

# FROM THE SOLAR SYSTEM TO THE DISTANT UNIVERSE

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## ABSTRACT

The Universe exhibits extreme conditions of temperature, density, radiation and gravitational fields. Consequently, astronomy is strongly relevant to physics, chemistry and biology, aside its cultural and philosophical interest.

Research in astronomy has common features with geophysics: experiments are impossible, and progresses can only come from a confrontation of models and theories to observations. Astronomical discoveries are particularly unpredictable, but have proven to be strongly dependent on new instrumentation. Like nuclear and particle physics, astronomy requires very large equipments, together with more modest facilities for long-term programs. The recent spectacular discoveries of extremely distant galaxies and of planets around nearby stars were done respectively with very large optical and radio telescopes on the Earth and in space, and with small instruments. Astronomy also involves service observing for the general community, for example for accurate time keeping or for monitoring the activity of the Sun.

In France, observational cosmology is already mature but theoretical cosmology is a relatively recent domain, showing rapid development. Extragalactic astronomy is also growing fast. The study of interstellar matter and star formation has been a strong point for many years and is very

active. Stellar and solar astronomy are in a phase of renewal. Solar-system astronomy has developed enormously and France is now a leader in this field. France is also a leader in the old field of astrometry and time measurement, for which the techniques have experienced considerable changes recently, for example with the HIPPARCOS astrometry satellite.

Most of astronomical research is based on observation of celestial objects at many different wavelengths. France has access to excellent instrumentation covering the whole electromagnetic spectrum. Gamma-ray astronomy from space is very developed, with the experiment SIGMA on the russian satellite GRANAT, and soon the INTEGRAL project of the European Space Agency (ESA). On the ground, CAT is just starting operation and there is another project, CELESTE. X-ray astronomy has not been very active recently in France, but this will change soon with the participation to the satellite XMM of ESA. In the ultraviolet, the visible and the near-infrared, french astronomers are regular users of the Hubble Space Telescope and share with other countries large ground-based facilities: the Canadian-France-Hawaii telescope, THEMIS for solar research, and the instruments of the European Southern Observatory (ESO). France takes a very active part in the development of techniques allowing to reach a very high angular resolution: adaptive optics and interferometry, which are both being implemented on the Very Large Telescope of ESO presently under construction in Chile. France has also been active in building the instrumentation of the mid- and far-infrared satellite ISO of ESA, and is presently gathering the remarkable scientific outcome of this mission. It also participates in various space projects in the far-infrared and sub-millimeter domains, in particular the satellites PLANCK and FIRST of ESA. Radioastronomy is also very developed, to a large part thanks to the french involvement in the Institut de Radio Astronomie Millimetrique (IRAM).

While observing the solar system with all these facilities, and also the space environment of the Earth with ground-based and space instruments in cooperation with other countries (EISCAT, SUPERDARN, soon the set of four satellites CLUSTER of ESA, etc.), french astronomers also take a very active part in various missions of solar-system exploration: CASSINI to Saturn and its satellite Titan, later ROSETTA to a comet, both built by ESA.

Finally, France and Italy are building together a large detector of gravitational waves, VIRGO.

Of course, as any healthy community, the french astronomers have longer-term projects and plans, but they are outside the scope of the present report.

The main problems of french astronomy are to organize in data bases the large amounts of information coming from all these instruments, to maintain the adequacy of the means for processing their data, and also to have enough computing facilities for maintaining an activity in theory and modelling appropriate to the pace at which the observations are gathered. Astronomers have good collaborations with physicists, chemists and geophysicists, but should tighten the present ties. They should also devote more effort in answering adequately the considerable public demand for astronomical knowledge. Finally, while astronomy is already well organized on a world-wide basis, a special effort should be devoted in building a genuine european astronomical community, based of course on the existing but independent european societies like ESA, ESO, IRAM and EISCAT.

A general discussion on the present and future of french astronomy will take place in a national colloquium to be held in Spring 1998.

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