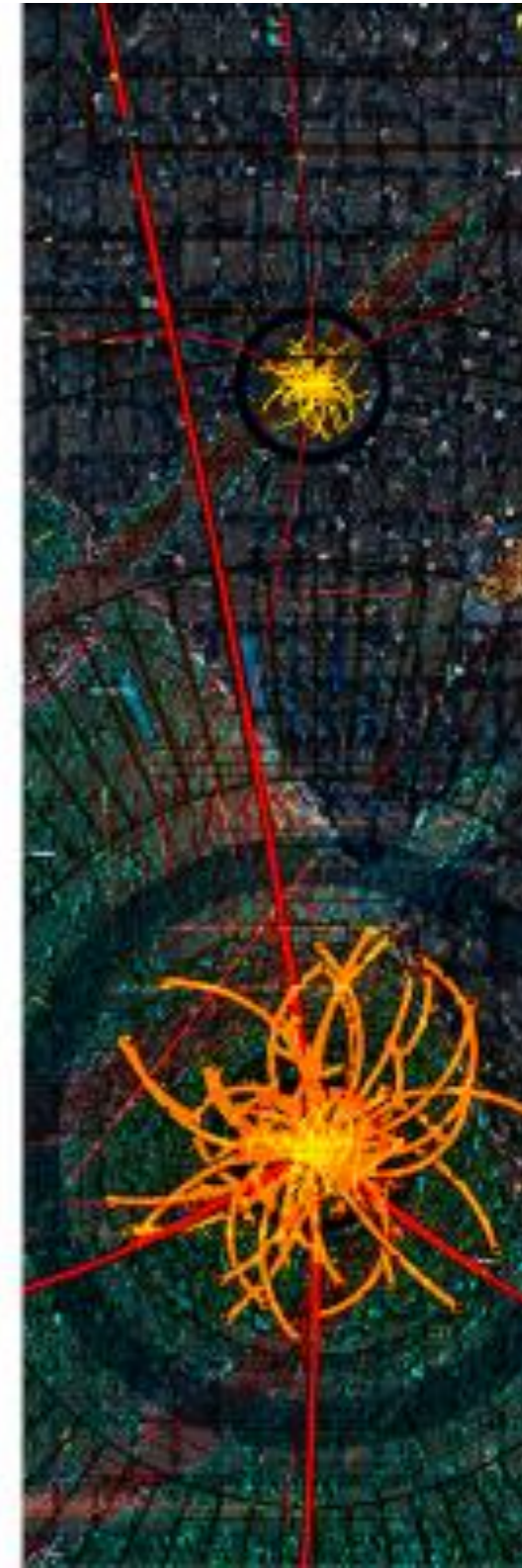
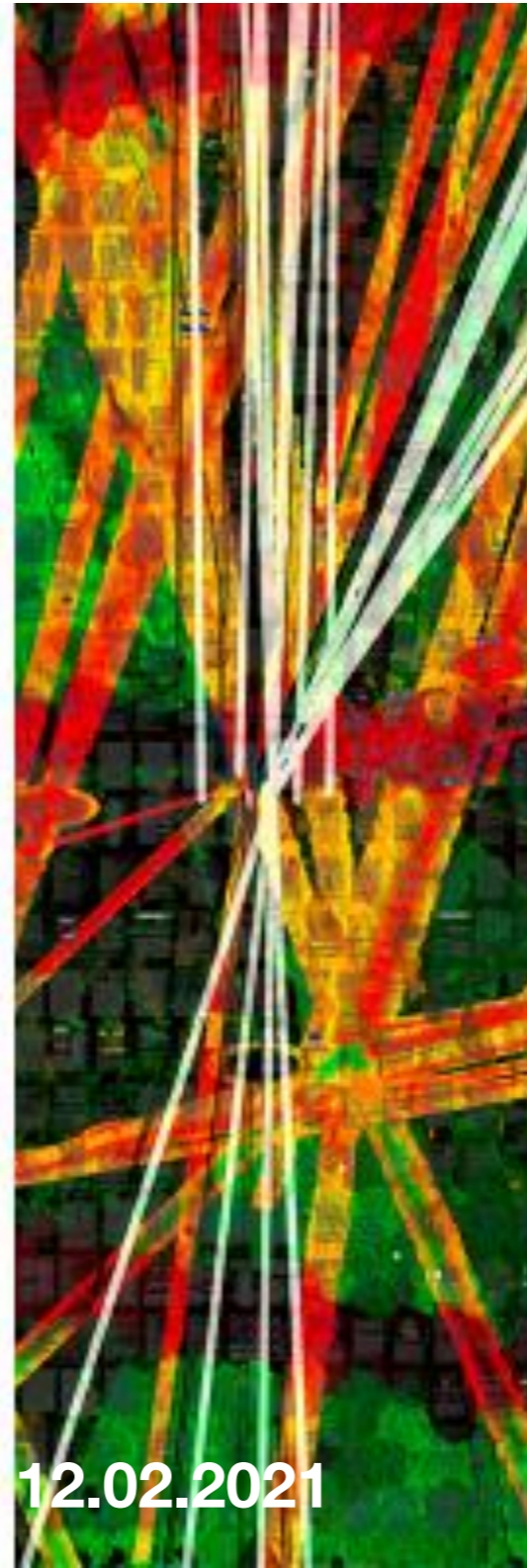
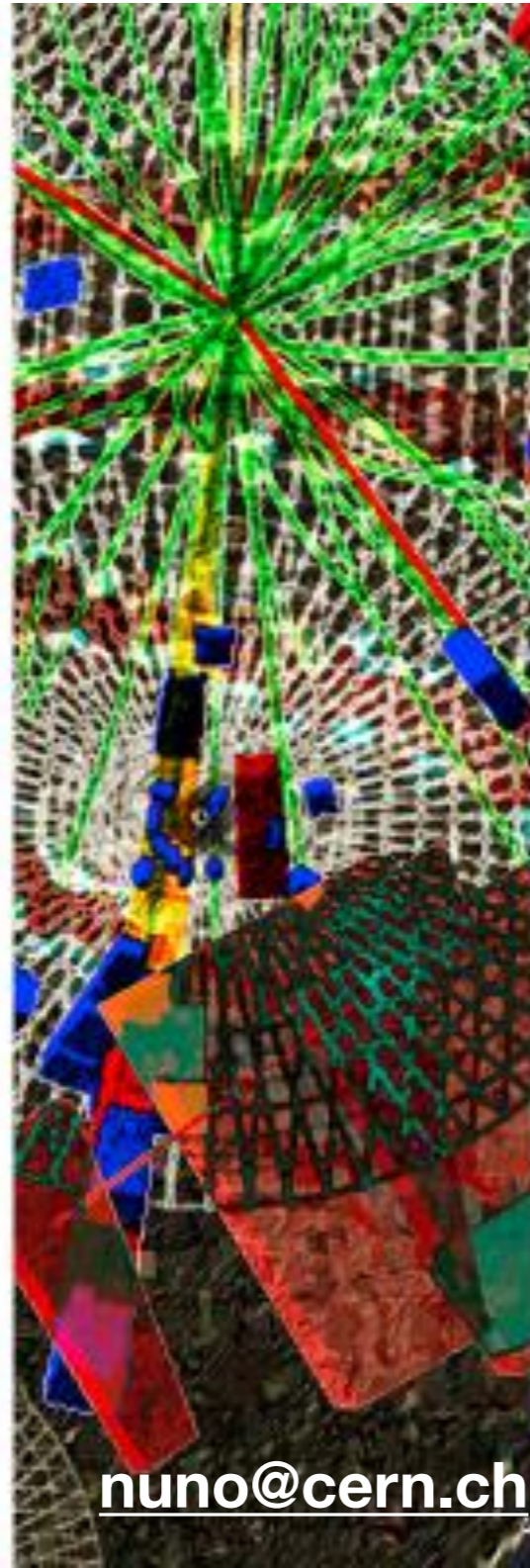


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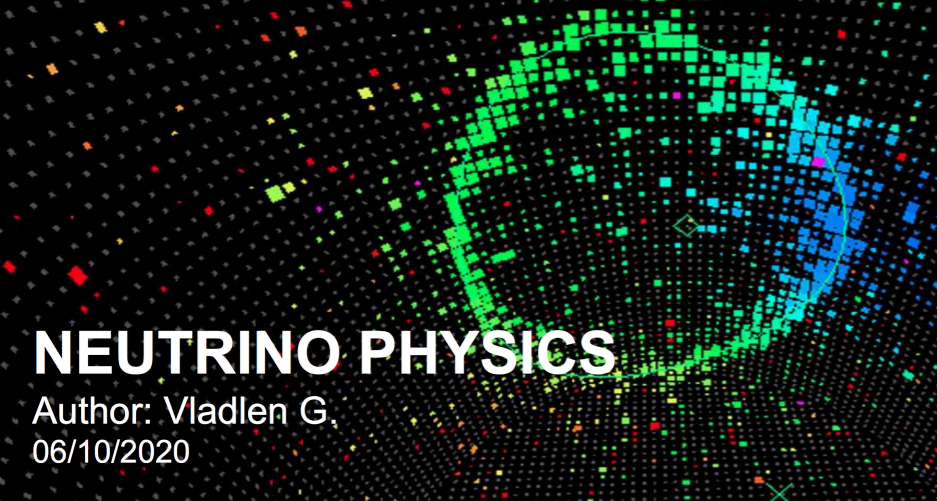


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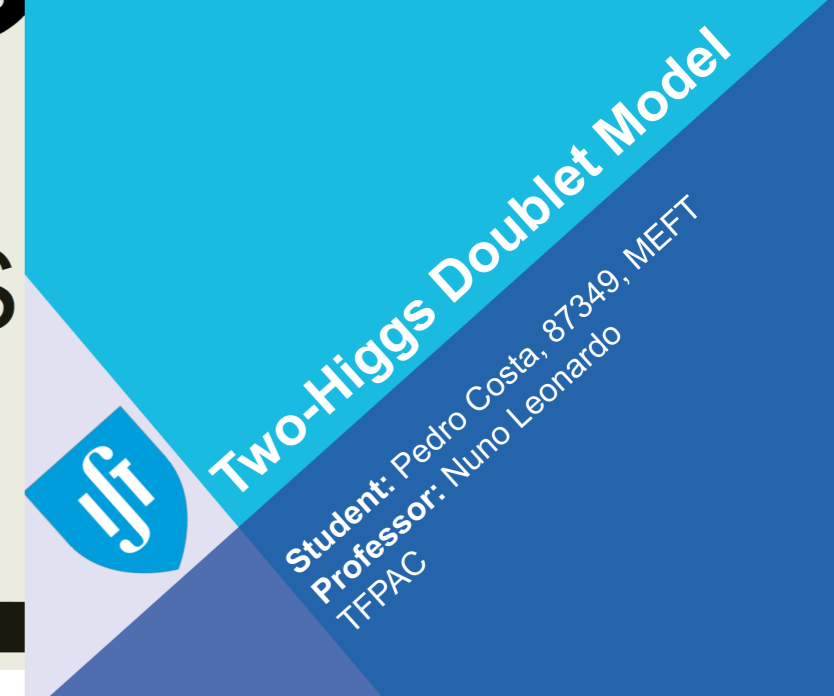
European Strategy for Particle Physics Preparatory Group

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NEUTRINO AND FLAVOUR PHYSICS

Beatriz Pereira (81813)
Professor: Nuno Leonardo
TFPAC - MEFT



Two-Higgs Doublet Model

Student: Pedro Costa, 87349, MEFT
Professor: Nuno Leonardo
TFPAC

NEUTRINO PHYSICS

Author: Vladlen G.
06/10/2020

Dark Matter and Dark Sectors

Tópicos de Física de Partículas, Astrofísica e Cosmologia

Pedro Lagarelhos - 94002

Dark Matter & Dark Sectors

Maria Faria



Supersymmetry

Maria Faria



Dark Matter and Dark Sectors

Tópicos de Física de Partículas, Astrofísica e Cosmologia
Instituto Superior Técnico

Beatriz Bordadágua
October 6th, 2020



Hot and Dense QCD Matter:
Quark-Gluon Plasma and its probes

Speaker: André Cordeiro (87303)

Professor: Nuno Leonardo

Instituto Superior Técnico

13 October, 2020

... and from the basis: particle detection

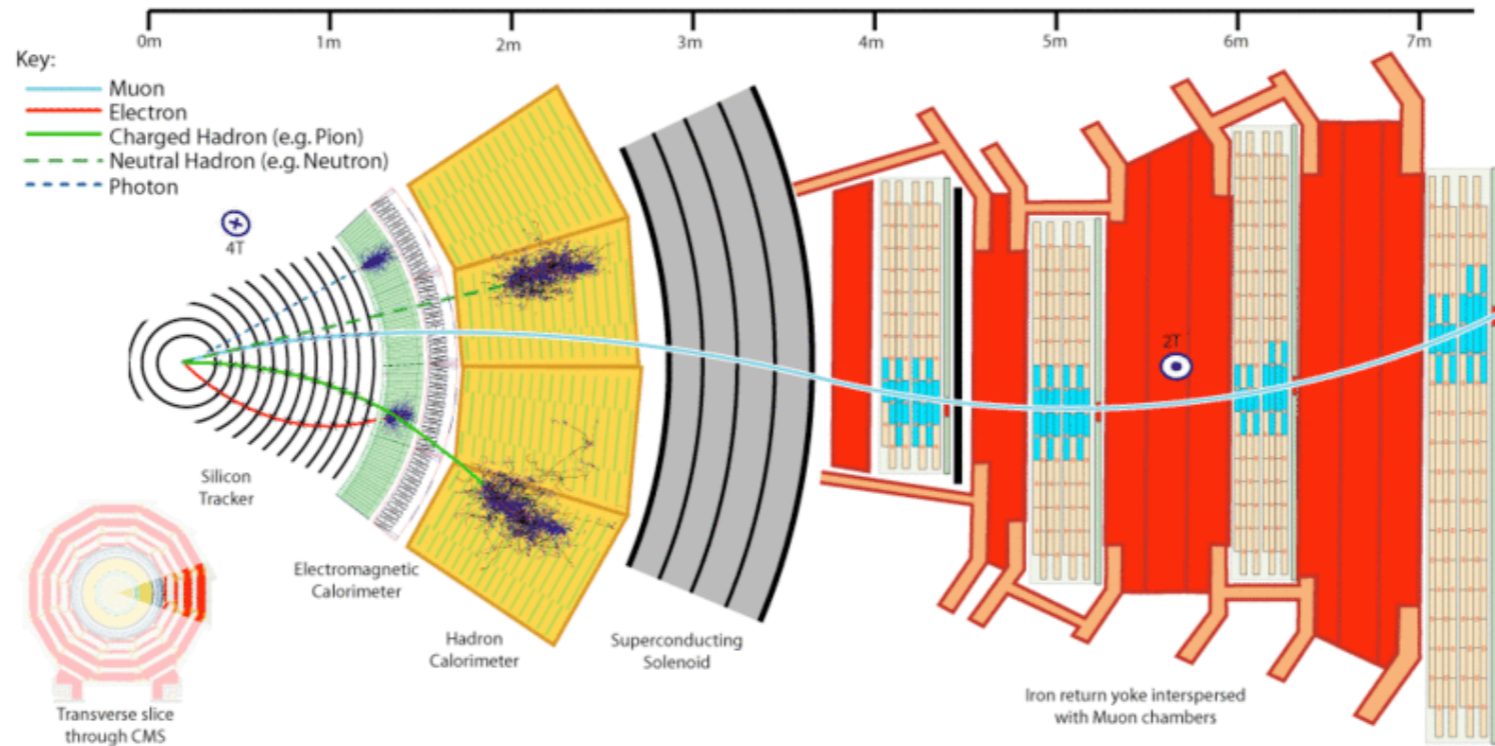
accelerators, colliders
luminosity, pileup, \sqrt{s}

PID, dE/dx , MIP, TOF, TR, RICH

tracking, calorimeters

LEP
BaBar, Belle
CDF, D0

LHC
HL-LHC
FCC
CEPC
ILC



AMS
TA
AUGER

Minos
Nova
DUNE
T2K

DAQ, FEDs, ADCs, EVB

Trigger, HLT, CPU/GPU farm

Grid, MC, Calibration

ATLAS, CMS, ALICE, LHCb, BelleII

SHIP, LDMX, NA64, SND, FASER, MATHUSLA, Codexb, AL3X, miliQan, MoEDAL, CAST, IAXO

... towards the Standard Model

measurement: cross section
search: $\mu\mu$ bump rare decay

spectroscopy
lifetime
CKM, CPV
quark mixing
meson oscillations
flavour anomalies
top

LFV, LFU

Leptons

e, μ, τ
 ν_e, ν_μ, ν_τ

l

Quarks

u, c, t
 d, s, b

q

ν oscillations
mass
CP

γ

Photon

W

W^+/W^-

Z

Z^0

QCD
Jets
QGP

g

Gluons

cosmic rays
 γ rays

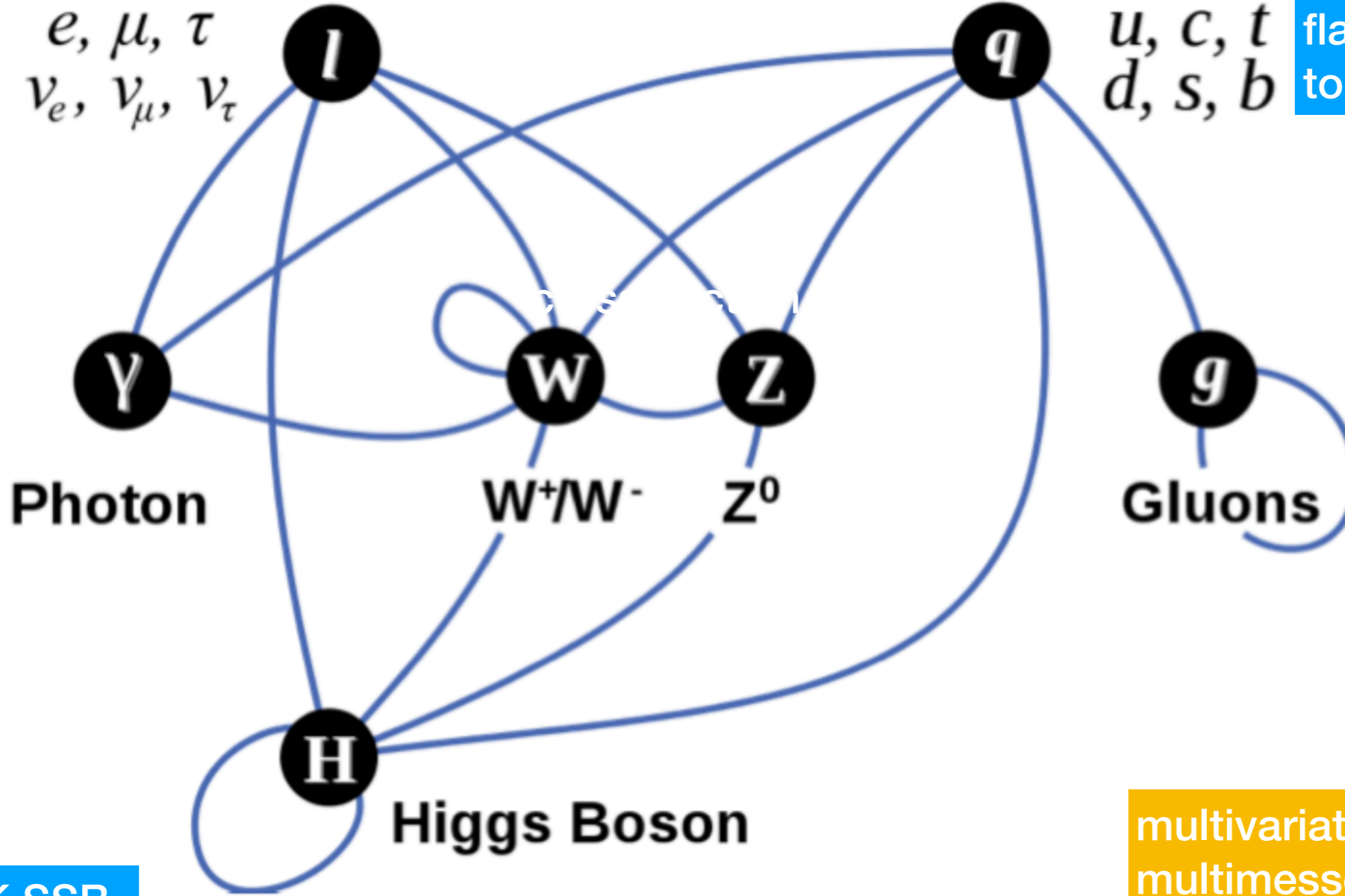
H

Higgs Boson

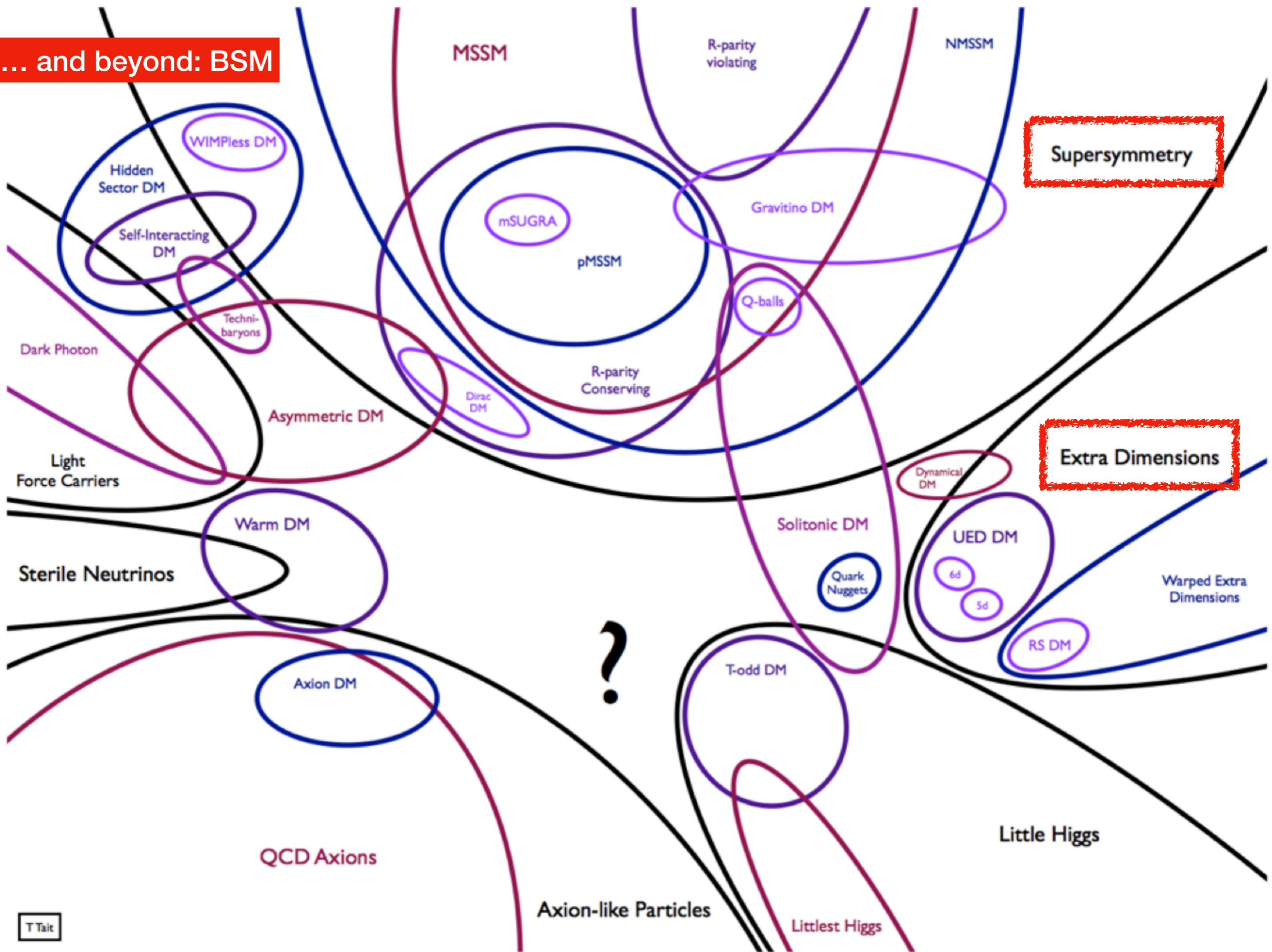
EWK SSB
properties
couplings

rare decays
FCNC

multivariate
multimessenger



... and beyond: BSM



Supersymmetry

Extra Dimensions

[Objetivo]

(looking back)

- perspectiva da cadeira

- introdução a tópicos de investigação atuais em física das altas energias
- familiarização com análises típicas e métodos experimentais em HEP
- facilitar e fornecer bases para exploração da literatura científica na área


- não é aqui o propósito

- fornecer detalhes da base teórica — cursos de introdução à física de partículas e teoria do campo bons para tal
- fornecer descrição detalhada de como funcionam os detectores — eg cursos e laboratórios de desenvolvimento de detectores e electrónica

- em termos mais práticos

- aprender sobre (como fazer) investigação em experiências de partículas


14:00 → 14:25 **Overview of parton distribution functions**

🕒 25m 

This paper provides a short overview of parton distribution functions (PDFs), starting with the historical motivation and main experimental results, as well as an introduction to the basics of PDF extraction from deep inelastic scattering (DIS) experiments, and a motivation for the inclusion of nuclear modified parton distributions (nPDFs). Recent literature is discussed, including recent measurements pertaining to evidence of nuclear modifications from electroweak processes, as well as a recent global fit to DIS and beam collision experiments to produce a nPDF set. The interplay of these publications is explored, highlighting the need for both careful parameterization and thorough experimental measurements.

arXiv:1503.05825, arXiv:1612.05741

Speaker: André Cordeiro (IST)

 tfpac_AndreCordeir...


14:45 → 15:10 **Search for heavy right-handed W gauge bosons and neutrinos**

🕒 25m 

We review the two most recent papers from the CMS and ATLAS collaborations searching for heavy right-handed gauge bosons and neutrinos in final states containing two charged leptons and two jets. Both analyses use Run 2 proton-proton collision data at 13TeV. CMS uses 2016 and ATLAS 2015+2016 data corresponding to a total integrated luminosity of 35.9/fb and 36.1/fb, respectively. In the CMS analysis, the region in the mWR-mNR plane excluded at 95% confidence level extends to mWR = 4.4 TeV for Majorana neutrinos. In the ATLAS analysis, the excluded region extends to mWR = 4.7 TeV for both Majorana and Dirac NR neutrinos and the mNR > mWR scenario is explored for the first time.

arXiv:1803.11116, arXiv:1809.11105

Speaker: Maria Faria (IST)


 tfpac_MariaFaria.pdf

15:30 → 15:55 **A review of top quark physics**

A review of top quark physics is presented. An overview of the top quark properties and collaborations, are given, and analyses of four top quark production by both collaborations

arXiv:2007.14858, arXiv:1908.06463

Speaker: Pedro Lagarelhos (IST)


 tfpac_PedroLagarel...

16:15 → 16:40 **b-tagging methods in CMS and ATLAS**

For a better identification and understanding of beyond the standard model physics, it need to be refined at the high energy collision experiments. This report reviews all the simulation techniques and methods of b-tagging. Comparing the performances of the Calibration methods to calculate b-jet tagging efficiency such as Tag and Probe and the whole b-tagging process.

arXiv:1805.01845, arXiv:1712.07158

Speaker: Vladlen Galetsky (IST)

 tfpac_VladlenGalets...

17:00 → 17:25 **Exclusive production at the LHC**

arXiv:2003.02811, arXiv:1604.04464

Speaker: Gonçalo Diogo (IST)

14:45 → 15:10 **Axions as cold dark matter candidates**

🕒 25m 

The axion is a hypothetical particle that first appeared as an explanation to the CP problem of Quantum Chromodynamics, however, its potential as a dark matter particle was soon discovered. Nonetheless, decades after it was first postulated, there is no experimental evidence of the axion despite several searches for this minuscule particle. The difficulty in this process was already foreseen, given that the axion couples very weakly to the Standard Model, in addition to being very stable. But all is not lost, the silver lining in the so far fruitless search for this "invisible" boson is that several constraints on the axion's mass, as well as its coupling constants have been set, opening the door to new challenges. This paper starts with an introduction to the axion and its origin, describing its role as a dark matter particle. Secondly, it highlights some of the constraints imposed by experiments. Lastly, two papers are reviewed in more detail, which describe two very different, but equally important experiments.

arXiv:1705.02290, arXiv:2010.00169

Speaker: Clara Severino (IST)

15:30 → 15:55 **A review of Kepler and PLATO 2.0 missions from the asteroseismic point of view**

🕒 25m 

The paper presents a review on stellar astrophysics, specifically asteroseismology. First, an introduction to the theory of oscillations in stars that explains the stellar interior properties. Second, a comparison of two extremely important missions Kepler and PLATO 2.0. One has already a tremendous amount of data that dictates the limit of what we know today, the other will be launched in 2026 with incredible precision and range that will answer the questions that remain.

arXiv:1310.0696, arXiv:1001.0139

Speaker: Beatriz Bordadágua (IST)

16:15 → 16:40 **Particle acceleration mechanisms within blazars**


🕒 25m 

This paper aims to summarily review the most noteworthy particle acceleration mechanisms which are thought to operate within blazars, with particular focus on the processes which occur in the jets associated with these phenomena. First, an initial description of blazars and their characteristics is provided, followed by a characterisation of the particle acceleration mechanisms proposed to operate within these phenomena. Second, the paper delves into a more detailed description of the particular case of the coincidence of the IceCube- 170922A neutrino and TXS 0506+056 blazar, including the methods and instruments involved throughout the study of this noteworthy phenomenon.

arXiv:1705.02021, arXiv:1604.00318

Speaker: Pedro Costa (IST)

17:00 → 17:25 **Multiple galactic sources**

🕒 25m 

arXiv:2010.06205, arXiv:1909.08609

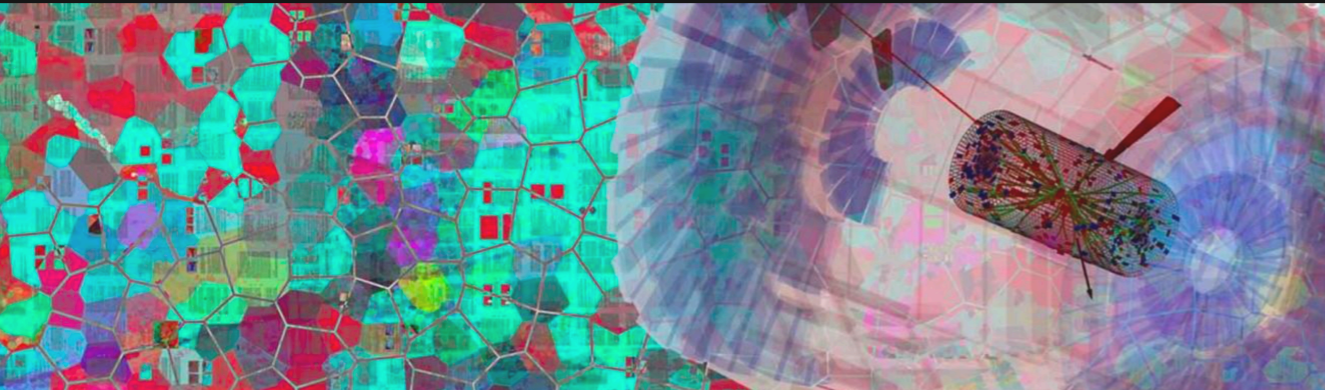
Speaker: Beatriz Pereira (IST)

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Search for heavy right-handed W bosons & neutrinos

Tópicos de Física de Partículas



Author: Maria Faria ist196958
Professor: Nuno Leonardo



A review of top quark

Tópicos de Física de Partículas, Astrofísica e

A review on Kepler and PLATO 2.0 missions from the asteroseismic point of view

Tópicos em Física de Partículas, Astrofísica e Cosmologia

Beatriz Bordadágua

February 12th, 2021



Axions as dark matter candidates

Clara Severino, 87309

Topics in Particle Physics, Astrophysics and Cosmology | MEFT | IST

Overview of Parton Distribution Functions

Speaker: André Cordeiro (87303)

Tópicos de Física de Partículas, Astrofísica, e Cosmologia

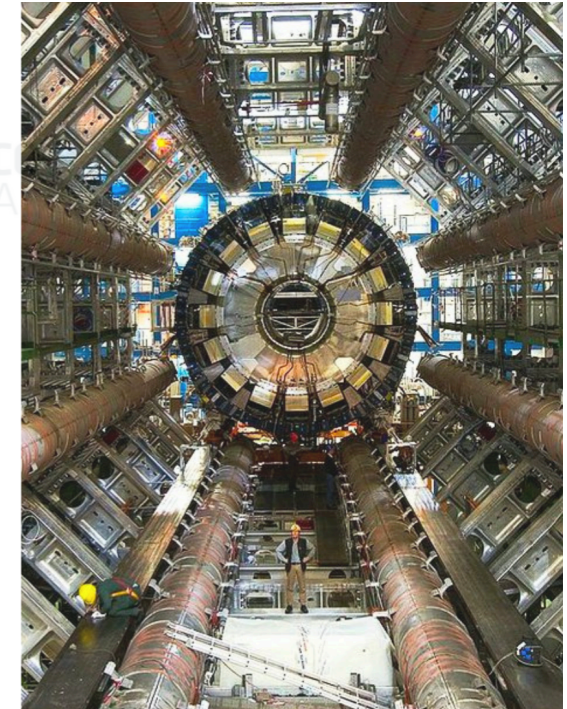
Instituto Superior Técnico

11 February, 2021



B-TAGGING: A REVIEW

Based on CMS and ATLAS Collaboration papers from Run 1 and 2 at LHC



PARTICLE ACCELERATION MECHANISMS WITHIN BLAZARS

TFPAC - Pedro Costa - 87349

Teacher: Nuno Leonardo

Review Article: b-tagging methods between CMS and ATLAS

Vladlen Galetsky^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. For a better identification and understanding of beyond the standard model physics, current known processes of tagging from jets originated from heavy flavour quarks need to be refined at the high energy collision experiments. This report reviews all the way from the hardware used at ATLAS and CMS Collaborations to the respective simulation techniques and methods of b-tagging. Comparing the performances of the state of the art techniques in view of the Run 2 data at the Large Hadron Collider. Calibration methods to calculate b-jet tagging efficiency such as Tag and Probe and Likelihood Method are also addressed along with the systematic uncertainties for the whole b-tagging process.

KEYWORDS: LHC, b-tagging, CMS, ATLAS

A review of top quark physics

Pedro Lagarehos, 94002^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. A review of top quark physics is presented. An overview of the top quark properties and their most recent measurements at the LHC, by the ATLAS and CMS collaborations, are given, and analyses of four top quark production by both collaborations are compared and summarised.

A review of *Kepler* and PLATO 2.0 missions from the asteroseismic point of view

Beatriz Bordadágua^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. The paper presents a review on stellar astrophysics, specifically asteroseismology. First, an introduction to the theory of oscillations in stars that explains the stellar interior properties. Second, a comparison of two extremely important missions *Kepler* and PLATO 2.0. One has already a tremendous amount of data that dictates the limit of what we know today, the other will be launched in 2026 with incredible precision and range that will answer the questions that remain.

KEYWORDS: STELLAR OSCILLATIONS, SPACE MISSIONS

Overview of Parton Distribution Functions

André Cordeiro^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. This paper provides a short overview of parton distribution functions (PDFs), starting with the historical motivation and main experimental results, as well as an introduction to the basics of PDF extraction from deep inelastic scattering (DIS) experiments, and a motivation for the inclusion of nuclear modified parton distributions (nPDFs). Recent literature is discussed, including recent measurements pertaining to evidence of nuclear modifications from electroweak processes, as well as a recent global fit to DIS and beam collision experiments to produce a nPDF set. The interplay of these publications is explored, highlighting the need for both careful parameterization and thorough experimental measurements.

KEYWORDS: QCD, PDF, PARTON MODEL, NUCLEAR MODIFICATION FACTOR

Review Article: Search for heavy right-handed W gauge bosons and neutrinos in final states with two charged leptons and two jets

Maria Faria^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. We review the two most recent papers from the CMS and ATLAS collaborations searching for heavy right-handed gauge bosons and neutrinos in final states containing two charged leptons and two jets. Both analyses use Run 2 proton-proton collision data at $\sqrt{s} = 13$ TeV. CMS uses 2016 and ATLAS uses 2015+2016 data corresponding to a total integrated luminosity of 35.9 fb^{-1} and 36.1 fb^{-1} , respectively. In the CMS analysis, the region in the $m_{W_R} - m_{N_R}$ plane excluded at 95% confidence level extends to $m_{W_R} = 4.4$ TeV for Majorana neutrinos. In the ATLAS analysis, the excluded region extends to $m_{W_R} = 4.7$ TeV for both Majorana and Dirac N_R neutrinos and the $m_{N_R} > m_{W_R}$ scenario is explored for the first time.

KEYWORDS: CMS, ATLAS, W_R BOSON, N_R NEUTRINO

Particle Acceleration Mechanisms within Blazars

Pedro Costa^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. This paper aims to summarily review the most noteworthy particle acceleration mechanisms which are thought to operate within blazars, with particular focus on the processes which occur in the jets associated with these phenomena. First, an initial description of blazars and their characteristics is provided, followed by a characterisation of the particle acceleration mechanisms proposed to operate within these phenomena. Second, the paper delves into a more detailed description of the particular case of the coincidence of the IceCube-170922A neutrino and TXS 0506+056 blazar, including the methods and instruments involved throughout the study of this noteworthy phenomenon.

KEYWORDS: Particle Acceleration, Gamma rays, Cosmic Rays, Astrophysical Neutrinos, Multi-messenger Astronomy

Axions as cold dark matter candidates

Clara Severino, 87309^{1,a}

¹ Instituto Superior Técnico, Lisboa, Portugal

Abstract. The axion is a hypothetical particle that first appeared as an explanation to the CP problem of Quantum Chromodynamics, however, its potential as a dark matter particle was soon discovered. Nonetheless, decades after it was first postulated, there is no experimental evidence of the axion despite several searches for this minuscule particle. The difficulty in this process was already foreseen, given that the axion couples very weakly to the Standard Model, in addition to being very stable. But all is not lost, the silver lining in the so far fruitless search for this "invisible" boson is that several constraints on the axion's mass, as well as its coupling constants have been set, opening the door to new challenges. This paper starts with an introduction to the axion and its origin, describing its role as a dark matter particle. Secondly, it highlights some of the constraints imposed by experiments. Lastly, two papers are reviewed in more detail, which describe two very different, but equally important experiments.

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Author(s): Maria Faria

ref: LIP-STUDENTS-20-19

Publication: 2020-12-30

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