Preface

A special characteristic in the domination of the General Theory of Relativity (GTR) for such a long time, it is that there have been relatively few tests and experimental applications. New developments in technology and the extraordinary advances being made in the observation of the Universe mean that this situation is now changing fast.

One of the best-known examples, an "object" which has entered everyday use in a very short time despite its technological and theoretical complexity, is the Global Positioning System (GPS). This system, an application of the c=constant postulate, is used perfectly naturally by pilots, drivers and tourists who are all clearly unfamiliar with the intricacies of its design. It would work properly for just a few hours if it were not able to compensate for gravitational time dilation, it is sensitive to the Shapiro effect, geodesic curvature and the definition of simultaneity and it also measures other more subtle effects of Relativity. In effect, GPS is a laboratory of the Relativity with the size of our planet.

The first GTR laboratory was our Solar System, where classic tests of General Relativity were performed by observing the orbit of planets together with light and the time it takes to arrive on earth. These tests were reproduced in the stronger gravity fields of binary pulsars, where they produced indirect evidence of gravitational radiation.

In 1937, Zwycky suggested that gravitational lenses (specifically multiple images of a distant galaxy generated by a closer one acting as a lens) could be used to test General Relativity on the cosmological scale. However, by the time the first double system (Q0957+561) was discovered in 1979, it had been so long since General Relativity had become established that such a test was no longer seen as relevant. When this view was later overturned, gravitational lenses became not just a test but one of the most useful applications of General Relativity and one of the most powerful tools in modern day Cosmology. The two versions of the lens effect, "strong" and "weak", are providing a great deal of information for our models of the cosmos, including about the distribution of dark matter throughout the Universe. It is entirely possible that they will lead to some very pertinent conclusions about the validity and completeness of the GTR.

X Ray Astronomy has recently opened up a new testing ground for Relativity. The FeKalpha line profile of iron in the active nuclei of some galaxies behaves in accordance with models of relativistic kinematics at very high gravitational redshift. As predicted by the models, these lines' emitters are situated in the innermost orbits of accretion discs rotating around supermassive black holes (which are very common in the centre of galaxies) near to the horizon. The new point of view of the physics of black holes could open up new avenues for investigating these phenomena.

Advances in technology have led to new interferometry techniques which can be used to detect gravitational waves from the Earth or from space. Detecting and characterising gravitational waves will have significant theoretical implications and

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they will open a new window on the Universe. Gravitational radiation will give us direct information about enigmatic objects like GRBs as well as details of the processes in which very strong gravitational fields are involved.

The current state of play therefore promises much in terms of new links between Relativity, Astrophysics and technology. These links will lead to new tests of the General Theory of Relativity together with a greater range of applications for the theory and the discoveries it will led to in Astrophysics and Cosmology. This promising outlook has led to our desire to stage this XXXth Spanish Relativity Conference at the Instituto de Astrofísica de Canarias, as the latest in a series which would not have been possible without the valuable contributions made by all those who have participated.

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