1 Motivation and status (Dominik Stöckinger, TU Dresden)

Magnetic moments in general and the muon anomalous magnetic moment $a_\mu = (g_\mu - 2)/2$ in particular are clean and sensitive probes of fundamental particles and interactions. After the Brookhaven measurement, a_μ is sensitive to all interactions of the Standard Model of particle physics. The observed deviation from the Standard Model theory prediction might be due to physics beyond the Standard Model (BSM), but at the same time it constrains BSM scenarios. A new generation of a_μ measurements will further increase the experimental accuracy and the sensitivity to SM and BSM physics. The goal of the workshop is to initiate and contribute to progress on the SM theory prediction of a_μ, and in the following paragraphs we will give a reminder of the current status and the motivation for further improvement.

Huge progress has been achieved on the SM theory prediction of a_μ in the past years. We highlight the 5-loop QED computation [1], the inclusion of high-precision e^+e^--data into the hadronic vacuum polarization contributions [2, 3, 4], the resolution of the τ-vs.-e^+e^--puzzle [4, 5], and the exact evaluation of the electroweak contributions after the Higgs boson mass measurement [6]. As a result of this progress, the SM theory prediction has a smaller uncertainty than the Brookhaven measurement, but the precision of the hadronic contributions needs to be further improved to match the new experiments.

One new a_μ measurement will be carried out at Fermilab [7]. It combines the technique of the Brookhaven experiment with specific advantages present at Fermilab. Datataking is expected to start in 2017. A second promising experiment is planned at J-PARC. It would make use of an entirely complementary strategy and therefore provide important cross-checks. Both experiments promise to reduce the uncertainty by a factor four, down to a level less than half as large as the current SM theory uncertainties coming from the hadronic vacuum polarization and hadronic light-by-light contributions.

Measuring and computing the SM prediction for a_μ as precisely as possible is very important also to study hypothetical new physics scenarios. This statement is independent of whether the current deviation will increase or decrease. The importance of a_μ as a constraint on BSM physics is due to two facts. First, different types of BSM physics can contribute to a_μ in very different amounts, so a_μ constitutes a meaningful benchmark and discriminator between BSM models. Second, the constraints from a_μ on BSM models are different and complementary to constraints from other observables from the low-energy and high-energy frontier.

Both aspects can be illustrated within the framework of supersymmetric models, as shown in Figure 1. The red points in the Figure show that the a_μ-predictions of various benchmark scenarios proposed in the literature scatter widely. Any future measurement of a_μ will rule out many of these points, illustrating the discriminating power of a_μ. The green points in the Figure illustrate the complementarity of a_μ. In the hypothetical scenario considered in [8], the LHC can find most supersymmetric particles and measure their masses, and yet there are several very different choices of supersymmetric parameters which give an equally good fit to LHC data. The a_μ-

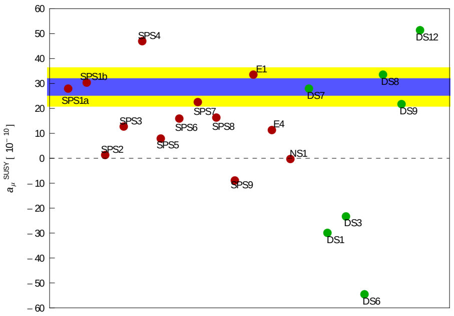

Figure 1: SUSY contributions to a_μ for the SPS and other benchmark points (red), and for the "degenerate solutions" from Ref. [8]. The yellow and blue bands are the ±1 σ errors from the Brookhaven and the planned Fermilab measurements.

predictions of these "degenerate solutions" however, differ, hence allowing to lift the LHC degeneracies by taking into account a_μ.

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