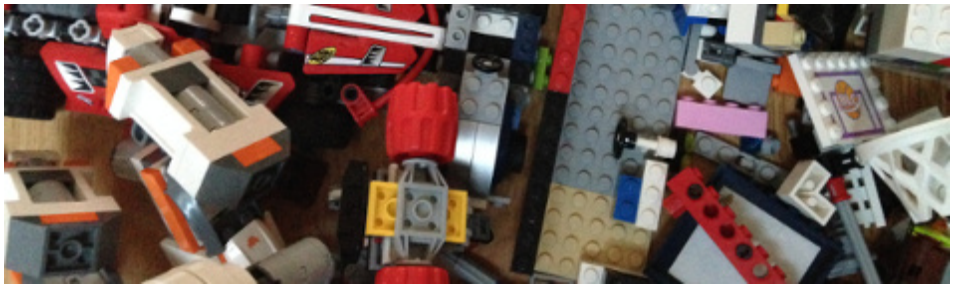
Workshop on Composite dynamics and dark matter (CoDyCE 3)



Rapport sur les contributions

https://indico.in2p3.fr/e/codyce3

ID de Contribution: **1** Type: **Non spécifié**

A Unified Approach to Composite Dynamics: from Electroweak Symmetry Breaking to Dark Matter

mercredi 5 novembre 2014 09:00 (1 heure)

Circa 95% of the universe is made of unknown forms of matter and energy, while to describe the remaining 5% one needs at least three fundamental forces, i.e. Quantum Electrodynamics (QED), Weak Interactions and Quantum Chromo Dynamics (QCD). Furthermore strong interactions are responsible for creating the bulk of the bright mass, i.e. the 5%. It is therefore natural to expect that to correctly describe the rest of our universe while providing a sensible link to the visible component new forces will soon emerge. For example the standard model sector responsible for breaking the electroweak symmetry spontaneously could be replaced by a new and more natural strongly coupled sector. Another interesting avenue is the possibility that dark matter itself, as the ordinary proton and neutron, is not an elementary particle but rather a state composed by new strongly coupled matter. I will argue that models of composite dynamics are indeed primary candidates for a better understanding of the origin of bright and dark matter in Nature. I will also show that we can make clear and falsifiable predictions for the Large Hadron Collider experiment as well as dark matter direct experiments searches. Understanding strong dynamics is therefore crucial to construct phenomenologically relevant extensions of the standard model of particle interactions, and ultimately being able to describe our Universe.

Auteur principal: SANNINO, Francesco (CP3 Odense)

Orateur: SANNINO, Francesco (CP3 Odense)

ID de Contribution: **2** Type: **Non spécifié**

Towards Constraining Composite Higgs Models via the Bootstrap

mercredi 5 novembre 2014 10:30 (1 heure)

We discuss how the bootstrap approach can be used to possibly set constraints on composite Higgs models, where the strongly coupled sector is assumed to be a spontaneously broken CFT with a global symmetry. As a preliminary step in this direction, we analyze the bounds on the OPE coefficients of the conserved vector currents associated with the groups SO(N), SU(N) and SO(N)xSO(M) under the assumption that in the singlet channel no scalar operator has dimension less than four, namely that the CFT has no relevant deformations. These OPE coefficients govern the leading CFT contribution to the RG evolution of the associated gauge couplings.

Orateur: SERONE, Marco (SISSA)

ID de Contribution: **3** Type: **Non spécifié**

Fermionic UV Completions of Composite Higgs Models

mercredi 5 novembre 2014 11:30 (1 heure)

We present some four-dimensional purely fermionic gauge theories that
give a UV completion of composite Higgs models. We start at the group theoretical level, addressing the necessary (but not sufficient) conditions for the viability of these models, such as the existence of top partners and custodial symmetry. We then study the dynamics of one of the most promising models, based on a SU(4) hyper-color group in more detail.

Work based on JHEP 1403 (2014) 077 [arXiv:1312.5330] and JHEP 1406 (2014) 142 [arXiv:1404.7137]

Orateur: FERRETTI, Gabriele (Chalmers U.)

ID de Contribution: **4** Type: **Non spécifié**

Dynamical generation of the weak and Dark Matter scales from strong interactions

mercredi 5 novembre 2014 14:00 (1 heure)

Assuming that mass scales arise in nature only via dimensional transmutation, we extend the dimension-less Standard Model by adding vector-like fermions charged under a new strong gauge interaction. Their non-perturbative dynamics generates a mass scale that is transmitted to the elementary Higgs boson by electro-weak and possibly Yukawa interactions. In its minimal version the model has the same number of parameters as the Standard Model and predicts that the electroweak symmetry gets broken and predicts new-physics in the multi-TeV region which is compatible with all existing bounds. It also provides two Dark Matter candidates stable thanks to accidental symmetries: a composite scalar in the adjoint of SU(2)_L and a composite singlet fermion. Their thermal relic abundance is predicted to be comparable to the measured cosmological DM abundance.

Based on: O.Antipin, M.Redi, and A.Strumia [arXiv:1410.1817]

Orateur: ANTIPIN, Oleg (INFN & Firenze U.)

ID de Contribution: **5** Type: **Non spécifié**

WIMP dark matter from dilaton exchange

mercredi 5 novembre 2014 15:00 (1 heure)

We study a model in which dark matter couples to the Standard Model through a dilaton of a sector with spontaneously broken approximate scale invariance. Scale invariance fixes the dilaton couplings to the standard model and dark matter fields, leaving only three free parameters: the symmetry breaking scale f, the dilaton mass m_dilaton , and the dark matter mass m_DM. One of these parameters is further fixed by requiring that thermal freeze-out results in the observed dark matter relic abundance. We show that a large parametric region exists where the effective theory is perturbative and produces cold, weakly interacting massive particle dark matter, with f, m_dilaton, m_DM of roughly similar magnitude and in the range ~1-10 TeV. We analyze the experimental constraints on the parameter space from collider, direct and indirect detection experiments, and demonstrate that dilaton exchange provides a consistent, calculable framework for cold dark matter.

Based on: K.Blum, M.Cliche, C.Csaki, and S.J.Lee [arXiv:1410.1873]

Orateur: LEE, Seung Joon (KAIST)

ID de Contribution: **6** Type: **Non spécifié**

Composite dynamics –Effective Models & Higgs Couplings

mercredi 5 novembre 2014 16:30 (1 heure)

In this talk I study a simple, experimentally viable effective Lagrangian, the Custodial Vector Model with symmetries protecting the (composite) Higgs couplings and the values of the electroweak parameters - Essentially the 'degenerate-BESS' model with a Higgs state. I will use this model as a basis to discuss how underlying strong dynamics may give rise to SM Higgs like state at LHC.

based on

arXiv:1410.6492 with D. Becciolini, D. B. Franzosi et al

PhysRevD.90.035012, arXiv:1309.2097 with A, Belyaev, M. Brown and R. Foadi

PhysRevD.87.095001 arXiv:1211.1083 with R. Foadi and F. Sannino

PhysRevD.77.097702 arXiv:0712.1948 with R. Foadi and F. Sannino

Orateur: FRANDSEN, Mads (CP3 Origins)

ID de Contribution: **7** Type: **Non spécifié**

Workshop

ID de Contribution: **8** Type: **Non spécifié**

New search strategies for composite quark partners at the LHC Run II

jeudi 6 novembre 2014 09:00 (1 heure)

Composite Higgs Models predict quark partners at the TeV scale which can be produced at the LHC Run II. The decay of such heavy quark partners lead to highly boosted objects in the final state (e.g. tops, Higgses and electroweak gauge bosons) which require refined search strategies. In this talk we propose boosted object searches which utilizes a simplified b-tagging procedure and the Template Overlap Method to tag the massive boosted objects and reject the corresponding backgrounds. In addition, we propose a new, pileup insensitive method, to tag forward jets which characterize our signal events. We show that this search strategy offers a new window to both detecting and measuring quark partners of mass up to ~ 2 TeV.

Based on:
M.Backović, T.Flacke, S.J.Lee and G.Perez,
"LHC Top Partner Searches Beyond the 2 TeV Mass Region," arXiv:1409.0409 [hep-ph]
M.Backović, T.Flacke, J.H.Kim and S.J.Lee,
"Detecting Composite Quark Partners in Boosted Higgs Searches at LHC Run II," arXiv:1410.xxxx [hep-ph]
M.Backović, T.Flacke, J.H.Kim and S.J.Lee,
"Searching for Boosted Tops and Boosted Higgses from Composite Top Partner decays at LHC Run II," (work in progress)

Orateur: FLACKE, Thomas (KAIST)

ID de Contribution: **9** Type: **Non spécifié**

Lattice composite Higgs dynamics

jeudi 6 novembre 2014 14:00 (1 heure)

I will summarize the recent efforts to investigate composite (goldstone) Higgs models on the lattice, with a focus on the current numerical results relevant for the LHC experiments and the challenges waiting to be addressed in the future.

Orateur: PICA, Claudio (CP3 Odense)

ID de Contribution: **10** Type: **Non spécifié**

Concluding remarks

vendredi 7 novembre 2014 11:30 (30 minutes)