The XACT laboratory

X-ray astronomy

X-ray astronomy is far more recent than optical astronomy and supplies unique data on the physics and history of the universe.

As the X-radiation from space is prevented from reaching the Earth by the atmosphere, it is necessary that in order to detect X-rays, instruments are brought beyond the atmosphere.

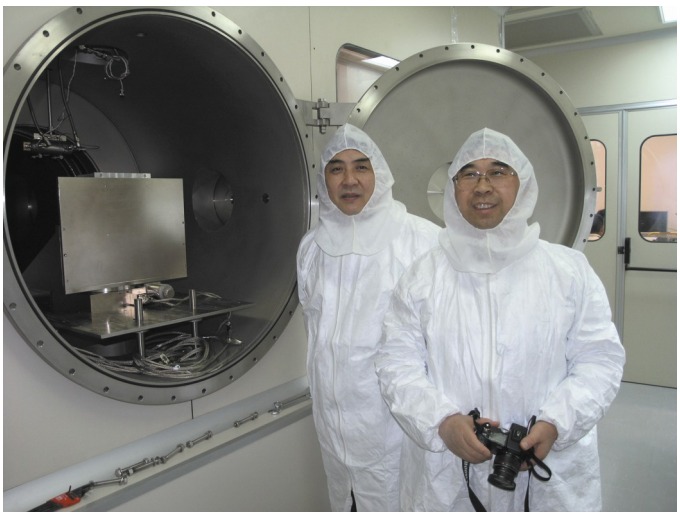
From rockets to orbiting observatories

Back in the 60s, the first experimental observations of celestial X-ray sources employed rockets as a means to maintain the X-ray detectors at a high enough altitude to detect radiation for a few minutes. These experiments aimed to confirm the scientific value of X-ray observations, as the existence of extra-solar X sources was still unproven.

Nowadays astronomy no longer employs rockets but real orbiting observatories able to X-ray scan the sky for a duration of several years. Rockets, however, are still in use to test the functionality of new generation equipment.

Experiments based on orbiting observatories require long preparation times (sometimes over ten years) and involve researchers and institutions from various countries to plan and carry out the mission.

Performance testing, calibration and adjustments procedures on the instruments prior to the launch are crucial operations as on these relies the success of the mission and a correct interpretation of the observational data.



Inside the clean room, during the installation of the LOXIA detector for the Chinese CHANG'E1 mission in the vacuum chamber.

The origin of the XACT laboratory

In the early 90's at the Palermo Observatory a laboratory was set up a, with the purpose of developing and calibrating equipment for X-ray astronomy.

At the XACT (*X-ray Astronomy Calibrating and Testing*) laboratory, pieces of instruments such as fileter, detectors and optical parts have been calibrated and tested for use in some of the most important international X-ray astronomy missions of the past 15 years.

The OAPa team has achieved specific skills in projecting and calibrating filters used in X-ray astronomy missions. Filters are essential for the proper operation of astronomical X-ray detectors, as they stop visible and UV light and low-energy particles which would otherwise hit the detector, damaging it or reducing its effectiveness.

Throughout the years, the laboratory has been expanded and provided with most advanced equipment, in line with the latest requirements for ongoing space missions.

The XACT laboratory consists of:

- **A 34,5 metre long, increasing-diameter steel cylinder**, known as the XACT facility (fig. 1, p. 13). Kept in high vacuum conditions, its purpose is to produce an X-ray beam somehow resembling the radiation emitted by astronomical sources. A cylinder of such a length is necessary to create a representation of a great distance source as it occurs when observing celestial bodies from space. The pumping system, which creates and maintains vacuum conditions inside the XACT Facility (thus ensuring that the emission is diffused and not absorbed), guarantees an impurity-free environment. At one end of the cylinder is located the X-ray source (**C**); at the other end lies the tube section where the equipment used for testing and calibrating is lodged (**A**). This final section of the cylinder is provided with a door (1 metre of diameter) leading into a clean room, which through continuous air filtering reduces to a minimum the dust in the environment.

  A large cylindrical chamber (2.5 metre of diameter) can house X-ray telescopes for calibration.

- **A cryostat**, which is a very sophisticated refrigerator able to reach a temperature of 30 thousandths of a degree above absolute zero and maintain it constant within some millionths of a degree. This instrument is used in the laboratory to study calorimeters, a new class of X-ray detectors able to determine with precision the energy