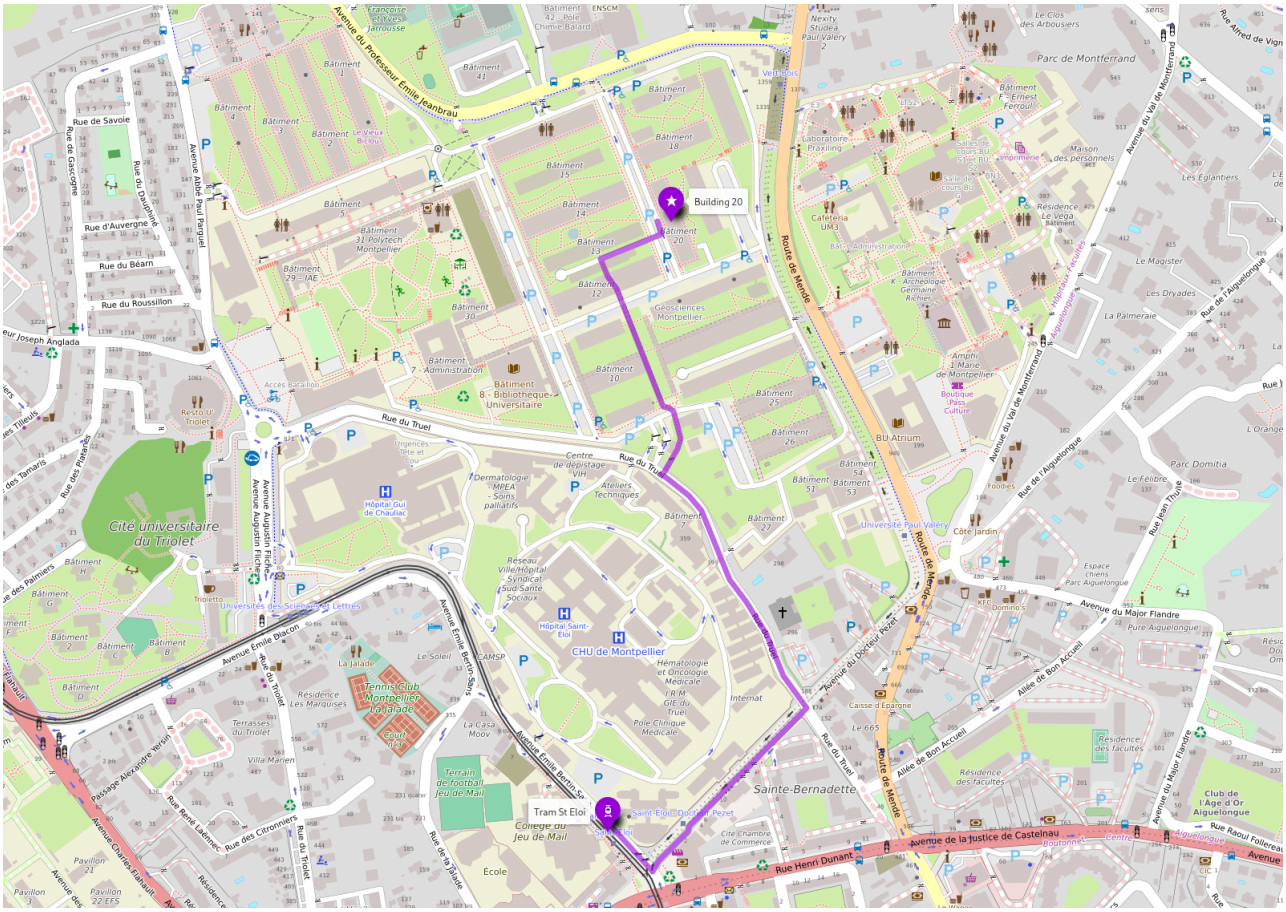
Pymodaq days 2025

We are excited to welcome you in Montpellier for the PyMoDAQ days 2025!
If you cannot join in person, do not hesitate to attend remotely using this link:
https://umontpellier-fr.zoom.us/j/93699624995

We will be waiting for you starting from 13h30 on October 8th, to begin with the first session of the PyMoDAQ days at 14h00!

The meeting will take place in the Physics amphitheater, in **building 20 on the campus Triolet** of the University of Montpellier, see the map below. The entrance of the campus is located at the 498 rue du Truel, reachable using the tramway line 1 (blue), stop St-Eloi.
Be careful, the tramways and buses are free only for people living in Montpellier. You need to buy a ticket, there are vending machines at some tramway stations, or use the app M'Ticket TAM.



Internet access is available directly via eduroam in the building. If you do not have an eduroam account, we will create a guest wifi account for you, just ask us when you arrive.

The organization team: Christelle Eve, Aurore Finco, Pierre Valvin, Sébastien Weber

Wednesday October 8th

Session 1				
14h00 – 14h30	**Sébastien Weber** **Aurore Finco** **Pierre Valvin**	CEMES L2C L2C	Introduction to PyMoDAQ	
14h30 – 15h15	**Alexandra Ibanez** **Roméo Beignon**	L2C	Live demonstration from the labs	

14h00 – 14h30	**Coffee break**

Session 2				
15h45 – 16h15	**Valentin Rollo**	CEMES	PyMoDAQ at the heart of a laser beam shaping experiment	abstract page 6
16h15 – 16h45	**Sébastien Weber**	CEMES	The data mixer extension	
16h45 – 17h15	**Bernhard Lang**	University of Geneva	PyMoDAQ in the Physical Chemistry Department in Geneva	abstract page 7

17h30 – 18h30	**Lab tours** **Please register in a group upon your arrival or at the coffee break**

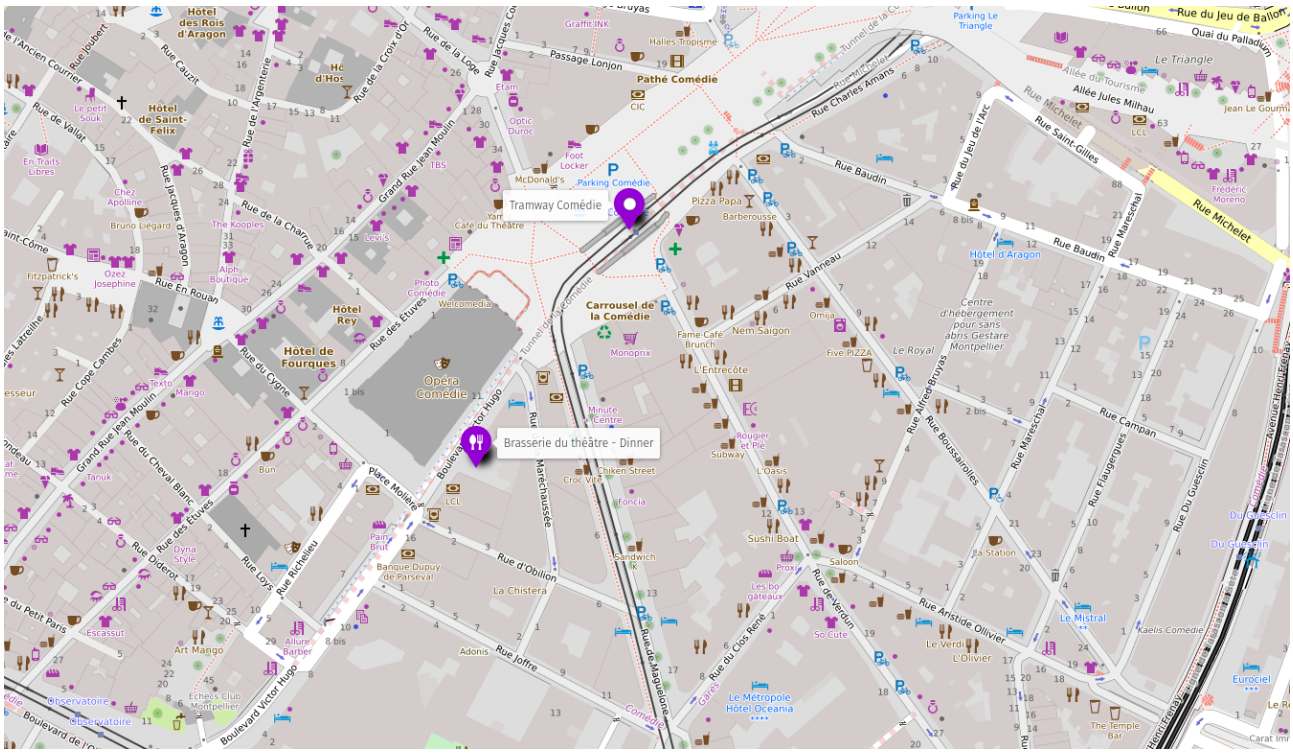
Thursday October 9th

Session 3				
09h00 – 09h30	**Malik Irain**	CEMES	**Round table discussion** Configuration mechanisms	
09h30 – 10h00	**Constant Schouder**	ISMO	Upgraded PID module	
10h00 – 10h30	**Jocelyn Rebufa**	Cedrat Technologies	Implémentation du module PyMoDAQ de Cedrat Technologies	abstract page 7
10h30 – 11h00	**Coffee break**			

Session 4				
11h00 – 11h30	**Malik Irain**	CEMES	Communication With Devices Outside of PyMoDAQ	abstract page 8
11h30 – 12h00	**Sébastien Weber**	CEMES	Bayesian Optimisation with PyMoDAQ	abstract page 8
12h00 – 12h30	**Constant Schouder**	ISMO	**Round table discussion** The user-friendliness of PyMoDAQ	
12h30 – 14h00	**Lunch break**			

Session 5				
14h00 – 14h30	**Benedikt Burger**	TNG Technology Consulting GmbH	AI-Assisted Coding for Scientific Workflows: Boosting Productivity with Guardrails	abstract page 9
14h30 – 15h00	**Brian Squire**	University of North Texas	PyRPL Integration: A Real-Time FPGA Control Module for PyMoDAQ	
15h00 – 16h00			**Round table discussion** Artificial intelligence	
16h00 – 16h30	**Coffee break**			
16h30 – 16h45	**Anne-Antonella Serra**	MITI CNRS	Le rôle de la MITI dans le soutien des réseaux technologiques	
16h45 – 17h30	**Pymolympics**			

We meet for dinner at **19h30 at La Brasserie du théâtre**, 22 rue Victor Hugo.



Friday October 10th

Session 6				
09h00 – 10h00	**David Bresteau** **Malik Irain**	LIDYL CEMES	**Round table discussion** Management of the Github repositories Scripting PyMoDAQ	
10h00 – 10h30	**Maria Flesch**	CEMES	FAIR data with PyMoDAQ	
10h30 – 11h00	**Coffee break**			

Session 7				
11h00 – 11h30	**Aurore Finco**	L2C	Analysis of scanning NV microscopy data with PyMoDAQ data and gui	abstract page 9
11h30 – 12h30	**Sébastien Weber**	CEMES	**Round table discussion** Live acquisition with ramp/speed control The future sequencer/configurator extension	
12h30 – 14h00	**Lunch break**			

Abstracts

Wednesday, 15h45

PyMoDAQ at heart of a laser beam shaping experiment

Valentin Rollo, Arnaud Arbouet and Sébastien Weber
CEMES, Toulouse

PyMoDAQ is a free and open-source software, entirely written in python. It is designed to orchestrate experimental setups, while facilitating data acquisition and analysis in line with the « Findable Accessible Interoperable Reusable » (FAIR) principles of open science. Its modular architecture enables users to easily integrate their own detectors (e.g. CCD cameras, spectrometers, powermeters) and actuators (e.g. moving mirror, temperature controller, piezoelectric translation stage) making it possible to quickly control custom experimental setups and perform efficient data acquisition. Moreover, this software is used on a daily basis at CEMES especially on our new Ultrafast Transmission Electron Microscope (UTEM) which is the main instrument of my PhD. In addition, I am developing an experimental setup that combines the UTEM with a laser beam shaping experiment. In conventional optic, the properties of light can be easily manipulated – for instance, polarization through wave plates, or amplitude and phase through the use of a Spatial Light Modulator (SLM). The SLM used in our case, a Holoeye pluto 2.1, is a liquid crystal display where each pixel can be individually controlled to induce a specific local phase shift to the light. This allows us to generate arbitrary intensity (or phase) distributions. As this optical setup is part of a larger experiment managed by PyMoDAQ, we had to develop a dedicated PyMoDAQ instrument plugin to drive the SLM. However, the difficulty of this experiment lies in the fact that the phase to be applied to the SLM has to be calculated given an intensity or/and phase target at a specific location in the beam path with the UTEM. Dedicated algorithms – for example, Gerchberg-Saxton, or conjugate gradient minimisation – which convert the target intensity distribution into the corresponding phase pattern have been developed. To properly control such a complex setup, we developed a PyMoDAQ extension made of several independent submodules such as:

- **Algorithm module:** provides a framework to implement various algorithms adapted to particular needs and setups.
- **Target field module:** enables the definition of simple or complex phase/intensity targets field (e.g. loaded from an image, or mathematical expression).
- **Correction module:** applies Zernike phase polynomials to correct the optical aberrations of the setup.
- **Propagation module (under development):** aims to simulate the beam propagation from the SLM to a given location in the setup.

All modules require potential customisation. Therefore, a factory pattern has been used in their implementation enabling users to create their own algorithms, target functions and corrections.
The aim of this presentation is to highlight the usefulness of PyMoDAQ in our experiment, while demonstrating – through a live demonstration on a simple optical bench – this new extension used to shape the amplitude of a laser beam. Finally, I will briefly introduce a complementary extension dedicated to signal optimization through various algorithms, presented as a perspective for future developments and intended to be coupled with the correction module.

Wednesday, 16h45

PyMoDAQ in the Physical Chemistry Department in Geneva

Bernhard Lang
Département de Chimie Physique, Université de Genève

Several lab class experiments for teaching spectroscopy to chemistry and biochemistry students on the bachelor level have been implemented in Geneva using PyMoDAQ and will go into production mode next year.

- Absorption and emission spectroscopy using an Avantes USB spectrograph,
- Fluorescence and luminescence lifetime measurements using home-built time-correlated single-photon counting set-ups, two types of time taggers being used, a commercial tagger with nominal resolution of 1ps (qutools) and a home-built one with 40ns resolution based on an Arduino Due,
- Raman spectroscopy on home-built set-ups based on a teledyne blackfly camera (http://www.open-raman.org).

Future plans for teaching:

- A simple home-built electron spin resonance (ESR) spectrometer (https://www.jabolatorium.com),
- Ruby luminescence lifetime measured with the ADC of an Arduino (simple arduino scope with PyMoDAQ backend),
- Porting to PyMoDAQ an existing set-up based on a Raspberry camera.

PyMoDAQ involved in research work:

- Chemical kinetics on the minutes to hours time scale with minimal probe light exposure and permanent background correction,
- Online spectral monitoring (Titanium-Sapphire oscillator, NOPA) using various USB spectrographs from Avantes, Ocean Optics and RGB Lasersystems,
- Temperature monitoring of an Oxford Instruments cryostat for optical spectroscopy.

Thursday, 10h00

Implémentation du module Pymodaq de Cedrat Technologies

Jocelyn Rebufa
Cedrat Technologies

Pymodaq intègre de nombreux fournisseurs de contrôleurs pour les piézo électriques. Cedrat technologies, spécialisés en solutions sytèmes piézo-électriques, est sur le point de proposer son propre package, dont les spécificités seront présentées.
Par ailleurs, Pymodaq étant un outil puissant pour communiquer avec tous les équipements de laboratoire et de zone de recette, un code très simple d'édition et de séquencement de dashboard a été implémenté. Des évolutions du package national instruments seront aussi proposées, couvrant un grand nombre des applications de mesure spécifiques rencontrés à Cedrat Technologies.

Thursday, 11h00

Communication With Devices Outside of PyMoDAQ

Malik Irain, Sébastien Weber
CEMES, Toulouse

PyMoDAQ is an open-source platform for data acquisition that relies on a framework of community-contributed plugins. Through the years and thanks to an increasing community, a wide array of instruments are now supported in PyMoDAQ. However, while about 50 plugins exist, this does not cover the full spectrum of instruments that could benefit from PyMoDAQ integration. Indeed, several existing experimental setups can benefit from being integrated into PyMoDAQ but writing their associated plugins is time and resources consuming, especially if the setup is implemented in another language.
To address this limitation, PyMoDAQ includes the LECO protocol, originally included for communication between two PyMoDAQ instances. With a few modifications, this protocol can be used to enable communication over the network with external programs, allowing data and commands to be exchanged without writing a full instrument plugin, using pure JSON payload. This approach broadens the range of setups that can interact with PyMoDAQ, providing an easy to implement solution for integrating instruments and software written in other languages, with only few limitations.
In this presentation, LECO communication with PyMoDAQ will be introduced. The key LECO components will be described, along with illustrations of the sequence and types of messages exchanged when interacting with an actuator or a detector. Highlight will be placed on how to build an external program able to interface itself with PyMoDAQ, and demonstrations in various languages will be made!

Thursday, 11h30

Bayesian Optimisation with PyMoDAQ

Sébastien Weber
CEMES, Toulouse

PyMoDAQ is a free and open-source software [1] entirely written in python. It is designed to orchestrate experimental setups while facilitating data acquisition (DAQ) and analysis in line with the « Findable Accessible Interoperable Reusable » (FAIR) [2] principles of open science. Its modular architecture enable users to easily integrate their own detectors (e.g. CCD cameras, spectrometers, powermeter) and actuators (e.g. moving mirror, temperature controller, piezoelectric translation stage) making it possible to quickly control custom experimental setups and perform efficient data acquisition.
A setup orchestration is not only limited to DAQ. Indeed often a setup need to be optimised before doing any DAQ. For instance, in a microscope where the proper collection of light is paramount, the objective position is often optimised before or even during the acquisition. Similarly the optimisation of a signal involving a few varying parameters impose a very broad search space where uniform sampling is highly time consuming.
The PyMoDAQ Bayesian optimisation extension has been developed for such purposes. It's using a well known Bayesian algorithm to determine through learning what could/should be the best location in a search phase space in order to optimise a given signal. During that presentation, the principle of Bayesian optimisation will be presented and a demonstration of the extension will be done on an optical setup to highlight the various features of the extension and how to adapt it best to a given experimental setup.

References:
[1] S. J. Weber, Rev. Sci. Instruments 92, 045104 (2021)
[2] Wilkinson, M., Dumontier, M., Aalbersberg, I. *et al.* The FAIR Guiding Principles for scientific data management and stewardship. Sci Data 3, 160018 (2016). https://doi.org/10.1038/sdata.2016.18

Thursday, 14h00

AI-Assisted Coding for Scientific Workflows: Boosting Productivity with Guardrails

Benedikt Burger
TNG Technology Consulting GmbH

This talk explores practical AI tools and techniques to accelerate software development in scientific research environments. Tailored for scientists and research engineers, we'll demonstrate how AI can **streamline experiment-supporting code generation, review, and optimization - while emphasizing safety and critical oversight**. Through live examples with different tools (e.g. Qwen code for CLI automation, Roo code for IDE refactoring) we'll cover **effective prompting, risk mitigation, and context-aware AI usage** to enhance coding efficiency in a scientific context.

Friday, 11h00

Analysis of scanning NV microscopy data with PyMoDAQ data and gui

Aurore Finco
Laboratoire Charles Coulomb, Montpellier

I will show how we profit from the data structure provided by pymodaq_gui and from the visualization tools from pymodaq_gui to rework our data analysis procedures, making them more user friendly while staying rigorous and reproducible. Since our data is intrinsically 3D, as we record magnetic resonance spectra at each pixel of a 2D map, the various graphical data navigation widgets provide very convenient interfaces to explore them. I will show how we load data coming from different models of scanning NV microscopes, controlled or not by PyMoDAQ, how we fit and replot it, how we extract profiles, etc.

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