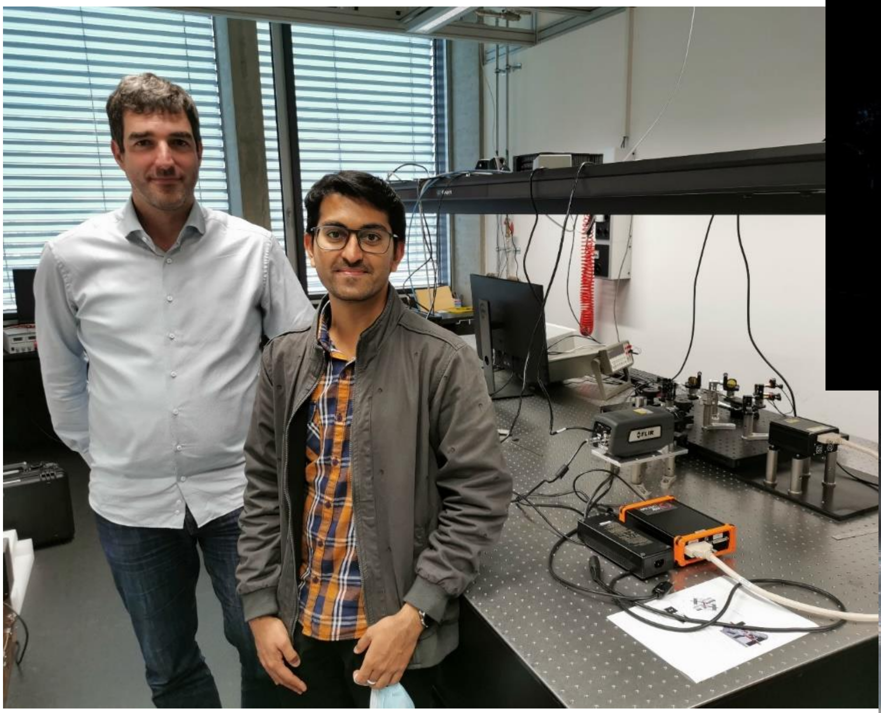
Finding life on exoplanets in the galaxy far, far away..

Case study



Left to right: Dr. Adrian Glauser and Dr. Mohanakrishna Ranganathan inside their lab at ETH Zurich

Looking up to the night sky filled with stars has had humanity dream, generations after generations, about our place in the vast universe and the question about life outside our planet Earth is a mythical scientific interrogation on which two scientists in Switzerland are actively working. Dr. Adrian Glauser and Dr. Mohanakrishna ("Mohan" for short) Ranganathan are two scientists at ETH Zurich university who study possible places outside Earth where life could exist – the so-called "exoplanets".

Looking at exoplanets from telescopes, scientists receive detailed information (under the form of infrared light) about the composition and possible presence of life on these planets. However, one problem is sorting out the infrared light collected by the telescopes and in particular getting rid of misleading infrared light sent by the stars surrounding the exoplanet and also collected by the telescopes. In other words, the telescopes are able to collect a lot of light out there in deep space but scientists need to zero in on only a tiny fraction of this light that is sent by the exoplanet. The experiment at ETH Zurich is meant to help solve this problem by blocking out the information collected by stars. As Adrian puts it, "we want to kill the light from the star to see the exoplanet".

Because the useful information collected by telescopes is mainly made up of light, the system that Adrian and Mohan are working on is an optical system meant to block as much as possible the interfering light collected from the stars. To do that, they use a technique called "interferometry" that will block, or nullify, the light collected by stars. Furthermore, to further reduce interfering light, especially infra-red (IR) light, the project is ultimately to collect light from deep space in a very cold environment where the instrument itself

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will not generate interfering infraredlight, ie a cryogenic environment. This is why their special project is called "Nulling Interferometry Cryogenic Experiment", or "NICE". When you add this to the mother project at ETH regarding exoplanets that is called "The Large Interferometer For Exoplanets" (LIFE)[1], you get a nice wrap up of their project: NICE LIFE.

So why use a quantum cascade laser for their experiment? Well, they need to replicate the light of the stars and must create IR radiation in the 4 to 18 microns spectrum so a 4 microns source was a convenient way to start at ambient temperature. Later on, at cryogenic temperatures, Adrian and Mohan will probably use a blackbody to mimick the IR radiation of stars. In their lab, they split the beam of the QCL in two spatially coherent beams to replicate the two beams collected by two telescopes. They need to imitate two telescopes in order to get as close as possible to the spatial resolution of a very large telescope (about 100m in diameter).

Then, thanks to their optical setup, they can decrease the optical power emitted by the QCL over a dynamic of six orders of magnitude, thus ranging from 180 mW to 180 nanoWatts. A camera picks up the signal and then they can prove that their interferometer works and can block IR radiation based on the the double slit experiment principle.

It appears that mirSense was chosen as the supplier of qcl lasers because the price offered for the 4 microns system was reasonable.

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[1] Learn more about the Large Interferometer for Exoplanets here: https://www.life-space-mission.com/contact/