

## Total Solar Eclipse 2019 - CESAR expedition: education, outreach and science.

M. Pérez-Ayúcar (1), J. Zender (2), M. Castillo (1), M. Breithelner (1), W van Reeve (1)  
(1) European Space Astronomy Center (ESAC), Madrid, Spain ([miguel.perez.ayucar@esa.int](mailto:miguel.perez.ayucar@esa.int))

(2) European Space Technology Center (ESTEC), Noordwijk, The Netherlands ([joe.zender@esa.int](mailto:joe.zender@esa.int))

### Abstract

Solar transits are rare astronomical event of profound historical importance and with an enormous potential to engage nowadays students and general public into Planetary Sciences and Space. Although historic scientific importance (examples, to measure the distances in the solar system, to observe the solar corona) has diminished since humanity roams our solar system with robotic spacecrafts, eclipses remain a spectacular astronomical event that is used very effectively to engage general public and students to Science and Space in general.



Figure 1: Total Solar Eclipse US 2017. Image credit: CESAR team

The educational project CESAR (Cooperation through Education in Science and Astronomy Research), has been covering since 2012 such events (Venus transit 2012, 2016 Mercury Transit, August 2017 Total Eclipse, live Sun transmissions, solar eclipses, ISS transits ...). For the Total Solar Eclipse on July 2nd, 2019, the CESAR team and collaborators will travel to ESO La Silla observatory. The goals of the expedition are 1) scientific 2) educational and 3) outreach.

Fostering education with appealing science and technology for the new generations is one of the main drivers of the expedition. Several telescopes will be used: high resolution inner corona images and live streaming (field of view 2-3 Sun diameters), and outer corona still images (~10 Sun diameters). Images and streaming will be broadcast live in a open-access hangout, from ESAC, with live connections to La Silla and scientists/engineers talks. Questions and answers sessions were performed so that world-wide audience can interact with the scientists and engineers.

On outreach, this eclipse will receive world-wide attention in the news and pose awareness of space and space activities. We therefore aim to reach general public as well as scientists and students, via news in CESAR and ESA web pages, and the direct live stream and hangout.

The science goals are diverse. The team will do Polarization measurements of the Corona with simple polarization filtering, improving the equipment and procedures from the USA TSE 2017, and with a KPOL telescope (an electronic tunable polarizer) from the Turin Observatory group in high angular resolution (1 deg). Also improved Flash Spectrum of the Chromosphere upgrading the spectrograph used in TSE 2017. And measurement with a multi-constellation and multiband GNSS receiver of changes in Earth's Ionosphere caused by the Moon's shadow transit over the observation area.

In this paper we explain how this educational, outreach and scientific event was planned, the activities it comprised, and the follow up activities expected for future events. CESAR collaborates for TSE 2019 with ESA Education and Communications offices, ESO Communication and Outreach, the ESA Galileo Science Office and the Turin Observatory.



Figure 2: Sun Corona during Total Solar Eclipse US 2017. Image credit: CESAR team. Lens: 300mm.

Filter: horizontal polarizer. Camera: Canon 60D.  
Processing: 6 image stacking and rotational gradient