Introduction

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Introduction to the use of the tau spectral functions and its measurements

The use of Tau Spectral Functions

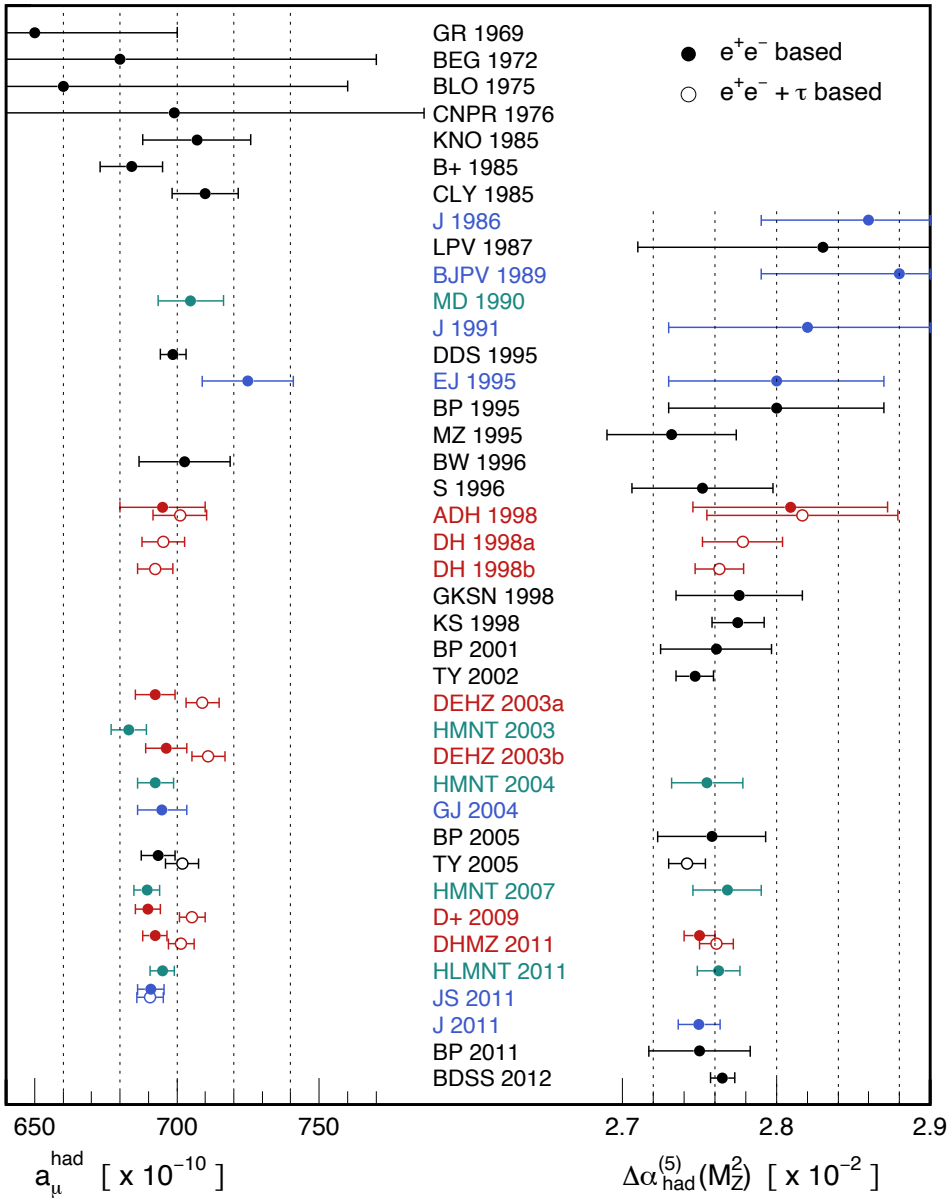
The use of the tau spectral function data to evaluate the hadronic contribution to muon g-2 + running α was proposed by Alemany-Davier-Hoecker in 1997 [ADH 1997]

Since then, a number of evaluations of a_μ by using the tau spectral function in the 2π channel were performed

Some of the earlier evaluations are shown in the right figure [DHMZ 2016]

Recent evaluations $a_\mu[\tau, 2\pi]$ are:

- ALEPH 2013 [$516.2 \pm 2.9 \pm 1.9_{IB}$]
- MR 2020 [$519.6 \pm 2.8 \, {}^{+1.9}_{-2.1}{}_{IB}$]
- DHLMZ 2023 [$517.3 \pm 2.9 \pm 1.9_{IB}$]



Tau Spectral Functions

The spectral function is the normalised mass spectrum scaled with other kinematic factors

$$v_{\pi\pi^0}(s) = \frac{m_\tau^2}{6|V_{ud}|^2 S_{\rm EW}} \frac{B(\tau^- \to \pi^-\pi^0\nu_\tau)}{B(\tau^- \to e^-\bar{\nu}_e\nu_\tau)} \frac{dN_{\pi\pi^0}}{N_{\pi\pi^0} ds} \left[\left(1 - \frac{s}{m_\tau^2}\right)^2 \left(1 + \frac{2s}{m_\tau^2}\right)\right]^{-1}$$

Fundamental ingredient relating long distance hadrons to short distance quarks (QCD)

Experimentally, the two key components of the spectral function are

- Branching fraction of the decay mode (see the talk by Michel)
- The shape of the mass spectrum

The measurements of the branching fraction and mass spectrum are the topic of today

The use of the tau spectral function in the evaluation of the hadronic contribution to a_μ needs also to apply the isospin breaking corrections ➔ the topic of the 2nd half of the online tau workshop on Dec. 9th