Astronomy at the University of Haifa

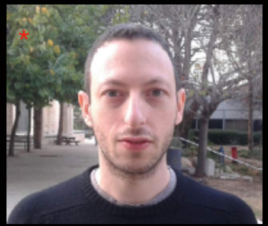
Our group

The group was established as part of the Haifa Center for Theoretical Physics & Astrophysics (HCTPA) in 2017. We are currently the only research group in the northern part of Israel focusing on astronomy (observational astrophysics). The group is partly supported by grants from the Israeli Science Foundation (ISF), the German Science Foundation (DFG), and the budgetary and planning committee (VATAT). The group has strong research ties with leading universities around the world, such as Princeton University, University of California, and the University of Göttingen.

The group has been home to:

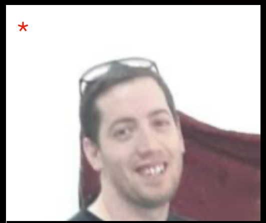

Prof. Doron Chelouche (PI) *


Dr. Carina Fian *


Dr. Gabriel Cotlier *


Dr. Catalina Sobrino *


Dr. Tiffany Lewis


Mr. Saar Katalan *


Mr. Martin Ochmann *


Dr. Francisco Pozo Nuñez

* active members

Why Astronomy?

Astronomy is probably the first scientific discipline that arose when our ancestors gazed into the sky. Nowadays, Astronomy is a subfield of physics, exploring the last frontier for humankind: space. It also offers a means to communicate science to the public, and draw the younger generation to science. This is, in fact, why many of us embarked on a career in science.

At its core, Astronomy is basic science driven by the desire to shed light on the constituents of the universe, the birth and death of stars, like our sun, the evolution of galaxies, like the milky way, and the processes conducive of life. That Astronomy is at the forefront of science is evident from the list of recent Nobel Prizes awarded to astronomers for their contributions to understanding the geometry of the Universe (2011), the direct detection of gravitational waves (2016), and the realisation that supermassive black holes exist (2020). The latter topic is the focus of astronomical research at the university.

Last but not least, Astronomy is a central promoter of technology which affect our everyday life, from the development of satellites, to imaging techniques and advanced data analysis methods.


Andromeda galaxy (c) N. Lefaudeux

Telescope Design and Construction

We are currently in the design phase of the second largest telescope in Israel, which would be dedicated to the study of the environs of supermassive blackholes in galaxy centers. Using a unique imagery system, which was developed in house, the telescope will be able to compete with the largest telescopes in the world.

Telescope construction is to commence soon, and we are seeking support to purchase and manufacture state-of-the-art components of our imaging system, notably a high-quality camera, custom-made set of filters, and a high-fidelity polarimeter.

The telesope will be installed near Mitpze -Ramon, which is at the Negev dessert, where the observing conditions are among the best in Israel.


ASA AZ800 (c) ASA

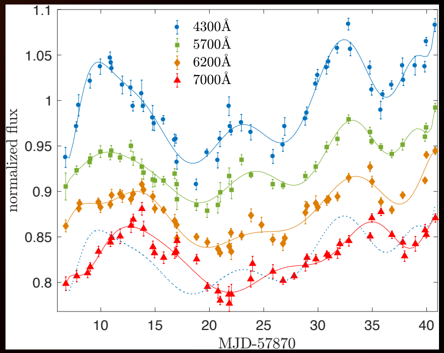
The telescope will also serve as part of a network of telescopes, which is devoted to the study of the transient sky. As such, it will be completely robotic, and able to autonomously monitor the sky. Data will be transmitted to our computers on campus on a daily basis, where they will be further analyzed.

Probing the environs of supermassive black holes

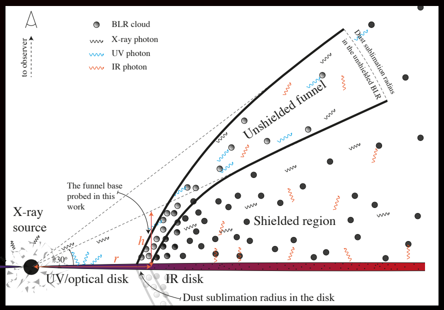
Black holes are fundamental entities in Einstein's theory of general relatively. Their existence has recently been confirmed via novel astronomical observations. Specifically, supermassive black holes (SMBH), whose mass can be millions to billions times larger than our Sun, are known to exist at the centers of most if not all galaxies.

During their "active" phase, SMBH can devour mass from their vicinity, in which case their immediate environs light up, which can outshine entire galaxies. These extreme environments are so powerful that they can alter the evolutionary course of their host galaxies with implications for the birth of new stars and planets, and the existence of life. The study of such environments, which cannot be recreated on Earth is essential for understanding how our galaxy, the solar system, and our planet, with us on it, came to be.

As the environs of far away SMBHs are minuscule as they appear in the sky, standard imaging techniques are insufficient to study them even with the best telescopes. Our group uses a technique, which is akin to radar, in which light echoes are traced as they propagate from very near black hole out to its immediate environs. Our group is one of very few groups worldwide that possess the expertise and equipment to study those regions. Our new telescope and imaging system will place the University of Haifa at the forefront of the field.



Light echoes as measured in several bands across the electromagnetic spectrum from the immediate environs of an active black hole. Colors of the different curves roughly correspond to the light intensity variation as would be perceived by the human eye. The position of the peaks occurs at different times for different colours (MJD is the time measured in days), thus demonstrating the effect of light echoes.



A depiction of the structure of the material in the vicinity of a black hole, which is consistent with our data. Specifically, the data collected by our group proved that, contrary to the common conception in the field, whereby much of the emission near the SMBH comes from a flattened configuration of material in the form of a disk, there is substantial material at great heights above the disk. This has major implications for the rate at which black hole grow over cosmic time.

From Chelouche et al. in *Nature Astronomy* (2019)