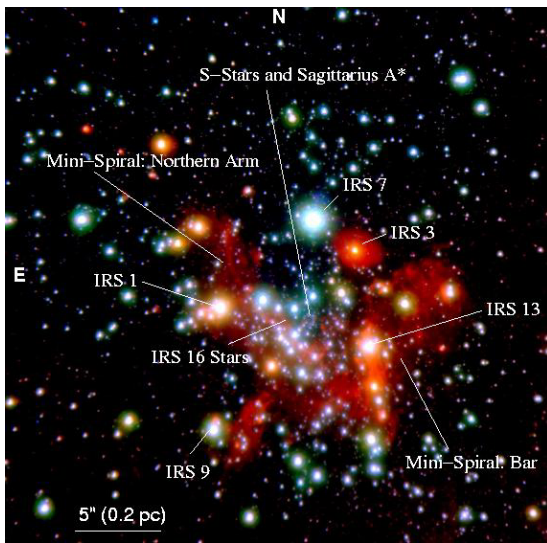




Infrared spectroscopy in the Galactic Center



The Center of our Milky Way is the only nucleus of a Galaxy which we can study in detail as we can resolve there individually the stellar populations. Together with the existence of the supermassive black hole of Sgr*, this part of our Galaxy is one of the most extreme environment where star formation can happen. Crowding, heavy interstellar reddening obliges to work in the infrared. Recently, many developments in infrared spectroscopy has been obtained. With the upcoming KMOS large survey at ESO starting in ten thousand of objects will be observed. This METEOR proposes to analyse these spectra and derive stellar parameters as well as alpha-abundances

In this METEOR, the focus will be on the analysis of KMOS spectra which will be obtained this summer 2026 at the VLT (ESO, Chile) within a large accepted ESO program lasting at least three years. The goal of this large survey is to get the largest spectroscopic dataset so far in the Galactic Center region. Courses about infrared spectroscopy and data reduction will be taught and during the practical work, the newest data from the ESO KMOS large survey (VLT/Chile) will be analysed.

— OBJECTIVES —

- The student will learn the complex structure of the Galactic center, its stellar populations and the basic theoretical aspects of the formation of the Galactic Center
- A specific focus will be done to the two main structures in the Galactic Center: the nuclear star cluster and the nuclear stellar disc.
- The student will learn to use infrared spectroscopy as a powerful tool to study the dust obscured population in the Center of our Galaxy and run the stellar parameter pipeline.

— PREREQUISITES —

- ☒ S1. Data Sciences
- ☒ S2. Stellar physics
- ☒ S2. Statistics

— THEORY —

by MATHIAS SCHULTHEIS

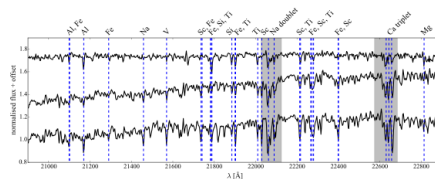
The nucleus of the Milky Way is the most extreme environment in our Galaxy. It is hosting a massive star cluster of 30 million solar masses coexisting with a supermassive black hole of 4 million solar masses. This central star cluster is a typical representative of a very common class of objects called nuclear star clusters (NSCs), the densest stellar systems in the universe we

know of. Given their position at the center of the potential well of a galaxy and their coexistence with black holes, nuclear star clusters potentially play a key role in the formation and certainly in the growth of the central supermassive black holes. In addition, a course on galactic Archeology as a powerful tool to trace the chemical evolution history of the Milky Way will be given.

— APPLICATIONS —

by MATHIAS SCHULTHEIS & GEORGES KORDOPATIS

The student will work a stellar reduction pipeline STARKIT allowing to fit simultaneously the observed spectrum with a grid of synthetic spectra for cool M giants. An important role is the prior assumption for Starkit as well as the choice of the masked regions. A comparison sample of high-resolution spectra ($R = 45.000$) will be used to do a detailed comparison.



A typical KMOS spectrum in the center of the Milky Way in the K-band at around 2.2 micron.

- Tier 1: Courses about the Galactic Center and infrared spectroscopy and exercises
- Tier 2: project
- Tier 3: project

— EVALUATION —

- Theory grade [30%]
 - Oral exam (50%): questions about the Galactic Center and infrared spectroscopy
 - Presentation of an article (50%): critical spirit
- Practice grade [30%]
 - Exercises (30%): thought-process and results
 - Project (70%): initiative, progress, analysis
- Defense grade [40%]
 - Oral and slides quality
 - Context
 - Project / Personal work
 - Answers to questions

— BIBLIOGRAPHY & RESOURCES —

Two review papers about these topics:

- Schultheis2025
- Neumayer2020

— CONTACT —

☎ +33.6.24.85.49.79
 ✉ mathias.Schultheis@oca.eu

— MAIN PROGRESSION STEPS —