Open Questions in Particle Physics and Cosmology

Report of Contributions

Contribution ID: **0**   Type: **not specified**

Dark Matter in E6 Grand Unification

We discuss fermionic dark matter in non-supersymmetric E_6 Grand Unification. The fundamental representation of E_6 contains, in addition to the standard model fermions, exotic fermions and we argue that one of them is a viable, interesting dark matter candidate. Its stability is guaranteed by a remnant discrete symmetry that originates when the E_6 gauge symmetry is broken spontaneously. We compute the symmetry breaking scales by solving the renormalization group equations numerically after imposing gauge coupling unification. Since the Yukawa couplings of the exotic and the standard model fermions have a common origin the mass of the dark matter particles is constrained. We find a mass range of 10^7 GeV $< m_{DM} < 10^{11}$ GeV for our E_6 dark matter candidate, which is possibly in the reach of next-generation direct detection experiments.

Primary author: Mr SCHWICHTENBERG, Jakob (Institute for Theoretical Particle Physics (TTP) at the Karlsruhe Institute of Technology (KIT))

Presenter: Mr SCHWICHTENBERG, Jakob (Institute for Theoretical Particle Physics (TTP) at the Karlsruhe Institute of Technology (KIT))

Contribution ID: **1**   Type: **not specified**

Simplified dark matter models with a spin-2 mediator at the LHC

Following the LHC DM working group proposal, a simplified Dark Matter model approach has been widely adopted for the interpretation of LHC Run-II searches. In particular models with s-channel spin-1 and spin-0 mediators have been studied in detail. In this talk I will discuss the LHC phenomenology of the less explored spin-2 mediator scenario, presenting constraints on the model parameter space from the current 13 TeV LHC data. I will show the complementarity among different searches, in particular monojet and multijet plus missing energy searches and resonance searches. For universal couplings of the mediator to standard model particles, dilepton (and diphoton) resonance searches provide the strongest constraints for mediator masses above 200 (500) GeV. Missing energy searches are competitive only in the low-mass region. They can, however, be more important in non-universal coupling scenarios and/or when the coupling of the mediator to dark matter is much larger than its couplings to SM particles.

Primary author: LAA, Ursula (LPSC Grenoble)

Co-authors: MAWATARI, Kentarou (LPSC Grenoble); YAMASHITA, Kimiko (Ochanomizu University); KRAML, Sabine (LPSC Grenoble)

Presenter: LAA, Ursula (LPSC Grenoble)

Contribution ID: **2**   Type: **not specified**

Dark matter in the Sun: scattering off electrons vs nucleons

The annihilation of dark matter (DM) particles accumulated in the Sun could produce a flux of neutrinos, which is potentially detectable with neutrino detectors/telescopes and the DM elastic scattering cross section can be constrained. Although the process of DM capture in astrophysical objects like the Sun is commonly assumed to be due to interactions only with nucleons, there are scenarios in which tree-level DM couplings to quarks are absent, and even if loop-induced interactions with nucleons are allowed, scatterings off electrons could be the dominant capture mechanism. We consider this possibility and study in detail all the ingredients necessary to compute the neutrino production rates from DM annihilations in the Sun (capture, annihilation and evaporation rates) for velocity-independent and isotropic, velocity-dependent and isotropic and momentum-dependent scattering cross sections for DM interactions with electrons and compare them with the results obtained for the case of interactions with nucleons. Moreover, we improve the usual calculations in a number of ways and provide analytical expressions in three appendices. Interestingly, we find that the evaporation mass in the case of interactions with electrons could be below the GeV range, depending on the high-velocity tail of the DM distribution in the Sun, which would open a new mass window for searching for this type of scenarios.

Primary author: GARANI, Raghuveer (Physikalisches Institut, University Bonn)

Co-author: PALOMARES-RUIZ, Sergio (University Valencia)

Presenter: GARANI, Raghuveer (Physikalisches Institut, University Bonn)

Contribution ID: **3**   Type: **not specified**

New constraints on the 3-3-1 model with right-handed neutrinos

In the framework of a 3–3–1 model with right-handed neutrinos and three scalar triplets we consider different spontaneous symmetry breaking patterns seeking for a non-linear realization of accidental symmetries of the model, which will produce physical Nambu-Goldstone (NG) bosons in the neutral scalar spectrum. We make a detailed study of the safety of the model concerning the NG boson emission in energy loss processes which could affect the standard evolution of astrophysical objects. We consider the model with a Z2 symmetry, conventionally used in the literature, finding that in all of the symmetry breaking patterns the model is excluded. Additionally, looking for solutions for that problem, we introduce soft Z2-breaking terms in the scalar potential in order to remove the extra accidental symmetries and at the same time maintain the model as simple as possible. We find that there is only one soft Z2-violating term that can get rid of the problematic NG bosons.

Primary author: Mr ROSSI SCHMITZ, Ernany (University of Bonn)

Co-authors: Dr L. SANCHEZ-VEGA, Bruce (IFT-Unesp Sao Paulo); Dr C. MONTERO, Juan (IFT-Unesp Sao Paulo)

Presenter: Mr ROSSI SCHMITZ, Ernany (University of Bonn)

Contribution ID: **4**
Type: **not specified**

Black holes and axions stars

In the paper arXiv:1609.04724, shortly to be published in JCAP, we studied, for the first time, collapse of axion stars numerically using the full non-linear Einstein equations of general relativity and the full non-perturbative cosine potential. We identified three regions of the parameter space: i) long-lived oscillating axion star solutions, with a base frequency modulated by self-interactions, ii) collapse to a BH and iii) complete dispersal due to gravitational cooling and interactions. Using full 3+1 Numerical Relativity, many open problems which defy a perturbative approach can be solved, including the behaviour of the axion field around highly spinning black holes. I will briefly discuss the results in our paper and future directions.

Primary author: Dr CLOUGH, Katy (Goettingen)

Presenter: Dr CLOUGH, Katy (Goettingen)

Contribution ID: **5**   Type: **not specified**

Dark matter from hidden gauge symmetry

Many models of Higgs portal dark matter find themselves under pressure from increasingly tight direct detection constraints. In the framework of gauge field dark matter, we study how such bounds can be relaxed while retaining the thermal WIMP paradigm. When the hidden sector gauge symmetry is broken via the Higgs mechanism, the hidden sector generally contains unstable states which are lighter than dark matter. These states provide dark matter with an efficient annihilation channel. As a result, the dark matter relic abundance and the direct detection limits are controlled by different parameters, and the two can easily be reconciled. This simple setup realizes the idea of 'secluded' dark matter naturally. In addition, we show that multi-component dark matter particles naturally emerge from the hidden gauge symmetry with CP conservation, which give interesting phenomenology of dark matter.

Primary author: Dr TOMA, Takashi (Technische Universität München)

Presenter: Dr TOMA, Takashi (Technische Universität München)

Contribution ID: **6**   Type: **not specified**

Time-dependent Features in the Primordial Power Spectrum

In a Quantum Field Theory with a time-dependent background time-translational symmetry is broken. We therefore expect renormalization to lead to time-dependent loop corrections.
In my talk I will discuss the first order corrections to the power spectrum and the time-dependence that we observe.

Primary author: Mr DRESTI, Simone (Georg-August University Göttingen)

Presenter: Mr DRESTI, Simone (Georg-August University Göttingen)

Contribution ID: **7**
Type: **not specified**

Unitarity Implications of Vector Boson Scattering in Composite Higgs Models

Unitarity constraints on the scattering of longitudinal weak bosons can provide information about the spectra and effective description of Composite Higgs models. We use this information to construct realistic scenarios and study the potential of observing signals of strong vector boson scattering at the LHC and a 100 TeV collider.

Primary author: Dr BUARQUE FRANZOSI, Diogo (II Physics Institute, Goettingen U.)

Presenter: Dr BUARQUE FRANZOSI, Diogo (II Physics Institute, Goettingen U.)

Contribution ID: **8**

Type: **not specified**

Prospects for BSM physics searches in the Higgs sector at the LHC

Abstract: With the discovery of the $m_h = 125$ GeV Higgs boson, a new pathway to testing BSM models with extended Higgs sectors was opened. Many models predict Higgs couplings to new particles, which motivate a variety of searches at the LHC. Furthermore, modifications to the SM could enhance the Higgs trilinear coupling, putting it within the range of present day experiments. This talk presents the prospects of searches for BSM physics involving the Higgs boson at the LHC, with a focus on searches for pairs of Higgs bosons and interpretations in the context of 2HDM, MSSM, Randall-Sundrum, and Dark Matter models.

Primary author: Mr VEATCH, Jason (Göttingen University)

Presenter: Mr VEATCH, Jason (Göttingen University)

Contribution ID: **10**

Type: **not specified**

Three tier approach to Dark Matter

Monday, 3 April 2017 10:00 (40 minutes)

Primary author: Prof. ROSZKOWSKI, Leszek (University of Sheffield and NCBJ)

Presenter: Prof. ROSZKOWSKI, Leszek (University of Sheffield and NCBJ)

Session Classification: Cosmology

Contribution ID: **11**   Type: **not specified**

Mechanisms for Baryogenesis

Monday, 3 April 2017 10:45 (40 minutes)

Presenter: Mr HAMBYE, Thomas (Univ. of Brussels (ULB))

Session Classification: Cosmology

Contribution ID: **12**
Type: **not specified**

Singularities in Cosmology

Monday, 3 April 2017 12:00 (40 minutes)

Presenter: Prof. MUKHANOV, Viatcheslav (LMU - Munich)

Session Classification: Cosmology

Contribution ID: **13**   Type: **not specified**

The serendipity of Electroweak Baryogenesis

Monday, 3 April 2017 14:30 (40 minutes)

Presenter: Dr SERVANT, Geraldine (CERN)

Session Classification: Cosmology

Contribution ID: **14**   Type: **not specified**

Axions

Monday, 3 April 2017 15:15 (40 minutes)

Presenter: JAECKEL, Joerg (ITP Heidelberg)

Session Classification: Cosmology

Contribution ID: **15**   Type: **not specified**

Black Holes and axions stars

Monday, 3 April 2017 16:30 (25 minutes)

Presenter: Dr CLOUGH, Katy (Goettingen)

Session Classification: Cosmology

Contribution ID: **16**   Type: **not specified**

Time-dependent features in the primordial spectrum

Monday, 3 April 2017 17:00 (25 minutes)

Presenter: Mr DRESTI, Simone (Georg-August University Göttingen)

Session Classification: Cosmology

Contribution ID: **17**   Type: **not specified**

New Constraints on the 3-3-1 Model with right-handed neutrinos

Monday, 3 April 2017 17:30 (25 minutes)

Presenter: Mr ROSSI SCHMITZ, Ernany (University of Bonn)

Session Classification: Cosmology

Contribution ID: **18**   Type: **not specified**

Higgs Physics

Tuesday, 4 April 2017 09:00 (40 minutes)

Presenter: SPANNOWSKY, Michael (Durham University)

Session Classification: Particle Physics and BSM

Contribution ID: **19**   Type: **not specified**

Two-Higgs doublet models in colliders and in the sky

Tuesday, 4 April 2017 09:45 (40 minutes)

Presenter: BERNON, Jeremy (LPSC)

Session Classification: Particle Physics and BSM

Contribution ID: **20** Type: **not specified**

Composite Models

Tuesday, 4 April 2017 11:00 (40 minutes)

Presenter: Prof. SANNINO, Francesco (CP3-Origins, SDU)

Session Classification: Particle Physics and BSM

Contribution ID: **21**   Type: **not specified**

GUTs and the Early Universe

Tuesday, 4 April 2017 11:45 (40 minutes)

Presenter: BUCHMULLER, Wilfried (DESY)

Session Classification: Particle Physics and BSM

Contribution ID: **22**   Type: **not specified**

Gravitational Waves and BSM

Tuesday, 4 April 2017 14:30 (40 minutes)

Presenter: Dr SCHWALLER, Pedro (CERN)

Session Classification: Particle Physics and BSM

Contribution ID: **23**   Type: **not specified**

BSM from asymptotic safety

Tuesday, 4 April 2017 15:15 (40 minutes)

Presenter: Prof. LITIM, Daniel (University of Sussex)

Session Classification: Particle Physics and BSM

Contribution ID: **24**   Type: **not specified**

Dark Matter and late kinetic decoupling

Wednesday, 5 April 2017 09:00 (40 minutes)

Presenter: BRINGMANN, Torsten (Hamburg University)

Session Classification: Dark Matter

Contribution ID: **25**

Type: **not specified**

Phenomenology of self-interacting WIMPs

Wednesday, 5 April 2017 09:45 (40 minutes)

Presenter: Dr KAHLHOEFER, Felix (DESY)

Session Classification: Dark Matter

Contribution ID: **26**   Type: **not specified**

Dark Matter Models

Wednesday, 5 April 2017 11:00 (40 minutes)

Presenter: Prof. ZUPAN, Jure

Session Classification: Dark Matter

Contribution ID: **27**   Type: **not specified**

Direct Detection of Dark Matter

Wednesday, 5 April 2017 11:45 (40 minutes)

Presenter: Dr CATENA, Riccardo (Institut fuer Theoretische Physik Goettingen)

Session Classification: Dark Matter

Contribution ID: **28**   Type: **not specified**

Prospects for BSM physics searches in the Higgs sector at the LHC

Tuesday, 4 April 2017 16:30 (25 minutes)

Presenter: Mr VEATCH, Jason (Göttingen University)

Session Classification: Particle Physics and BSM

Contribution ID: **29**   Type: **not specified**

Simplified dark matter models with a spin-2 mediator at the LHC

Tuesday, 4 April 2017 17:00 (25 minutes)

Presenter: LAA, Ursula (LPSC Grenoble)

Session Classification: Particle Physics and BSM

Contribution ID: **30**   Type: **not specified**

Implications of Vector Boson Scattering Unitarity in Composite Higgs Models

Tuesday, 4 April 2017 17:30 (25 minutes)

Presenter: Dr BUARQUE FRANZOSI, Diogo (II Physics Institute, Goettingen U.)

Session Classification: Particle Physics and BSM

Contribution ID: **31**   Type: **not specified**

Dark Matter in E6 Grand Unification

Wednesday, 5 April 2017 14:00 (25 minutes)

Presenter: SCHWICHTENBERG, Jakob (Institute for Theoretical Particle Physics (TTP) at the Karlsruhe Institute of Technology (KIT))

Session Classification: Dark Matter

Contribution ID: **32**   Type: **not specified**

Dark matter in the Sun: scattering off electrons vs nucleons

Wednesday, 5 April 2017 14:30 (25 minutes)

Presenter: GARANI, Raghuveer (Physikalisches Institut, University Bonn)

Session Classification: Dark Matter

Contribution ID: **33**   Type: **not specified**

Dark matter from hidden gauge symmetry

Wednesday, 5 April 2017 15:00 (25 minutes)

Presenter: Dr TOMA, Takashi (Technische Universität München)

Session Classification: Dark Matter

Contribution ID: **34**

Type: **not specified**

Sommerfeld effect at finite temperature

Wednesday, 5 April 2017 15:30 (30 minutes)

Presenter: BINDER, Tobias (ITP, Goettingen University)

Session Classification: Dark Matter