Higgs and BSM Lectures - HU - SS 2017

25h of lectures + 8h of exercises

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Mondays: Lise-Meitner-Haus (Newtonstraße 15) / Seminar room 3.101
Fridays: Walter-Nernst-Haus (LCP) (Newtonstraße 14) / Seminar room 1.11

**** Lecture schedule ****
(to be confirmed and still subject to changes)

- Monday 17/04: Easter Monday - no lecture
- Friday 21/04: no lecture
- **Monday 24/04:** Lecture 1 + exercises 15:00-17:30
- Friday 28/04: no lecture
- Monday 01/05: bank holiday - no lecture
- Friday 05/05: no lecture
- **Monday 08/05:** Lecture 2 + exercises 15:00-17:30
- Friday 12/05: no lecture
- **Monday 15/05:** Lecture 3 + exercises 15:00-17:30
- **Friday 19/05:** Lecture 4 + exercises 15:00-17:30
- **Monday 22/05:** Lecture 5 + exercises 15:00-17:30
- Friday 26/05: no lecture
- **Monday 29/05:** Lecture 6 + exercises 15:00-17:30
- Friday 02/06: no lecture
- Monday 05/06: no lecture
- **Friday 09/06:** Lecture 7 + exercises 15:00-17:30
- **Monday 12/06:** Lecture 8 + exercises 15:00-17:30
- **Friday 16/06:** Lecture 9 + exercises 15:00-17:30
- Monday 19/06: no lecture
- Friday 23/06: no lecture
- **Monday 26/06:** Lecture 10 + exercises 15:00-17:30
- Friday 30/06: no lecture
- **Monday 03/07:** Lecture 11 + exercises 15:00-17:30
- Friday 07/07: no lecture
- **Monday 10/07:** Lecture 12 + exercises 15:00-17:30
- Friday 14/07: no lecture
- Monday 17/07: no lecture
- **Friday 21/07:** Lecture 13 + exercises 15:00-17:30

**** Lecture outline ****

Lecture 1: EW and SM Higgs
1. why SU(2)xU(1)?
2. V-A structure of the weak interactions
3. spontaneous symmetry breaking and particle masses
4. rho parameter and custodial symmetry

Lecture 2: Golstone equivalence theorem, unitarization of scattering amplitude
1. h->WW decay
2. t->Wb decay
3. Higgs unitarization in VV->VV, VV->hh, VV->ff
4. perturbative unitarity

Lecture 3: RG effect in the Higgs potential
1. triviality bound
2. stability bound
3. naturalness bound and hierarchy problem
4. Coleman-Weinberg potential

Lecture 4: Tests of the SM and oblique corrections
1. EW precision measurements
2. S and T oblique corrections
3. W and Y oblique corrections (LEPII constraints and LHC constraints from high-energy behavior)

Lecture 5: Higgs low-energy theorems
1. gg->h
2. h->gamma gamma
3. matching from gauge coupling running

Lecture 6: Higgs effective theory
1. power counting
2. SILH basis
3. RG effects

Lecture 7: General introduction to extra-dimensions
1. which problems x-dims could solve?
2. Kaluza-Klein decomposition
3. Arkani-Hamed Dimopoulos Dvali large extra dimensions

Lecture 8: AdS/CFT for model builders I
1. Randall Sundrum warped extra dimension(s)
2. AdS metric
3. Scalars in AdS

Lecture 9: AdS/CFT for model builders II
1. Gauge fields in AdS
2. Fermions in AdS

3. AdS/CFT dictionary

Lecture 10: Higgsless and composite Higgs
1. EW symmetry breaking by boundary conditions
2. unitarization of scattering amplitudes by KK exchange
3. Higgsless models
4. holographic composite Higgs models

Lecture 11: Composite Higgs models
1. Higgs as pseudo-Goldstone boson
2. SO(5)/SO(4) model
3. EFT description

Lecture 12: Composite Higgs models
1. Higgs coupling
2. top partners
3. non-minimal composite Higgs models

Lecture 13: Relaxion models
1. QCD model
2. Quadratic model
3. Higgs-relaxion mixing
4. cosmological signatures