GR 1: Invited Talks 1

Time: Monday 9:30–12:30 Location: H 2013

Invited Talk GR 1.1 Mon 9:30 H 2013

Was Einstein Right? A Centennial Assessment — •Clifford Will — University of Florida, Gainesville FL USA

A century after Einstein's formulation of general relativity, a remarkable diversity of precision experiments have established it as the "standard model" for gravitational physics. Yet it might not be the final word. We review the array of measurements that have verified general relativity in the laboratory, in the solar system and in binary pulsars. We then describe some of the opportunities and challenges involved in testing Einstein's great theory in strong-field, dynamical regimes and in cosmology.

Invited Talk GR 1.2 Mon 10:10 H 2013

Precision tests of General Relativity using cosmic clocks — •Michael Kramer — Max-Planck-Institut fuer Radioastronomie

The best tests of theories of gravity for strongly self-gravitating bodies are provided by radio pulsars. Observations of those allow for precision tests of general relativity, all of which have been passed by Einstein's theory with flying colours. In particular in recent years, the exploitation of new systems allowed to probe a wide range of effects, including gravitational wave emission, spin effects, and possible violations of the strong equivalence principle or gravitational Lorentz invariance. Experiments are also ongoing to directly detect low-frequency gravitational waves using regular observations of millisecond pulsars. This talk will review these recent results.

20 min. break

Invited Talk GR 1.3 Mon 11:10 H 2013

Results from the Wilkinson Microwave Anisotropy Probe — •Eiichiro Komatsu — Max-Planck-Institut für Astrophysik, Garching, Germany

The Wilkinson Microwave Anisotropy Probe (WMAP) mapped the distribution of temperature and polarization over the entire sky in five microwave frequency bands. These full-sky maps were used to obtain measurements of temperature and polarization anisotropy of the cosmic microwave background with the unprecedented accuracy and precision. The analysis of two-point correlation functions of temperature and polarization data gives determinations of the fundamental cosmological parameters such as the age and composition of the universe, as well as the key parameters describing the physics of inflation, which is further constrained by three-point correlation functions. WMAP observations alone reduced the flat Lambda cold dark matter cosmological model (six) parameter volume by a factor of >68,000 compared with pre-WMAP measurements. The WMAP observations (sometimes in combination with other astrophysical probes) convincingly show the existence of non-baryonic dark matter, the cosmic neutrino background, flatness of spatial geometry of the universe, a deviation from a scale-invariant spectrum of initial scalar fluctuations, and that the current universe is undergoing an accelerated expansion. The WMAP observations provide the strongest ever support for inflation; namely, the structures we see in the universe originate from quantum fluctuations generated during inflation.

Invited Talk GR 1.4 Mon 11:50 H 2013

General Relativity as everyday practical tool: time, navigation and geodesy — •Claus Lämmerzahl — ZARM, University of Bremen, Am Fallturm, 28359 Bremen, Germany

The effects of Special and General Relativity are very tiny. For standard everyday velocities the special relativistic Doppler effect is of the order 10^{-15} and also the gravitational redshift over ten meters height difference is of similar order. The reason for that is the comparatively large velocity of light. However, in the last years we experienced a boost of improvements of experimental accuracy and precision so that today these tiny effects can be measured with high precision. This opens up the possibility to determine precisely the gravitational potential with clocks, distances with laser interferometers and the gravitational field with gravi- and gradiometers based on freely falling masses like atoms. This can be done on ground or from space. In all these different measurement schemes relativity plays an essential part. This talk will highlight these recent and possible future developments and the huge impact they have on Earth sciences including the physics of the ocean, on navigation, positioning, leveling, and metrology.