WP2
Novel techniques and technologies for actinide research

Mid-Term Review / 25.11.2020

Valentin Fedosseev / CERN

LISA
LASER IONISATION AND SPECTROSCOPY OF ACTINIDES

This Marie Sklodowska-Curie Action (MSCA) Innovative Training Networks (ITN) receives funding from the European Union's H2020 Framework Programme under grant agreement no. 861198

Objectives and tasks distributions

- Investigate novel target concepts, optimized for the extraction of actinides from thick ISOL targets

  Task 1 (CERN)

- Advance the in-source laser spectroscopy technique for achieving a sub-Doppler resolution required for efficient isomer separation and precise measurements of hyperfine structure and isotope shifts in actinides

  Task 2 (CERN)

- Improve the overall efficiency of the gas cell to gain sensitivity for the shortest actinide isotopes

  Task 3 (GANIL)

- Develop narrow linewidth Ti:Sapphire and OPO laser systems optimized for actinide research

  Task 4 (MSL) and Task 5 (HUB)

Progress report on task 1

Sebastian Rothe, CERN

Target developments for extraction of actinides from thick ISOL targets followed by laser-induced molecular break-up and/or ionization

- Mia AU (ESR 3) started October 1st at CERN
  - 1 month late due to delay of visa process (COVID19 related)
  - Enrolled in the PhD programme at Mainz JGU
- **Training started** at offline ion beam facilities.
- **Proposal drafted** for use of irradiated targets at ISOLDE (collab. with Bianca REICH) -> towards MS7
- Participated remotely in yield measurement campaigns at TRIUMF (in line with TRIUMF secondment)
- Secondment to Mainz needs to be adjusted in view of available beam time at ISOLDE in Q1-Q2 2021 and the results.

Progress report on task 2

Valentin Fedosseev, CERN

Development of high-resolution in-source hot-cavity RILIS methods for actinides

- Bianca Reich started on September 1 at CERN
  - Enrolled in the PhD programme at Mainz JGU
  - Secondment at Mainz JGU from November 2020
- Work planning according to ICDP

-> May 2021
- Installation of LIST ion source, implantation of PI LIST

-> Sep 2021
- Setting up the laser system for high resolution spectroscopy at RILIS

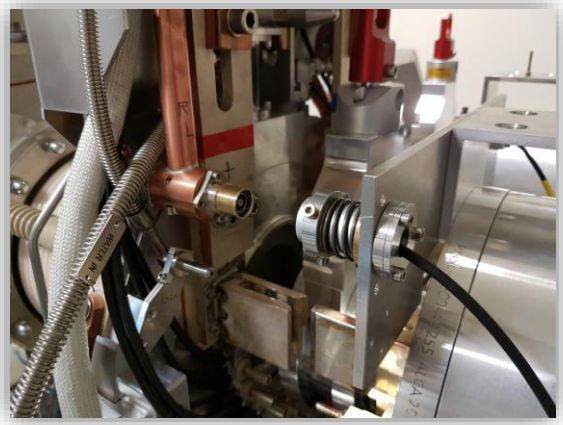
2021-2022
- Off-line laser spectroscopic studies on actinides

2022-2023
- On-line studies of radioactive isotopes using the laser resonance ionization method

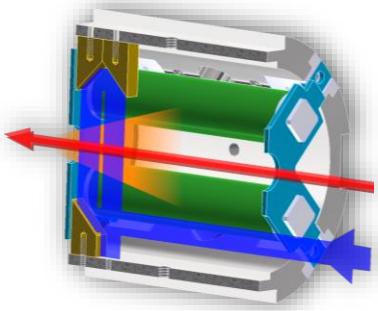
- Initial training courses at CERN - done
- Training at Mainz – on-going

Project status

- New ISOLDE frontends made compatible with LIST

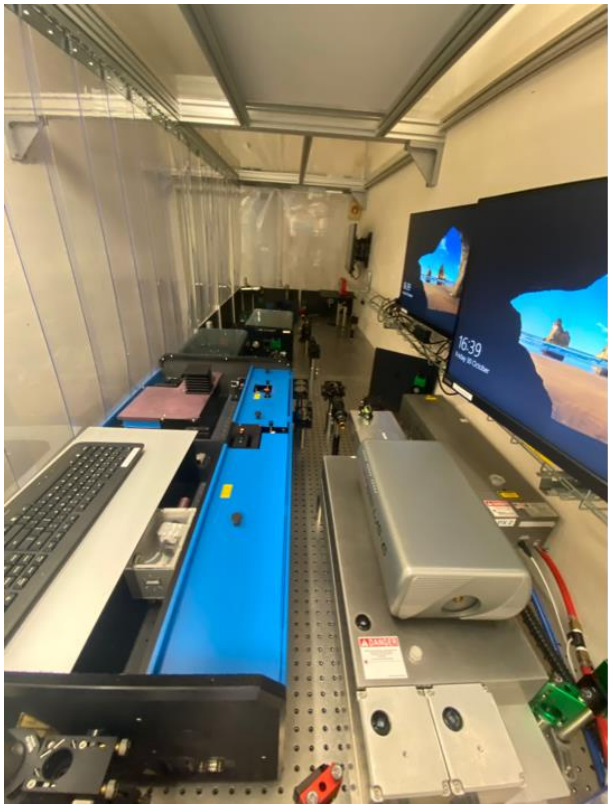


Automatic RF coupling at target



Modified extraction electrode machined and will be tested at Offline-2 and GPS

- Laser setup at Offline-2 mass separator is ready for testing



PI-LIST will be tested at off-line 2 separator

Progress report on task 3

Nathalie Lecesne, GANIL

Optimization of in-gas-jet laser spectroscopy for high resolution measurement of actinides

- Anjali Ajayakumar:

  at GANIL since 9/11/2020 (2 months delay due to COVID restrictions)
- Secondments @ JYU & JGU
  reported in 2021 after COVID
- No delay foreseen in deliverable and milestone:
  - D2.1: Optimized TiSa laser system for high resolution laser spectroscopy : Month 24 (November 21) ✓
  - MS8: First high resolution off-line laser spectroscopy measurement at GANIL: Month 30 (April 22) ✓

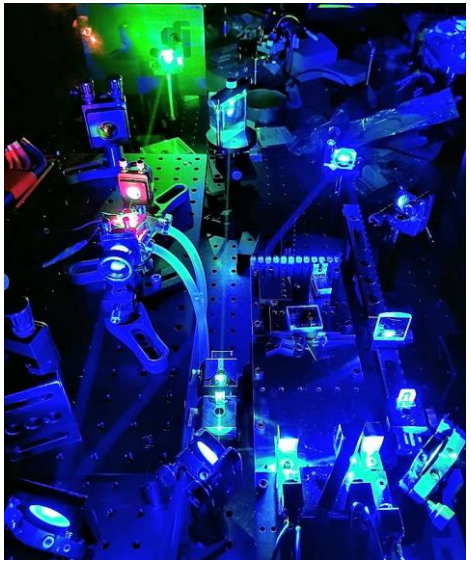
Optimization of in-gas-jet laser spectroscopy for high resolution measurement of actinides

- Status of the project:

- S^3 Low Energy Branch: off line commissioning
- Gas cell & Broadband TiSa laser system : to be installed & tested: end 2020 – beginning 2021
- Narrow bandwidth TiSa laser system: development ongoing.

Optimization of in-gas-jet laser spectroscopy for high resolution measurement of actinides

- S3LEB Technical Workshop (online):



- Wednesday 2, December, 9h-17h
- Laser technology, gas cell facilities, S3LEB status
- You are welcome (7 ESRs already registered!)

lecesne@ganil.fr

Progress report on task 4

James Bain, MSL

Development of low noise high power tuneable pulsed narrow linewidth Ti:Sa amplifier for ion beam spectroscopy applications

- ESR 9 in post on 1st September 2020
  - Julius Wessolek appointed
- Enrolled in PhD at University of Manchester
  - Supervision from Prof. Kieran Flanagan
- Currently no firm timeframe for non-critical laboratory access at M Squared
  - Glasgow currently at highest tier of lockdown restrictions
- Focus on remote/desk-based activities
  - Literature survey
  - Develop understanding of M Squared proprietary technologies and engineering approaches
  - System design and theoretical modelling
  - Extensive experimental planning ahead of laboratory return

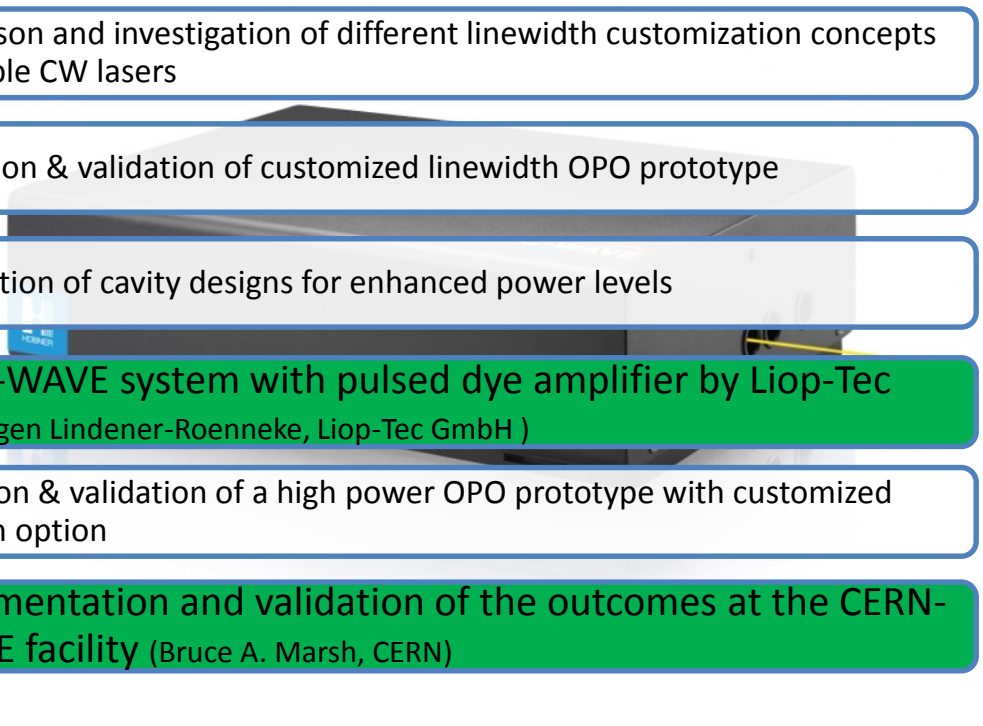
Progress report on task 5

Korbinian Henz, HUB

Development of C-WAVE OPO as a turn-key solid-state alternative to CW dye laser

- Start of project is delayed due to Covid-19
  (German embassy in Mexico is closed, VISA application still pending)

- Project plan (including milestones and deliverables) will shift by a currently unknown “offset”



Milestones and Deliverables

Schedule of relevant deliverables

Number	Title	Lead beneficiary	Type	Dissemination level	Due date (months)
D2.1	Optimized Ti:Sa laser system for high resolution laser spectroscopy	GANIL	Report	Public	24 On-time
D2.2	Implementation of PI-LIST at ISOLDE	CERN	Report	Public	36 On-time
D2.3	Pulsed narrow linewidth Ti:Sa amplifier	MSL	Report	Confidential	36 Delay ?
D2.4	Production of actinide isotopes using thick ISOLDE-type targets	CERN	Other	Public	42 On-time
D2.5	HighPower C-WAVE with customized linewidth option	HUP	Report	Confidential	45 Delay ?

Schedule of relevant milestones

Number	Title	Lead beneficiary	Due date (months)	Means of verification
MS4	Project check	CERN	13	Project check meeting following the 1st progress report submission
MS5	Evaluation of linewidth customization concepts	HUB	12 + 12 months	SWOT analysis of concept
MS6	Standard C-WAVE laser prototype with customized linewidth option	HUB	18 + 12 months	Laboratory prototype validated
MS7	Actinide molecules created and detected	CERN	24 + 2 months	Mass scan and particle ID (e.g. from decay tagging)
MS8	First high-resolution off-line laser spectroscopy measurement at GANIL	GANIL	30	Resonance peak linewidth of no more than 300 MHz in off-line conditions
MS9	Design of Ti:Sa amplifier	MSL	30 + X months	Laboratory prototype validated
MS10	On-line test of actinide production, extraction, dissociation and ion beam production	CERN	40	Presentation of test results to the Group for the Upgrade of ISOLDE (GUI)