



INTRODUCTION TO QUANTUM FIELD THEORY (THEORY OF SCALAR FIELDS) - PART 2

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PRE-REQUISITES : Introduction to Quantum Field Theory (Theory of Scalar Fields) - Part 1 offered by NPTEL by the same

Author.

INTENDED AUDIENCE : Students pursuing PhD in High Energy Physics. Advanced MSc. Physics students interested in Quantum Field Theory

COURSE OUTLINE :

This course, which is the second part of the course on Introduction to Quantum Field Theory (Theory of Scalar Fields) makes the connection between the Experimentally observable quantities such as cross-section and theoretically computable scattering amplitudes. Here we also discuss renormalization at one loop in ϕ^4 theory.

ABOUT INSTRUCTOR :

Prof. Anurag Tripathi is Assistant Professor in the Department of Physics at IIT Hyderabad since 2015 and his area of research is Theoretical High Energy Physics. For more details visit <https://www.iith.ac.in/~tripathi/>.

COURSE PLAN :

Week 1: Review of the basics of Scalar Field Theory covered in QFT part-1

Week 2: The S-Matrix, Scattering Amplitude, Scattering in interacting theory

Week 3: Scattering Cross-Section formula

Week 4: The Kallen-Lehmann Representation. The Z factor.

Week 5: Lehmann, Symanzik and Zimmermann (LSZ) reduction.

Week 6: Analytic properties of functions defined through integrals. Optical theorem

Week 7: Ultraviolet Divergences in ϕ^4 theory and power counting, UV regularization:

(a) Momentum cutoff, (b) Pauli Villars, and (c) Dimensional regularization.

Week 8: Renormalization of ϕ^4 theory at one loop: Renormalization of 2-pt function

Week 9: Mandelstam invariants, Renormalization of 4-point function. Subtraction Schemes: MS and $\overline{\text{MS}}$ schemes.

Week 10: Renormalization group equations, beta functions and anomalous dimension

Week 11: Solution to Callan-symanzik equations. Running coupling constant.

Week 12: Fixed points: Ultra Violet and Infrared Stable fixed points. Scale invariance at fixed points. Behaviour of two point function near fixed points.