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