

NewCompStar School 2016 - “Neutron stars: gravitational physics theory and observations”



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Tests of general relativity and neutron star mass measurements from timing of radio pulsars

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In this lecture, I will introduce some basic concepts related to neutron stars, radio pulsars and their evolution. I then describe in detail timing of radio pulsars in binary systems, using the results from the first binary pulsar, PSR B1913+16, as an important example. First, I describe how pulsar timing of this system was used to determine the masses of the components, and then I describe how it was used to test general relativity and to achieve, in the 1980's, the first detection of gravitational wave emission.

This fundamental discovery opened up a wide field of research, by encouraging the construction of ground-based gravitational wave detectors, but also by further stimulating pulsar surveys (which I describe in some detail), which lead to the discovery of many more binary pulsars.

I then describe many of the results from these new pulsars. I concentrate first on neutron star mass measurements, in particular the special difficulties that arise from measuring masses of millisecond pulsars, and the great rewards from this effort, with a special emphasis on the consequences for our knowledge of the behaviour of super-dense matter in the cores of neutron stars. I finally describe in detail the current status of tests of general relativity, both with double neutron star systems (in particular the “double pulsar” system, J0737-3039), millisecond pulsar - white dwarf systems and the triple system, J0337+1715.

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