PRIMORDIAL MATTER IN THE OUTER SOLAR SYSTEM: A STUDY OF ITS CHEMICAL COMPOSITION FROM REMOTE SPECTROSCOPIC ANALYSIS

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Abstract. Our knowledge of the primordial matter from the objects of the outer solar system has made a considerable progress over the past years, in spite of the lack of any in situ measurements of these objects at the present time. The recent progress of ground-based instrumentation and the launch of the two Voyager fly-by missions have provided a huge amount of new informations about the origin and the evolution of the 'primitive' Solar System objects.

The most significant discoveries concerning the atmospheres of the Giant Planets can be summarized as follows: (1) there does not seem to be any differentiation in the internal structure of Jupiter during the planet's history; thus, the H$_2$/He ratio measured on Jupiter seems to be representative of the H/He ratio of the Primordial Nebula; (2) there is some evidence for a helium differentiation, relative to hydrogen, in Saturn's interior; (3) there seems to be a carbon enrichment on both Jupiter and Saturn by a factor about 2; this result is consistent with a model in which the planetary core is formed first, and the atmosphere accreted by this core in a second stage; (4) the D/H ratio measured on Jupiter should be representative of the D/H value in the Primordial Nebula, 4.5 billion years ago; this value is 2 to 5 times larger than the mean value measured in the local interstellar medium now; (5) Titan's atmosphere is dominated by nitrogen and contains traces of organic and prebiotic molecules (HCN, C$_2$N$_2$, HC$_3$N); the chemical composition of Titan's atmosphere could be favorable for the early stages of life development.

The small bodies of the Solar System – asteroids and comets – are still very poorly known. However they contain a key information about the physical and chemical properties of dust in the Primordial Nebula and the interstellar medium. With the launch of expected fly-by missions towards Comet Halley and, possibly, towards asteroids, we may hope to know a new development of our understanding of these objects, comparable to the progress we have known on the Giant Planets over the past ten years.

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During the past fifteen years, due to the development of both ground-based and space astronomy, our knowledge of the Solar System has progressed by several orders of magnitude. The Mariner, Pioneer, Venera, and Viking space missions have answered many questions about the physical and chemical conditions of Mars and Venus atmospheres, while, in the case of the Giant Planets, the Pioneer and Voyager space missions, coupled with more and more sophisticated ground-based experiments, have started to give us the physical parameters and the chemical composition of the atmospheres of Jupiter, Saturn and Titan. The increasing interest for the study of our Solar System can be interpreted in several ways. From a 'geophysical' point of view, the study of terrestrial planets, which are the most evolved objects of the Solar System, gives...