

Physics Team “Cosmological Constant” - Report of Activities

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Literature:

Jerome Martin “Everything you always wanted to know about the cosmological constant problem – but were afraid to ask”, arXiv: 1205.3365

Report of the Study Group:

The cosmological constant is nowadays the best-fitting explanation to why our universe expands at an accelerated rate. However, it is unclear how to interpret this constant, and whether it really is constant. Dark energy research is conducted at the ITP, which could offer an alternative explanation to the accelerated expansion of the universe. Also, inflation has remarkable similarities with the nowadays observed accelerated expansion, and is also investigated in ITP. Research on the cosmological constant can be done at different levels, broadly separable into “phenomenological approaches” and “in depth quantum field theoretical approaches”. Therefore, we combined the knowledge of our groupmembers from Philosophenweg 16 (phenomenology) and Philosophenweg 19 (QFT), in order to try and understand each others perspective. Our basis was Jerome Martins review article, which details the physics of the cosmological constant.

The connection to particle physics becomes evident, when interpreting the cosmological constant as a vacuum energy, which is connected to available species of particles in our universe. From phase transitions via Supersymmetry to Fermionic or vector fields – the cosmological constant problem touches on many topics which are traditionally rather ascribed to particle physics.

Concrete outcomes:

- A major point was to disentangle clearly, what Jerome Martin calls the “bare cosmological constant” and the “vacuum energy contribution to it”.
- The physics of a “cut-off” scale was also discussed with Jörg Jäckel – it influences the cosmological constant problem via the reasoning of the constant having a “atypically” small value when compared to typical particle physics scales.
- Knowledge was transferred between phenomenologists and QFT-researchers

Tips for follow-up groups:

Another hot topic on the border between traditional particle physics at LHC and early universe particle physics is CP-violation and the matter-antimatter asymmetry in our universe.