Preface

Pulsar timing is one of the most precise branches of physics. It has led to verification of a most important prediction of general relativity: the existence of gravitational radiation (Taylor & Weisberg 1989; Taylor 1995). The rate of decay of the orbital period of the binary pulsar PSR 1913+16 which provided this proof, at the same time ruled out a number of rival theories of Einstein's version of general relativity (Taylor & Weisberg, 1989), a very fundamental result.

Timing of millisecond pulsars has allowed some of the most precise tests of general and special relativity in the solar system, showing for example that the moon and planets influence the rate of atomic clocks on Earth; it also helped to test the long-term precision of terrestrial atomic time standards (Taylor 1987, 1991). Furthermore it has led to the discovery of the first planetary system around another star - the only other planetary system so far known to have terrestrial planets (Wolszczan, this volume). Pulsar timing also provided us with the sole way - so far - to probe the internal structure of neutron stars, by studying pulsar glitches and post-glitch behaviour. This has provided very strong evidence for the presence of a superfluid in the neutron star core and allows one to study the interactions between this core and the solid crust of the star. Pulsars in addition are powerful probes for studying the interstellar medium: the dispersion of the arrival times of the pulses at different frequencies yields information about the total number of free electrons along the line of sight and thus on the distance of the pulsar. Fluctuations in brightness and arrival times provide information on the density fluctuations in the interstellar medium and on the transverse velocity of the pulsar. Timing studies of X-ray pulsars also reveal important information on neutron stars: like for binary radio pulsars, doppler-timing of the orbital motion yields information on neutron star masses and companion masses; X-ray timing studies promise even to allow tests of strong-field general relativity (Van der Klis, this volume). It is wonderful that something as simple as measuring the arrival times of pulses can give such a wealth of information.

The first international meeting devoted solely to timing was the NATO Advanced Study Institute 'Timing Neutron Stars' held in Çesme in the spring of 1988 (Ögelman & van den Heuvel 1989). Since then many new discoveries have been made, particularly in the field of binary and millisecond pulsars and on fast X-ray variability of accreting neutron stars. The 75th anniversary of the Astronomical Institute 'Anton Pannekoek' of the University of Amsterdam coinciding with the 10th anniversary of the Amsterdam-Utrecht Center for High Energy Astrophysics provided a nice occasion for a new meeting on this subject. Funding for the meeting was provided by the Royal Netherlands Academy of Arts and Sciences through the programme of Royal Academy Colloquia. Additional support was provided by the Netherlands Science Foundation NWO, through a Spinoza grant to one of us (van den Heuvel).

We were very happy to have gathered at this Colloquium almost all of the major workers in this field worldwide, observers as well as theoreticians. We very much enjoyed their lively presentations and contributions to the discussions which are reproduced here in written form. Time, of course, always is scarse and a few review speakers have not been able to send in their manuscripts before our final deadline (in late 1997). For their presentations we refer to papers or reviews published elsewhere: Alpar (1995); Bildsten et al. (1997); Lamb (1991); Sauls (1989); Spruit & Phinney (1998) and Srinivasan (1997). For the field of physics of neutron star interiors we have taken the freedom to invite an additional contribution from N. Glendenning which seems very relevant for the subject of this meeting. It predicts an observable effect from a phase transition in the neutron star interior.

We would like to thank all participants to the colloquium for their contributions which made this for us a wonderful meeting, and this book one with which we are very happy. We thank Mrs. Manita Kooy of the Royal Academy for her invaluable help in organizing this Colloquium.

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Mysteries in Relativistic Astrophysics

Parallel to the Royal Academy Colloquium there was a one-day symposium for the general public on 'Mysteries in Relativistic Astrophysics', organized by graduate students and staff of the Astronomical Institute, to celebrate the 75th anniversary of the Institute. Speakers at this symposium on 26 September 1996, which was held in conference center 'de Rode Hoed' in Amsterdan and attended by some 300 participants, were professors P. Charles (Oxford University), R. Ellis (Cambridge University), M. Schmidt (California Institute of Technology), J.H. Taylor (Princeton University) and C. Wheeler (University of Texas at Austin).