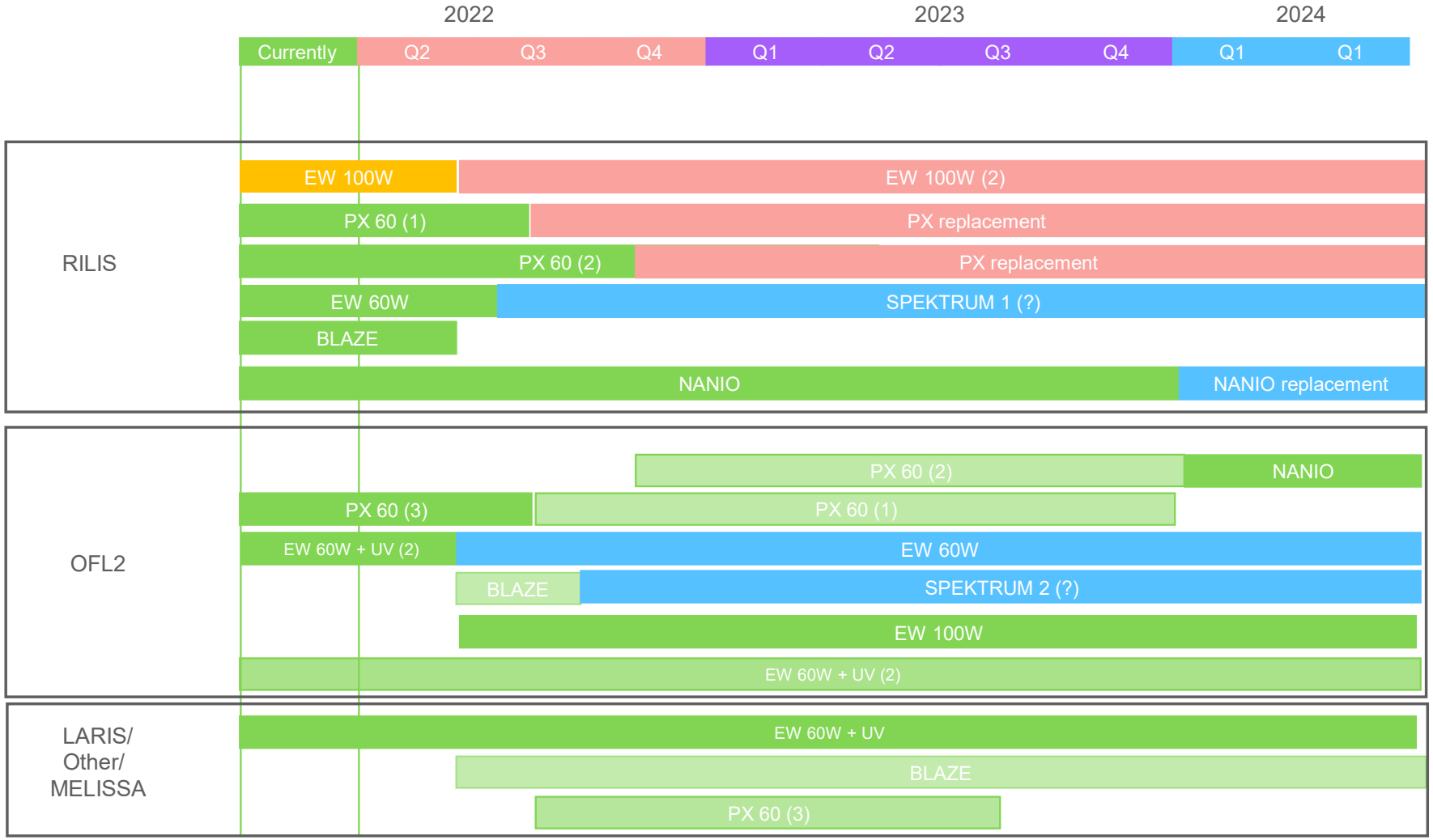
- Plan to buy 1 new dye pump laser (delayed due to covid)

→ We have enough lasers and spares to operate 2022

→ Some expected downtime during summer when we have to swap around lasers in the lab (no interference with physics)

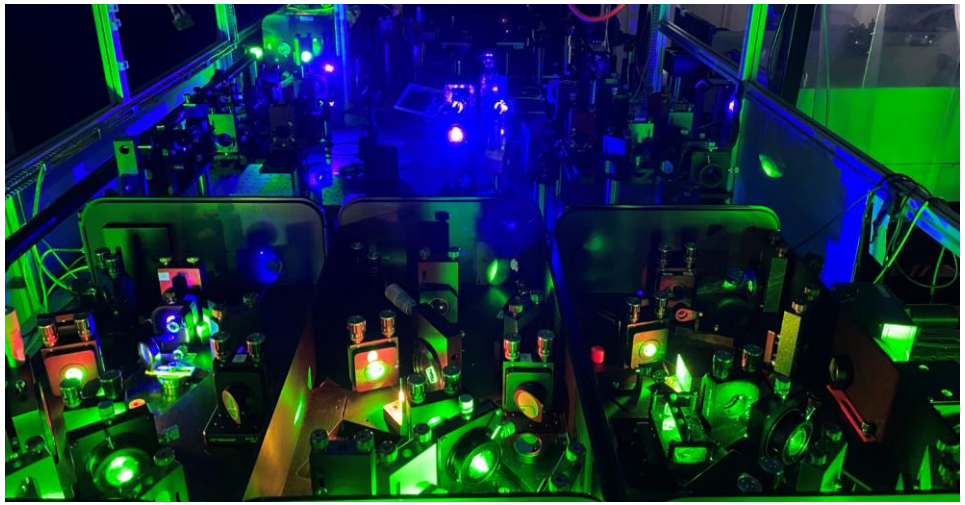
→ Upgrades are funded by RILIS consolidation project

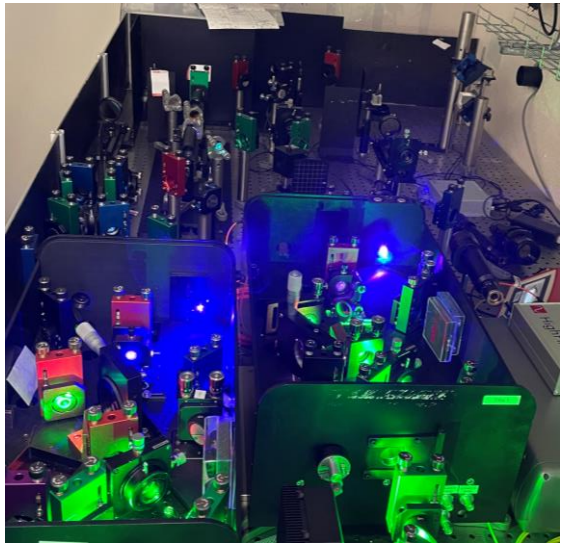
Consolidation Timeline

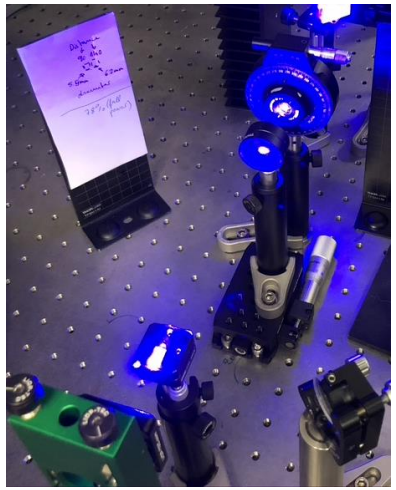


Ongoing developments

Tunable lasers







- Thanks to space optimization during LS2 we operated 4 TiSa and 3 dye lasers in 2021

→ Reduced setup times between runs

- 2 new triplers made parallel setup of UV beams possible → reducing setup time between experiments, loaner for MELISSA
- Design of new TiSa baseplates ongoing: we need more lasers for the development labs
- Loan CW laser from Hübner expected mid 2022 → use for seeding of PDA
- New ring-laser design from Mainz → replace breadboard laser for NB spectroscopy
- Z-cavity design for BB Raman laser

→ Will replace fully tested hemi-spherical design (problems with optical coating damage thresholds)

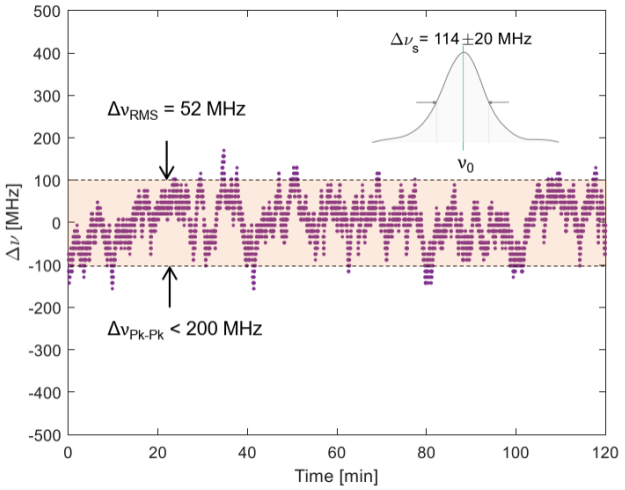
Narrowband Raman laser for high resolution spectroscopy

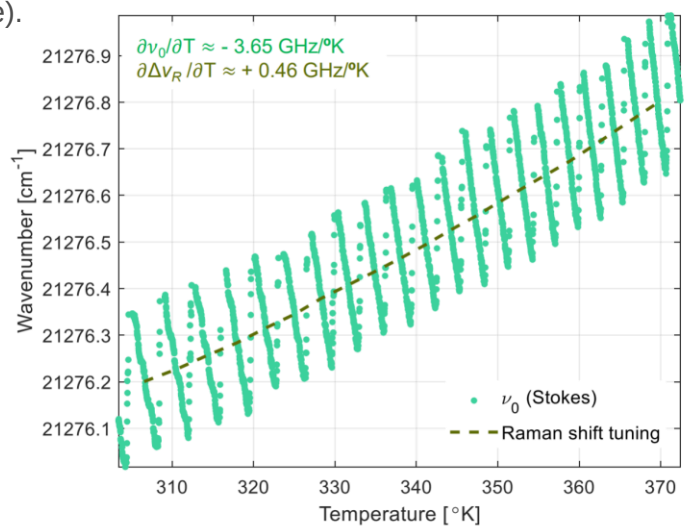
- Developed python libraries for:

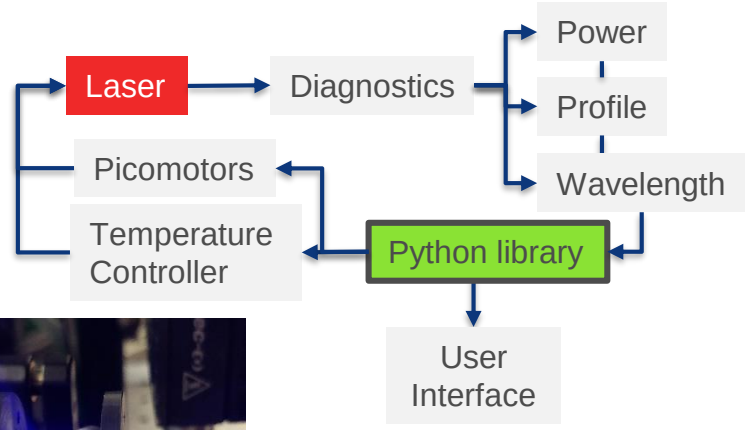
1. Picomotor control and laser auto-alignment.
2. Linewidth and wavelength readout from LM-007 wavemeter.
3. Power-meter readout compatibility with CERN power-meters.

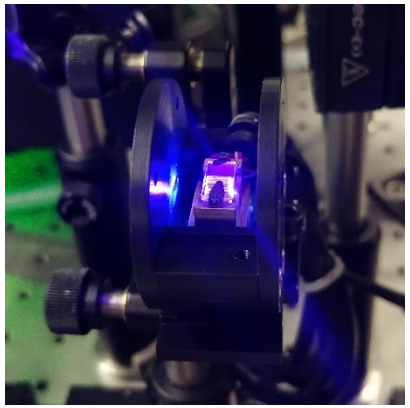
- Developed interface including processed linewidth and wavelength while ensuring single mode operation.
- Testing of frequency stabilisation and tuning using the developed tools:

1. Demonstrated continuous single mode operation at stabilised wavelength (Stokes center-frequency fluctuations
< 52 MHz (RMS)).
2. Demonstrated full FSR tuning (~10 GHz range).









→ Standalone Narrow linewidth laser system
→ Will be used for PI-LIST spectroscopy at OL2 in February

Slide provided by G. Stoikos

The LARIS lab refurbishment – test bench for RILIS

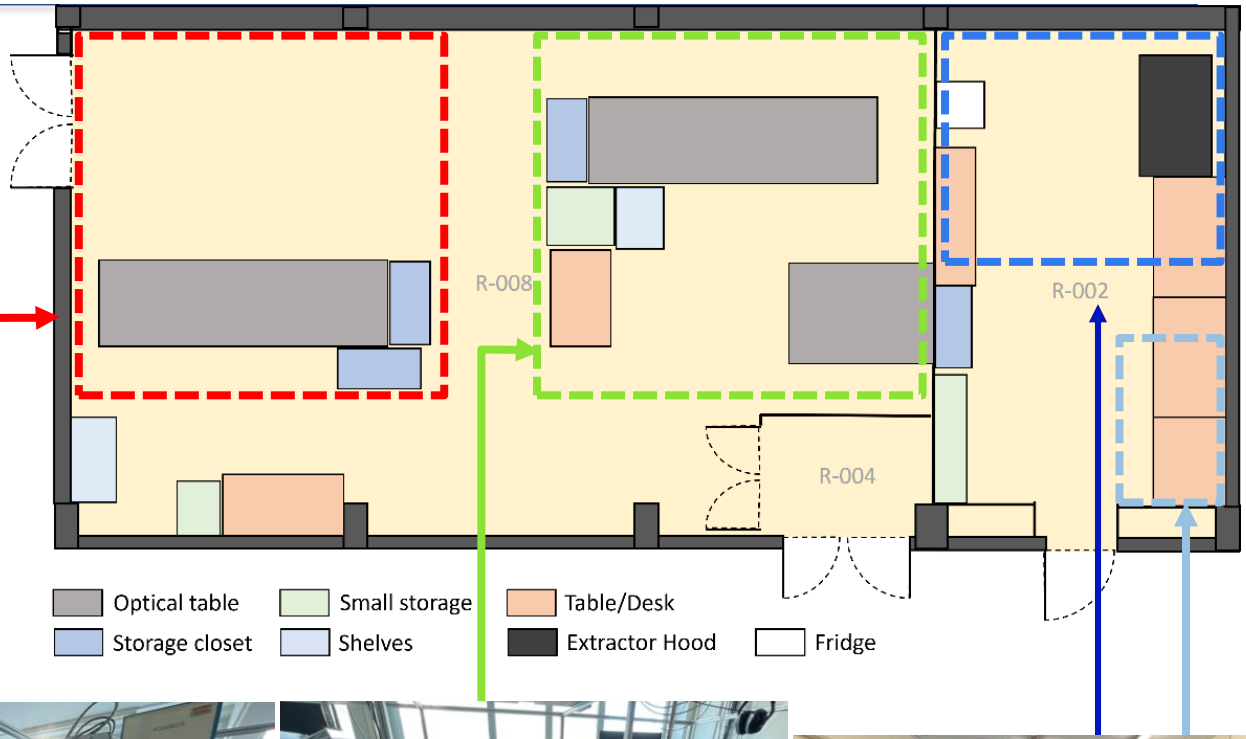
- Laser development
- Ionization scheme development
- Pump laser storage and maintenance
- Chemical preparation of Dyes
- Radiation damage tests

SY-STI/BMI R2E Project

Mario Sacristan Barbero, Federico Faccio

+ storage for spare laser chillers

+ laser training for newcomers



Slide provided by C. Bernerd

The Team

The SY-STI-LP section and our mandates

SY*(stems)*-S*(ources)* T *(argets)* I*(nteractions)*-L*(asers)* P*(hotocathodes)* section mandates:

→ laser installations and optical beam lines used to produce charged particle beams in the CERN accelerator complex and research facilities

- ISOLDE-RILIS
- ISOLDE-OFFLINE2
- LARIS
- MEDICIS-MELISSA
- Photoemission Laboratory
- AWAKE
- CLEAR
- Laser safety support for AT sector
- Emerging projects: Gamma Factory and FLASH photoinjector

→ Development and implementation of novel lasers and photonic methods for production of ions, electrons and plasma

- LISA ITN training network (https://lisa-itn.web.cern.ch)
- Part of PRISMAP (https://www.prismap.eu)

RILIS team 2021

Valentin Fedosseev

Section Leader
SY-STI-LP

Retiring Early/Mid 2022

Bruce Marsh

Staff Member
SY-STI-LP

Eduardo Granados

Staff Member
SY-STI-LP

Bianca Reich

LISA-ITN ESR

Contract will not be renewed Left CERN in January 2022

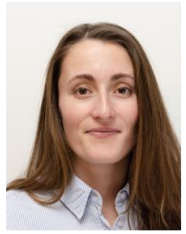
Reinhard Heinke

CERN Fellow
Since April 2021

Daniel Echarri

Finishing PhD mid 2022

Singular Light KT project



Katerina Chrysalidis

CERN Fellow
Since Jan 2020

Ralitsa Mancheva

TECH Student

Completed in Dec 2021

Cyril Bernerd

KuL Post-Doc
PJAS in STI-LP
MELISSA responsible
Since Oct 2021

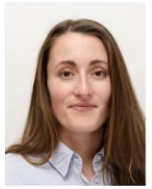
Georgios Stoikos

Became TECH Student for SLM Raman development

RILIS team 2022

Bruce Marsh
Section Leader
SY-STI-LP

Reinhard Heinke
CERN Fellow

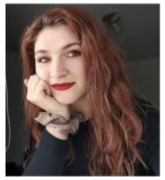


Katerina Chrysalidis
CERN Fellow

Eduardo Granados
Staff Member (~40% RILIS)
Raman laser development
SY-STI-LP

Valentin Fedosseev
Will become a
Honorary Staff Member
From May onwards

Isa Hendriks
TECH Student
Pulsed heating
TOFLIS



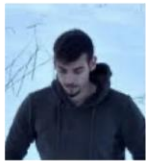
Ralitsa Mancheva
DOCT Student
PRISMAP

Daniel Echarri
PhD Student - leaving in mid 2022
Singular Light KT project

?

LISA-ITN ESR
Starting in April

Cyril Bernerd
KuL Post-Doc
PJAS in STI-LP
MELISSA responsible



Georgios Stoikos
TECH Student
SLM Raman laser

?

New Engineer in LP section (~30% RILIS and MEDICIS):
Recruitment ongoing (~April 2022)
RILIS laser maintenance
RILIS controls
MEDICIS operation

?

New Physicist in LP section (Replacement for Bruce):
Recruitment ongoing, >70% RILIS + offline R&D
(~October 2022)

x

Thank you for
your attention!