

Pasquale D. Serpico (LAPTh, Annecy, France): *High energy physics processes in astrophysics*

The main goal of the present lectures is to outline the main mechanisms and processes through which high-energy particles evolve in configuration and energy space in typical galactic and extragalactic environments. The important concept of collisionless diffusion of charged particles will be tackled, followed by a description of particle interactions and loss mechanisms in the Galactic and extragalactic medium. These interactions are an important ingredient entering the propagation equation and contribute shaping the spectrum of high-energy charged particles, whose population observed at the Earth (top of the atmosphere) is known as “Cosmic Rays”. The neutral byproducts of the charged energetic particle interactions (gamma rays and neutrinos) point back to their production point, and are themselves signals one can look for and study.

Some key topics: Cosmic ray diffusion, from heuristics to a more rigorous approach; Collisional interactions: Synchrotron, Inverse Compton, Hadronic interactions (including gamma ray and neutrino production from pion decay); Diffusion-loss equation, description and basic solutions.

The main reference is M. Longair, “High energy astrophysics”, Cambridge Univ. Press. For the cosmic ray propagation part, classical texts like V. S Berezinskii et al. “Astrophysics of cosmic rays” (edited by V.L Ginzburg) Amsterdam: North-Holland, 1990 remain useful. Other references (including reviews and articles) will be cited during the course, and some lecture notes (including exercises) will be provided.