# The Space Research Laboratory

The Space Research Laboratory is concerned on the studies of the satellites dynamics. The satellites observations unit is one of the oldest branches in the laboratory. It is started in 1957 using portable wide-angle telescopes. In 1966, a bilateral agreement for executing joint program for satellite tracking was signed with the Astronomical Council of the USSR academy of sciences. Accordingly, a satellite tracking station has established at Helwan for both visual and photographic observations by means of NAFA-25 and AFU-75 cameras. In 1974, the laser ranging equipments belonging to the INTERCOSMOS countries has installed at Helwan for precise ranging and positioning of satellites. The Smithsonian Observatory participated in 1977 and in 1982 as a third part for joint observations at Helwan taking the advantage of its suitability for satellite tracking and ranging.

In 1987, a full automatic station has constructed for blind observations of artificial earth satellites by using the laser beam. The precession of its measurements becomes below 1 cm due to the conscious modifications and upgrading of the station.

AFU-75 used for photographic observations of satellites
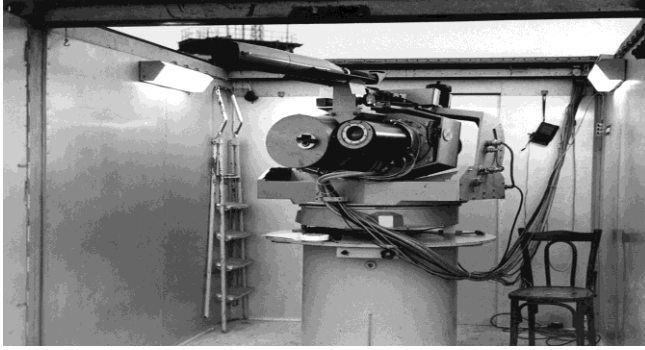
Half-automatics and full automatic satellite laser tracking station.
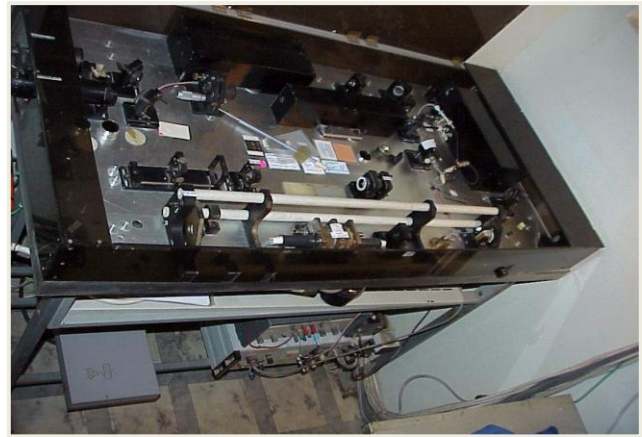
The Mount and the Laser Generator

Overview:

Nowadays, a space environment is a branch of astronautics, aerospace, engineering and space physics that seeks to understand and address conditions existing in space that affect the operation of spacecraft. Problems for spacecraft can arise from radiation, space debris, upper atmospheric drag and spacecraft electrostatic charging. The types of space environment effects depend on the altitude and inclination of spacecraft orbit and their interactions with spacecraft vary with local time, season, geomagnetic and solar activity with magnitude varying from negligible to mission threatening. Studies of the space environment and its effects on surfaces and on equipments of the satellites are also one of the interests of the space science laboratory.

The Space Plasma Unit is build to generate plasma with specific properties in high vacuum plasma chamber. The experimental and simulated tests of this system show the plasma effects on different components of spacecraft s'

surface. This mechanism studies the charging process, which leads the different surface potentials. Moreover, the arcing phenomena will be studied in details in terms of arcing current, voltage and temporal evolution of discharge spots.

The newest unit at the space research laboratory, is the Nanotechnology Unit. The Unit is used for the generations of the nanoparticles and studies of their properties. It is used for the preparation of some samples of Cadmium cyanide, Gold and Silver of nano-materials.

The Research Trends in the Space Laboratory are:-

➢ **Satellites Dynamics.**
- Satellite motion: orbit determination and perturbing forces.
- Computation of related phenomena (e.g. rise, set and ground trace) of artificial earth satellites motion.
- Spacecraft stability and attitude control.
- Design of artificial satellites for special missions as frozen orbits.

➢ **Satellite Laser Ranging and Applications.**
- Satellite tracking from Helwan SLR-Station
- Data Fitting using high accuracy methods such as Spline and overlap techniques.
- Distance determination on Earth's surface

➢ **Space Geodesy from SLR data.**
- Determinations of stations positions and velocities.
- Studies of the crustal deformations.
- Studies of the tectonic motion.

➢ **Spacecraft- Environment interactions**
- Space environment: physical properties, mechanisms, and effects.
- Space plasma: properties and effects; theoretical and experimental studies.

➢ **Nanotechnology: Nano-material generation and applications.**
- Nano particle properties: optical and electrical characteristics; theoretical and experimental studies.
- Nano-thin film production for photovoltaic cells used in space applications

➢ **Meteoroids and Space Debris.**
- Optical and photometric studies
- Analytical studies
- Observations and prediction (installation in progress).