

Indian Institute of Technology, Kanpur

Instructor: Joydeep Chakraborty

Effective Field Theory: PHY673A

Pre-requisites: Quantum Field Theory-I, Particle physics

S. No.	Broad Title	Topics	No. of Lectures
1.	Basics of Functional Integral	Brief introduction to Path Integral formalism. Quantization of Gauge Theory. 1-loop Effective Action construction.	4
2.	Introduction to Effective Field Theory(EFT)	Basic idea of EFT, Local vs non-Local operators, Few qualitative examples: heavy quark EFT, Four-Fermi Theory, Blue Sky, Binding Energy, scaling in no-Relativistic Field Theory	4
3.	Quantum Corrections and Gauge Symmetries	Classification of Operators: Relevant, Irrelevant, Marginal. Logarithmic correction to couplings and their running. Spontaneous Breaking of Symmetries.	4
4.	Integrating out Heavy Fields And Matching	Methods to Integrate out heavy fields: explicit loop calculation, using functional integrals. Computation of Effective Operators and the respective Wilson Coefficients (WCs). Light-Heavy field matching criteria, Anomalous dimension matrix and running of effective operators. Introduction to CoDEx: an automated package to compute WCs and effective operators.	14
5.	Standard Model (SM) and Beyond Standard Model (BSM) as EFT	Matching of SM-EFT and the BSM physics. Examples of BSM scenarios and explicit computation of WCs and Effective Operators. Hilbert Series Method to count the number of such operators.	14
Total number of lectures:			40

Recommended References:

1. H. Georgi, Effective field theory, annurev.ns.43.120193.001233.
 2. D. Kaplan, Effective field theory, hep-ph/0510023.
 3. B. Henning, X. Lu and H. Murayama, How to use the Standard Model effective field theory, JHEP01(2016)023.
 4. B. Henning, X. Lu and H. Murayama, One-loop Matching and Running with Covariant Derivative Expansion, JHEP01(2018)123.
 5. Introduction to Effective Field Theories, Aneesh V. Manohar, hep-ph/ 1804.05863.
-