Subjects of the lectures 2017-18

24-9-2018 **2 h** – Introduction to the course. Passage of charged particle through the matter. Cross sections. Energy loss for ionization. Bethe and Bloch formula. Density effect and shell correction. Bragg's curve, range. Landau distribution. Multiple coulombian scattering.

25-9-2018 **2h** – Bremsstrahlung, energy loss for electrons and positrons, critical energy. Radiation length. Pair production- Photoelectric effect. Compton scattering.

2-10-2018 **2h** - Electromagnetic showers. / Bremsstrahlung and pair production at very high energy.

5-10-2018 **2h** - Energy loss for high energy muons. / Gaseous detectors, general considerations. Primary and secondary ionization, diffusion of ions and electrons, drift velocity.

9-10-2018 **2h** - Proportional counter, Amplification, signal from a proportional counter. Signal in the gaseous detector with a wire. Ageing. MWPC.

16-10-2018 **2h** - Drift chamber. Resolution, space-time relation, ionization measurement, Lorentz angle. Ionization measurements. CD in CERN-UA1 experiment. Examples: TPC, MPGD.

19-10-2018 **2h** – MPGD, GEM, micromegas. RPC. Photon detection.

23-10-2018 **2h** – Photomultiplier. Solid state photon detector. Scintillators.

6-11-2017 **2 h** – Cherenkov counters. Threshold and differential counters. RICH detectors. Examples of RICH in present experiments. Example: Cherenkov and scintillation light in a BGO crystal.

7-11-2018 **2 h** – Electromagnetic calorimeters. Dimensions. Resolution. Position detectors.

9-11-2018 **2 h** –Hadronic showers. Energy components in the shower. Compensation.

13-11-2018 **2 h** – Energy resolution for calorimeters. Calibration. Homogeneous and sampling calorimeters. Calorimeters with scintillating fibers. Readout of the signals. Examples of calorimeters. Dual readout calorimetry.

20- 11-2018 **2 h** - pn junction. Silicon detectors with microstrips and pixels. Vertex detectors and trackers. Examples (NA11, DELPHI, CDFII).

21-11-2018 **2 h** – PID detectors: ionization measurement, TOF detectors, TDR transition radiation detectors. / Structure of the experiments at colliders and at fixed target.

23-11-2018 **2 h** – Spectrometers. / Exercise (introduction): example of the setup for an antiproton beam preparation.

27-11-2018 **2 h** - Sources of particles. Van de Graaf and Cockcroft-Walton accelerators. Cyclotron, betatron.

28-11-2018 **2 h** – Motion of a particle in the electromagnetic field. Betatron oscillations. Alternating gradient focusing. Phase stability. Acceleration / Comment on spark chamber operation. Part of the suggested exercise.

4-12-2018 **2 h** – Synchrotron oscillations. Alternating gradient focusing. Motion in the phase space. Betatron oscillations in phase space.

5-12-2018 **2 h** –Transport matrices, quadrupole. Matrix for FODO cell, Hill's equation / Synchrotron radiation. Linacs. CERN SPS.

7-12-2018 **2 h** –Collider. Luminosity, P-Pbar colliders, stochastic cooling.

11-12-2018 **2 h** – LHC.

12-12-2018 **2 h** – Future accelerators: LHC program, Linear colliders ILC, CLIC. Futur circular colliders, muon collider.

14-12-2018 **2 h** – ATLAS.

18-12-2018 **2 h** – Neutrino detectors, neutrino oscillations.

21-12-2018 **2 h –** Neutrino Experiments – Future experiments.

08-01-2019 **2 h** – Neutron detection. CNAO and detectors for health physics.

09-01-2019 **2 h** – Dark matter. Direct detection: status and perspective. (prof. V.Ippolito)

11-01-2019 **2 h** – CMS, LHCb.

15-01-2019 **2 h** – Detectors for rare events @ Gran Sasso. (prof. F.Bellini)

16-01-2019 **2h -** New acceleration techniques. (prof. M.Ferrario)

21-01-2019 10.00 – 17.00 Visit to the Laboratori Nazionali di Frascati dell'INFN.
(Lectures by Professors C.Milardi, E. De Lucia, A.Cianchi, R.Pompili)