Questions and answers - Wolfgang Altmannshofer Lecture 1

The following questions were submitted through Google Form. Some / all may have been answered in the Q&A session already. Nevertheless, we request our lecturers to provide written answers here for the benefit of those who could not attend that session. Thank you!

Slide 5. You mentioned CPT invariance. How well has this been tested experimentally?

CPT violation and Lorentz violation are searched for in many different contexts.
This paper keeps track of pretty much all relevant tests: https://arxiv.org/abs/0801.0287
In the context of flavor, one can for example use meson oscillations to test CPT.
I believe the best constraints come from kaons: https://arxiv.org/abs/1312.6818

Slide 14.What would be the implications if the CKM matrix were non-unitary?

The first option is that the 3x3 CKM matrix is indeed non-unitary.
That could happen for example if the SM quarks mix with a vector-like 4th generation.

The second option is that some of the observables that we use to determine the CKM matrix elements are affected by new physics. In that case the true CKM is still unitary, but we would be misinterpreting the measurements and the CKM would appear to be non-unitary.

Page 33. Can you explain this figure again? I did not get it.

The figure shows the constraint on the new physics scale Lambda that is associated with different dim-6 operators that contribute to meson oscillations.
For example, the green open bar above C1 means you switch on the operator (s gamma_mu P_L b)(s gamma^mu P_L b) and set C1 = 1. Given the agreement between the measured Bs mixing frequency and the SM prediction, one finds a constraint Lambda > 100 TeV. The full bars correspond to setting the coefficients to the CKM

structure that appears in the SM. In the case of Bs mixing that would be Vts*Vtb. This gives a constraint Lambda > 10 TeV. And so on...