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The Muon $g-2$ Experiment: Review the Controversy

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The ability to measure the leptonic anomalous magnetic moment very precisely provides a stringent test on the Standard Model (SM). The current experimental result of the measurement of the anomalous magnetic moment of muon a_μ (up to relative precision of 0.5 ppm) from the BNL Muon $g-2$ experiment (E821) shows a discrepancy of 2.4σ between the experimental result and the theoretical value predicted by the SM. Some has argued that this might hint a ‘New Physics’ beyond the SM. However, in the calculation of the a_μ from the SM, though the QED and the electroweak contributions can be determined up to sufficient precision to compare with the experimental result, the hadronic contribution depends upon the experimental data from either the e^+e^- annihilation to hadrons or the hadronic τ decay. By using the latter dataset, the discrepancy between experimental determination of a_μ and the SM is reduced to 0.9σ . The controversy lies in the fact that the experimental results from the e^+e^- annihilation to hadrons or the hadronic τ decay are inconsistent with each other by themselves. Further investigations are needed before a conclusion can be made.

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