

# Hadronic Vacuum Polarization from LQCD

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# Current status

- g-2 as precision test for standard model
- LQCD as only first principle method for HVP contribution to g-2
- New result from Mainz<sup>1</sup>, main sources are for uncertainties are long-distance window and isospin breaking

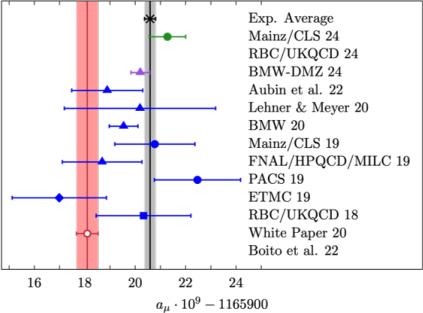


Figure: Current HVP result

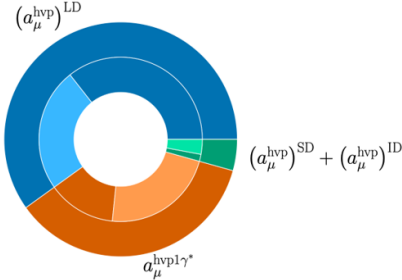


Figure: Sources of uncertainties

<sup>1</sup>The hadronic vacuum polarization contribution to the muon g-2 at long distances:  
arXiv: 2411.07969

# Low-Mode Averaging (LMA)

- Low-lying eigenstates dominate statistical error
- Decompose Dirac operator into low-mode contribution and a propagator for the remaining high modes
- Procedure:
  - ▶ Calculate the lowest eigenstates directly
  - ▶ Project out the eigenstates and solve the remaining Dirac equation
  - ▶ Cross terms by placing eigenmode as source

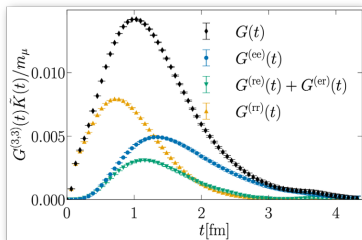


Figure: Different contributions within LMA

# Further Planned Steps

- Calculate strong isospin breaking using LMA
- $C(x_0, y_0, ) = \sum_{\vec{x}, \vec{y}, z} \langle J_\mu(y) | (\bar{u}u - \bar{d}d)(z) | J_\nu(x) \rangle$
- Procedure:
  - ▶ Disconnected diagrams, reasons: not been included yet and computational less difficult
  - ▶ Connected diagrams
  - ▶ possible combination with QED effects
- Final goal: better understanding of isospin breaking effects and reduction of the error of the HVP contribution to  $g-2$