Workshop on

Flavour changing and conserving processes

September 12-15, 2015, Capri

Outlook

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Roberta Vinci defeated Serena Williams, 2-6, 6-4, 6-4, and Flavia Penetta defeated Simona Halep, 6-1, 6-3, at semifinals of the United States Open, Sept 11

The Workshop started with review by David Hertzog of the status of new muon g-2 experiments at FNAL and J-PARC and theory review by Kirill Melnikov.

Brookhaven experiment:

$$a_\mu^{\rm exp} = 116\ 592\ 089(63) \times 10^{-11}, \quad a_\mu^{\rm th} = 116\ 591\ 830(50) \times 10^{-11}$$

$$a_\mu^{\rm exp} - a_\mu^{\rm th} = (259 \pm 81) \times 10^{-11}$$

This discrepancy which is more than three standard deviations will become more than five deviations in the FNAL experiment where experimental error will be four times smaller.

Thus, decreasing the theoretical error becomes a crucial challenge.

Theory of the muon g-2 was a subject of a majority of the talks:

Melnikov, Jegerllehner, Knecht, Zhang, Benayoun, Trentadue, Procura, Cappielle, Bijnens, Greynat, Nufeller, Steinhauser, Masjuan

Mostly it was about SM prediction for g-2, particularly on hadronic vacuum polarization and light-by-light contributions.

Few talks on NP explaining the deviation in g-2 in supersymmetric and extra Higgs models:
Stockinger, Chun, Heek

Also I'd separate out two talks on lattice experiments in calculation of g-2 by Petschlies and Lehner.

It is in addition to talks on physical experiments on g-2: Hertzog, Morriciani, Eidelman, Montagna, Chislett, Semertzidis.

Other subjects like dipole moments of electron and tau, dark photon, and particularly lepton flavour violation were discussed both on theoretical and experimental sides.

I would like to limit my outlook by theory of the muon g-2, my apology for not covering much.

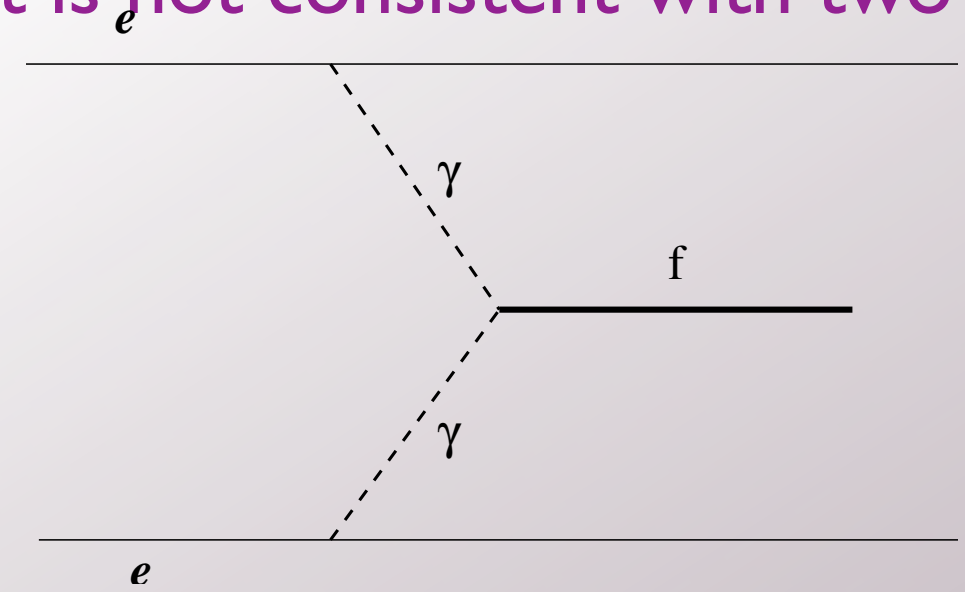
In my view we had very good discussion of different issues associated with hadronic contributions.

Unfortunately, I do not see much of novelty in the approaches to, say, hadronic light-by-light which would allow to diminish the theoretical uncertainty. This uncertainty could be, actually, much larger than the quoted one, $a_\mu^{\rm HLbL} = (105 \pm 26) \times 10^{-11}$, if we are missing something in our understanding of strong interaction effects.

As an example, let me mentioned that the pseudovector exchange could be much larger based on the large branching

$$\frac{\Gamma(f_1(1285) \to \gamma\rho^0)}{\Gamma_{\rm total}} = (5.5 \pm 1.3) \times 10^{-2}$$

It is not consistent with two-photon production

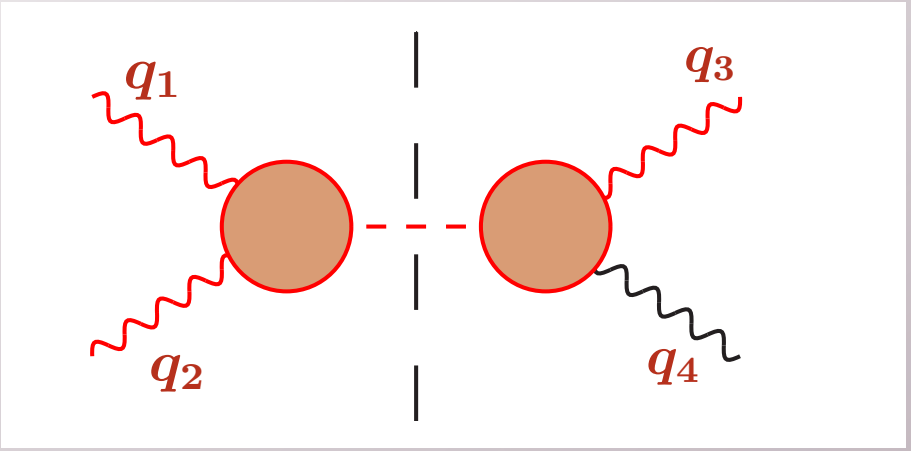


$$\Gamma(f_1(1285) \to \gamma\gamma^*) = (2.8 \pm 0.8)\ \mathrm{keV}$$

which gives much less. The data are quite old.
It shows an importance of experimental input from two-photon production.

Let me comment on the procedure of dispersion reconstruction suggested in Massimiliano Procura's talk.

For the one-pion exchange it is presented by the diagram



$$F_{\gamma^*\gamma^*\pi}(q_1^2, q_2^2)\,\frac{1}{(q_3+q_4)^2 - m_\pi^2}\,F_{\gamma^*\gamma\pi}(q_3^2, 0)$$

In application to g-2 we take the limit $q_4 \to 0$, so come to

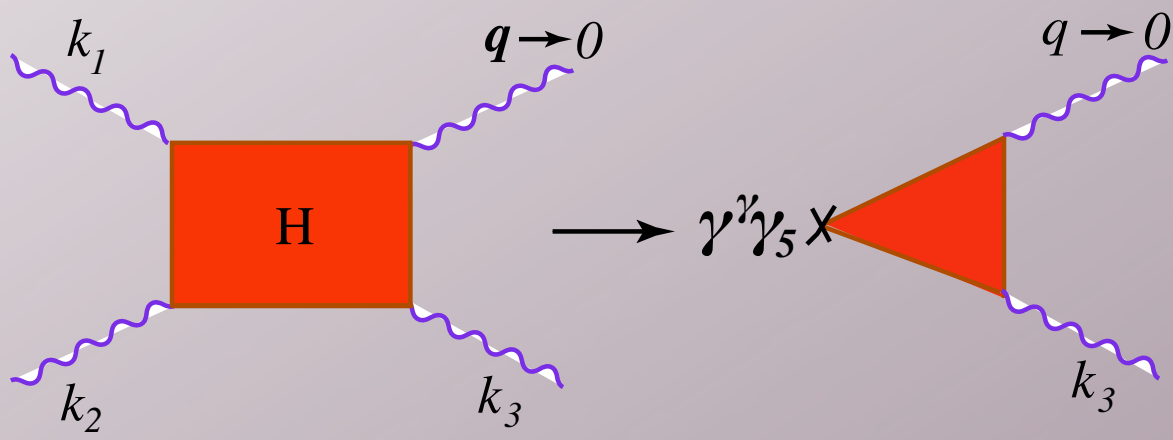
$$F_{\gamma^*\gamma^*\pi}(q_1^2, q_2^2)\,\frac{1}{q_3^2 - m_\pi^2}\,F_{\gamma^*\gamma\pi}(q_3^2, 0)$$

what is equivalent to

$$F_{\gamma^*\gamma^*\pi}(q_1^2, q_2^2)\,\frac{1}{q_3^2 - m_\pi^2}\,F_{\gamma^*\gamma\pi}(m_\pi^2, 0) + Polynomial\ in\ q_3^2$$

Note that applying the dispersive approach to the effectively three-point amplitude we would put the polynomial to zero,

Moreover, we can use the QCD operator product expansion to show that this polynomial is vanishing indeed.



It shows an absence of consistency in the approach suggested.

Let me conclude by expressing some optimism on reaching the goal of a better theory in spite of much difficulty. This optimism is based on now a quite high level of attention to subject.

Workshops like this one play a huge role in the further development. So I would like to express mine and other participants gratitude to organizers for such a remarkable meeting.