

## AGPhil 3: Particles and Fields

Zeit: Montag 15:20–16:20

Raum: JUR G

AGPhil 3.1 Mo 15:20 JUR G

**The Appearance of Mass in Fundamental Theories of Physics**  
— ●HARALD MARKUM — Atominstitut, Vienna University of Technology, Austria

In Classical Newtonian Mechanics the Hamiltonian function consists of a sum of kinetic and potential energy, where the mass of a body enters as a parameter. Within gravity one does not distinguish between gravitational mass in the attraction of bodies in contrast to the inertial mass of objects in empty space; experimentally no difference can be found. In Special Theory of Relativity there appears the energy-momentum relation, where the value of the mass depends on the velocity; the rest mass is the same parameter as in Classical Mechanics.

In Quantum Mechanics the mass stays as a parameter in the Hamiltonian; excited states in the Hydrogen atom are proportional to the rest mass. In Quantum Field Theory the mass becomes a (divergent) parameter, which has to be fixed to the experimental value via a renormalization procedure.

In the Standard Model of Particle Physics the masses depend on the vacuum expectation value of the Higgs Field. The fermions are additionally influenced from a Yukawa Coupling, being an open parameter. The mechanism which gives the proton its mass from the three quarks and the gluon field is an actual research topic. Neutrinos have a finite mass but their sizes have not been measured.

In the Three Body Problem the mass of the interacting particles

plays a decisive role; in general such systems are chaotic. In Astrophysics we are confronted with the problem of dark mass and dark energy. We give an overview of the different definitions and measurements.

AGPhil 3.2 Mo 15:50 JUR G

**The photon is no strict particle and nonlocality is far from being proven** — ●KARL OTTO GREULICH — Fritz Lipmann Institut Beutenbergstr.11 D07745 Jena

Two aspects of philosophical discussions on physics are the wave particle dualism and non locality including entanglement. However the strict particle aspect of the photon, in the common sense view, has never been proven. The accumulation time argument, the only experimental verification of a strictly particle like photon, has so far not yet been satisfied (1). Also, experiments thought to prove nonlocality have loopholes which have so far not yet been safely closed, and now an even more serious loophole emerges (2). Thus, also nonlocality cannot be seen as proven. This demands some fine tuning of philosophical discussions on critical experiments in physics.

1 K.O. Greulich Single molecule experiments challenge the strict wave particle dualism of light 2010 Int J Mol Sci, in press

2 K.O. Greulich Another loophole for Bell inequalities 2009 SPIE Proceedings 7421 in press

3 see also [http://www.fli-leibniz.de/www\\_kog/](http://www.fli-leibniz.de/www_kog/)