LECTURE 1

Ouverture

Introduction to astronomy an its history , from naked eye to telescopes to space telescopes (4440)

Astronomy is the science of gathering information on celestial objects. This can be done in three ways:

1) In situ, i.e. by visiting celestial bodies and , when possible, gather samples. This only applies to solar system objects, etc. etc. (incl. Meteorites, etc.)
2) Through the electromagnetic emission of celestial objects. This has been, and still is, the most important information channel from the sky. In particular, each photon carries with it FOUR types of info: its arrival direction (alpha and delta), its arrival time, its energy and its state of polarization. Astronomical telescopes should ideally try to extract from the travelling photon all four types of information as accurately as possible. Obviously, this implies astronomy with e.m. telescopes in space, since our atmosphere only lets though a small fraction of the e.m. spectrum.
3) Through non-e.m. (non-photonic) emission of celestial objects. This has so far been limited to cosmic ray particles (observed since nearly a century now) and, more recently, to neutrinos. To date, these have been seen to come from the Sun and from SN 1987a. Gravitational wave astronomy is the next obvious step, but none has been observed yet, owing to the great detection difficulties .Depending on the g.w. frequency range, space detectors can be required.

Note in passing that great breakthroughs in particle physics have come from an astronomical context: in 1932 antimatter (positrons) was first observed in cosmic rays and up to the fifties fundamental physics discoveries (mu and pi mesons, etc.) were made with particles from space. More recently, the mass of the neutrino has finally been nailed down thanks to observations of the Sun. In the future, it is possible that proof of the existence of SUSY particles (as well, for example, of that of light pseudoscalar bosons) could come from astronomical searches of dark matter through its e.m. signatures in the diffuse sky emission or around compact objects such as neutron stars.

In Lecture 1, we start by dealing with astronomy in situ, with space telescopes in our planetary system, with an aim to understand the nature and origin of solar system bodies. The bodies around our Sun are: the four (inner) rocky planets (Mercury, Venus, Earth, Mars), the outer four gaseous giants (Jupiter, Saturn, Uranus and Neptune, the latter two being much more icy that gaseous) and the smaller bodies (Pluto, asteroids, Kuiper belt objects, comets, Oort cloud objects).
Missions to rocky planets include:

- the continuing exploration of Mars. For ESA, this now means the ongoing MARS EXPRESS mission and the upcoming EXOMARS lander (2011?)
- planet Venus has been visited, after the early Soviet successes, by NASA'S MAGELLAN in the nineties. ESA's VENUS EXPRESS is now on its way to the planet.
- planet Mercury is the target of NASA's MESSENGER mission, now on its way, while the much more ambitious BEPICOLOMBO ESA/JAXA probe will be launched in 2013.

Missions to outer planets include:

- the NASA GALILEO mission to Jupiter and its moons, terminated a few years ago
- the ESA/NASA mission CASSINI, now orbiting Saturn, after the successful descent of the HUYGENS probe to the surface of Titan.
- NASA's NEW HORIZON, which has just started its journey towards Pluto (Uranus and Neptune had been visited a quarter of a century ago by NASA's VOYAGERs)

Missions to comet include:

- the first encounter of mankind with a comet: ESA's GIOTTO which flew by Halley in 1986
- NASA's STARDUST, which just brought back to Earth the first pristine cometary material
- ESA's ROSETTA, on its way through the Solar System to a rendez-vous with a distant comet, on which it will land in 2014

(in all, 13 space missions for planetary system astronomy will be reviewed)