Indian Institute of Technology, Kanpur

First Course Hand Out

Effective Field Theory - PHY673

Instructor: Joydeep Chakrabortty (joydeep@iitk.ac.in)

Lectures: Wednesday and Friday (10:30 AM - 12:00 PM)

Evaluation: Mid-Sem (20%), Final Sem (30%), Quiz + Assignments (20%), Seminar (30%)

Topics:

Broad Title	Topics
Basics of Functional Integral	Brief introduction to Path Integral formalism. Quantization of Gauge Theory. 1-loop Effective Action construction. Introduction to Heat-Kernel
Introduction to EFT	Basic idea of EFT, Local vs non-Local operators, Classification of Operators:
Hilbert Series and EFT	Hilbert Series method to compute the symmetry invariant effective Operators.
NREFT, Chiral EFT, SCET	Basics of Non-relativistic, Chiral and Soft Collinear Effective Field Theory
Integrating out Heavy Fields	Methods to Integrate out heavy fields: Computation of Effective Operators and the respective Wilson Coefficients (WCs).
EFT at Finite Temperature	Hilbert Series construction and Integrating out heavy Fields at Finite Temperature.
SMEFT	Matching of SM-EFT and the BSM physics. With Examples

7. Recommended References:

(i) H. Georgi, On-shell effective field theory, Nucl. Phys. B361 (1991) 339–350.
(ii) M. K. Gaillard, The Effective One Loop Lagrangian With Derivative Couplings, Nucl. Phys. B268 (1986) 669–692
(iii) D. B. Kaplan, Five lectures on effective field theory, 2005. nucl-th/0510023.
(iv) A. V. Manohar, Effective field theories, Lect. Notes Phys. 479 (1997) 311–362, [hep-ph/9606222].
(v) C. P. Burgess, Introduction to Effective Field Theory, Ann. Rev. Nucl. Part. Sci. 57 (2007) 329–362, [hep-th/0701053].
(vi) I. Z. Rothstein, TASI lectures on effective field theories, 2003. hep-ph/0308266.