SUMMER SCHOOL IN HIGH ENERGY PHYSICS

Basics of the standard model and physics at the LHC
Hanoi, 19-28 July 2010

This school is an activity between a VAST – CNRS cooperation program and is jointly organized by *Institut National de Physique Nucléaire et de Physique des Particules* (IN2P3), CNRS, Paris, *Hanoi University of Science* (HUS), VNU, Hanoi, and *Institute of Physics* (IOP), VAST, Hanoi.

The school program consisting of lectures, tutorial sessions and computer practices, covers some theoretical basic elements and calculation technique of the standard model and physics at the LHC.

The school will be held from 19-28 July 2010 in

Meeting room (1st floor)
Institute of Physics
10 Dao-Tan, Ba Dinh, Hanoi

The school can accept about 10-15 participants who are principally master and Ph.D. students and junior researchers but some advanced undergraduate students may be admitted too.

APPLICATION

Interested people can complete an application form which should be submitted via post or fax to

Ms **Dao Thi Hong**

Institute of Physics
10 Dao-Tan, Ba Dinh, Hanoi

Phone & Fax: (04) 3766 2107
E-mail: lhcs@iop.vast.ac.vn

by the deadline **12 July 2010** (Monday). A scanned copy of a completed application with the applicant's original signature can be accepted via email by the same deadline.

1. *Introduction to the standard model and just beyond*
   by **Aldo Deandrea** (Lyon University, Lyon)

   Abstract

   The basis of the standard model of particle physics, in particular in the first lecture the effective low energy Fermi theory, the use of gauge symmetries and the basic mechanism of symmetry breaking in this context are given. In the second lecture the standard model Lagrangian, its symmetries and its Feynman rules are detailed. In a third lecture phenomenology and possible extensions, such as the two doublet Higgs model and larger symmetry groups as SU(5) will be discussed.

   Further reading

   - Exact and Broken Symmetries in Particle Physics, R.D.Peccei,
     e-print: http://xxx.lanl.gov/abs/hep-ph/0002225

   - Introduction to the Standard Model and Electroweak Physics, P.Langacker,
     e-print: http://arxiv.org/abs/0901.0241

   - The Standard Model of Electroweak Interactions, Antonio Pich,
     e-print: http://arxiv.org/abs/0705.4264

2. *An introduction to next-to-leading order calculations*
   by **Le Duc Ninh** (Max-Planck Institute of Physics, Munich and Institute of Physics, Hanoi)

   Abstract:

   In these lectures I will give an introduction to next-to-leading order (NLO) calculations in gauge theories. The level of discussion is aimed at students who are familiar with quantum field theory (QFT), Feynman rules and tree level calculations. The topics include renormalization, one-loop integrals and phase space integrals. This lecture is also devoted to some practical exercises on NLO calculations in QED and the Standard Model. I will introduce the computer programs
   - FeynArts (http://www.feynarts.de/),
   - FormCalc (http://www.feynarts.de/formcalc/),
   - LoopTools (http://www.feynarts.de/looptools/, version 2.4)

   and show how to use them in practice. The participants are encouraged to have those programs installed in their laptops with Linux OS.

References (*do not try to read everything*):

- An Introduction to Quantum Field Theory, Michael E. Peskin and Daniel V. Schroeder (almost everything about QFT).

- Particle Kinematics, E. Byckling and K. Kajantie, John Wiley and Sons (1973) (about phase space integrals).

- Techniques for calculation of electroweak radiative corrections at the one loop level and results for W physics at LEP-200, Ansgar Denner, **arXiv**: 0709.1075 [hep-ph] (advanced manual for NLO calculations).

- One Loop Corrections for e+ e- Annihilation Into mu+ mu- in the Weinberg Model, G. Passarino and M. Veltman, Nucl.Phys. **B160**, 151,1979.

- Scalar One Loop Integrals, Gerard 't Hooft, M.J.G. Veltman, Nucl.Phys. **B153**, 365-401, 1979.

3. *Beyond the Standard Model: Supersymmetry and Extra Dimensions* by **Giacomo Cacciapaglia** (Lyon University, Lyon)

Abstract:

In these lectures I will introduce possible extensions of the Standard Model at the TeV scale, which is the energy frontier currently being probed by the LHC experiments. The extensions are mainly motivated by the stability of the electroweak scale and by the presence of Dark Matter in the Universe. In the first lecture I will briefly introduce the idea of supersymmetry. In the following I will focus on extra dimensions, and introduce two models: Higgsless models in warped extra dimensions and a model of Kaluza-Klein Dark Matter in flat space. Some lecture notes will be provided.

Further reading:

- A Supersymmetry Primer, S.P.Martin,
  e-Print: http://arXiv.org/pdf/hep-ph/9709356

- Tasi Lectures on Electroweak Symmetry Breaking from Extra Dimensions, C.Csaki, J.Hubisz and P.Meade e-Print: http://arXiv.org/abs/hep-ph/0510275

- 2009 TASI Lecture -- Introduction to Extra Dimensions, Hsin-Chia Cheng,
  e-Print: http://arXiv.org/abs/1003.1162

SPONSORS

- Vietnamese Academy of Science and Technology (VAST), Hanoi.
- Centre National de la Recherche Scientifique (CNRS), Paris.
- Hanoi University of Science (HUS), Hanoi.
- Institute of Physics (IOP), Hanoi.

ORGANIZING INSTITUTIONS

- Institute of Physics (IOP), Hanoi.
- Hanoi University of Science (HUS), Hanoi.
- Institut National de Physique Nucléaire et de Physique des Particules (IN2P3), Paris.

PROGRAM COORDINATORS

- Patrick Aurenche (LAPTH, Annecy).
- Nguyen Anh Ky (IOP, Hanoi).
- Le Duc Ninh (MPI, Munich, and IOP, Hanoi).

LOCAL ORGANIZERS

- Ha Huy Bang (HUS, Hanoi).
- Le Hong Khiem (IOP, Hanoi).
- Nguyen Anh Ky (IOP, Hanoi).
- Dao Thi Hong (IOP, Hanoi), *secretary.*

Contact address :

Ms **Dao Thi Hong**

Institute of Physics
10 Dao-Tan, Ba Dinh, Hanoi

Phone & Fax: (04) 3766 2107
E-mail: lhcs@iop.vast.ac.vn