UNIVERSITÄT
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Physikalisches Kolloquium

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Muon g-2: experiment, standard model and lattice quantum chromodynamics

Twenty years ago in an experiment at Brookhaven National Laboratory, physicists measured the muon's anomalous magnetic moment, $a_\mu = (g_\mu - 2)/2$, with a remarkable precision of 0.54 parts per million. Since then, the standard model prediction for a_μ has exhibited a discrepancy with experiment of over 3 standard deviations, raising the tantalizing possibility of physical particles or forces as yet undiscovered. On April 7 a new experiment at Fermilab presented its first results, brilliantly confirming Brookhaven's measurement and bringing the discrepancy with the standard model to a near discovery level of 4.2 sigma. To fully leverage this and future measurements, and possibly claim the presence of new fundamental physics, it is imperative to check the standard model prediction with independent methods, and to reduce its uncertainties. After an introduction and a discussion of the current experimental and theoretical status of a_μ, I will present a lattice QCD calculation, by the BMW collaboration, of the contribution to this quantity that most limits the precision of the standard model prediction. The result of this calculation significantly reduces the gap between the standard model and experiment, and suggests that new physics may not be needed to explain the current, experimental, world-average value of a_μ .

Monday, December 20, 2021, 4:15 p.m.

via zoom