GR 2: General Aspects: Units, History and Quantum

Zeit: Montag 17:30–18:45 Raum: HS 4

Hauptvortrag GR 2.1 Mo 17:30 HS 4

Physical dimensions/units and universal constants: their invariance in special and general relativity — •Friedrich W. Hehl[1] and Claus Lämmerzahl[2] — [1]Inst.Theor.Physik, Univ., 50923 Köln, Germany — [2]ZARM, Univ., 28359 Bremen, Germany

The theory of physical dimensions and units in physics is outlined. This includes a discussion of the universal applicability and superiority of quantity equations. The International System of Units (SI) is one example thereof. By analyzing mechanics and electrodynamics, we are naturally led, besides the dimensions of length and time, to the fundamental units of action $\hbar$, electric charge q, and magnetic flux ϕ. We have $q \times \phi =$ action and $q/\phi = 1/$resistance. These results of *classical physics* suggests to look into the corresponding quantum aspects of q and ϕ (and also of $\hbar$): The electric charge occurs exclusively in elementary charges e, whereas the magnetic flux can have any value; in specific situations, however, in superconductors of type II at very low temperatures, ϕ appears quantized in the form of fluxons (Abrikosov vortices). And $\hbar$ leads, of course, to the Planck quantum h. Thus, we are directed to superconductivity and, because of the resistance, to the quantum Hall effect. In this way, the Josephson and the quantum Hall effects come into focus quite naturally. One goal is to determine the behavior of the fundamental constants in special and in general relativity, that is, if gravity is thought to be switched off versus the case in the gravitational field. Relations to the *new* International System of Units (SI) of 2019 are pointed out.

GR 2.2 Mo 18:15 HS 4

Interpreting the Schwarzschild Metric — •Dennis Lehmkuhl — Institut für Philosophie, Universität Bonn, Am Hof 1, 53113 Bonn

It is sometimes said that the Schwarzschild solution to the Einstein field equations was discovered in 1916 but that it took until the 1950s or 1960s before it was understood that the Schwarzschild metric represents a black hole. Such statements are puzzling, for the Schwarzschild metric was successfully used and applied from its very inception. In this talk, I will trace the history of different applications, interpretations and, intimately linked, coordinatizations of the Schwarzschild metric. The focus will be on a.) Einstein's use of an approximation to the Schwarzschild metric in the prediction of Mercury's perihelion in 1915 and his subsequent correspondence with Schwarzschild and others on the corresponding exact solution; b.) discussions of what we would today call the event horizon of the Schwarzschild metric during the 1920s; and c.) the development of a conceptual distinction between singularities and horizons in the late 1950s and early 1960s and the resulting new perspective on the Schwarzschild metric.

GR 2.3 Mo 18:30 HS 4

Gravitation and Quantum Theory - Reflections on some basic questions — •Thomas Görnitz — Karl-Mangold-Str. 13, 81245 München — Fachbereich Physik, Goethe-Uni Frankfurt/M

Einstein's GRTh has proven itself excellently in all empirical investigations, including the universal equality of inertial and heavy mass. Gravity proves to be a space-time geometry that affects everything identically. Nevertheless, there are cloudings of this fascinating image. It has been known since 1933 that there must be "dark matter". Homogeneity and isotropy of the background radiation led to the invention of inflation. The Kruskal metric shows a seamless incidence from the outside into the inside of a black hole, in which all matter disappears in a mathematical point. Most problematic is that the efforts to connect GRTh with quantum theory in a conventional way remained in vain, as did the search for particles to explain inflation or dark matter. Fundamental quantum theoretical reflections reveal the core of this problem and a way out of it. The solutions already achieved are presented.