PARTICLE PHYSICS AND MULTI-MESSENGER ASTROPARTICLES

Teachers: Marco Pallavicini (Univ. Genova), Matteo Sanguineti (INFN Genova)

Fisrt part (Marco Pallavicini)

- Recalls on weak interactions in the standard model. Neutral and charged weak currents. Weak interactions of quarks and hadrons.
- Natural and artificial sources of neutrinos
- Zero energy processes. Coherent scattering, detection of cosmic neutrinos,

neutrino mass

- Low energy processes: double beta decay; neutrino – nucleus scattering; neutrino - nucleon scattering; deep inelastic scattering

Second part (Matteo Sanguineti)

Cosmic rays:

- Introduction
- Brief history of the discovery (Hess, Pacini)
- Energy spectrum of cosmic rays
- Direct revelation of cosmic rays
- Calorimetric technique (interaction length, average free path, radiation length ...)
- Experiments on air balloon (CREAM, BESS ..)
- Satellite experiments (PAMELA, AMS ..)
- Indirect detection of cosmic rays
- Swarms of particles in the atmosphere (Electromagnetic swarm and hadronic swarm)
- Extended swarm detectors (KASKADE ..)
- Ultra-high energy cosmic rays (PAO, TA, CTA)

High energy neutrinos

- Connection between cosmic rays, gamma rays and high energy neutrinos
- High energy neutrino sources, notes on emission mechanisms
- Neutrino flows expected from some sources (Galactic sources, extragalactic diffuse flow, GRBs)
- Disclosure types: track type events; swarm-type events
- Telescopes for neutrinos: water (KM3NeT) vs ice (IceCube)
- Recent results (the beginning of the neutrino astronomy)