OPTIMISE
Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

cetal

Field Spectroscopy Facility
NATURAL ENVIRONMENT RESEARCH COUNCIL

Development of calibration protocols and procedures

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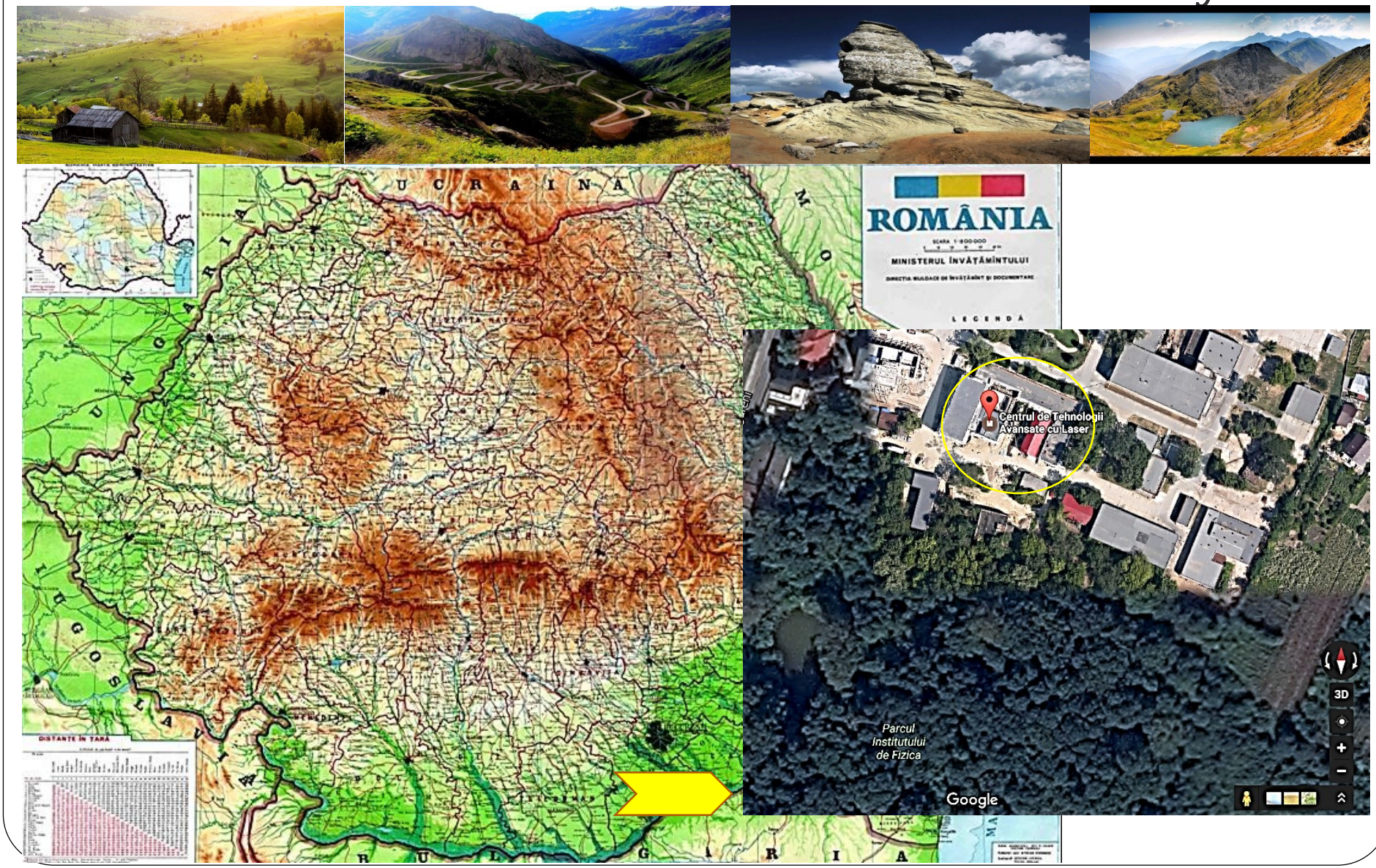
OPTIMISE Annual Workshop and MC meeting.
Limassol, Cyprus. 22nd – 24th Feb 2017

cost
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

CETAL - CENTER FOR ADVANCED LASER TECHNOLOGIES - Photonics Laboratory



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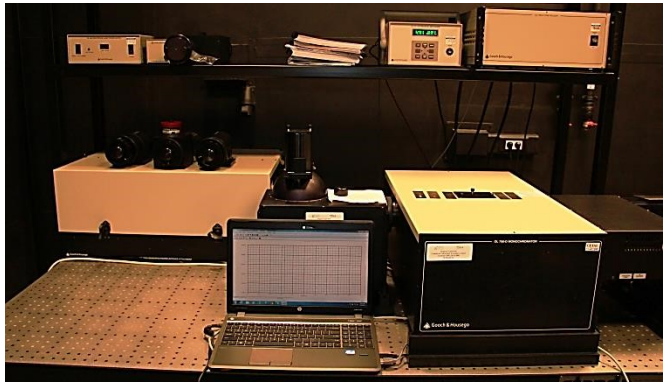
System with double monochromator



Wavelength range: 0.20 – 30 µm
Wavelength accuracy : ± 0.05%
Wavelength precision : ± 0.01%
Dispersion : 2 nm/mm
Bandwidth: 0.25 to 10 nm
Chopper rate -programmable, 10 – 500 Hz

High sensitivity detectors:
UV-Enhanced Silicon: 0.2 to 1.1µm
TE Cooled Ge: 0.8 to 1.8 µm
TE Cooled PbS: 1.0 to 3.2 µm
LN2 Cooled InSb: 1.0 to 5.5 µm
LN2 Cooled HgCdTe (Extended Range): 1.0 to 21 µm
Pyroelectric: 1.0 to 30 µm

NVS Imaging telescope
PTFE and Gold Integrating Spheres for Diffuse/ Total Reflectance
Goniometer system for specular reflectance and transmittance
etc.

Calibration Standard Lamps (200nm - 30µm)

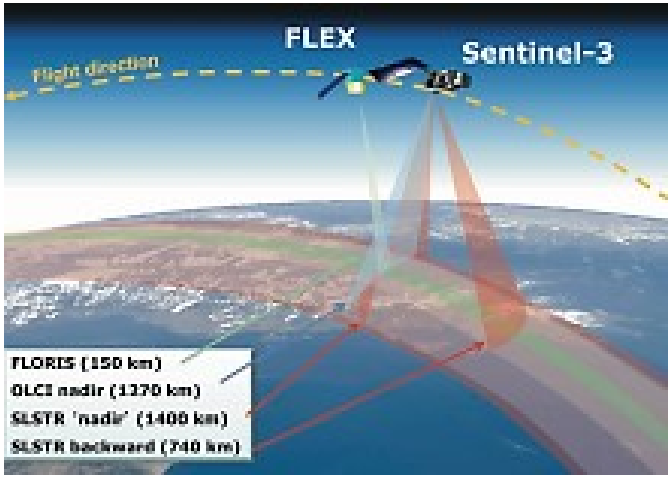
Variable Calibration Standard for Radiance / Luminance and Color temperature

-luminance, color temperature, 1/spectral radiance (350 to 2500 nm)
-Spectral Radiance Uncertainty @ 550 nm 2% relative to NIST

OL FEL High-accuracy Irradiance Standard

Transfer Uncertainty*
High accuracy ..... ± 1%
Super High-accuracy ..... ± 0.5%
Uncertainty* - Illuminance ..... ± 1%

STSM



https://earth.esa.int/web/guest/missions/esa-future-missions/flex/news/-/article/sentinels-and-flex-join-forces

Main objective → develop laboratory-based calibration and characterization procedures for spectrometers across the spectral range of the FLEX fluorescence imager, at sampling interval and band widths which will enable the detection of the solar flux in the telluric oxygen A and B bands reaching the Earth's surface measurements.

TITLE: Development of procedures and protocols for the calibration of spectrometer systems for measuring reflectance and fluorescence for near ground support of ESA FLEX observations

HOST Laboratory /Country and PI:
NERC Field Spectroscopy Facility, University of **Edinburgh, Edinburgh (UK)**
Coordinator: ***Dr. Alasdair Mac Arthur***

GUEST Laboratory/ Country and PI:
CETAL - National Institute for Laser, Plasma and Radiation Physics / Romania
ESR Name: ***Dr. Laura Mihai***
Duration: 6 days

Main tasks

- Establish laboratory common calibration procedures and protocols to be used for piccolo dual-field-of-view fibre optic-based spectrometers system (wavelength calibration, irradiance and radiance calibration)

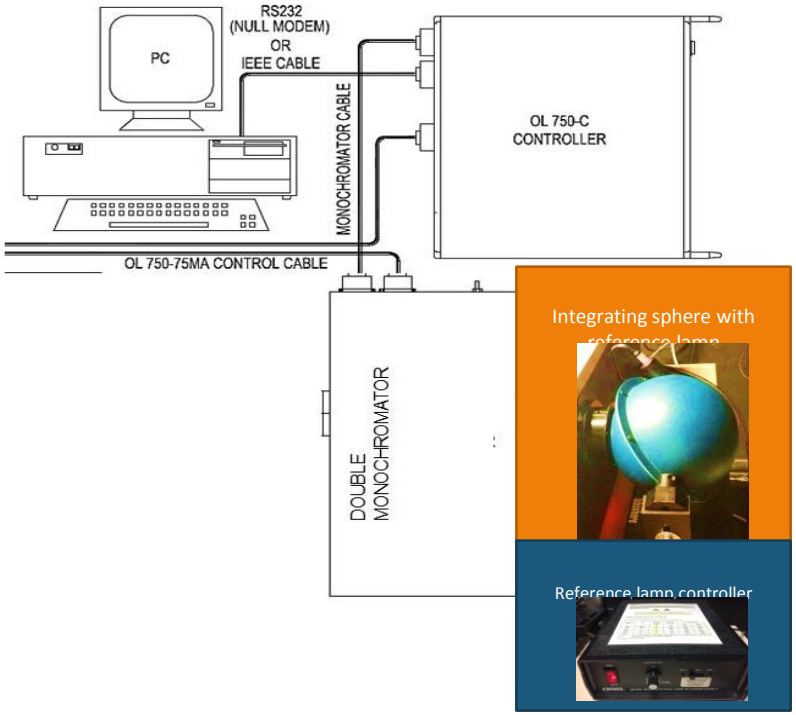
1. Characterize the calibration system (double monochromator system)

2. Calibrate and characterize spectrally the Piccolo dual-field-of-view fibre optic-based spectrometers system using two different methods: using reference lamps and using a double monochromator

3. Calibrate the Piccolo dual-field-of-view fibre optic-based spectrometers system in radiance and irradiance

1.Double-monochromator characterization

Slits	Aperture	Light Source	Range	Step
0.05, 0.5, 0.05	5.0mm	Neon	686-696 nm	0.05nm
0.05, 0.5, 0.05	5.0mm	Argon	758-768 nm	0.05nm
0.05, 0.5, 0.05	5.0mm	Argon	768-778 nm	0.05nm
1.25, 5.0, 1.25	5.0mm	Neon	686-696 nm	0.05nm
1.25, 5.0, 1.25	5.0mm	Argon	758-768 nm	0.05nm
1.25, 5.0, 1.25	5.0mm	Argon	768-778 nm	0.05nm
2.5, 5.0, 2.5	5.0mm	Neon	686-696 nm	0.05nm
2.5, 5.0, 2.5	5.0mm	Argon	758-768 nm	0.05nm
2.5, 5.0, 2.5	5.0mm	Argon	768-778 nm	0.05nm
5.0, 5.0, 5.0	5.0mm	Neon	686-696 nm	0.05nm
5.0, 5.0, 5.0	5.0mm	Argon	758-768 nm	0.05nm
5.0, 5.0, 5.0	5.0mm	Argon	768-778 nm	0.05nm

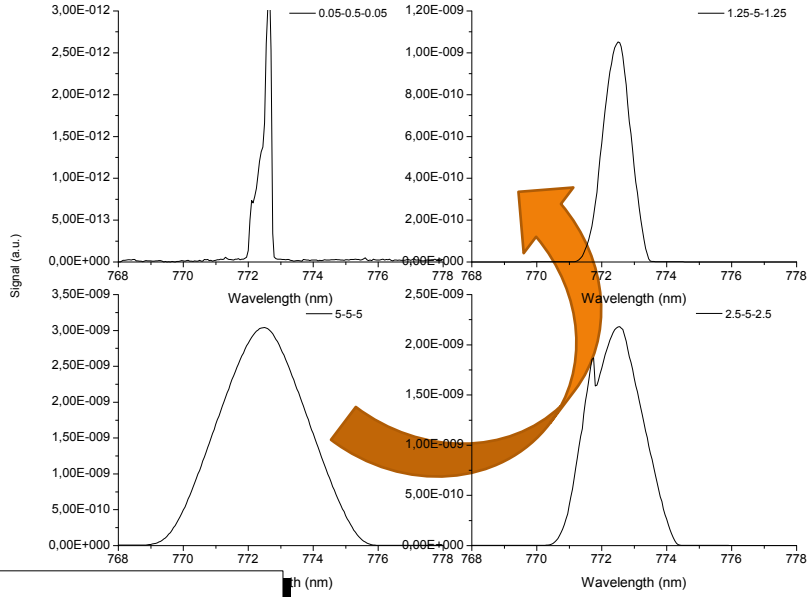


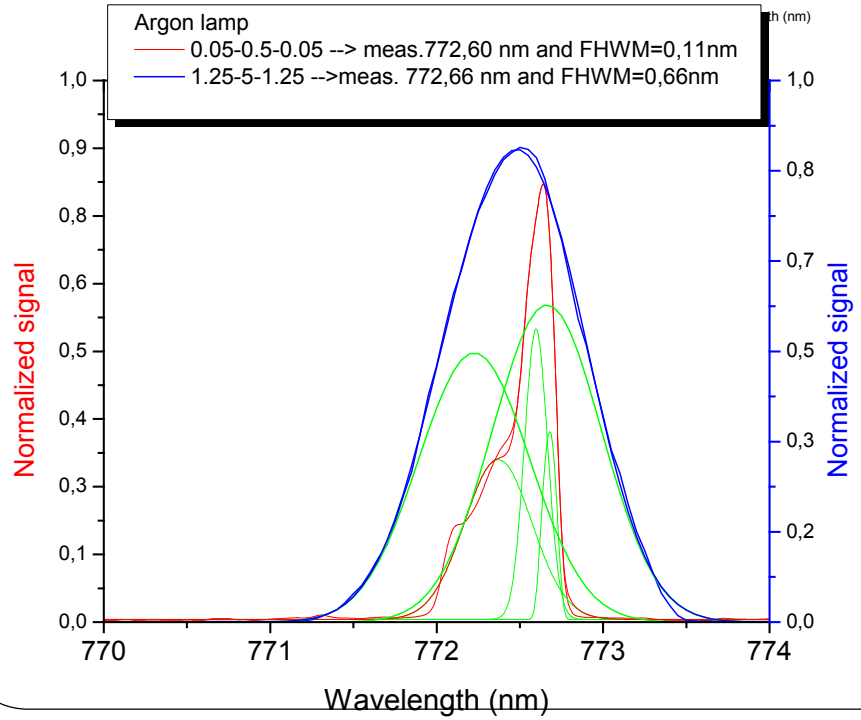
4 different slits

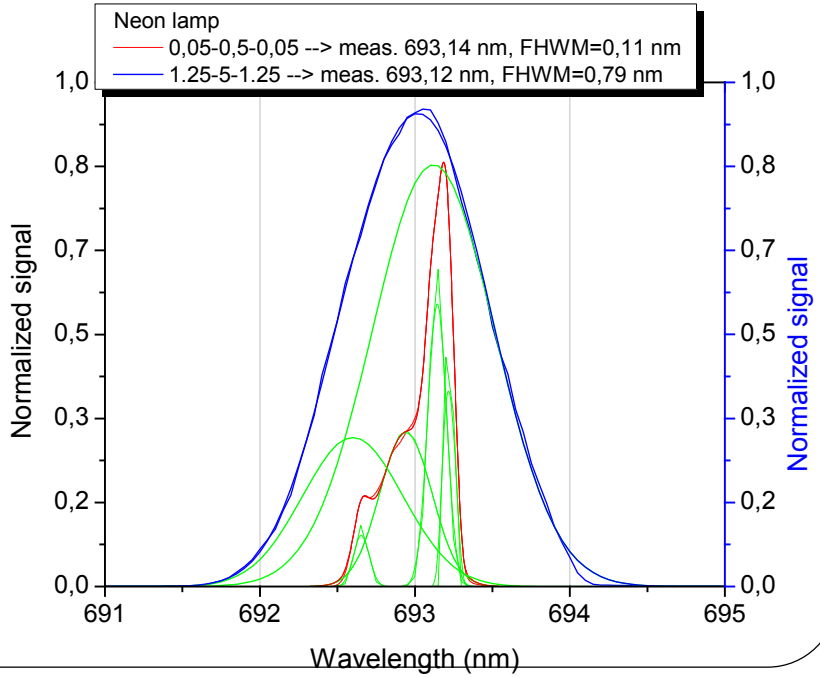
2 different light sources (pen lamps type →well known spectra)

different scanning spectral range

Double-monochromator characterization







Setups for piccolo spectral characterization

Slits	Aperture	Light Source	Range	Step
0.05, 0.5, 0.05	5.0mm	Neon	686-696 nm	0.05nm
0.05, 0.5, 0.05	5.0mm	Argon	758-768 nm	0.05nm
0.05, 0.5, 0.05	5.0mm	Argon	768-778 nm	0.05nm
1.25, 5.0, 1.25	5.0mm	Neon	686-696 nm	0.05nm
1.25, 5.0, 1.25	5.0mm	Argon	758-768 nm	0.05nm
1.25, 5.0, 1.25	5.0mm	Argon	768-778 nm	0.05nm
2.5, 5.0, 2.5	5.0mm	Neon	686-696 nm	0.05nm
2.5, 5.0, 2.5	5.0mm	Argon	758-768 nm	0.05nm
2.5, 5.0, 2.5	5.0mm	Argon	768-778 nm	0.05nm
5.0, 5.0, 5.0	5.0mm	Neon	686-696 nm	0.05nm
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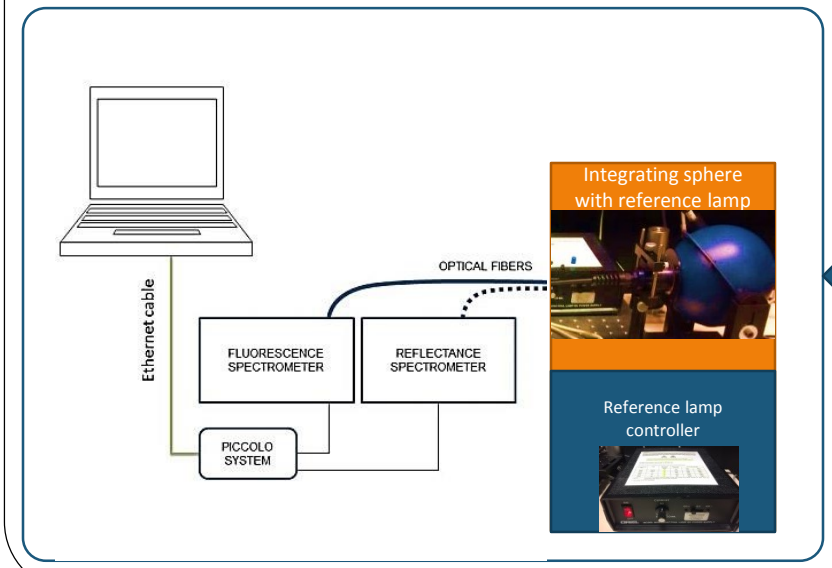
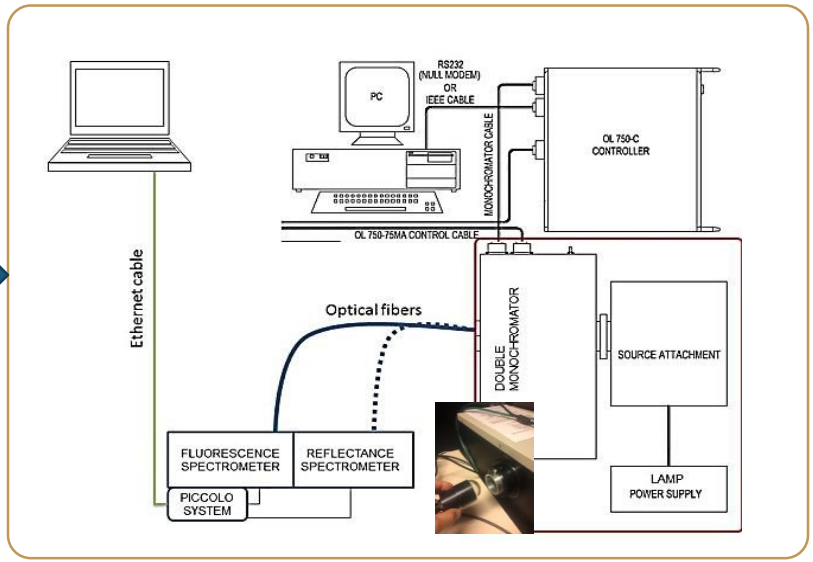
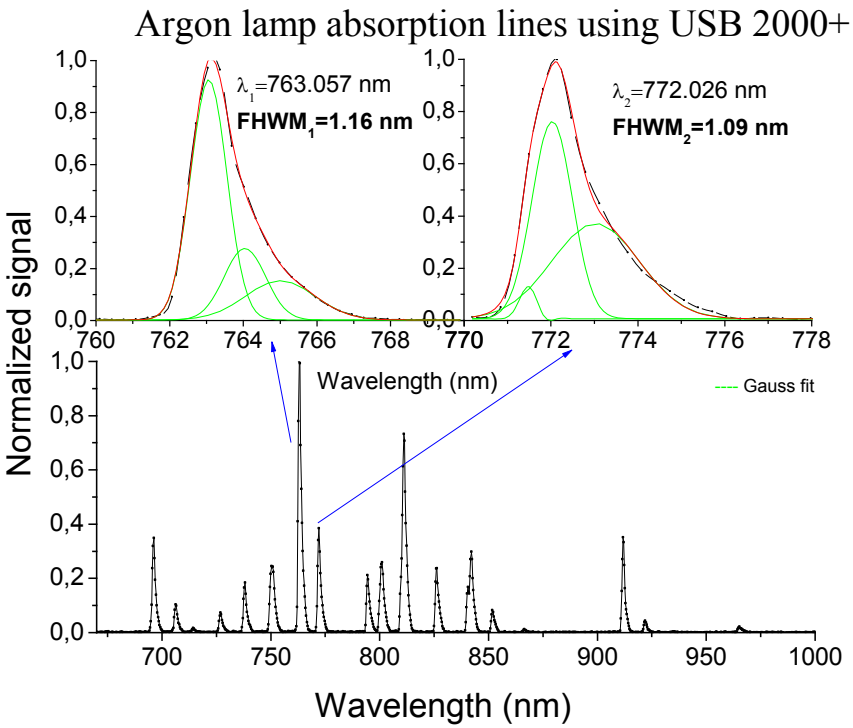
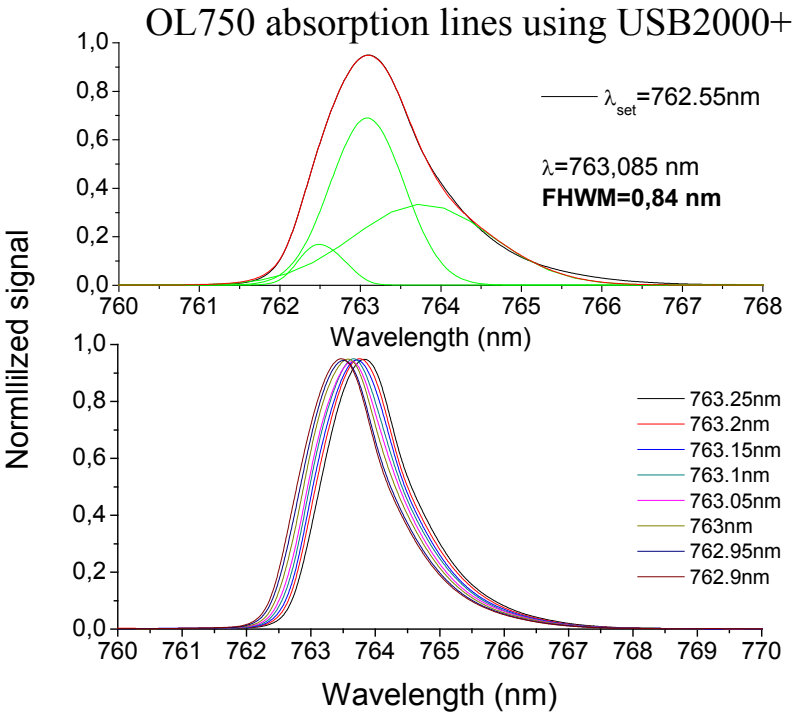


2.



2. Spectrometers system spectral characterization





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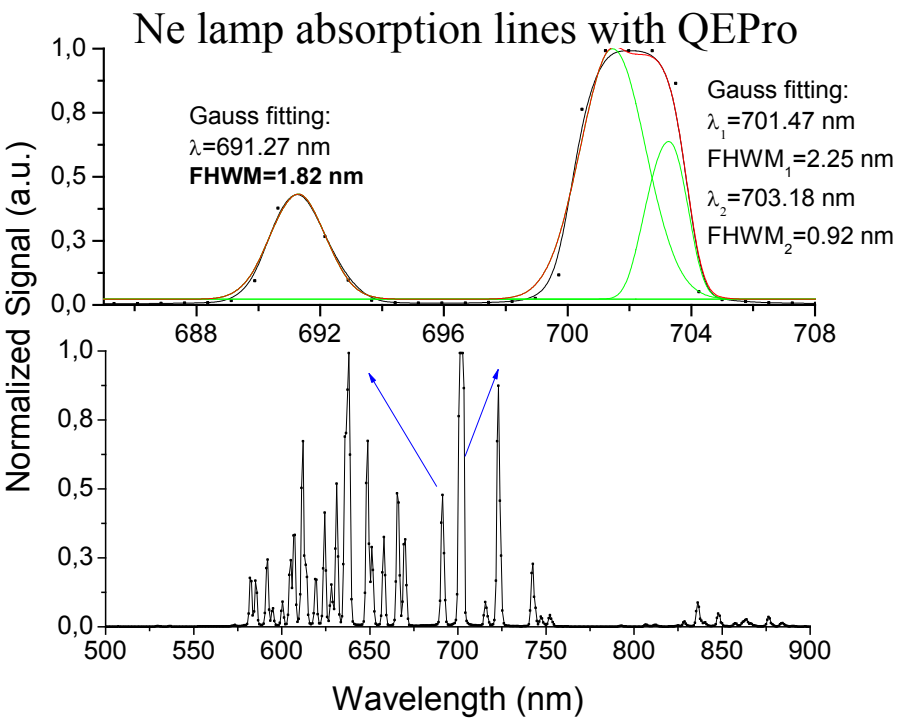
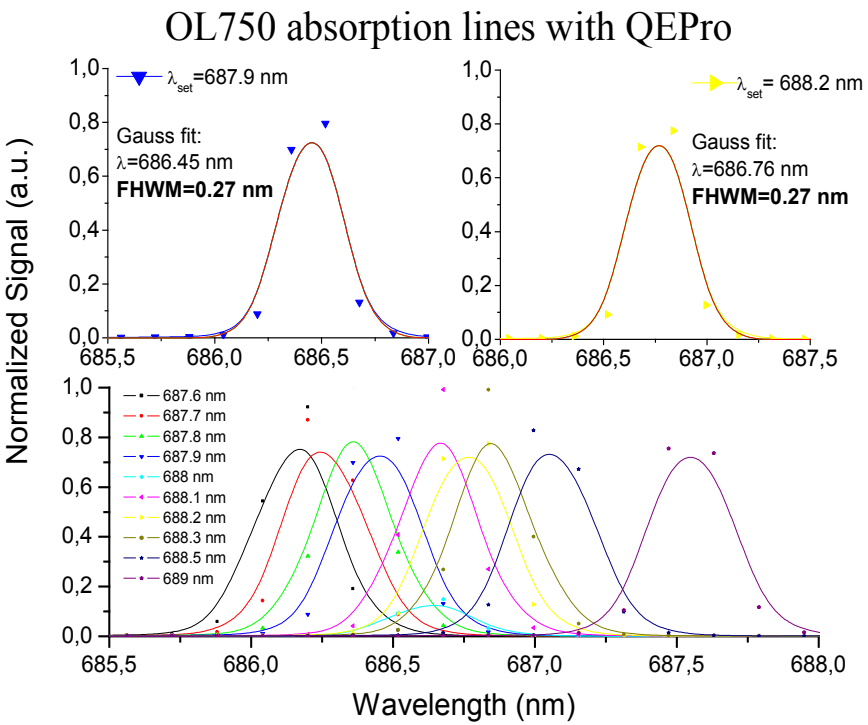
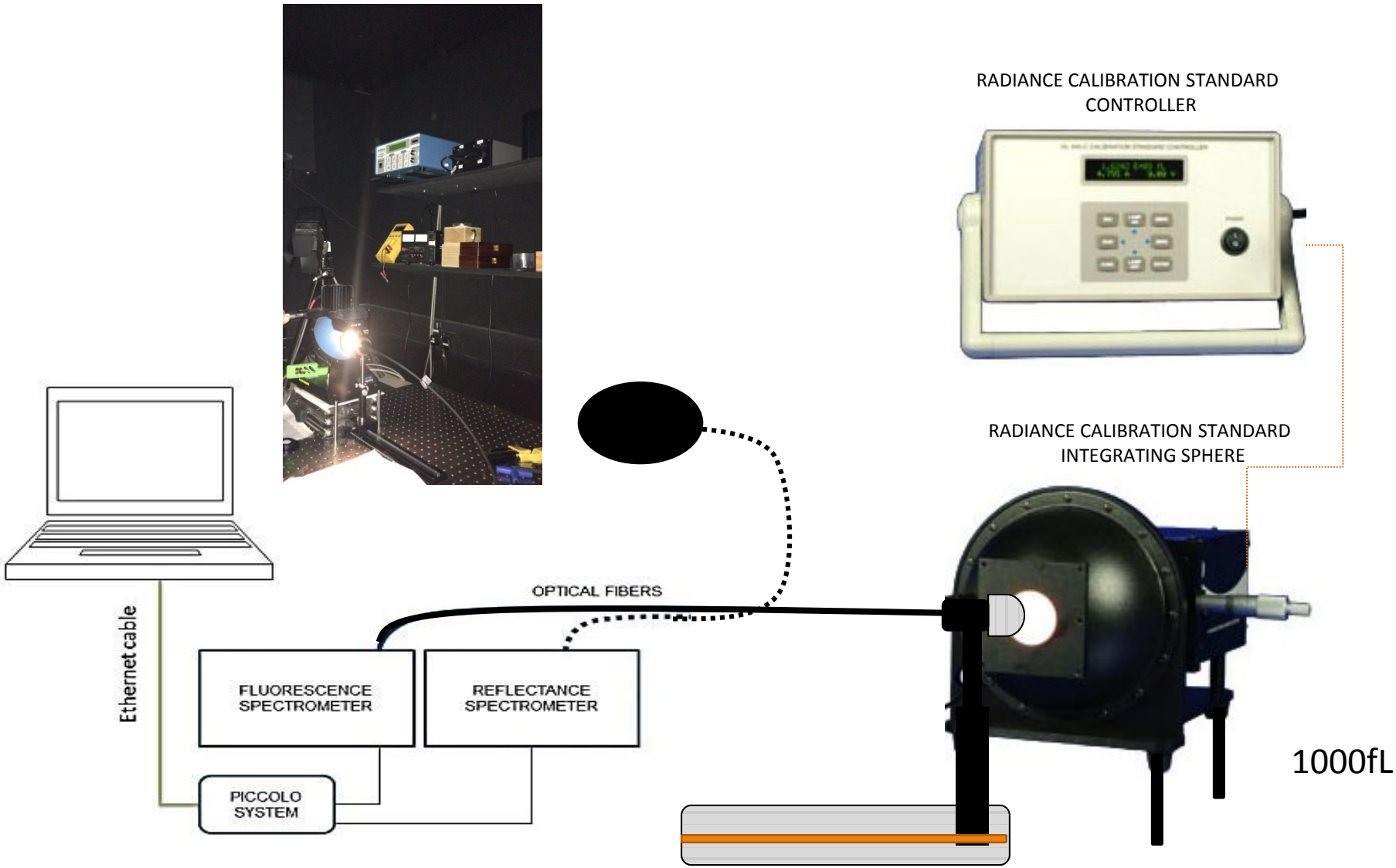


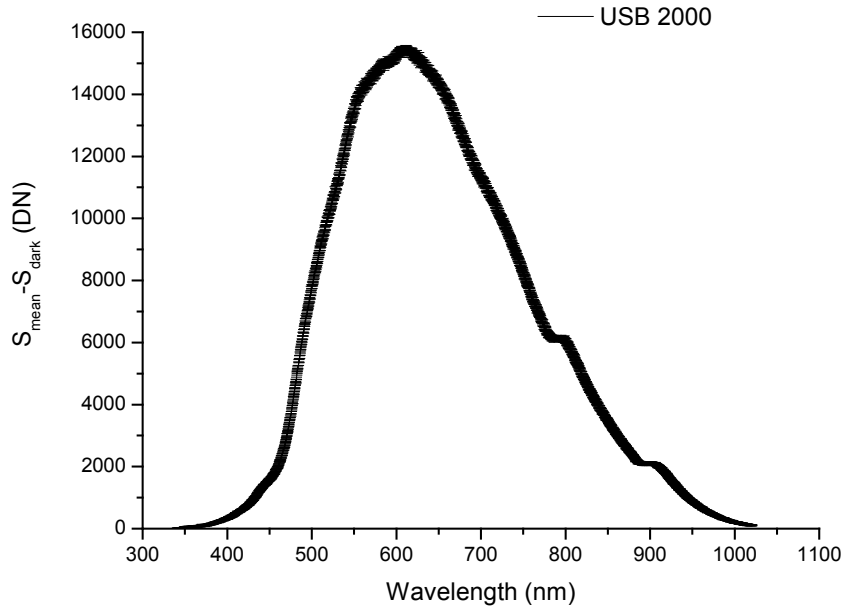


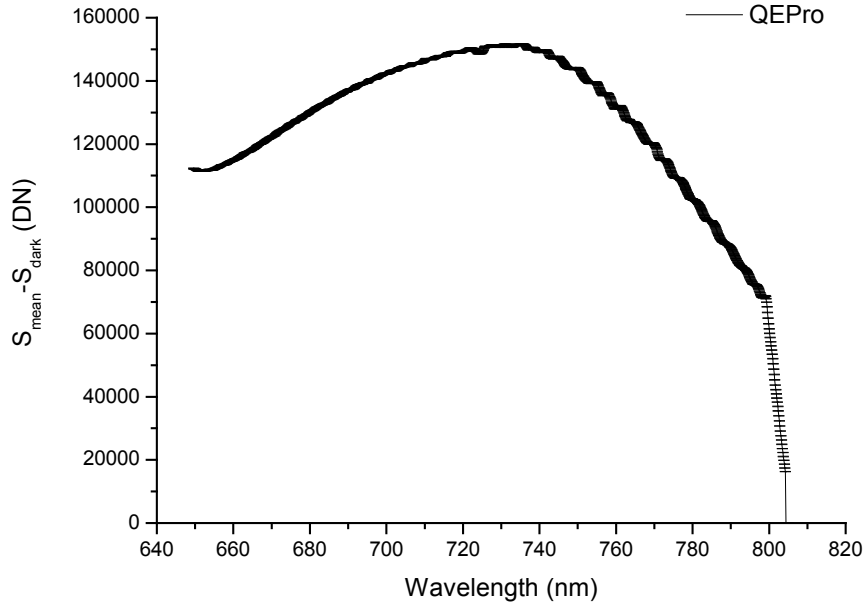
3. Setup for radiance calibration

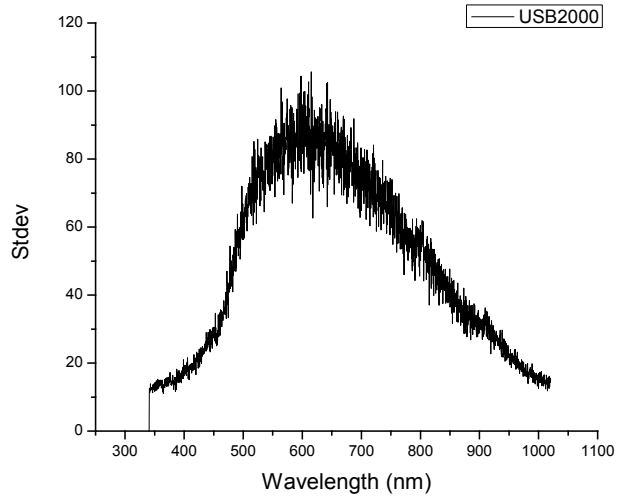


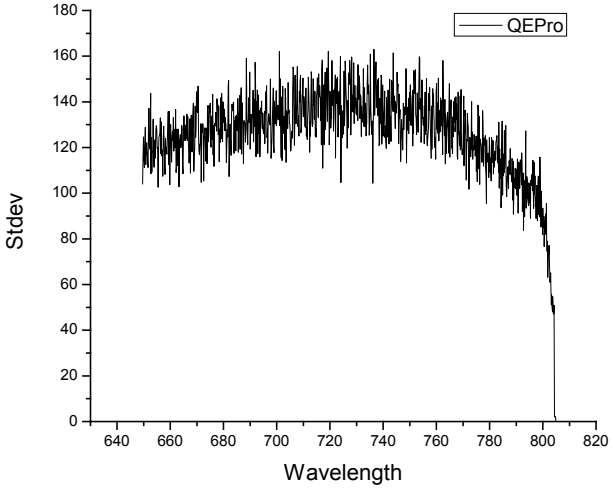
90 spectra x 3 / spectrometer

Field spectrometers radiance calibration









Future work and comments

Was done the wavelength characterization and calibration of a Piccolo dual-field-of-view fibre optic-based spectrometers system has been done using two different methods:

→ firstly was determined the FWHM and the shape of the OL750D source for different configurations, establishing the monochromator system performances.

→Secondly, the FWHM values and the spectral response peaks shapes were determined for the spectrometers system

Has to be done:

- a better characterization OL750D system spectral response with more spectral lines lamps.
- to assess the irradiance and FOV calibration methods
- to delevope the procedures to support FLEX hnear-ground instrumentation.

The general protocol and calibration procedure for a dual field system was established during the STSM, the next step being to repeat the procedure for the applicants own laboratory, in order to verify the procedure repeatability.

Acknowledgements

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I kindly acknowledge the support of **Chris MacLellan** from NERC/NCEO Field Spectroscopy Facility, Dr. **Alasdair Mac Arthur** University of Edinburgh and Dr. **Dan Sporea** from Photonics Laboratory, INFLPR.

Thank you for your attention!