Station-keeping balloon-based telescopes above the ground layer at Calar Alto

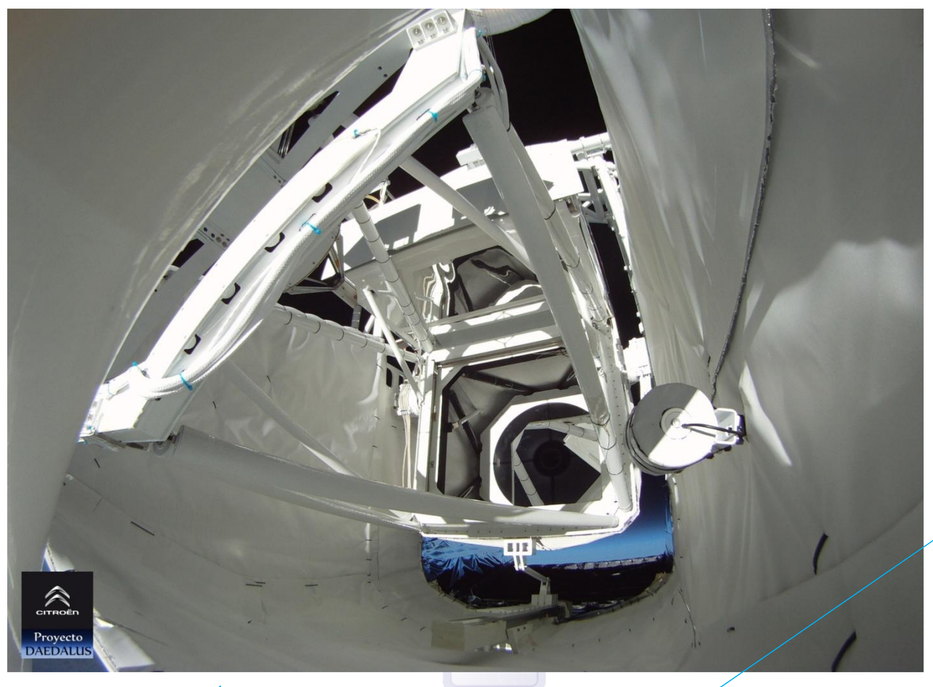
Jose-Luis Ortiz(1), Philipp Maier(2), Alejandro Sánchez de Miguel (1) Jesús Aceituno(3) José Juan López-Moreno(1), Rene Duffard(1), Thomas Mueller(2) Jürgen Wolf(4), Karsten Schindler(4), Friederike Graf(4)

(1) IAA-CSIC, Granada Spain.(2) Max Planck Institute for Extraterrestrial Physics, Garching, Germany (3) Centro Astronomico Hispano Aleman de Calar Alto, Spain (4) Institute of Space Systems, University of Stuttgart, Stuttgart, Germany

ORISON is an H2020 European-funded project to carry out a feasibility and design study of an astronomically-oriented balloon facility that could deploy one or several small-to-medium-sized stabilized telescopes and a suite of other scientific instruments as light payloads to do state of the art research in the stratosphere at acceptable costs.

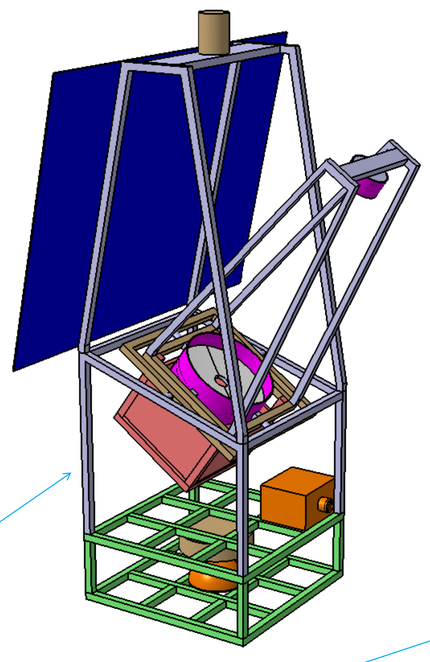
Even though the ORISON project is aimed at *stratospheric balloons* we are also considering the possibility of using balloon-based telescopes of the same design as in ORISON but attached to the ground to maintain them in restricted areas. The idea is to keep them above the ground layer of a good astronomical observatory without necessarily reaching the stratosphere. It is well known that the ground layer is responsible for half to two thirds of the seeing at an observatory site. Hence, nearly diffraction limited images with telescopes in the 0.4m to 0.5m range are possible in large fields of view with resolutions ranging from 0.2 to 0.4 arcsec. Also the telescopes can fly above the high humidity layer that is usually attached to the ground, allowing for more usable nights at Calar Alto. The ground layer is also responsible for a large degree of noise in the photometry of telescopes so telescopes above the ground layer can also perform better in the photometry sense, which is important in diverse areas of research, notably in exoplanet transit science. Using lucky imaging techniques we expect we might get both high spatial resolution and accurate photometry.

- **The ORISON platform is still in its conceptual design phase**



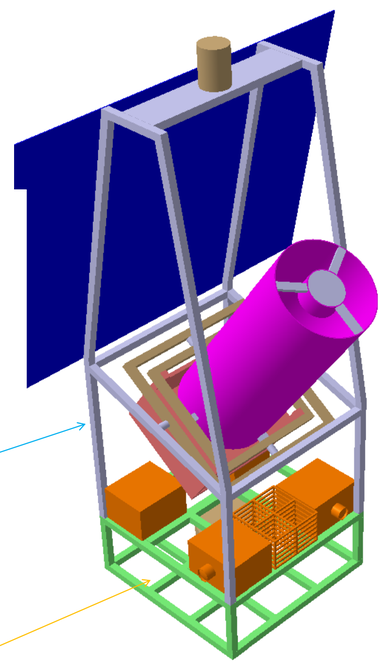
>1000 kg

SUNRISE is a 1m telescope for Solar Research that has flown in the past. This is a typical example of what is feasible, but ORISON aims for something lighter and simpler, with telescopes of smaller size and weight



100-200 kg

In the preliminary technical specifications we are aiming at two ~0.5m telescopes, one with a large FOV camera and another one with a high spatial resolution multichannel imaging spectrograph



100-200 kg

Some engineering aspects:

Station-keeping above Calar Alto can be maintained by different means. One is through the use of a nylon-type tether. We are currently assessing this possibility.

Assuming 100 kg suspended mass by the balloon, 500 m design altitude, and max. 870 m lateral displacement due to wind during regular operations. The estimated mass of a simple single nylon rope to hold the balloon would be 25 kg

1. Requirements

Balloon operating altitude above ground	500 m
Balloon lift capacity (suspended mass)	100 kg
Operating wind speed	6 m/s
Max. design wind loads	15 m/s (7 Beaufort, allows continuous operation of ca. 20 days on average at Calar Alto)
Carrier gas	Helium
Max. tether tilt angle/lateral displacement due to wind	30 deg / 870 m

2. Design Specifications

Balloon material	Composite Nylon
Balloon diameter / volume	7.36 m / 209 m^3
Tether material	Nylon Double Braid
Tether diameter	6 mm
Total tether length	1000 m

3. Results

Approximate tether mass	**25 kg**
Static load safety factor	5

If you want to

Fill out the future partners form on

www.orison.eu

Orison can have a modular part suitable for general use. It might host small permanent instruments for meteor science as well as other small instruments for specific missions.

"The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 690013."