

# PhD course on EFT: proposed topics for the exam

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Pick one of the topics listed below, or make your own proposal. In bracket some references where to read about the subject.

1. Goldstone soft theorem and Ward identity (Weinberg vol.II section 19.2, from eq.19.1.47 to 19.2.50, and section 2 of 1705.10078)
2.  $\beta$ -function from OPE and the Wilson-Fisher fixed point (J.Cardy sections 5.1-5.5)
3. Weinberg-Witten theorem (original paper)
4. Coleman-Mandula theorem (Weinberg III. chap.24 appendix.B and original paper)
5. Effective theory of phonons from spontaneously broken Poincaré symmetry (Nicolis et al. 1501.03845)
6. The QCD-axion mass from spurion analysis, it requires to know about anomalies (Weinberg vol. II section 23.6 Eq.23.6-17 to Eq,23.6.26, and section 2 of 1511.02867 up to Eq. 11)
7. EFT for Fermi Liquids (Polchinski hep-th/9210046)
8. False-vacuum decay (Coleman's Aspect of symmetry, chap.7, section 6)
9. Higgs mechanism and Goldstone equivalence theorem (e.g. appendix A of hep-ph/0701104, or [https://drive.google.com/file/d/1KJ61Cr1oPVVt-02XVTRKZHT0Zu0\\_wD8m/view](https://drive.google.com/file/d/1KJ61Cr1oPVVt-02XVTRKZHT0Zu0_wD8m/view))
10. Euler-Heisenberg via proper time method (M. Schwartz chapt.33)
11. YM and GR from spinor-helicity and consistent factorization (Cheung TASI lectures)

12. Functional integrals and one-loop matching (A. Falkowski's lectures, chapt.3)
13. The EFT for a composite Higgs boson (<https://arxiv.org/abs/1005.4269>, <https://arxiv.org/abs/1506.08481>, <https://arxiv.org/abs/1401.2457>)
14. Polology, factorization and LSZ for scattering amplitudes (M Schwartz, chapter 24.3, Weinberg I chapt.10.2 and 10.3)
15. Correction to the Extremality Bound for Charged Black holes from 4-derivative operators (and optionally, the connection with the Weak-gravity conjecture for black holes) (<https://arxiv.org/abs/hep-th/0606100>, <https://arxiv.org/abs/hep-th/0601001> )