Muonic
Atom
Spectroscopy
Theory
Initiative

What?
quantitative unbiased summary by a broad team of experts, resulting in the state-of-art SM predictions

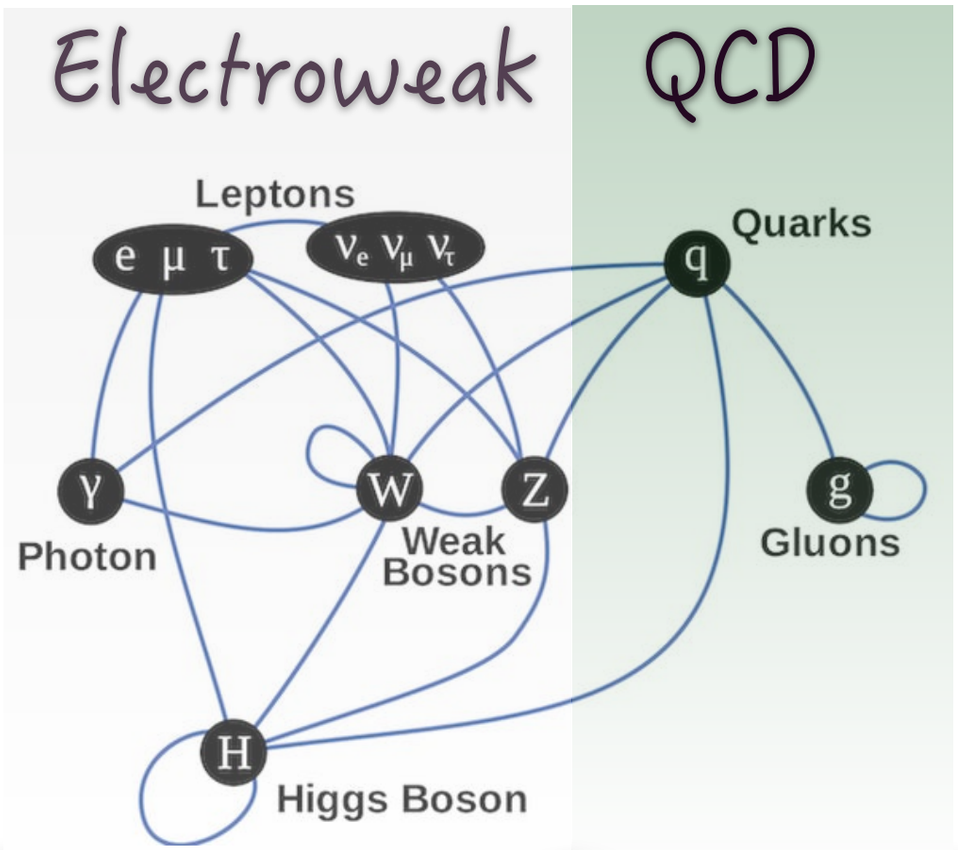
Why?
Consistency, consensus, credibility

How?
Workshops, review paper(s)

Antognini, Carlson, Hagelstein, Indelicato, Pachucki, Pascalutsa

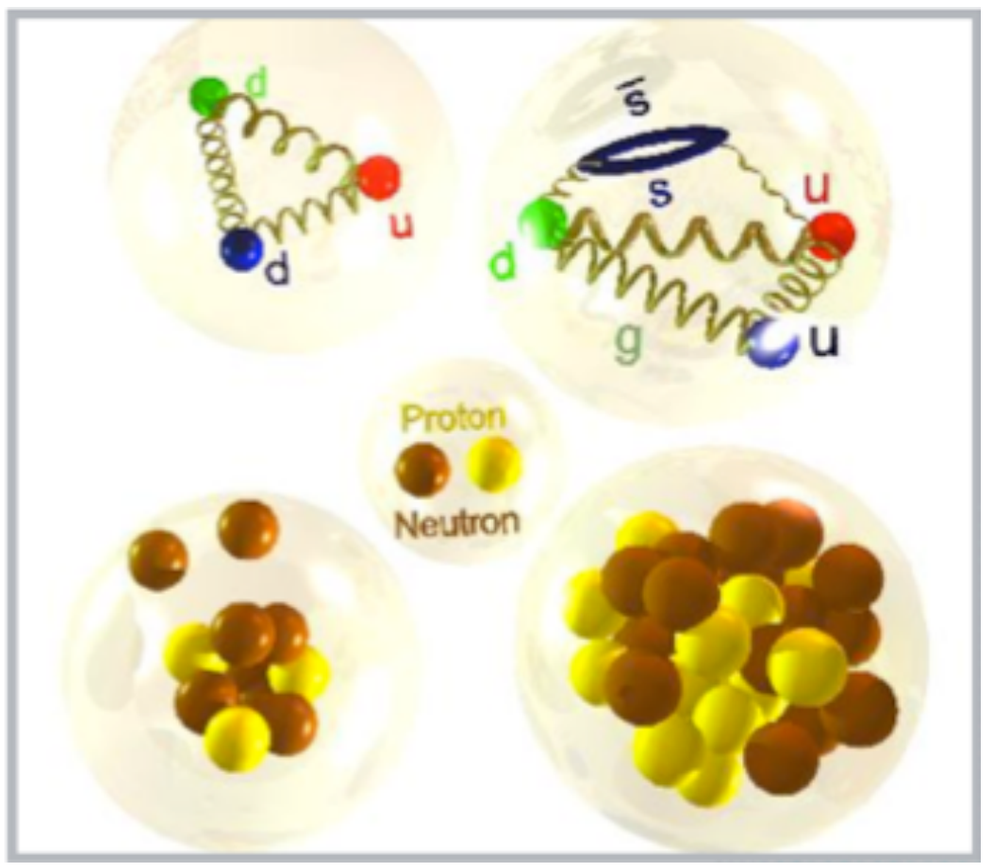
BIG GOALS OF PRECISION PHYSICS

Standard Model



1. beyond the SM

2. Non-perturbative SM



Lattice QCD

EFTs of QCD (chiral PT)

Data-driven

Inspired by "*g-2* Theory Initiative"

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The anomalous magnetic moment of the muon in the Standard Model

Contribution	Section	Equation	Value $\times 10^{11}$	References
Experiment (E821)		Eq. (8.13)	116 592 089(63)	Ref. [1]
HVP LO (e^+e^-)	Section 2.3.7	Eq. (2.33)	6931(40)	Refs. [2–7]
HVP NLO (e^+e^-)	Section 2.3.8	Eq. (2.34)	−98.3(7)	Ref. [7]
HVP NNLO (e^+e^-)	Section 2.3.8	Eq. (2.35)	12.4(1)	Ref. [8]
HVP LO (lattice, *udsc*)	Section 3.5.1	Eq. (3.49)	7116(184)	Refs. [9–17]
HLbL (phenomenology)	Section 4.9.4	Eq. (4.92)	92(19)	Refs. [18–30]
HLbL NLO (phenomenology)	Section 4.8	Eq. (4.91)	2(1)	Ref. [31]
HLbL (lattice, *uds*)	Section 5.7	Eq. (5.49)	79(35)	Ref. [32]
HLbL (phenomenology + lattice)	Section 8	Eq. (8.10)	90(17)	Refs. [18–30,32]
QED	Section 6.5	Eq. (6.30)	116 584 718.931(104)	Refs. [33,34]
Electroweak	Section 7.4	Eq. (7.16)	153.6(1.0)	Refs. [35,36]
HVP (e^+e^-, LO + NLO + NNLO)	Section 8	Eq. (8.5)	6845(40)	Refs. [2–8]
HLbL (phenomenology + lattice + NLO)	Section 8	Eq. (8.11)	92(18)	Refs. [18–32]
Total SM Value	Section 8	Eq. (8.12)	116 591 810(43)	Refs. [2–8,18–24,31–36]
Difference: $\Delta a_\mu := a_\mu^{\text{exp}} - a_\mu^{\text{SM}}$	Section 8	Eq. (8.14)	279(76)	

Muonic Atom Spectroscopy Theory Initiative
μASTI

<u>Working groups, possible divisions</u>

1. μH, μD, . . . , μX, Mu
2. Lamb shift, fs, hfs
3. QED, QCD = (lattice, EFTs, data-driven)

<u>Main outcome:</u> full SM result, consisting of many contributions

<u>Priority:</u>

HFS of light muonic atoms