### LIO International Conference 2025 on "New Approaches to Naturalness"



# **Report of Contributions**

https://indico.in2p3.fr/e/LIO\_naturalness

Physics of  $\theta\text{-vacua}$  in Standard Mo ...

Contribution ID: 33

Type: not specified

### Physics of $\theta$ -vacua in Standard Model and Gravity

*Tuesday, May 20, 2025 2:05 PM (55 minutes)* 

Presenter: DVALI, Gia

Session Classification: Gravity, Forms & Generalized Symmetries

Track Classification: Gravity, Forms & Generalized Symmetries

New insights from the  $\theta$ -vacua of ...

Contribution ID: 34

Type: not specified

### New insights from the θ-vacua of the Standard Model

*Tuesday, May 20, 2025 3:00 PM (30 minutes)* 

**Presenter:** SAKHELASHVILI, Otari **Session Classification:** Gravity, Forms & Generalized Symmetries

Track Classification: Gravity, Forms & Generalized Symmetries

Naturalness and Generalized Sym ...

Contribution ID: 35

Type: not specified

### **Naturalness and Generalized Symmetries**

*Tuesday, May 20, 2025 3:30 PM (30 minutes)* 

Presenter: KOREN, Seth

Session Classification: Gravity, Forms & Generalized Symmetries

Track Classification: Gravity, Forms & Generalized Symmetries

The Experimental Way

Contribution ID: 36

Type: not specified

### The Experimental Way

Tuesday, May 20, 2025 4:30 PM (55 minutes)

**Presenter:** DAGNOLO, Raffaele **Session Classification:** Wild Card

A cosmological solution to the ...

Contribution ID: 37

Type: not specified

# A cosmological solution to the doublet-triplet splitting problem

*Tuesday, May 20, 2025 5:25 PM (30 minutes)* 

**Presenter:** SESMA, Pablo (IPhT Saclay)

Session Classification: Cosmological Selection of Vacuum

A Critical Look at the Higgs

Contribution ID: 38

Type: not specified

### A Critical Look at the Higgs

Wednesday, May 21, 2025 9:00 AM (30 minutes)

Self-organised criticality, realised through cosmological dynamics in the early universe, is an alternative paradigm for addressing the electroweak hierarchy problem. In this scenario, an unnaturally light Higgs boson is the result of dynamics driving the electroweak vacuum towards a near-critical metastable point where the Higgs mass is bounded from above by the vacuum instability scale. To lower the vacuum instability scale close to the weak scale, previous realisations of this mechanism introduced new vector-like fermions coupled to the Higgs. Here we show that an Axion-Like Particle (ALP) coupling to the Higgs is an alternative possibility for achieving criticality with another well-motivated and naturally light candidate for new physics, thus leading to an entirely different set of testable phenomenological signatures. Our Axion-Higgs criticality model predicts an ALP in the MeV to O(10) GeV range. The entire natural region of parameter space can be thoroughly explored by a combination of future colliders, flavour experiments, and cosmological observatories.

Presenter: DETERING, Maximilian (King's College London)

Session Classification: Cosmological Selection of Vacuum

The Higgs mass metastability bound

Contribution ID: 39

Type: not specified

### The Higgs mass metastability bound

Wednesday, May 21, 2025 10:30 AM (30 minutes)

**Presenter:** STEINGASSER, Thomas

Session Classification: Cosmological Selection of Vacuum

A Multiverse Outside of the Swam...

Contribution ID: 40

Type: not specified

### A Multiverse Outside of the Swampland

Wednesday, May 21, 2025 9:30 AM (30 minutes)

Presenter: RIGO, Gabriele (IPhT, Saclay)

Session Classification: Cosmological Selection of Vacuum

The Relaxion: An update

Contribution ID: 41

Type: not specified

### The Relaxion: An update

Tuesday, May 20, 2025 5:55 PM (55 minutes)

In this talk, I re-visit the original relaxion model by Graham-Kaplan-Rajendran in the regime where the relaxion is subject to large fluctuations during its dynamics. I discuss the modified stopping conditions for such dynamics of the relaxion and the new parameter space. Interestingly, in a significant region of the parameter space, the relaxion can naturally account for the observed dark matter density in the universe.

**Presenter:** SERVANT, Geraldine (CERN)

Session Classification: Cosmological Selection of Vacuum

Infrared Neutrino Mass Models an ...

Contribution ID: 42

Type: not specified

### Infrared Neutrino Mass Models and how to test them

Wednesday, May 21, 2025 11:00 AM (30 minutes)

**Presenter:** ETTENGRUBER, Manuel

Session Classification: Flavor Puzzle

The gauge dual Standard Model: A ...

Contribution ID: 43

Type: not specified

# The gauge dual Standard Model: A new approach to naturalness and the flavour puzzle

Wednesday, May 21, 2025 2:15 PM (55 minutes)

**Presenter:** Dr CACCIAPAGLIA, Giacomo (LPTHE)

Session Classification: Flavor Puzzle

Modular Symmetries for Flavour P ...

Contribution ID: 44

Type: not specified

### **Modular Symmetries for Flavour Physics**

Wednesday, May 21, 2025 3:10 PM (55 minutes)

**Presenter:** KING, Stephen F.

Session Classification: Flavor Puzzle

Flavor Deconstruction

Contribution ID: 45

Type: not specified

### **Flavor Deconstruction**

Wednesday, May 21, 2025 4:45 PM (55 minutes)

**Presenter:** Prof. ISIDORI, Gino (University of Zurich)

Session Classification: Flavor Puzzle

Naturally small couplings from RG ...

Contribution ID: 46

Type: not specified

### Naturally small couplings from RG fixed points

*Thursday, May 22, 2025 2:15 PM (55 minutes)* 

**Presenter:** KOWALSKA, Kamila

Session Classification: Fixed Point & Compositeness

Custodial Naturalness: Electrowea...

Contribution ID: 47

Type: not specified

# Custodial Naturalness: Electroweak hierarchy from conformal and custodial symmetry

*Thursday, May 22, 2025 3:10 PM (30 minutes)* 

Presenter: TRAUTNER, Andreas (Max-Planck-Institut fuer Kernphysik Heidelberg)

Session Classification: ALPs, pNGBs & Accidents

**Track Classification:** Axion-Like Particles (ALPs), pseudo Nambu-Goldstone Bosons (pNGBs) & Accidents

Revisiting Quantum Criticality an...

Contribution ID: 48

Type: not specified

# Revisiting Quantum Criticality and Naturalness with the Standard Model

*Thursday, May 22, 2025 9:30 AM (30 minutes)* 

Presenter:GARCÉS VARAS, Juan PabloSession Classification:Fixed Point & Compositeness

Phase of Chiral Gauge Theories

Contribution ID: 49

Type: not specified

### **Phase of Chiral Gauge Theories**

*Thursday, May 22, 2025 9:00 AM (30 minutes)* 

We study the IR fate of Chiral Gauge Theories through functional methods and the Effective Average Action. Our results show a rich structure, from the existence of IR conformality to new patterns of Chiral Symmetry Breaking.

Presenter:VATANI, Shahram (CP3 UCLouvain)Session Classification:Fixed Point & Compositeness

Conjugate Fermions - Restoring N ...

Contribution ID: 50

Type: not specified

### Conjugate Fermions - Restoring Naturalness to Composite Higgs Models

Thursday, May 22, 2025 11:25 AM (30 minutes)

**Presenter:** HAGER, Maya Session Classification: Fixed Point & Compositeness

Holographic analysis of near-...

Contribution ID: 51

Type: not specified

#### Holographic analysis of near-conformal dynamics and light dilaton

Thursday, May 22, 2025 10:30 AM (55 minutes)

We carry out a detailed analysis of the region slightly outside the conformal window of a nontrivial infrared fixed point in a generic bottom-up holographic setup. We focus on models, which study the dynamics of a scalar field, dual to quark degrees of freedom, in a (nearly) AdS geometry. Such models realize the picture expected for vector-like near-conformal theories from Dyson-Schwinger analysis. The analysis covers a toy model, which allows for analytic solutions, and a more general setup as well, which encompass a complete model for the ultraviolet physics. We analyze the conditions for the appearance of a parametrically light scalar state in the spectrum, which can act as a candidate for the Pseudo-Nambu-Goldstone boson arising from breaking of the approximate conformal symmetry. We also present detailed results for the vacuum structure, correlators, and Ward identities in the near-conformal regime.

Based on: https://arxiv.org/abs/2504.18623

Presenter: HONG, Deog Ki

Session Classification: Fixed Point & Compositeness

Composite Hybrid Inflation

Contribution ID: 52

Type: not specified

### **Composite Hybrid Inflation**

Thursday, May 22, 2025 11:55 AM (30 minutes)

I will describe a model of hybrid inflation coming from a general composite theory. Starting from an effective chiral Lagrangian with a dilaton and pions, we identify inflation occurring during the walking dynamics of the theory. A Z2 symmetry-breaking term in the pion sector induces a shift in the inflaton's trajectory, which leads to a tachyonic instability phase. Curvature perturbations grow exponentially, producing copious primordial black holes and a stochastic gravitational wave background. We show that the primordial black hole mass and the gravitational wave frequency is strongly restricted by the anomalous dimension values, with larger anomalous dimensions giving lighter primordial black holes, and higher frequency gravitational waves. Future gravitational wave observatories are within the reach of probing associated signatures.

Presenter: ISNARD, Wanda (IP2I Lyon)

Session Classification: Fixed Point & Compositeness

Exploring the Boundaries of Natur ...

Contribution ID: 53

Type: not specified

### **Exploring the Boundaries of Naturalness**

*Thursday, May 22, 2025 5:05 PM (55 minutes)* 

Presenter: MCCULLOUGH, Matthew (CERN)

Session Classification: ALPs, pNGBs & Accidents

**Track Classification:** Axion-Like Particles (ALPs), pseudo Nambu-Goldstone Bosons (pNGBs) & Accidents

pNGB Higgs Naturalness at a Tipp ...

Contribution ID: 54

Type: not specified

### pNGB Higgs Naturalness at a Tipping Point

Friday, May 23, 2025 10:25 AM (30 minutes)

For pNGB-based approaches, the phenomenological question of Higgs naturalness finds itself at a tipping point between direct searches and precision. As we look ahead to the HL-LHC era and beyond, a scenario in which all measurements remain Standard Model-like would only sharpen the naturalness tension, driven increasingly by precision constraints. To illustrate this from a fresh perspective, we construct a maximally natural model, throwing into the mix three approaches to symmetry-based naturalness: Supersymmetry, Twin Higgs, and Gegenbauer-like pNGB Higgs models. We use the 'Kitchen Sink' model to discuss the interplay between direct exploration and precision, and the implications for FCC-ee and FCC-hh.

**Presenter:** GUERRERO MENKARA, Adriana

Session Classification: ALPs, pNGBs & Accidents

**Track Classification:** Axion-Like Particles (ALPs), pseudo Nambu-Goldstone Bosons (pNGBs) & Accidents

Hierarchy Problem Redux

Contribution ID: 55

Type: not specified

### **Hierarchy Problem Redux**

Wednesday, May 21, 2025 11:30 AM (55 minutes)

After discussing some history of the hierarchy problem, I recast the hierarchy problem as a legitimate paradox. The premises and reasoning of the paradox are explained. I discuss how each premise has been attacked and what ideas are still standing and which directions are perhaps less interesting today after a generation of experimental and theoretical work.

**Presenter:** WELLS, James (University of Michigan)

Session Classification: Wild Card

Accelerated Cosmic Expansion, M ...

Contribution ID: 56

Type: not specified

# Accelerated Cosmic Expansion, Mass Creation, and the QCD Axion

Friday, May 23, 2025 9:00 AM (55 minutes)

Presenter: NARDI, Enrico (INFN Roma Italy & Universidad de Antioquia, Medellin Colombia)

Session Classification: ALPs, pNGBs & Accidents

**Track Classification:** Axion-Like Particles (ALPs), pseudo Nambu-Goldstone Bosons (pNGBs) & Accidents

Accidentally light scalars

Contribution ID: 57

Type: not specified

### Accidentally light scalars

Friday, May 23, 2025 10:55 AM (55 minutes)

Presenter: BRUEMMER, Felix (LUPM Montpellier)

Session Classification: ALPs, pNGBs & Accidents

**Track Classification:** Axion-Like Particles (ALPs), pseudo Nambu-Goldstone Bosons (pNGBs) & Accidents

Swampland & Naturalness Problems

Contribution ID: 58

Type: not specified

### **Swampland & Naturalness Problems**

*Friday, May 23, 2025 1:50 PM (55 minutes)* 

**Presenter:** VALENZUELA, Irene (IFT UAM-CSIC Madrid) **Session Classification:** UV/IR Mixing

Track Classification: Ultraviolet (UV) / Infrared (IR) Mixing

UV/IR Mixing and Naturalness

Contribution ID: 59

Type: not specified

### **UV/IR Mixing and Naturalness**

Friday, May 23, 2025 2:45 PM (55 minutes)

**Presenter:** ABEL, Steven (IPPP)

Session Classification: UV/IR Mixing

Track Classification: Ultraviolet (UV) / Infrared (IR) Mixing

Magnetic Compactifications

Contribution ID: 60

Type: not specified

### **Magnetic Compactifications**

*Thursday, May 22, 2025 4:10 PM (55 minutes)* 

Presenter: DUDAS, Emilian (Ecole Polytechnique)

Session Classification: ALPs, pNGBs & Accidents

**Track Classification:** Axion-Like Particles (ALPs), pseudo Nambu-Goldstone Bosons (pNGBs) & Accidents

Welcome Words

Contribution ID: 61

Type: not specified

### Welcome Words

Tuesday, May 20, 2025 1:55 PM (10 minutes)

Presenter: Dr NORTIER, Florian (CNRS/IN2P3 - IP2I Lyon)

Last Words

Contribution ID: 62

Type: not specified

### Last Words

Friday, May 23, 2025 3:40 PM (5 minutes)

Presenter: Dr NORTIER, Florian (CNRS/IN2P3 - IP2I Lyon)