

Relativistic models of anisotropic compact objects

Physical acceptability · Effective density · Axial deformations

Daniel Suárez

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Universidad
Industrial de
Santander



Facultad
de Ciencias

Escuela
de Física



The problem

Compact-star models are easy to write down, but hard to trust.

My work asks:

Which anisotropic relativistic models remain physically acceptable once geometry, matter variables, stability and boundary behavior are tested together?

What I want to contribute

A physically constrained map of anisotropic compact-object models:

from spherical equilibrium to intrinsic axial deformation.

The goal is not only to generate solutions, but to classify which ones survive physical filters and which fail because the matter sector, geometry or boundary conditions become inconsistent.

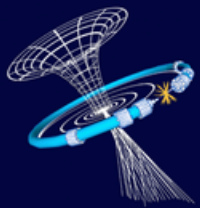
Einstein equations + matter closure + acceptability → viable models

About Me

- Ellen Victória Soares da Silva
- João Pessoa, Paraíba, Brazil
- Federal University of Paraíba (UFPB)
- Bachelor's and Master's Degrees
 - ✓ Supervisor: Prof. Dr. Paulo Sérgio Rodrigues da Silva
- Ph.D.
 - ✓ Supervisor: Prof. Dr. Carlos Antônio de Sousa Pires

- Undergraduate Studies
 - ✓ Physics of the Early Universe
 - ✓ Inflationary Theory
 - ✓ Neutrino Physics
- Master's Degree
 - ✓ Axions and Axion-Like Particles (ALPs)
 - ✓ Master thesis
- Ph.D.
 - ✓ Flavor Physics in the Quark Sector
 - ✓ Collider Physics
 - ✓ Tools: MadGraph, Pythia, Delphes

Thank you!



Flavor-Changing Ultraviolet Freeze-In

dark matter indicates the scale of flavor violation

Jacinto Paulo Neto

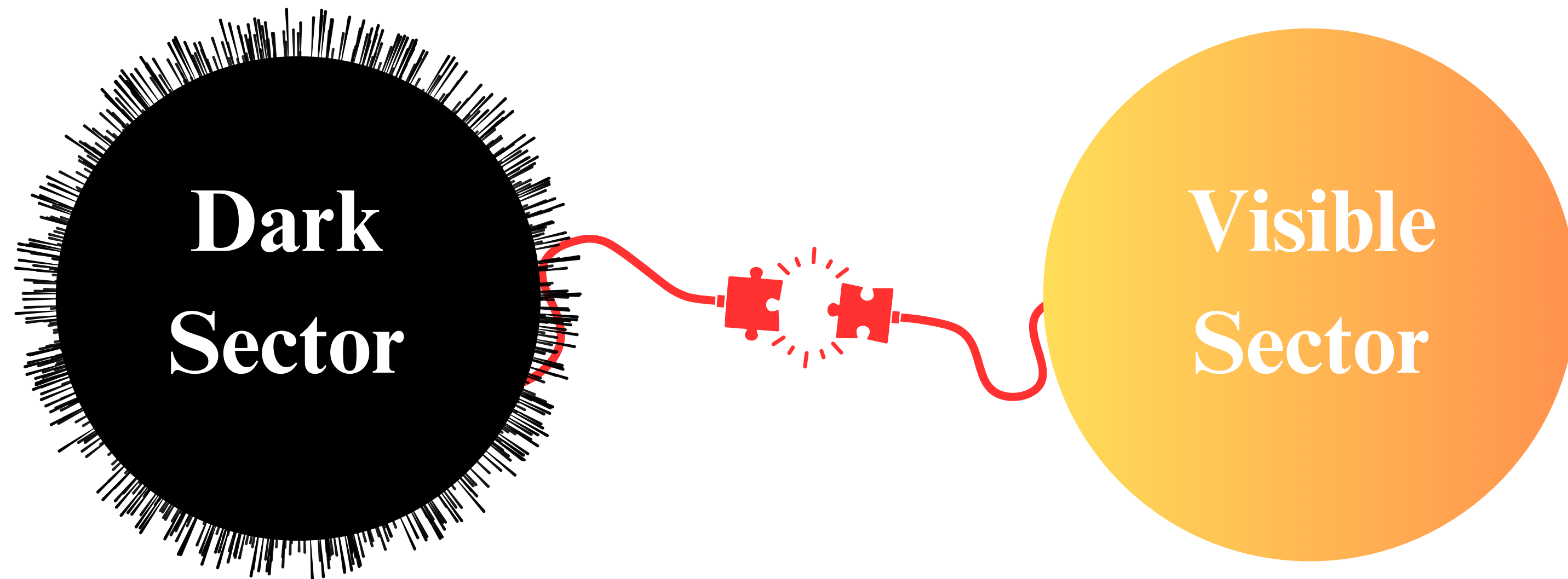
International Institute of Physics

Rio Grande do Norte U.



Motivation

- FCNC processes are strongly suppressed in the SM, and current measurements lack the sensitivity to probe SM predictions. Hence, observing it would point directly to New Physics (NP).
- At high temperatures, dark matter could be produced through the same NP flavor-changing interaction.



Motivation

- The SM could not account for any observation of flavor-changing neutral currents (FCNCs). Hence, observing it would point directly to New Physics (NP).
- At high temperatures, dark matter could be produced through the same NP flavor-changing interaction.

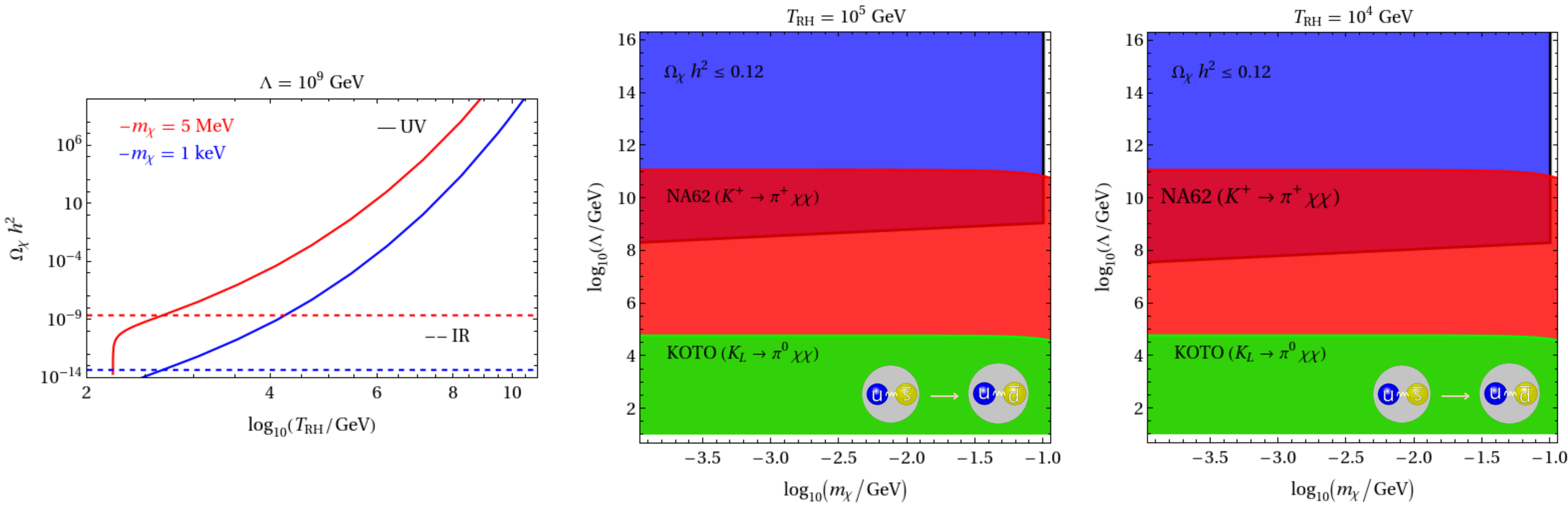
A large, solid orange circle. Inside the circle, the words "Visible Sector" are written in a white, serif font, stacked vertically.

Visible
Sector

Flavor-changing ultraviolet freeze-in

$$\mathcal{L}_{\mathbb{Z}_2}^{(6)} = C_{\mathbb{Z}_2,ij} \overline{Q}_{iL} \left(\tilde{H} u_{jR} + H d_{jR} \right) \chi^2 + \text{H.c.}$$

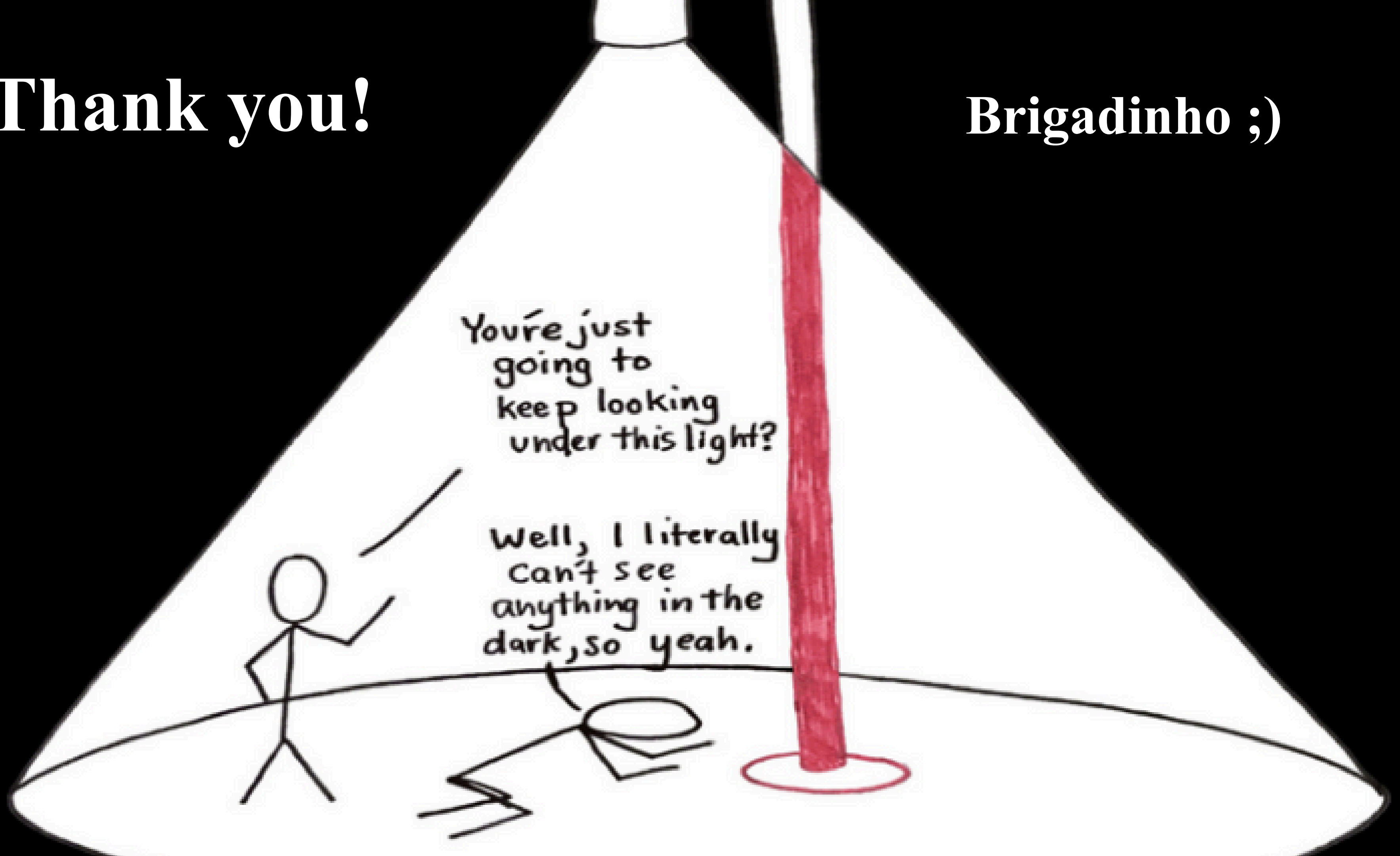
$$C_{\mathbb{Z}_2,ij} = \frac{e^{i\varphi_{ij}}}{\Lambda_{ij}^2}$$



JPN, Cook, Smirnov, Gorbahn, 2608.XXXXXX.

Thank you!

Brigadinho ;)



IDPASC presentation

Mueller-Navelet Jets in Diffractive Processes at LHC and FCC energies

João Vitor Bulhões; Victor P. Gonçalves; Francesco G. Celiberto.

2026

Mueller-Navelet jets

Process: $\text{proton}(p_1) + \text{proton}(p_2) \rightarrow \text{Jet}_1(k_1) + \text{Jet}_2(k_2) + X$

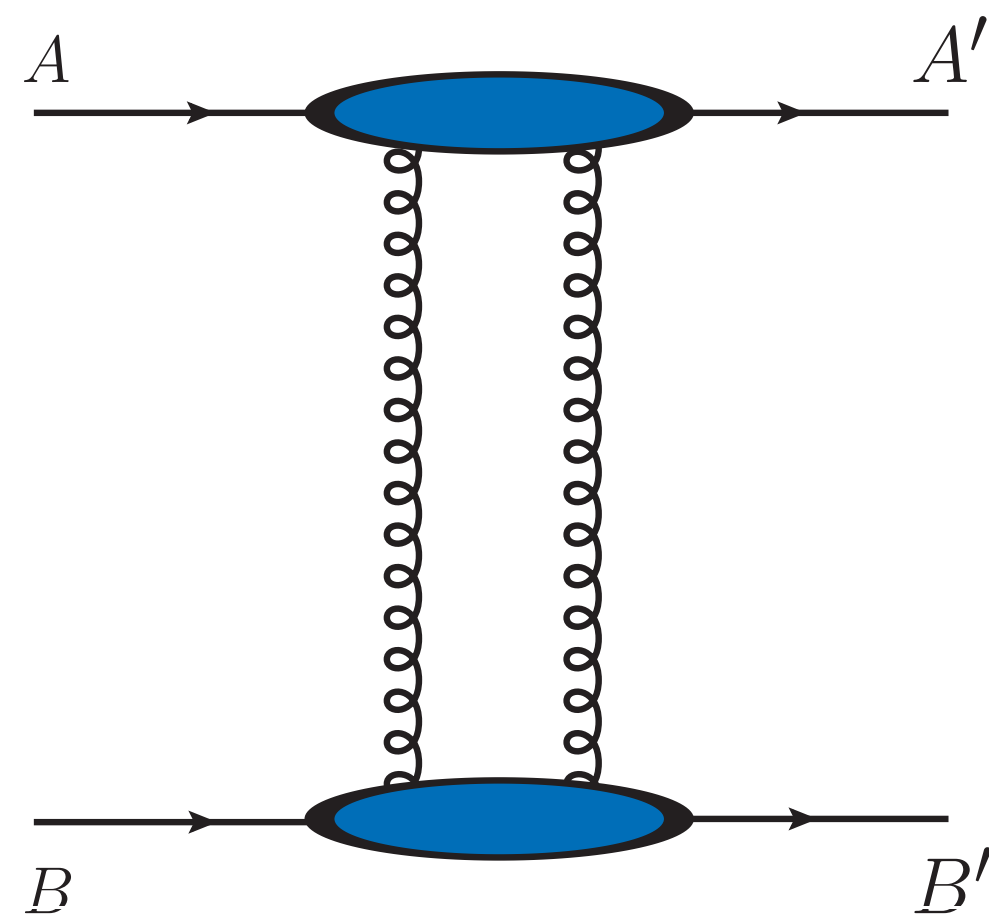
large jet transverse momenta: $\vec{k}_{j_1}^2 \sim \vec{k}_{j_2}^2 \gg \Lambda_{QCD}^2 \Rightarrow \text{pQCD applicable}$

large rapidity separation between jets: $\Delta Y = y_{J_1} - y_{J_2} = \ln \frac{x_{J_1} x_{J_2} s}{|\vec{k}_{J_1}| |\vec{k}_{J_2}|} \gg 1$

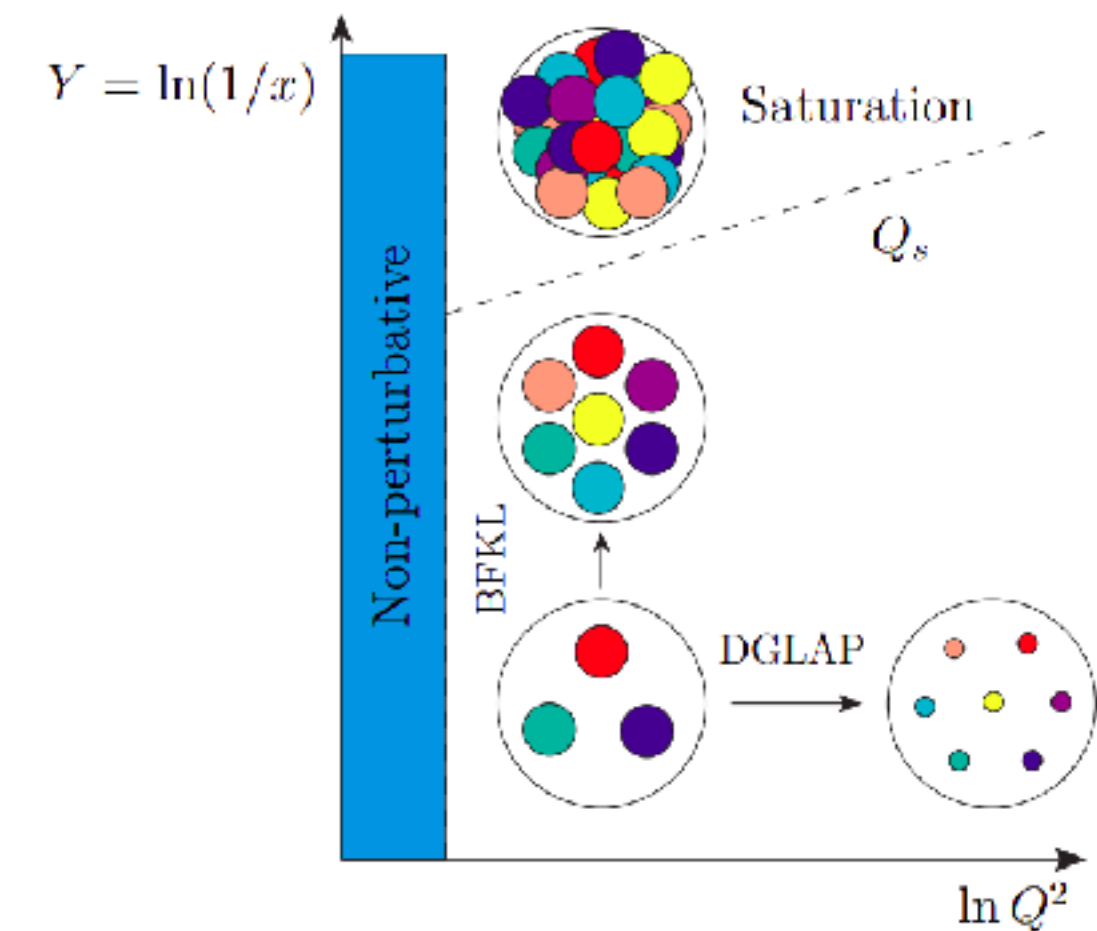
Large ΔY makes high-energy logarithms important $\rightarrow \alpha_s \ln s \sim \alpha_s \Delta Y \sim 1$

BFKL resummation: $\sum_n a_n^{(0)} \alpha_s^n \ln^n s + a_n^{(1)} \alpha_s^n \ln^{n-1} s$

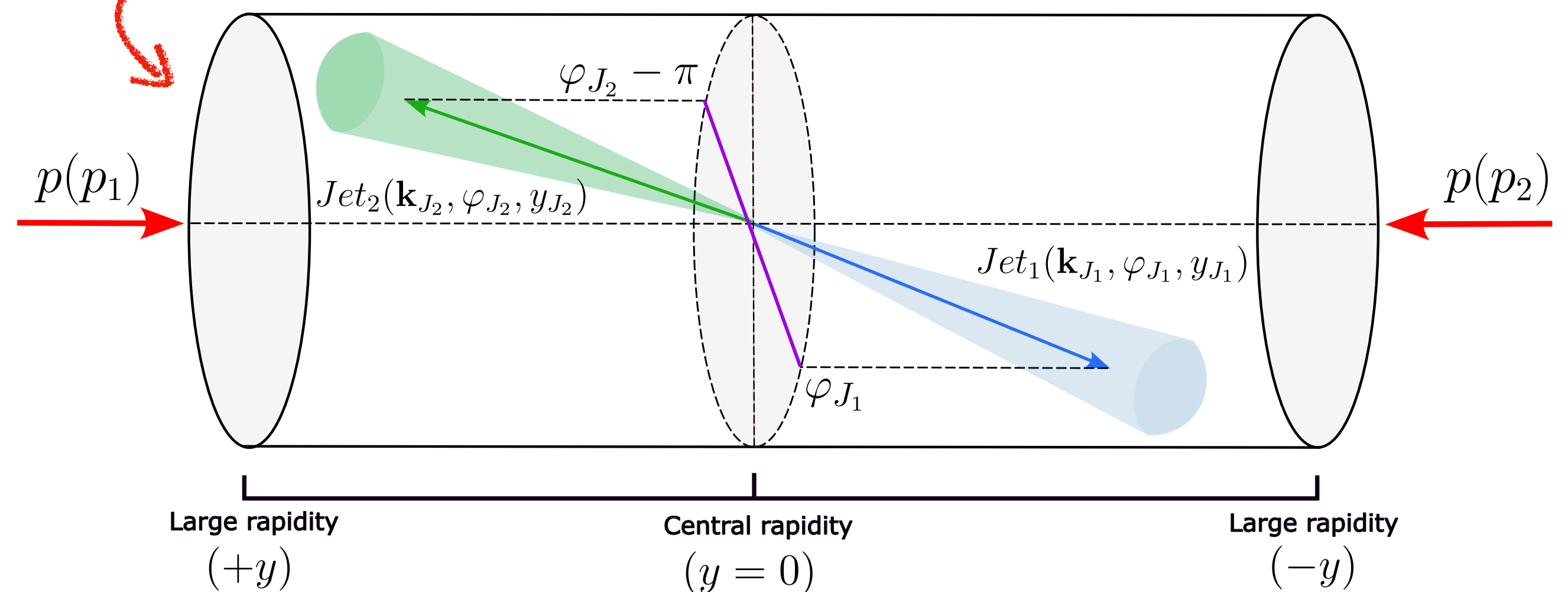
LL : $\alpha_s^n \ln^n s$, NLL : $a_n^{(1)} \alpha_s^n \ln^{n-1} s$.



$$\mathbf{k}_{J_1} + \mathbf{k}_{J_2} = 0$$



Mueller-Navelet jets at Born level = a back-to-back di-jet reaction



Mueller-Navelet jets

Process: $\text{proton}(p_1) + \text{proton}(p_2) \rightarrow \text{Jet}_1(k_1) + \text{Jet}_2(k_2) + X$

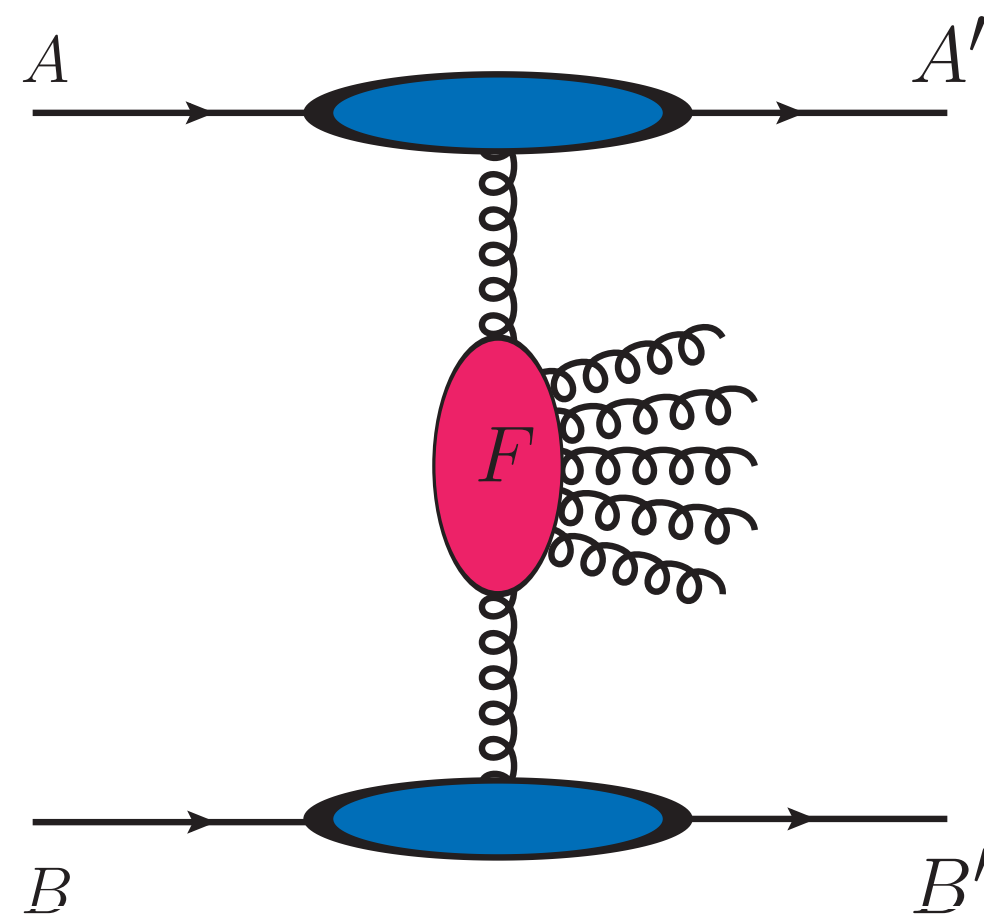
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large rapidity separation between jets: $\Delta Y = y_{J_1} - y_{J_2} = \ln \frac{x_{J_1} x_{J_2} s}{|\vec{k}_{J_1}| |\vec{k}_{J_2}|} \gg 1$

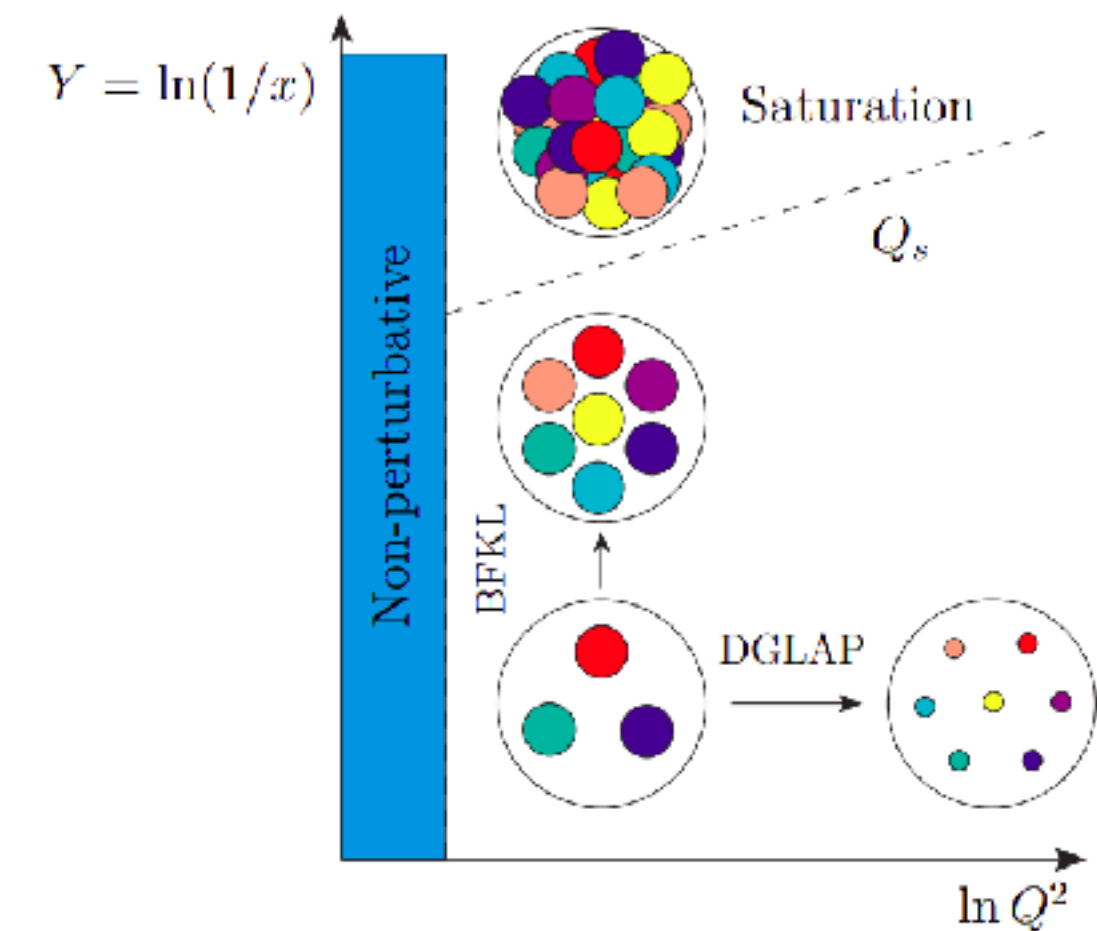
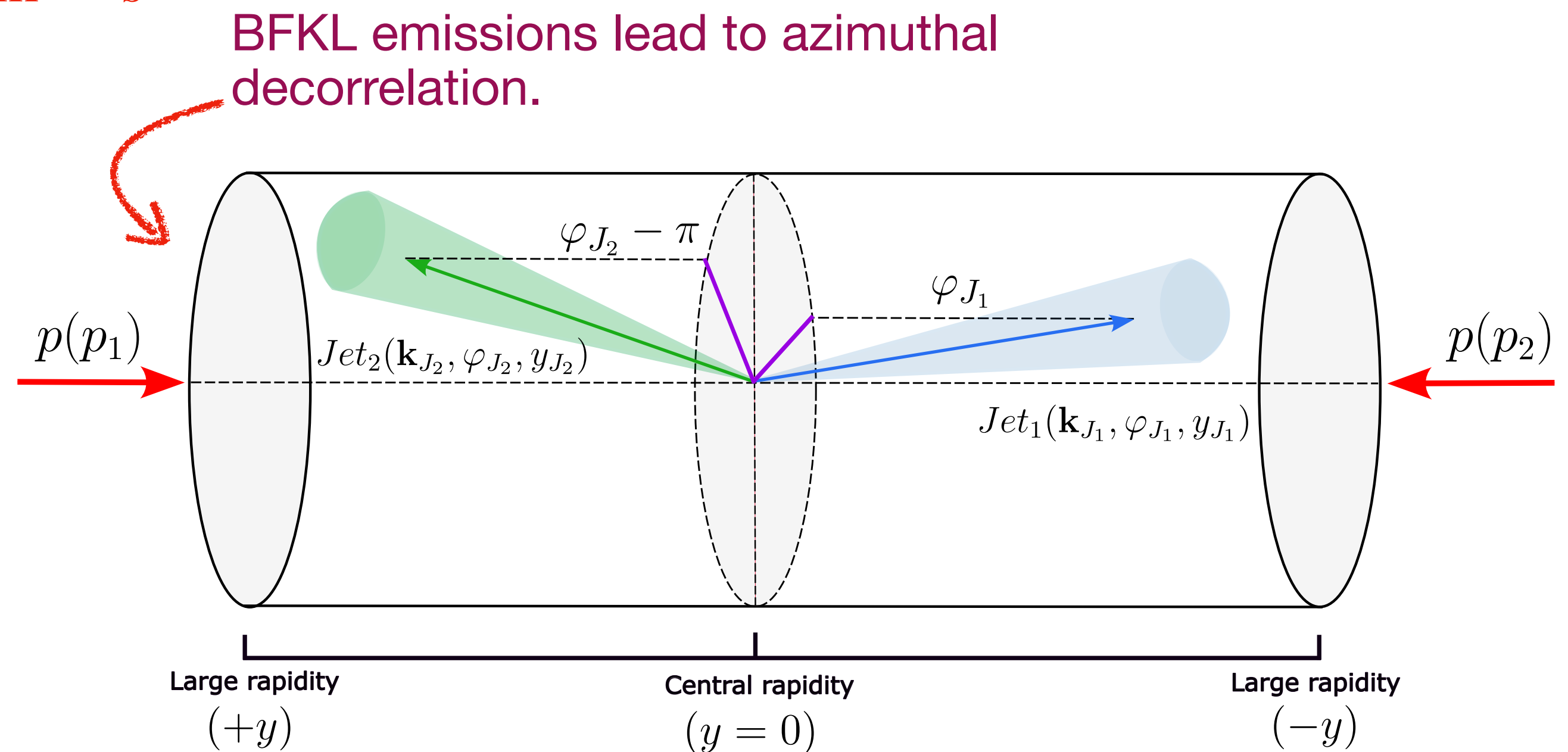
Large ΔY makes high-energy logarithms important $\rightarrow \alpha_s \ln s \sim \alpha_s \Delta Y \sim 1$

BFKL resummation: $\sum_n a_n^{(0)} \alpha_s^n \ln^n s + a_n^{(1)} \alpha_s^n \ln^{n-1} s$

LL : $\alpha_s^n \ln^n s$, NLL : $a_n^{(1)} \alpha_s^n \ln^{n-1} s$.



$$\mathbf{k}_{J_1} + \mathbf{k}_{J_2} \neq 0$$



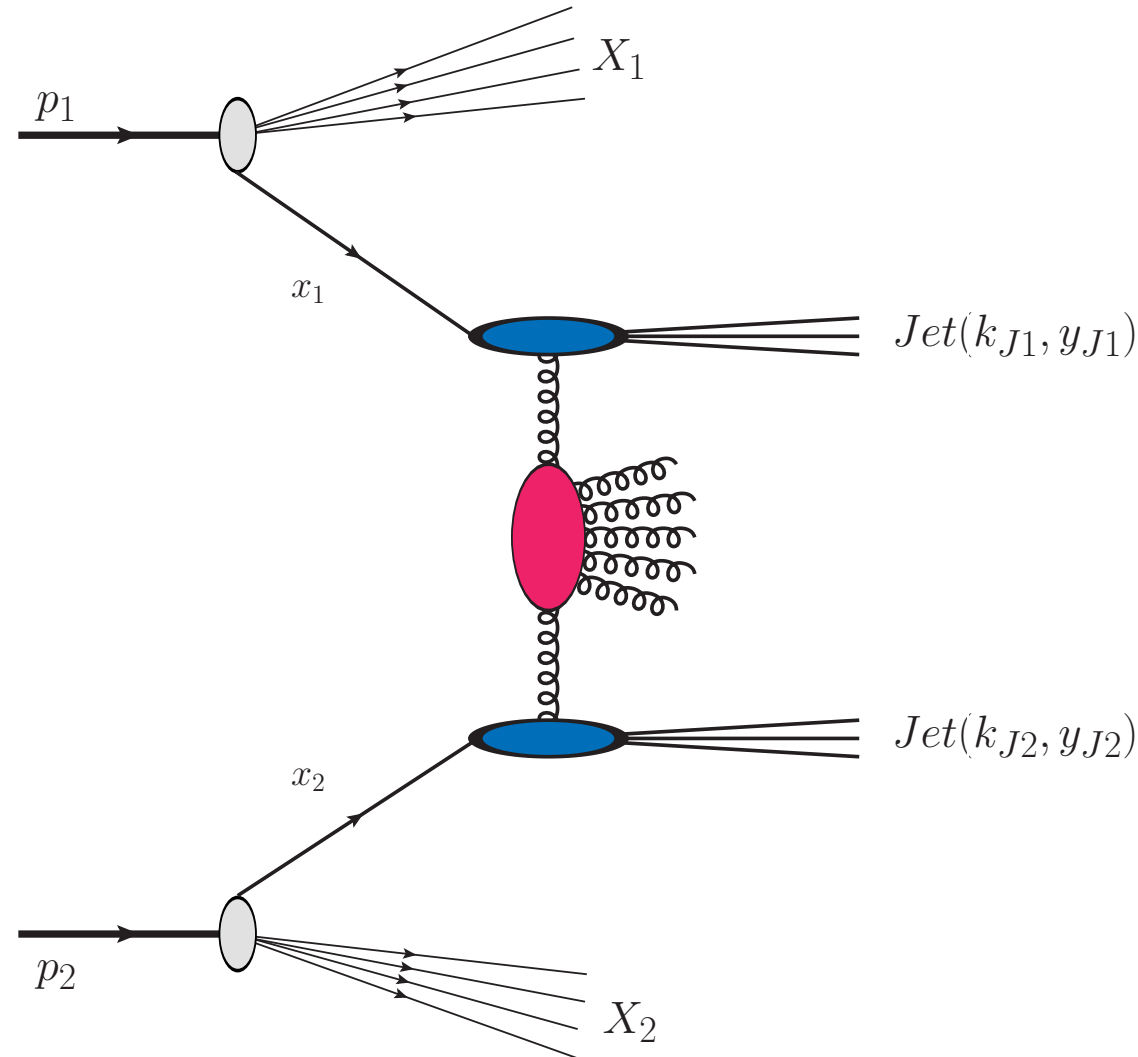
From inclusive to diffractive Mueller-Navelet Jets

Inclusive Mueller-Navelet Jets (previous studies)

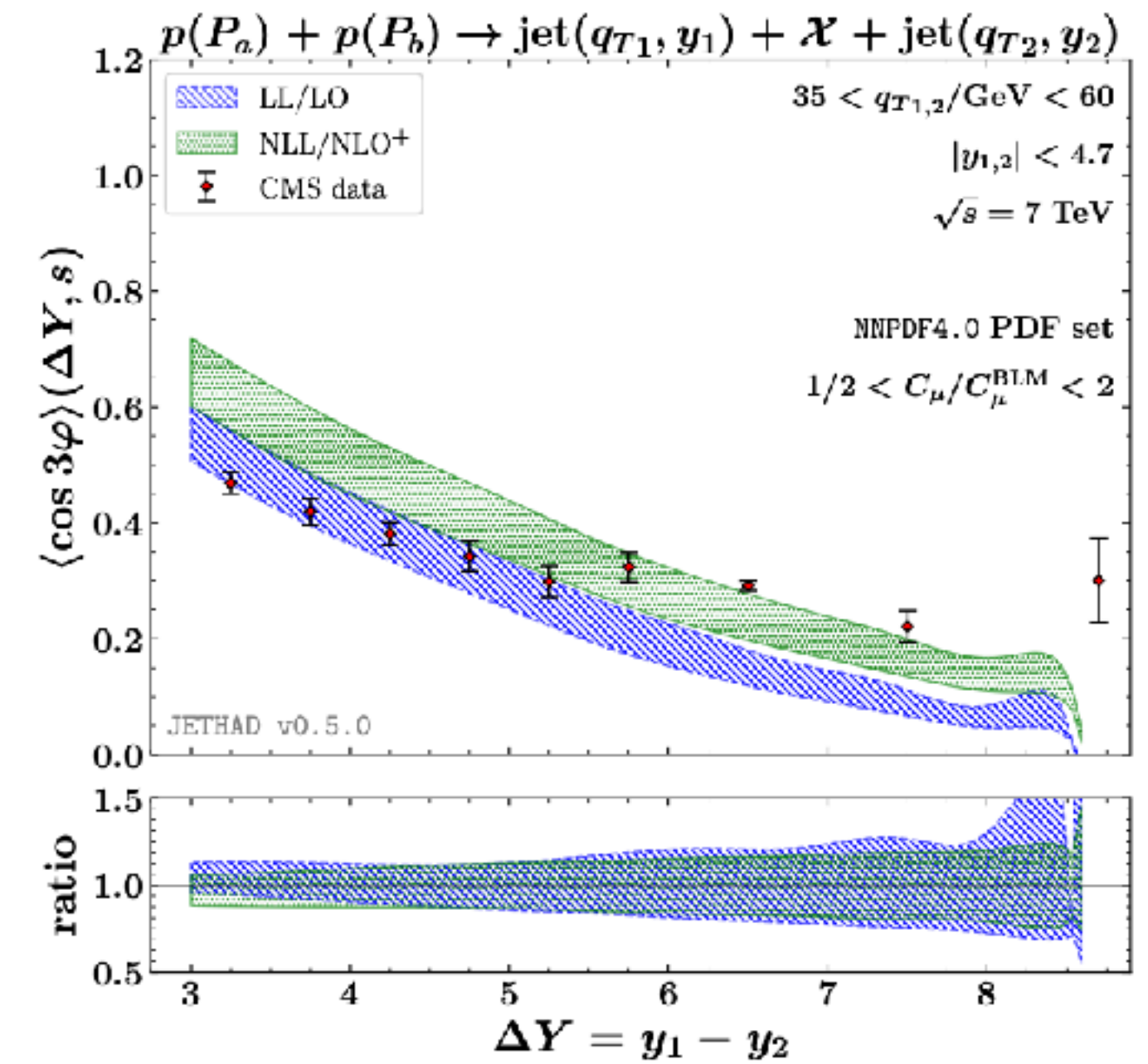
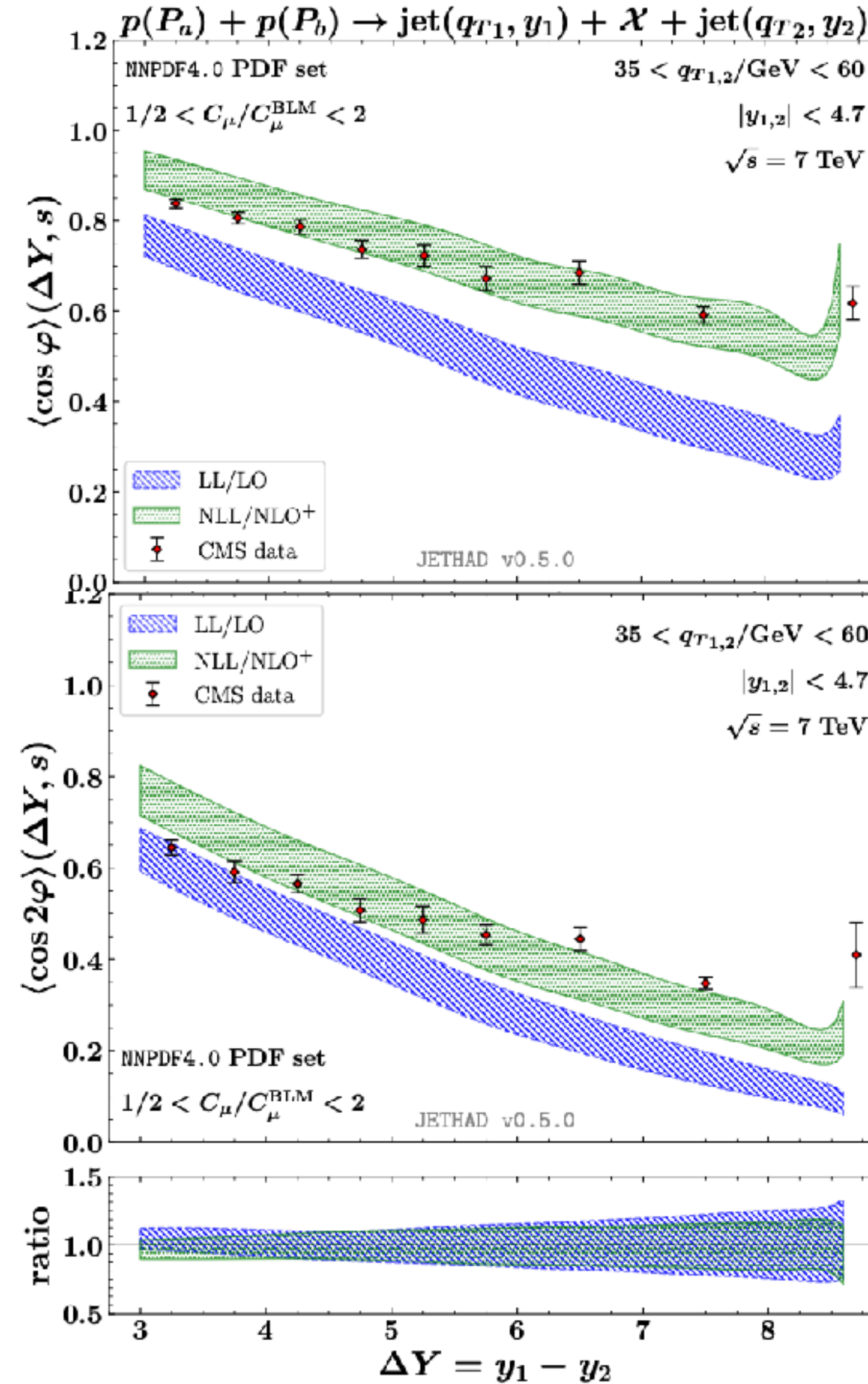
Celiberto & Papa, Phys. Rev. D 106 (2022) 114004

Ducloué, Szymanowski and Wallon JHEP 1305 (2013) 096.

Ducloué, Szymanowski and Wallon, Phys. Rev. Lett. 112 (2014) 082003.



- Both protons dissociate into hadronic systems X_1, X_2 .
- Partons come directly from the proton (usual PDFs).
- Inclusive process: everything besides the two jets is summed over.
- Sensitive to BFKL radiation between the jets.



Observables, kinematics and tools

From C_n to physical observables:

$C_0 \Rightarrow$ azimuthally averaged cross-section

$$\langle \cos(n\varphi) \rangle = \frac{C_n}{C_0}, \quad n = 1, 2, 3, \dots$$

The ratios C_n/C_0 quantify the azimuthal correlation between the two jets.

Integrated coefficients

$$C_{n,\text{BLM-}\overline{\text{MS}}}^{\text{NLL/NLO}^+} = \int_{k_1^{\min}}^{k_1^{\max}} dk_1 \int_{k_2^{\min}}^{k_2^{\max}} dk_2 \int_{y_1^{\min}}^{y_1^{\max}} dy_1 \int_{y_2^{\min}}^{y_2^{\max}} dy_2 \delta(\Delta Y - (y_1 - y_2)) C_{n,\text{BLM-}\overline{\text{MS}}}^{\text{NLL/NLO}^+}$$

Differential distribution in k_t

$$\frac{d\sigma(\mathbf{k}_1, s)}{d\mathbf{k}_1} = \int_{k_2^{\min}}^{k_2^{\max}} dk_2 \int_{\Delta Y^{\min}}^{\Delta Y^{\max}} d\Delta Y \int_{y_1^{\min}}^{y_1^{\max}} dy_1 \int_{y_2^{\min}}^{y_2^{\max}} dy_2 \delta(\Delta Y - (y_1 - y_2)) C_{n,\text{BLM-}\overline{\text{MS}}}^{\text{NLL/NLO}^+}$$

Azimuthal-angle distribution

$$\frac{d\sigma(\varphi, s)}{\sigma d\varphi} = \frac{1}{\pi} \left[\frac{1}{2} + \sum_{n=1}^{\infty} \langle \cos(n\varphi) \rangle \cos(n\varphi) \right], \quad \langle \cos(n\varphi) \rangle = \frac{C_n}{C_0}$$

Large ΔY enhance high-energy logarithms, making BFKL effects relevant.

With these observables we can investigate how the BFKL dynamics of MN Jets is modified when diffractive constraints are imposed.

Kinematic cuts

- pp collisions at $\sqrt{s} = 14$ TeV and 100 TeV
- Jet rapidities in the CMS acceptance:
 $|y_{J_1, J_2}| \in [-4.7, 4.7]$
- (a)symmetric transverse momentum cuts k_{J_1, J_2}
- Roman pot acceptances $\xi_{\text{CT-PPS/AFP}}$

Tools

- Fortran/C++
- CERNLIB
- APFEL++
- GKG18_DPDF_FitA
- CUBALIB

Numerical analysis

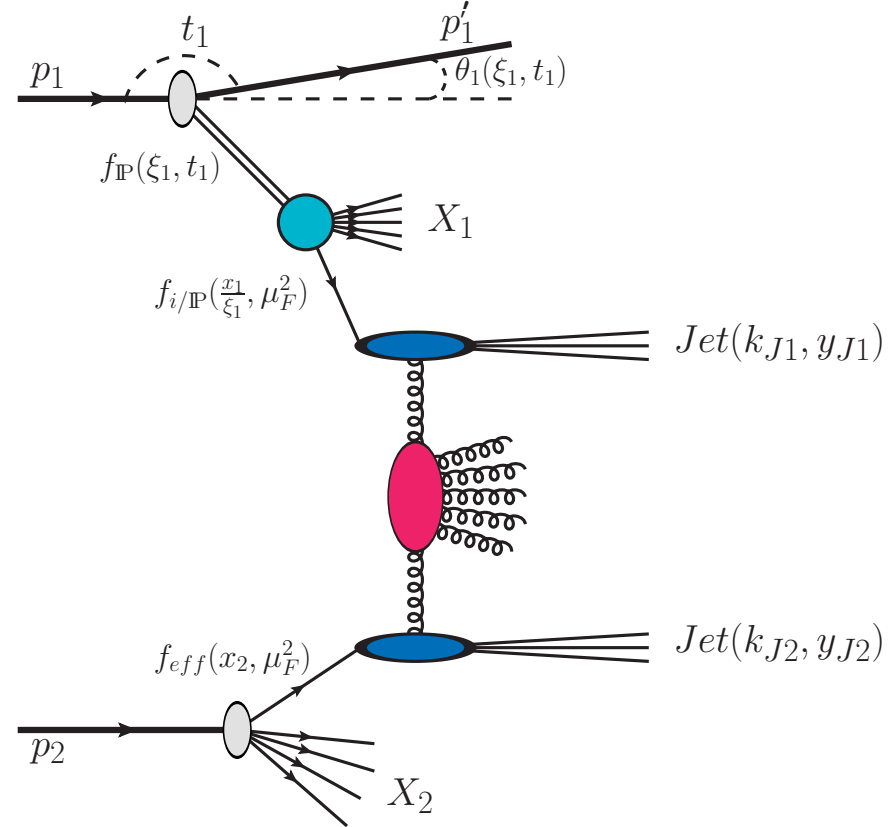
Integrated coefficients

The measured quantities are the integrated azimuthal coefficients, which depends on the rapidity interval ΔY

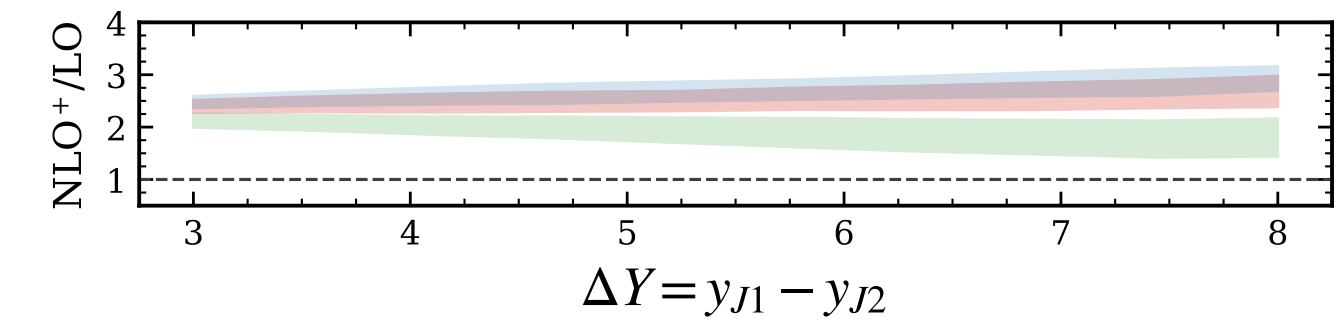
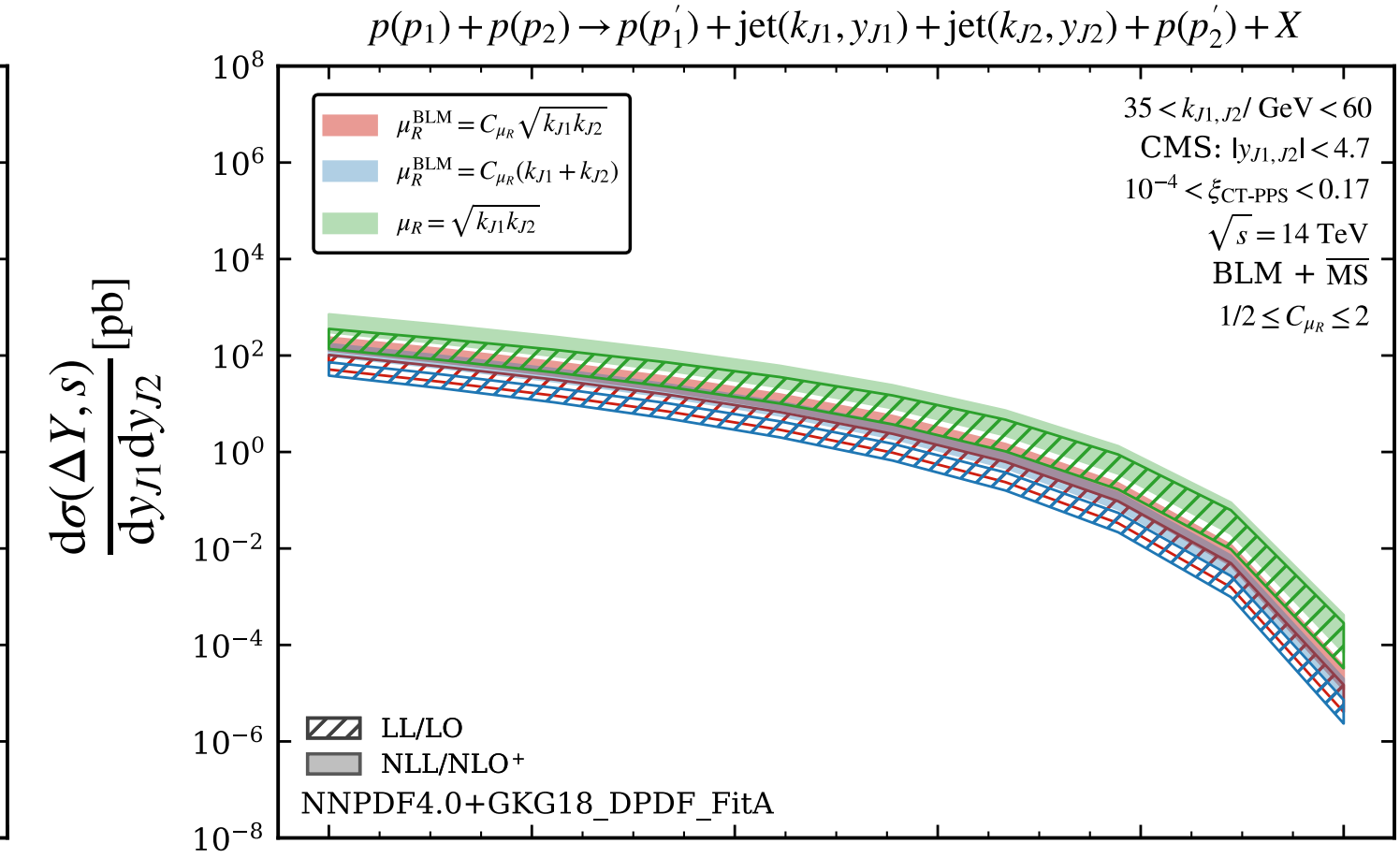
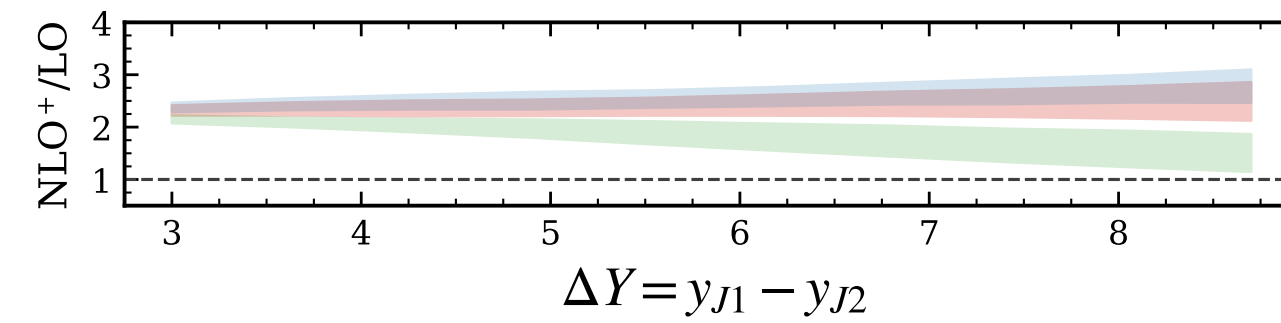
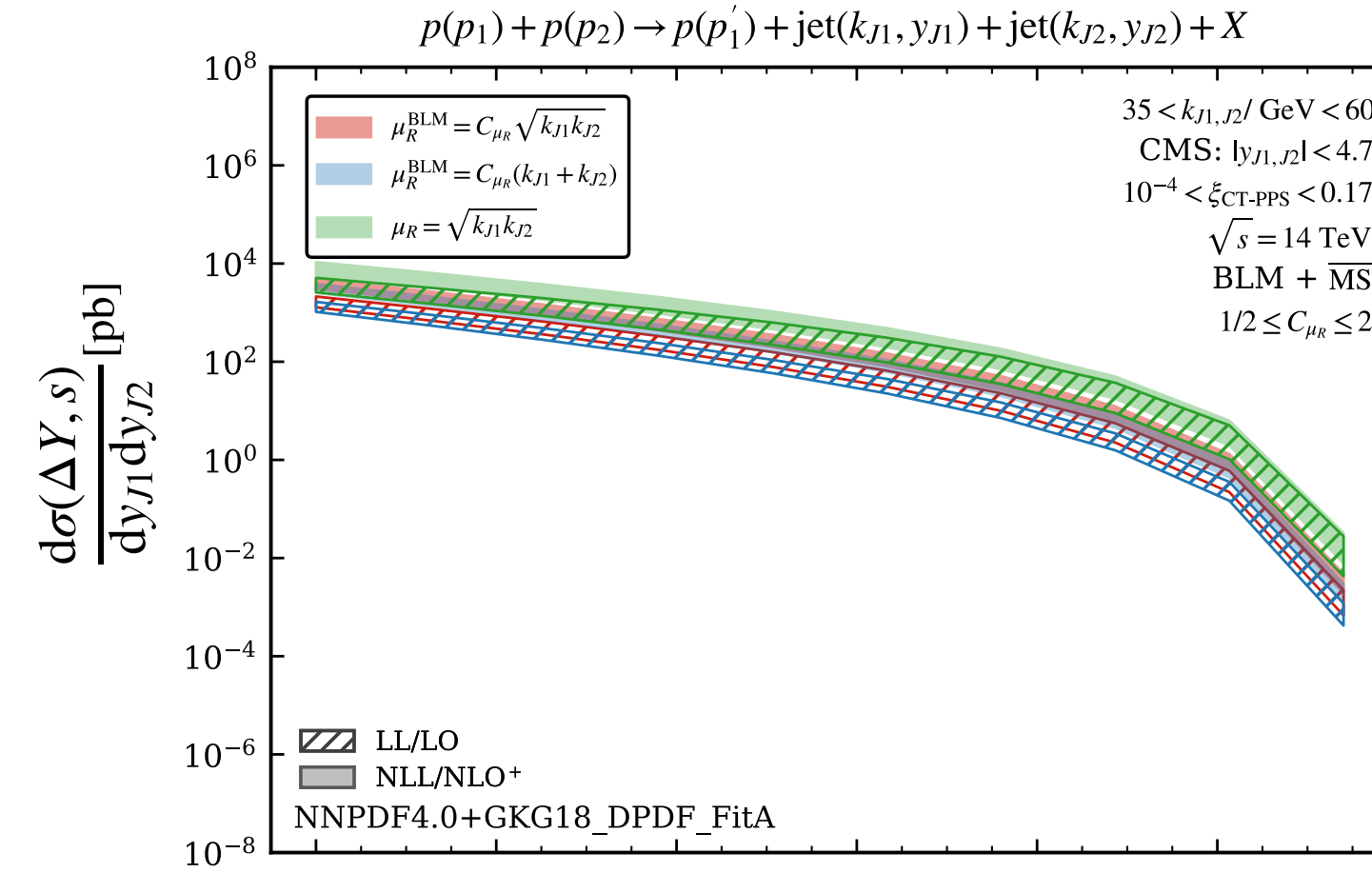
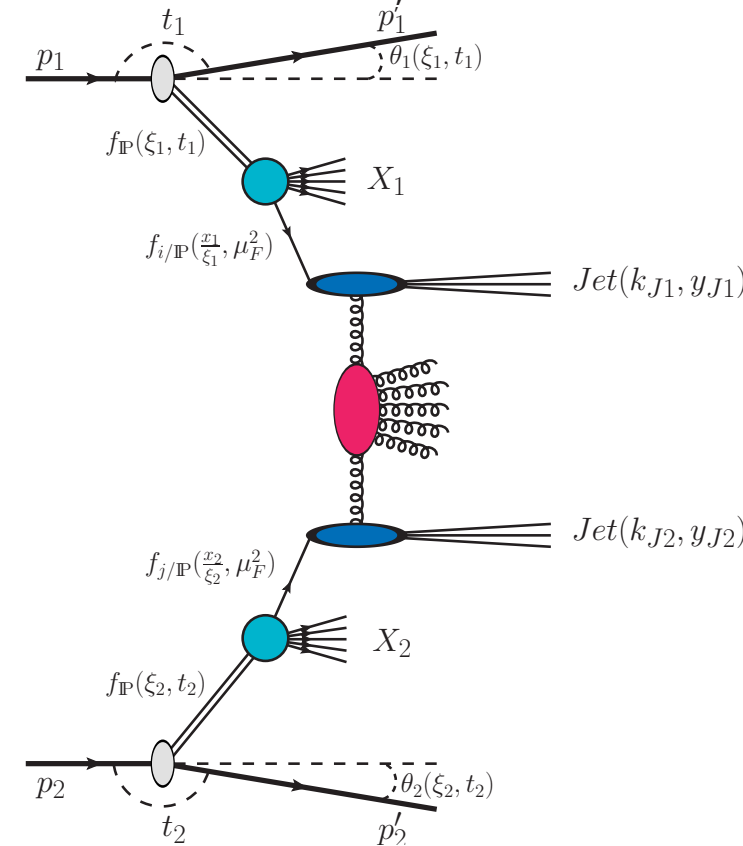
$$C_{n,\text{BLM-}\overline{\text{MS}}}^{\text{NLL/NLO}^+} = \int_{k_1^{\min}}^{k_1^{\max}} dk_1 \int_{k_2^{\min}}^{k_2^{\max}} dk_2 \int_{y_1^{\min}}^{y_1^{\max}} dy_1 \int_{y_2^{\min}}^{y_2^{\max}} dy_2 \delta(\Delta Y - (y_1 - y_2)) C_{n,\text{BLM-}\overline{\text{MS}}}^{\text{NLL/NLO}^+}$$

for $n = 0$.

$$p(p_1) + p(p_2) \rightarrow p(p'_1) + \text{Jet}(k_1, y_1) + \text{Jet}(k_2, y_2) + X$$



$$p(p_1) + p(p_2) \rightarrow p(p'_1) + \text{Jet}(k_1, y_1) + \text{Jet}(k_2, y_2) + p(p'_2) + X$$



Azimuthal correlation



What is being measured?

$$\varphi = \varphi_{J1} - \varphi_{J2} - \pi$$

$$\langle \cos(n\varphi) \rangle(\Delta Y, s) = \frac{C_n}{C_0},$$

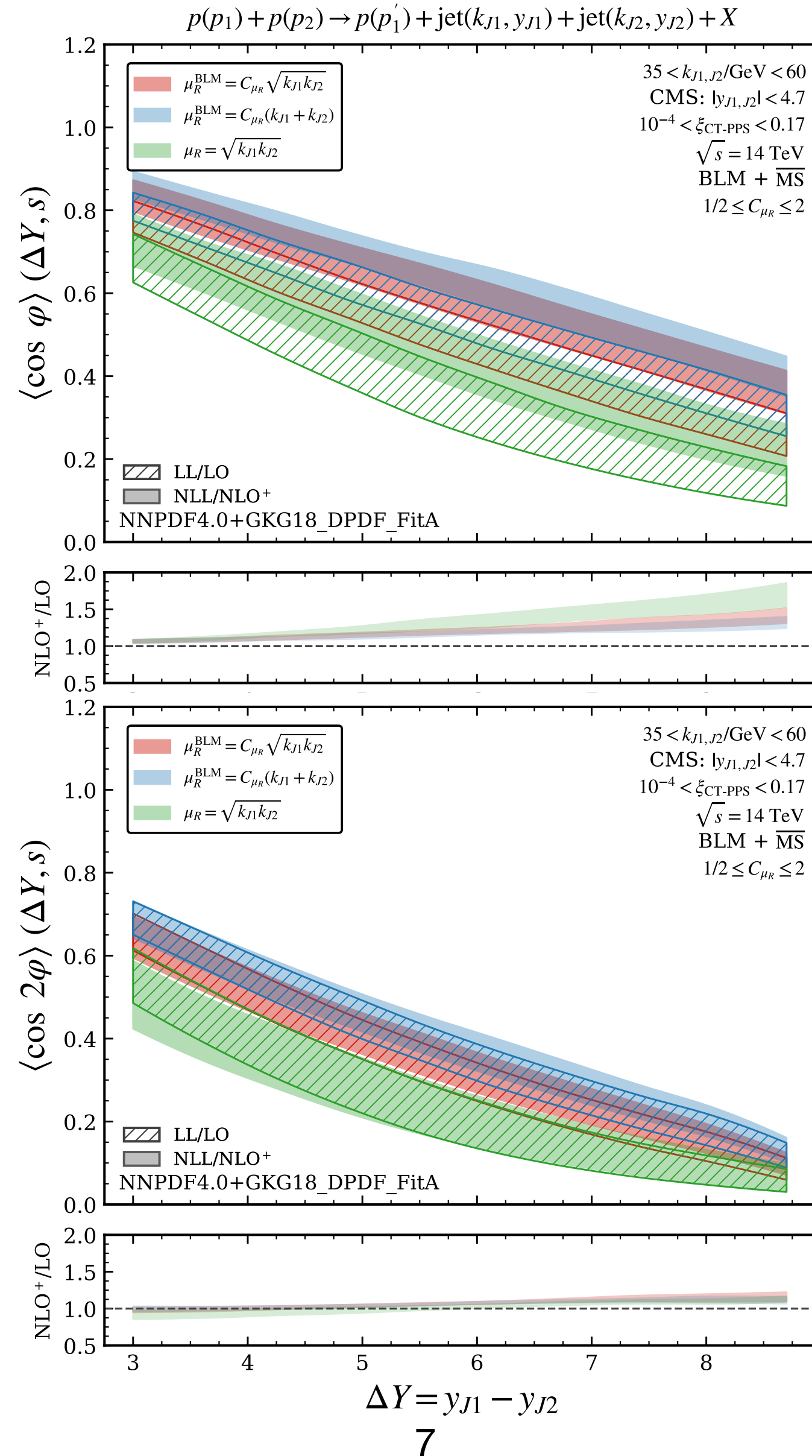
$$\frac{C_n}{C_0} \approx 1 \Rightarrow \text{jets strongly correlated}$$

$$\frac{C_n}{C_0} \rightarrow 0 \Rightarrow \text{jets decorrelated}$$

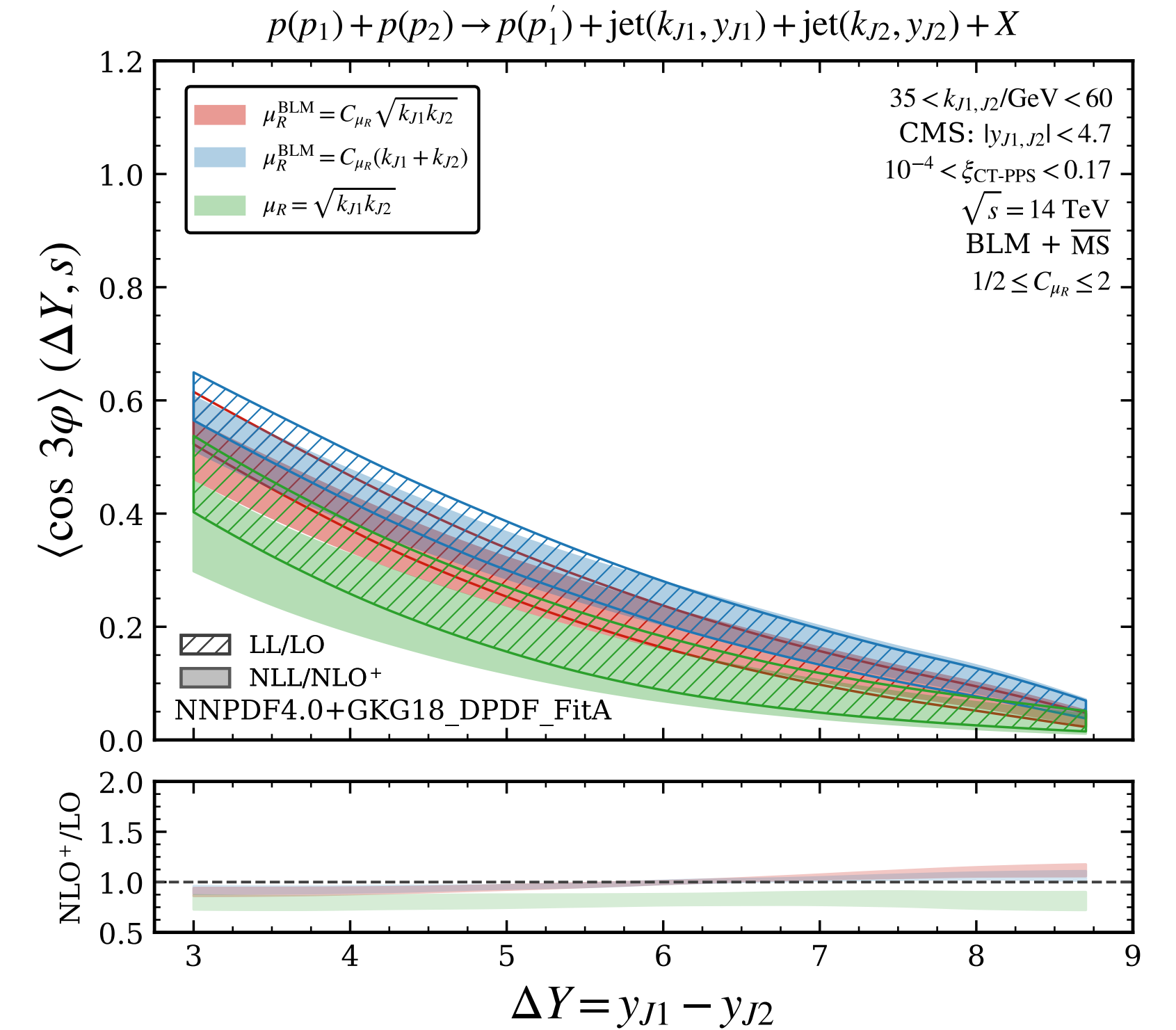
BFKL interpretation:

As ΔY increases, the azimuthal correlation decreases.

14 TeV



Single Diffractive



Thanks for your attention!

Jose R. Alves

PhD Candidate | High-Energy Physics

- ▶ **Current Status:** PhD Candidate at UFRN/IIP specializing in Direct Detection of Dark Matter in the interface of HEP and Condensed Matter.

Research Focus & Contributions



What else I do

Neutrino mass generation mechanisms, and general Beyond the Standard Model (BSM) theoretical frameworks.



Theoretical Models

Sustained research engagement involving the Inverse Seesaw mechanism, dark photon models, and advanced axion detection frameworks.

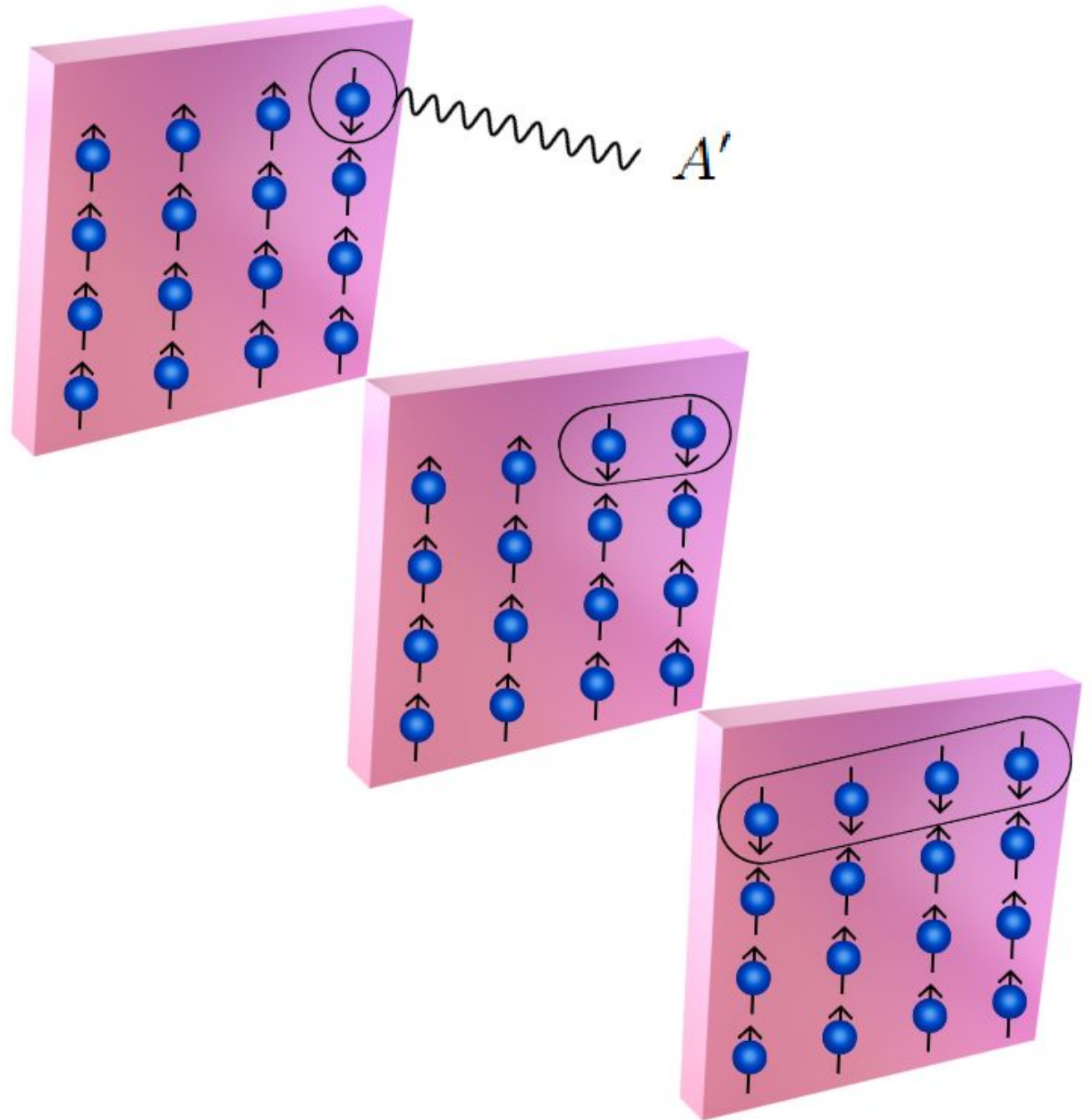


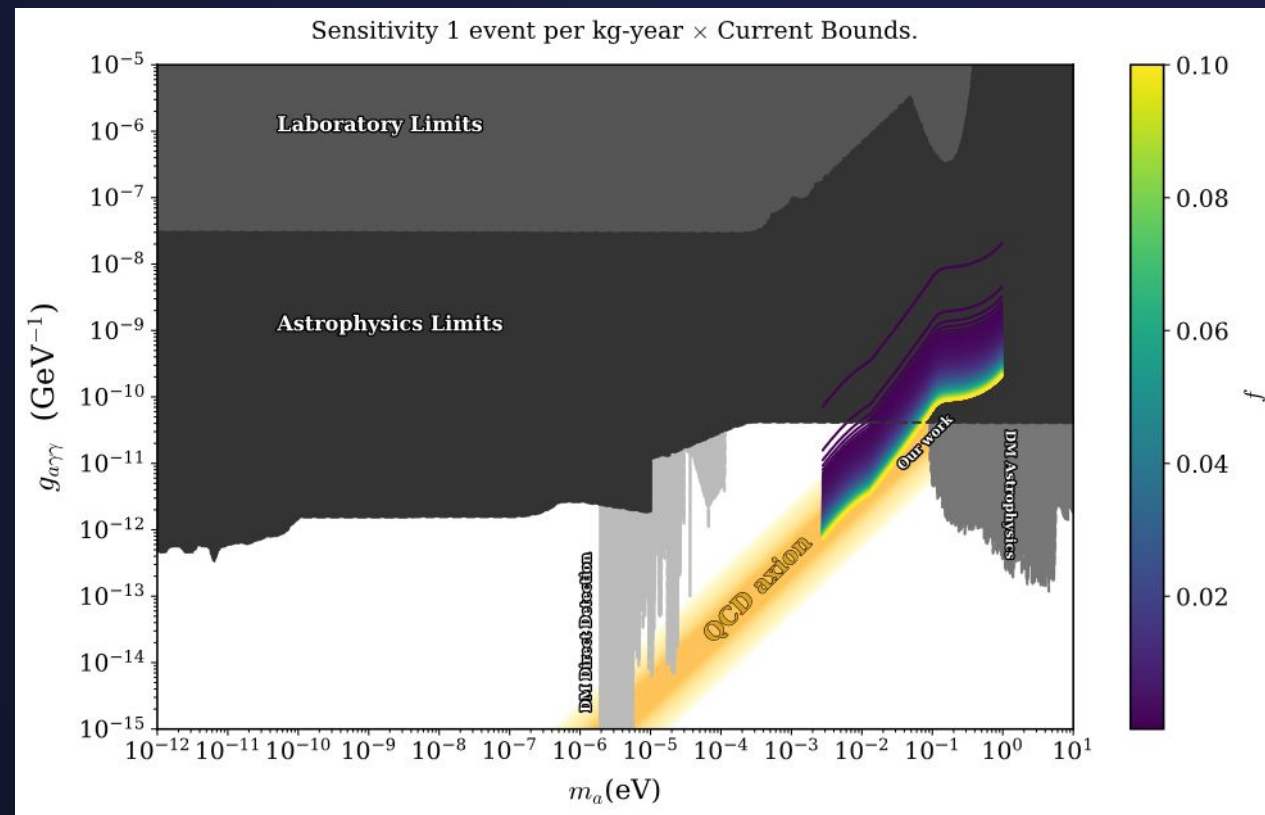
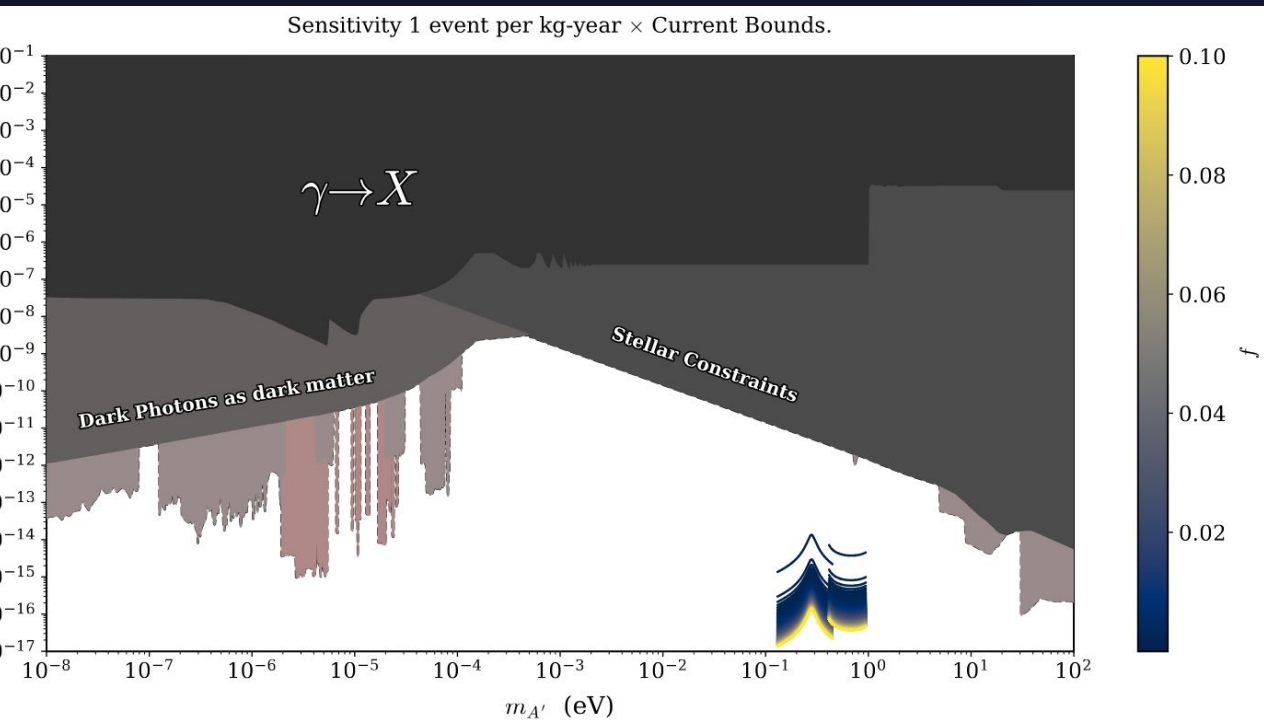
Featured Project

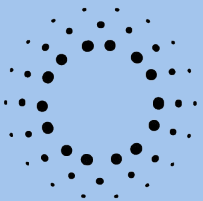
Co-authoring the recently submitted phenomenological manuscript "*Search for Axions and Dark Photons Using Single Molecule Magnets*".

Recent Contribution:

Search for Axions and Dark
Photons Using Single
Molecule Magnets.
(arXiv: 2601.01043)







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International Centre for Theoretical Physics
South American Institute for Fundamental Research

Going beyond $w_0 w_a$ with a coupled dark sector

Cosmology

HEP

Gravitation

Kaynan R. de Oliveira Pompeu

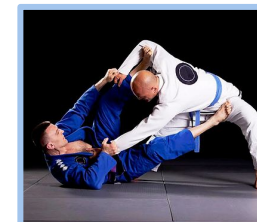
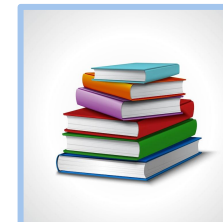
João Victor Rebouças

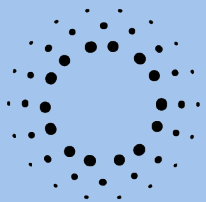
Rogério Rosenfeld

Research
Interests

“Going beyond Λ CDM with field-models”

Hobbies

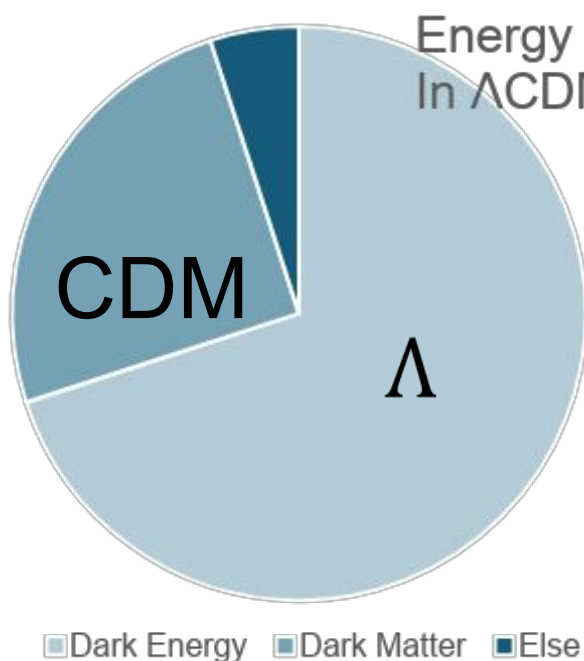




Flash motivation

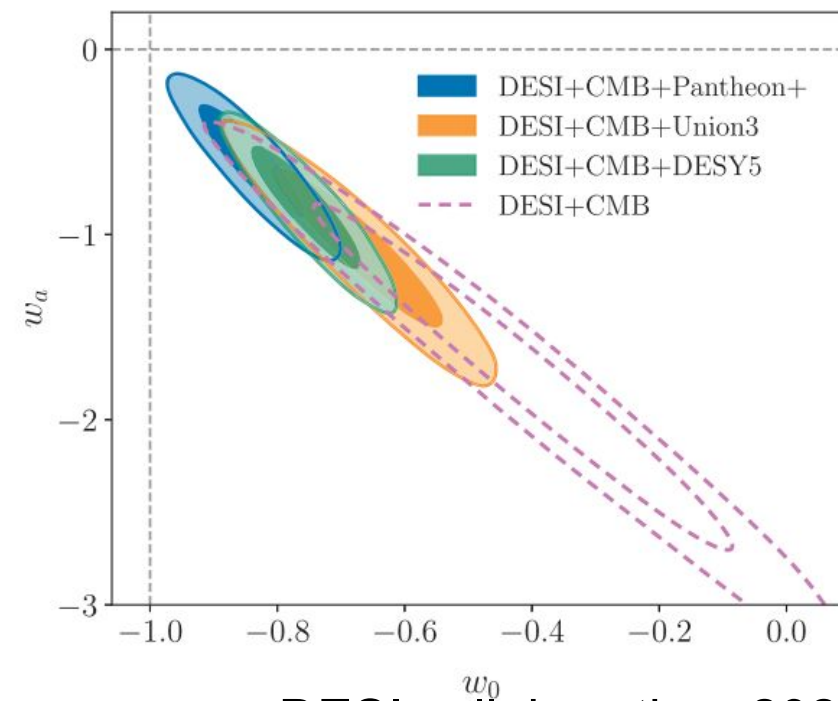
But there seems to be a preference for: $w = w_0 + w_a(1 - a)$

The best-fit shows Phantom dark energy ($w < -1$) at $z \approx 0.4$

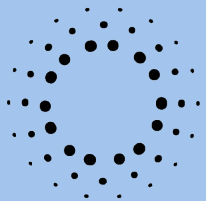


Cosmological fluids are characterized by their present-day density ρ_0 and their equation of state $P = w\rho$

Λ is compatible with $w = -1$



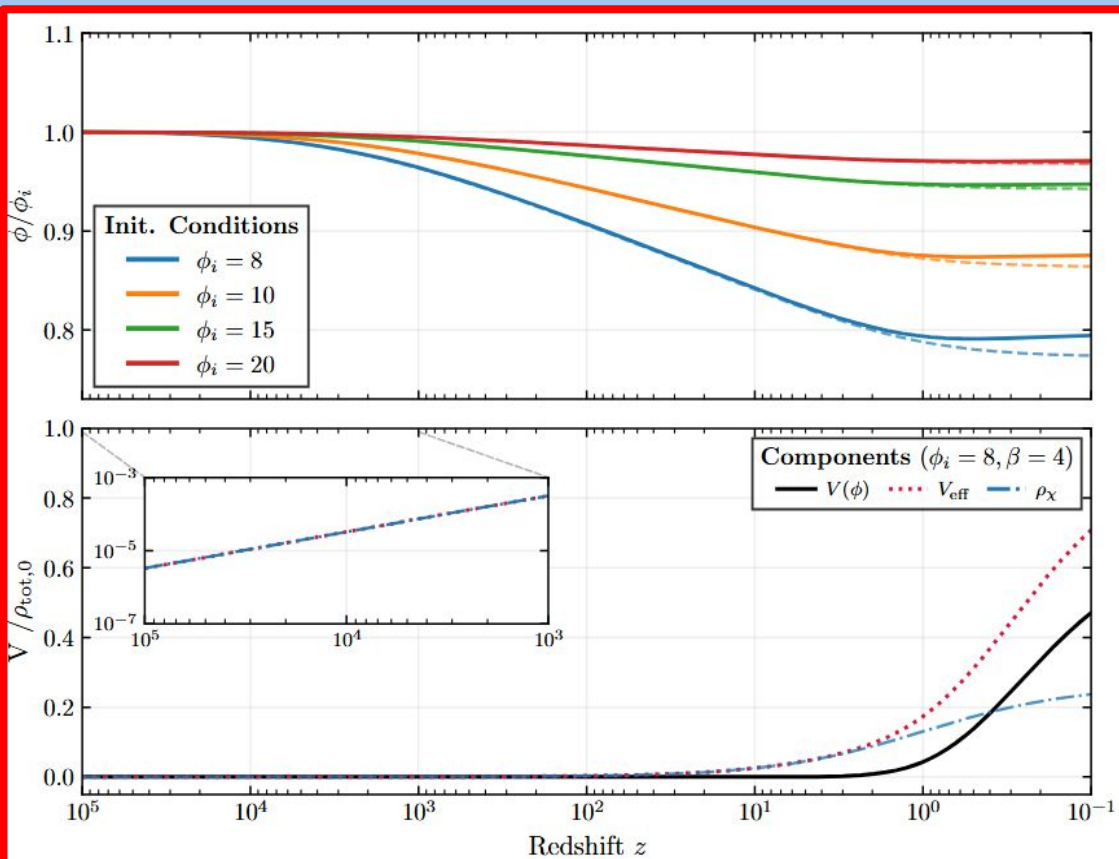
DESI collaboration, 2025



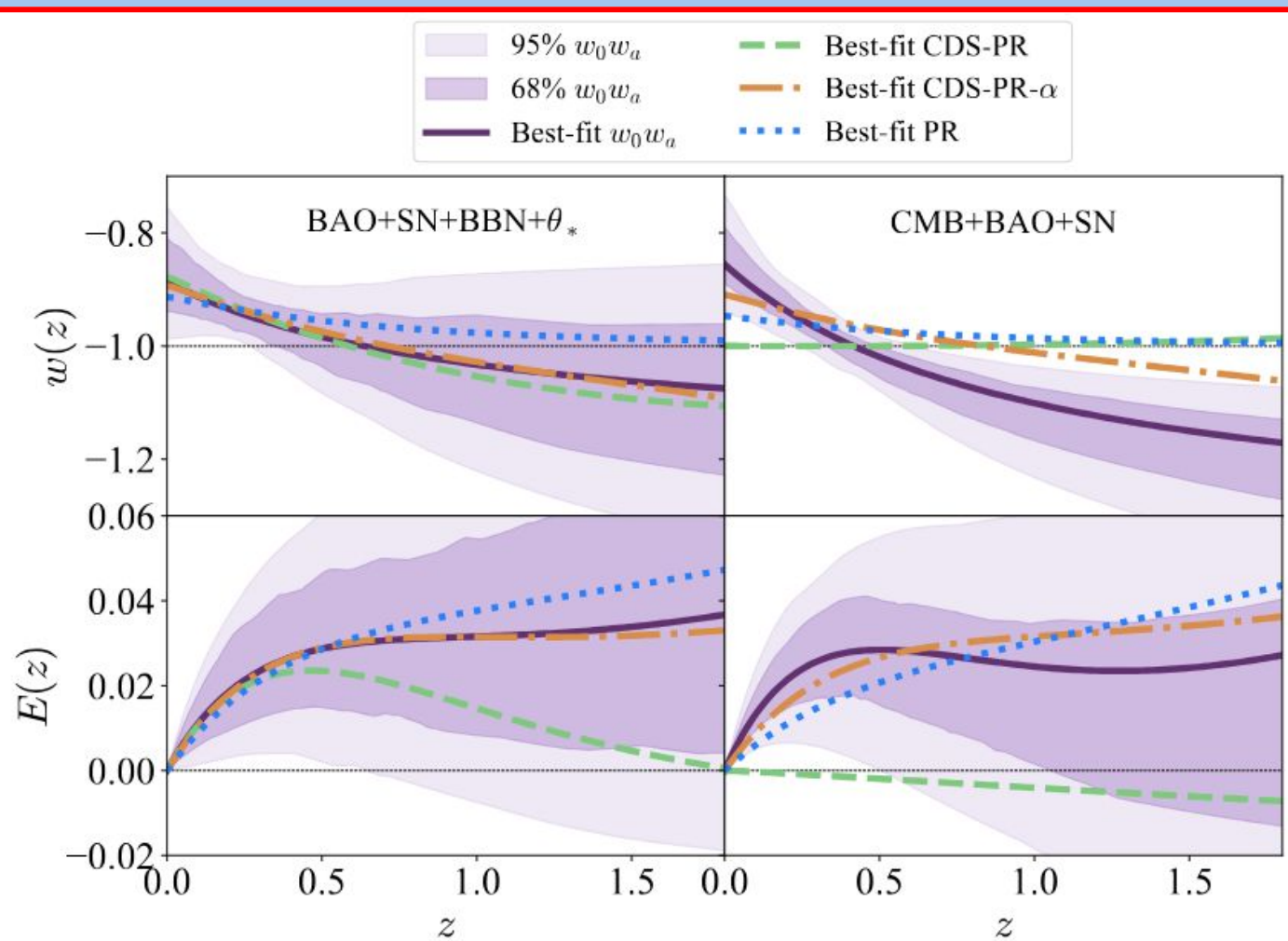
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South American Institute for Fundamental Research



Reproduces exactly the $w_0 w_a$ background!
Talk to me for more details!



15th IDPASC Summer School

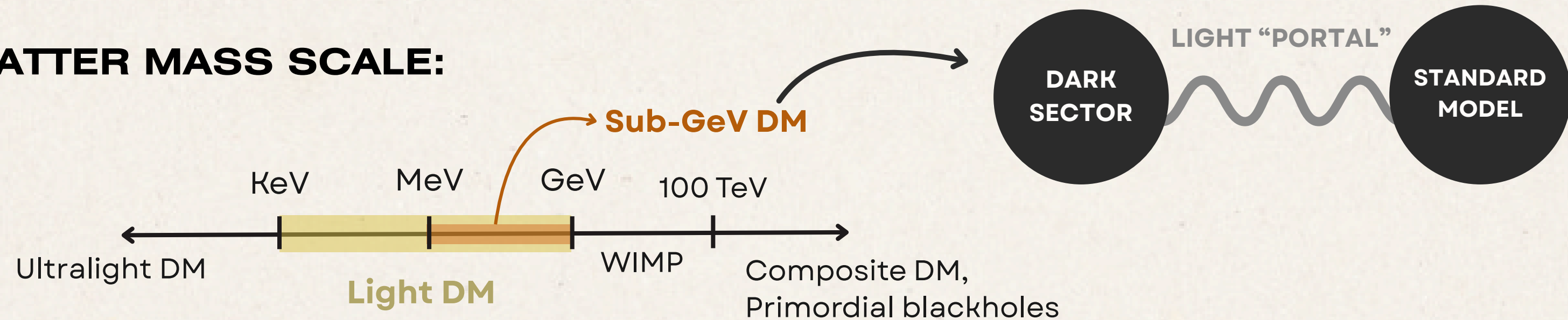
HELLO!
I'M LETÍCIA GUEDES
FROM **BRAZIL** AND I DO

**VISIBLE AND INVISIBLE
SEARCHES FOR SUB-GEV
DARK SECTORS**



LIGHT DARK SECTOR

DARK MATTER MASS SCALE:

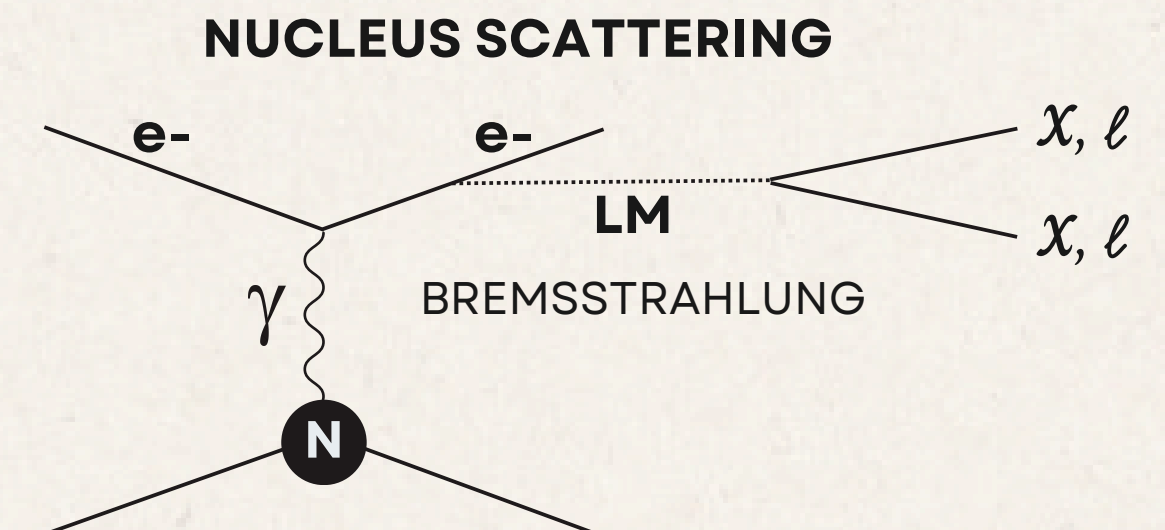
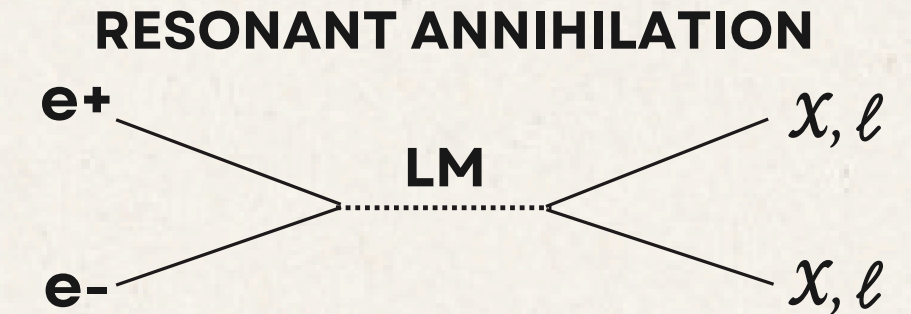


INVISIBLE SEARCH AT FIXED TARGET COLLIDERS:

NA64:

- Created for the dark photon search
- Lower beam energy (100 GeV e^-)
- Focused on the search for **leptophilic** hidden mediators

VARIETY OF MEDIATOR
(SCALAR, PSEUDOSCALAR, VECTORIAL)
AND DM TYPES
(FERMIONIC, SCALAR)



RESULTS

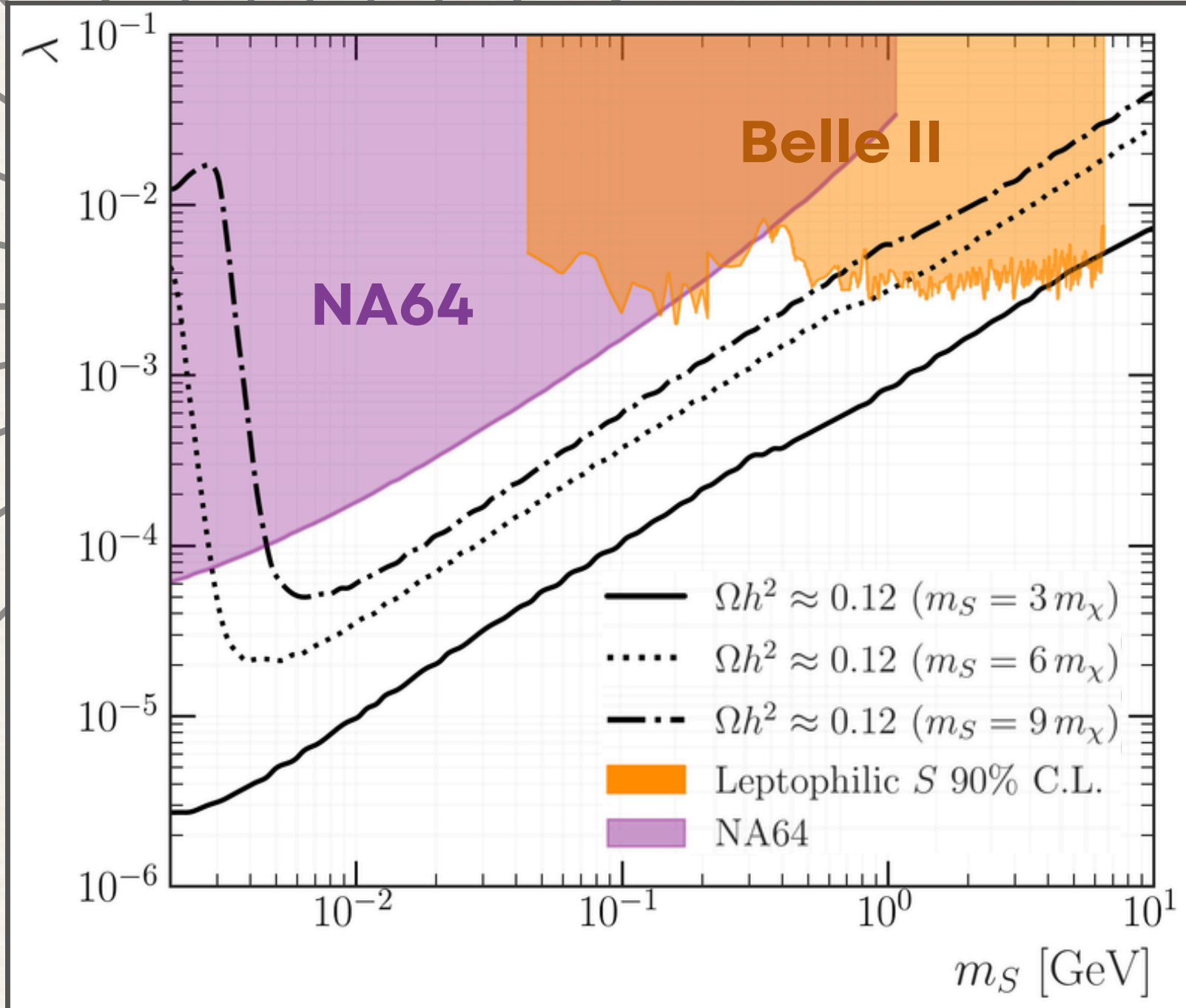
LAGRANGIAN OF THE MODEL:

$$\mathcal{L}_{eff} = \frac{1}{2}(\partial_\mu S)^2 - \frac{1}{2}m_s^2 S^2 + \underbrace{\sum_{\ell=e,\mu,\tau} \lambda \bar{\ell} \ell S}_{\text{Visible}} + \underbrace{g_X \bar{\chi} \chi S}_{\text{Invisible}}$$

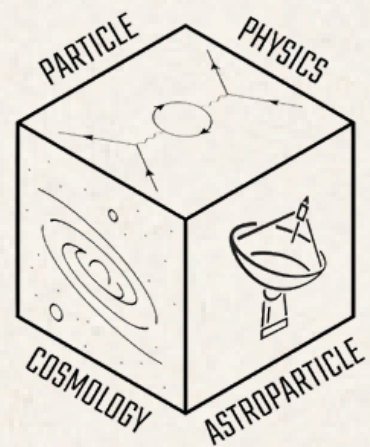
COMPUTATIONAL TOOLS:

- Feynrules
- FeynCalc
- Python
- MadGraph
- **MadDM**
- Geant4

DMG4 package



THANK YOU !



PARTICLE AND ASTROPARTICLE GROUP

Youtube: Astroparticles Natal

Website: [astroparticle IIP](http://astroparticle.iip.unbrasil.br)

Introduction & Current Research

IDPASC 2026 School - Brazil

Lukas Dumond F.

PhD Student in Physical Sciences
Universidad Técnica Federico Santa María (UTFSM)
SAPHIR — Valparaíso, Chile

July 2026



UNIVERSIDAD TÉCNICA
FEDERICO SANTA MARÍA

About Me

Academic Background:

- **Current:** PhD Student in Physics at UTFSM (Valparaíso, Chile).
- **Focus:** Particle physics, theoretical modeling, and Dark Matter phenomenologies.

Previous Work & Skills:

- Developed heuristic methods for computing the “maximal cut” in multi-scale Feynman diagrams.
- Strong background in scientific programming (**Python**, **Mathematica**).
- Passionate about bridging fundamental theoretical research with computational tools.



Current Research: Spin-3/2 Minimal Dark Matter

Project Goal: Extending the Standard Model with a Spin-3/2 Isotriplet to characterize it as a Minimal Dark Matter (MDM) candidate.

Theoretical Framework:

- Using the **Rarita-Schwinger** formalism.
- *Challenge:* Addressing off-shell spurious spin-1/2 modes to preserve unitarity and avoid quantum collapse at high energies.

Computational Implementation:

- **LanHEP/FeynRules:** Automatic generation of the Lagrangian and Feynman rules.
- **CalcHEP:** Computation of cross-sections and relic abundance.
- **micrOMEGAs:** Computation of cosmological observables (relic abundance and DM detection constraints).

Objective

To evaluate the stability and phenomenology of this model for future collider and indirect detection experiments.

Active Galactic Nuclei population studies with the Southern Wide-field Gamma-ray Observatory (SWGGO)

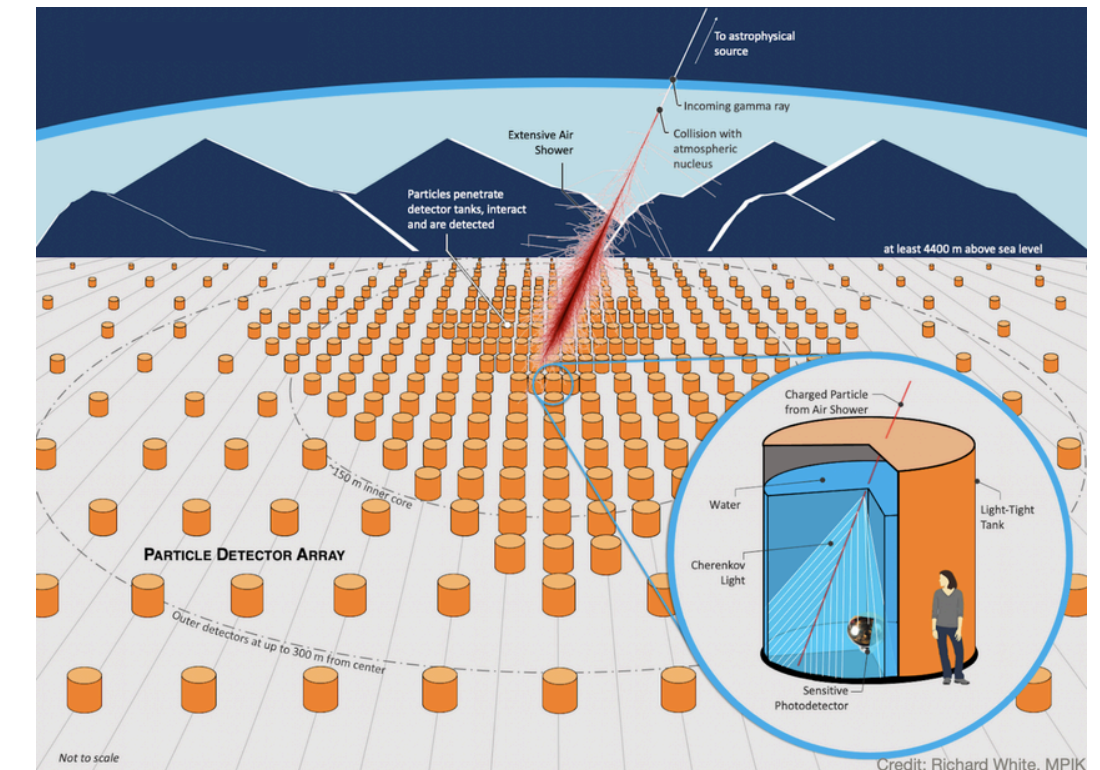
Marcela Gouvêa¹, Ulisses Barres de Almeida¹, Paolo Giommi^{2,3} on behalf of SWGGO collaboration

¹Centro Brasileiro de Pesquisas Físicas, Rua Dr. Xavier Sigaud 150, 22290-180, Rio de Janeiro, Brazil;

²Center for Astrophysics and Space Science (CASS), New York University-Abu-Dhabi, P.O. Box 129188 Abu Dhabi, United Arab Emirates;

³INAF, Brera Astronomical Observatory, via Brera, 28, I-20121 Milano, Italy;

- SWGGO will be a ground-based, wide-field gamma-ray survey instrument situated at Pampa La Bola, Chile (4.4km altitude, approx. -23° latitude). It is designed to operate from sub-TeV to PeV energies with a high duty cycle and large Field of View (FoV) for continuous sky monitoring [1].
- SWGGO offers a low-energy sensitivity (100-300 GeV) an order of magnitude superior to current wide-FoV detectors.
- This continuous monitoring enables real-time detection of highly variable AGN flares. Its rapid-response alerts will be critical for triggering follow-up observations by pointed instruments like CTAO.



This work aims to estimate the observation time (measured in daily transits) required to reach a 5 σ detection threshold for 4LAC sources, establishing a baseline for extragalactic survey capabilities.

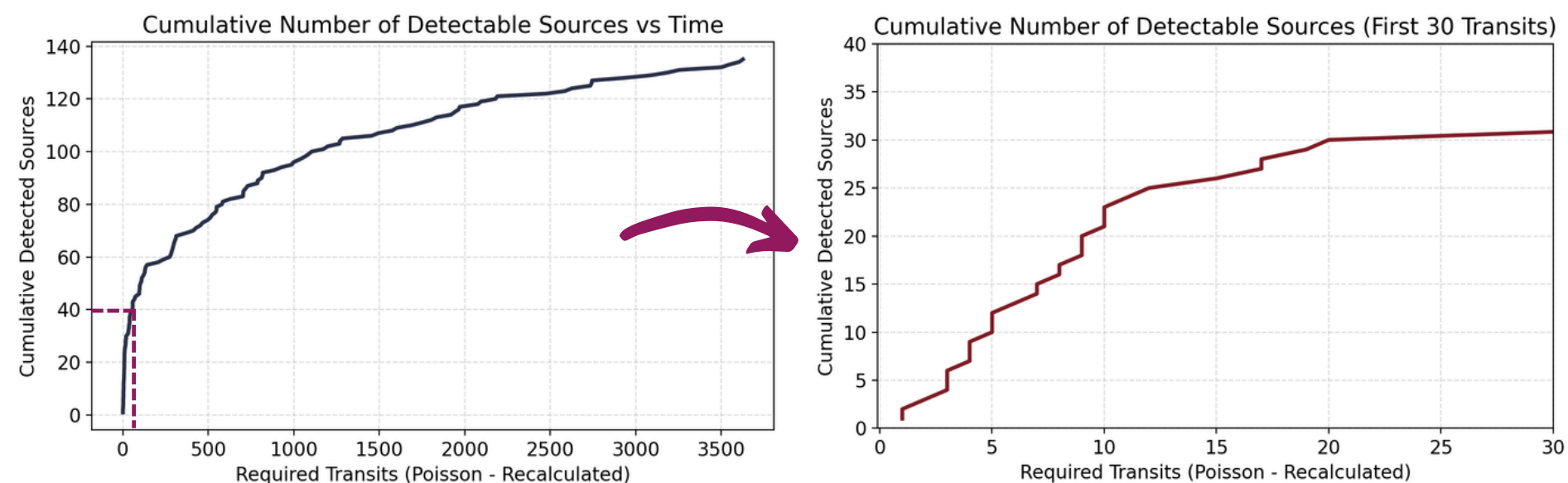


Figure 4: Cumulative Detectability Analysis.

$nT \leq 10$ (10 days)	$nT \leq 100$ (100 days)	$nT \leq 365$ (1 yr)	$nT \leq 1825$ (5 yrs)	$nT \leq 3650$ (10 yrs)
23 (17.0%)	49 (36.3%)	68 (50.4%)	112 (83.0%)	135 (100.0%)

Table 1: Summary of Detectable Sources by Timeframe.

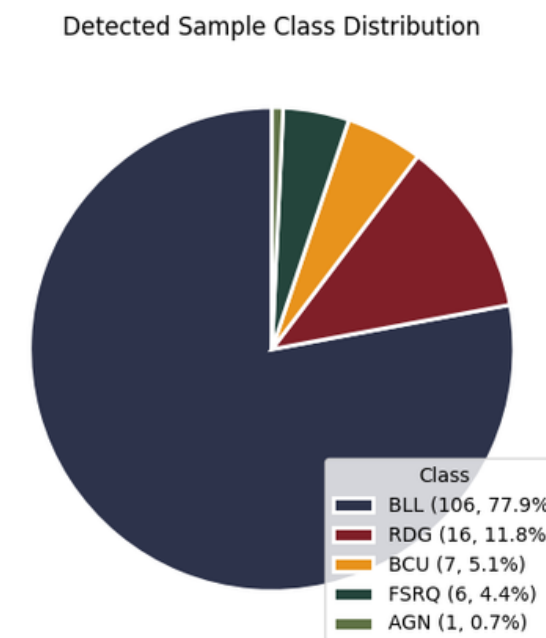


Figure 5: Distribution of source classes in the detected sample.

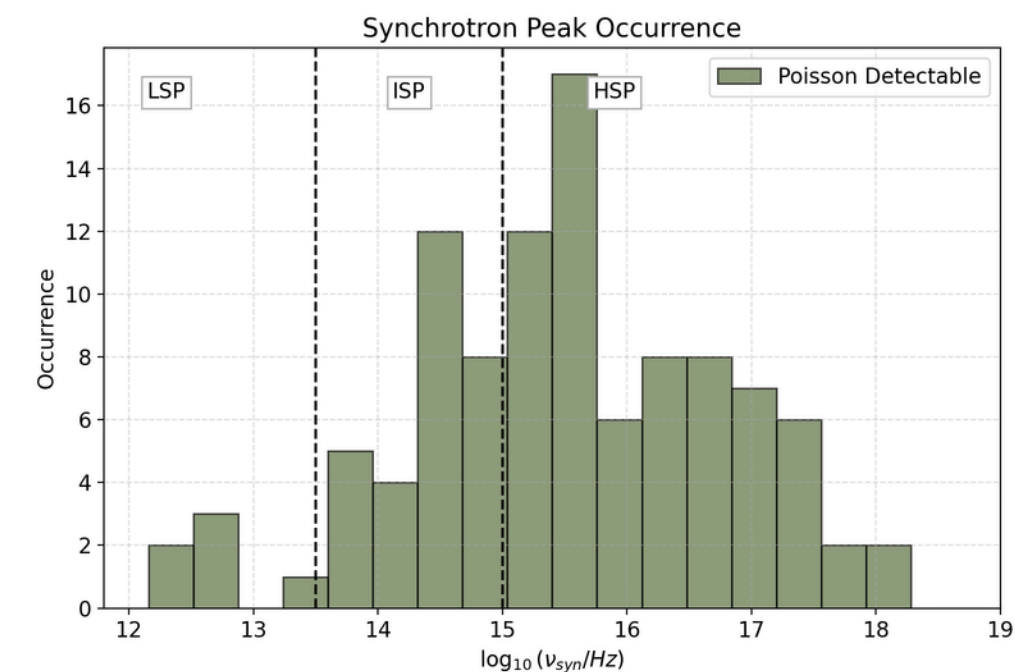


Figure 7: Distribution of detectable sources according to the Synchrtron peak position

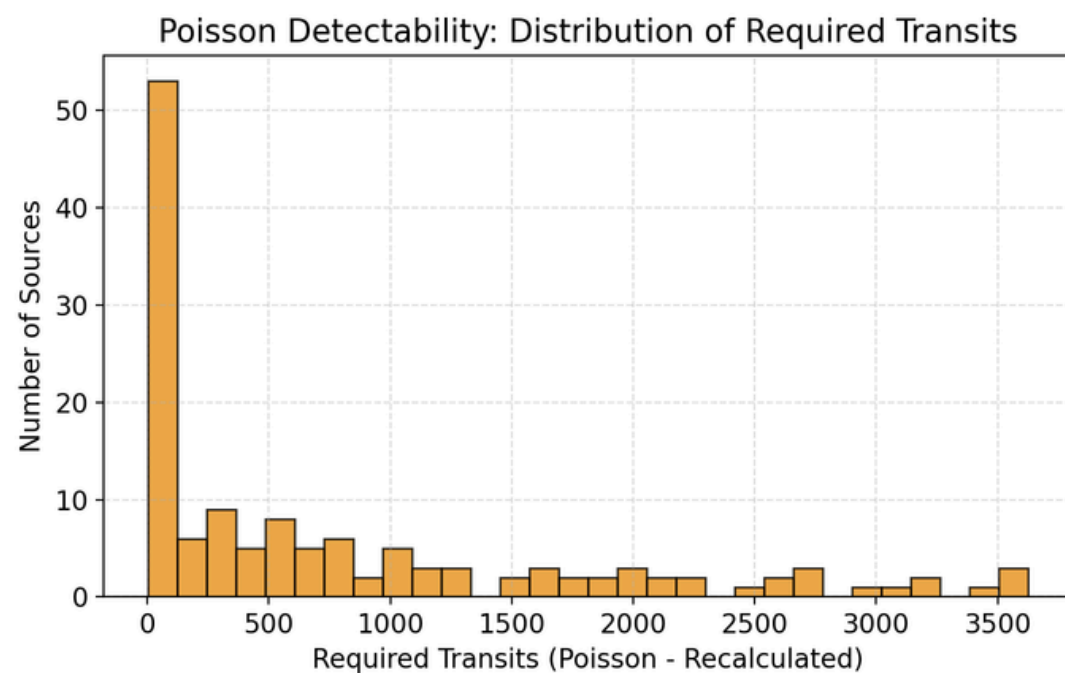


Figure 6: Histogram of required transits to detect sources

Name	Transits	TS Mode	Excess Mode	SED Class	Class	Redshift
4FGL J2158.8-3013	1	71.17	118.97	HSP	BLL	0.116
4FGL J0627.0-3529	1	27.84	55.44	HSP	RDG	0.055
4FGL J0847.0-2336	2	26.76	60.46	–	BLL	0.059
4FGL J1256.2-1146	3	37.07	74.96	HSP	BLL	0.058
4FGL J0505.6+0415	3	28.72	47.72	HSP	BLL	0.027
4FGL J0339.2-1736	3	25.31	72.12	HSP	BLL	0.066
4FGL J1443.9-3908	4	29.27	103.38	HSP	BLL	0.065
4FGL J0322.6-3712e	4	27.43	67.19	LSP	RDG	0.006
4FGL J0039.1-2219	4	26.48	88.48	–	BLL	0.062
4FGL J1958.3-3010	5	29.10	124.78	–	BLL	0.119

Table 2: Top 10 sources requiring the fewest transits for detection in the new Poisson analysis.

Optimistic case!

Other projects

THE ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES, 281:53 (15pp), 2025 December
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<https://doi.org/10.3847/1538-4365/ae146e>

OPEN ACCESS



1FLAT: A Firmamento-based Catalog of Active Galactic Nuclei in Fermi-LAT High-Galactic-latitude γ -Ray Sources

P. Giommi^{1,2}, M. Doro^{3,4}, M. Gouvêa⁵, L. Fronte⁶, F. Metruccio³, F. Arneodo⁷, U. Barres de Almeida⁵, S. Di Pippo^{7,8}, T. Kerscher⁹, A. Macciò¹, B. Mazzon¹⁰, M. Morrone³, E. Prandini^{3,4}, A. Rodríguez⁷, A. Ruina⁴, N. Sahakyan¹¹, L. Silveri⁷, and D. Tripathi⁷

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¹⁰ Department of Environmental Sciences, Statistics and Computer Science, Ca' Foscari University of Venice, via Torino 155, I-30170 Venezia, Italy

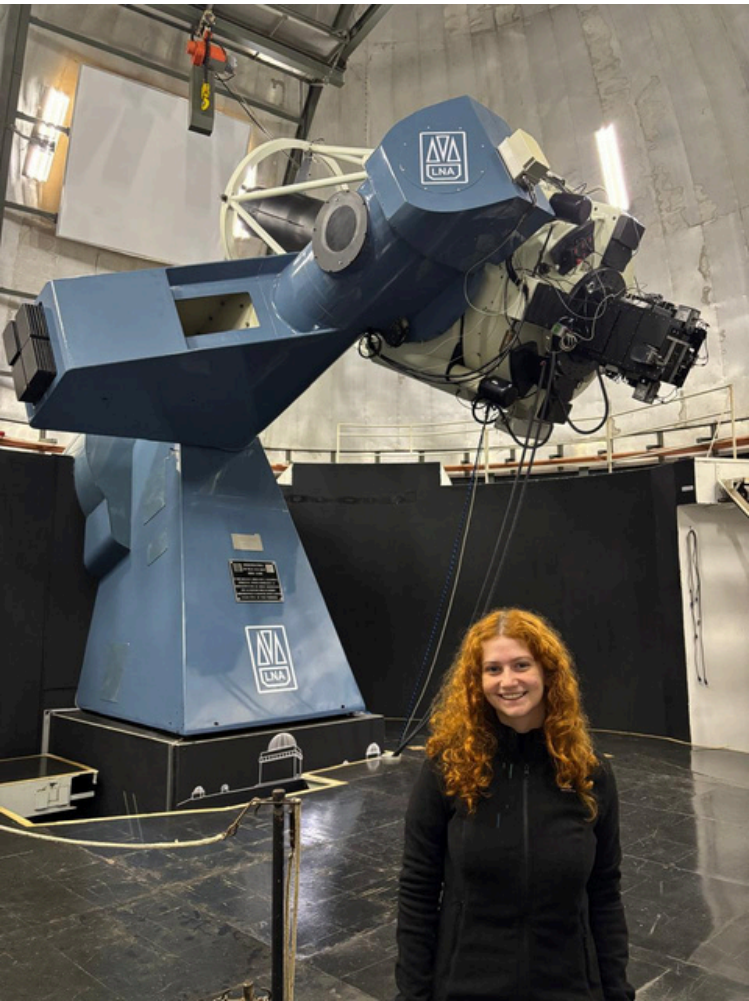
¹¹ ICRA Net-Armenia, Marshall Baghramian Avenue 24a, Yerevan 0019, Armenia

Received 2025 March 7; revised 2025 October 10; accepted 2025 October 14; published 2025 December 2

Optical polarization monitoring of blazars
with SPARC4 at OPD



Reassessment of 4FGL gamma-ray source
associations using Firmamento!



If you want to know more about any of these projects, come talk to me!

Multiwavelength modeling of Blazars with AI tools

Marcus André Morais Valiati^{1*}, Bernardo Fraga¹, Narek Sahakyan², Ulisses Barres de Almeida¹

¹Brazilian Center for Physics Research - CBPF, ²ICRANet-Armenia

1 Introduction

Active Galactic Nuclei (AGNs) are regions of space which contain a supermassive black hole that is accreting large quantities of matter from its accretion disk and are surrounded by a torus filled with dust. AGNs can produce a collimated jet of relativistic particles, resulted from its accreting process. These jets can achieve extremely large distances, up to hundreds of kiloparsecs scale. When this relativistic jet points towards the Earth (typically 15-20°), this AGN is classified as a Blazar [1].

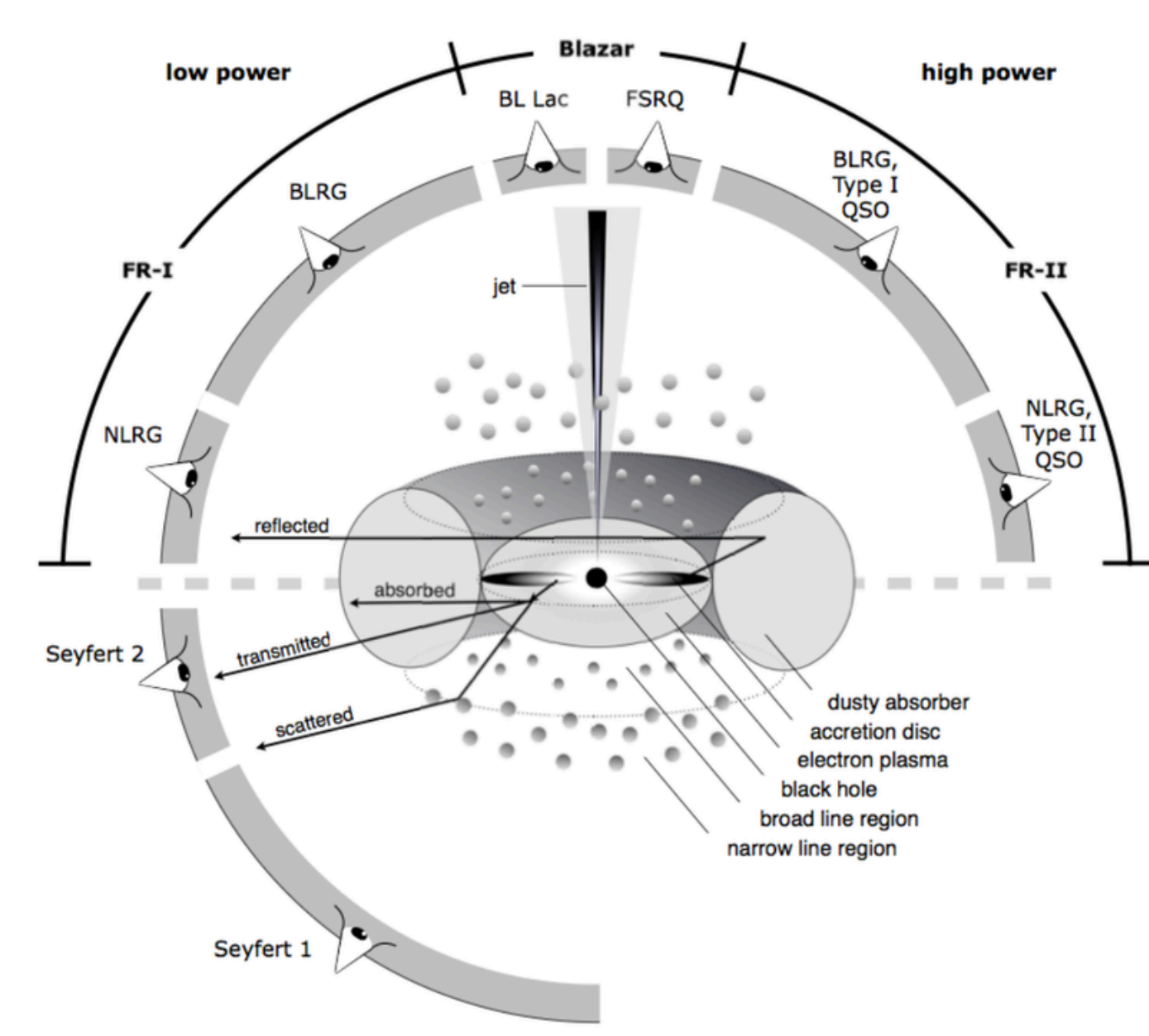
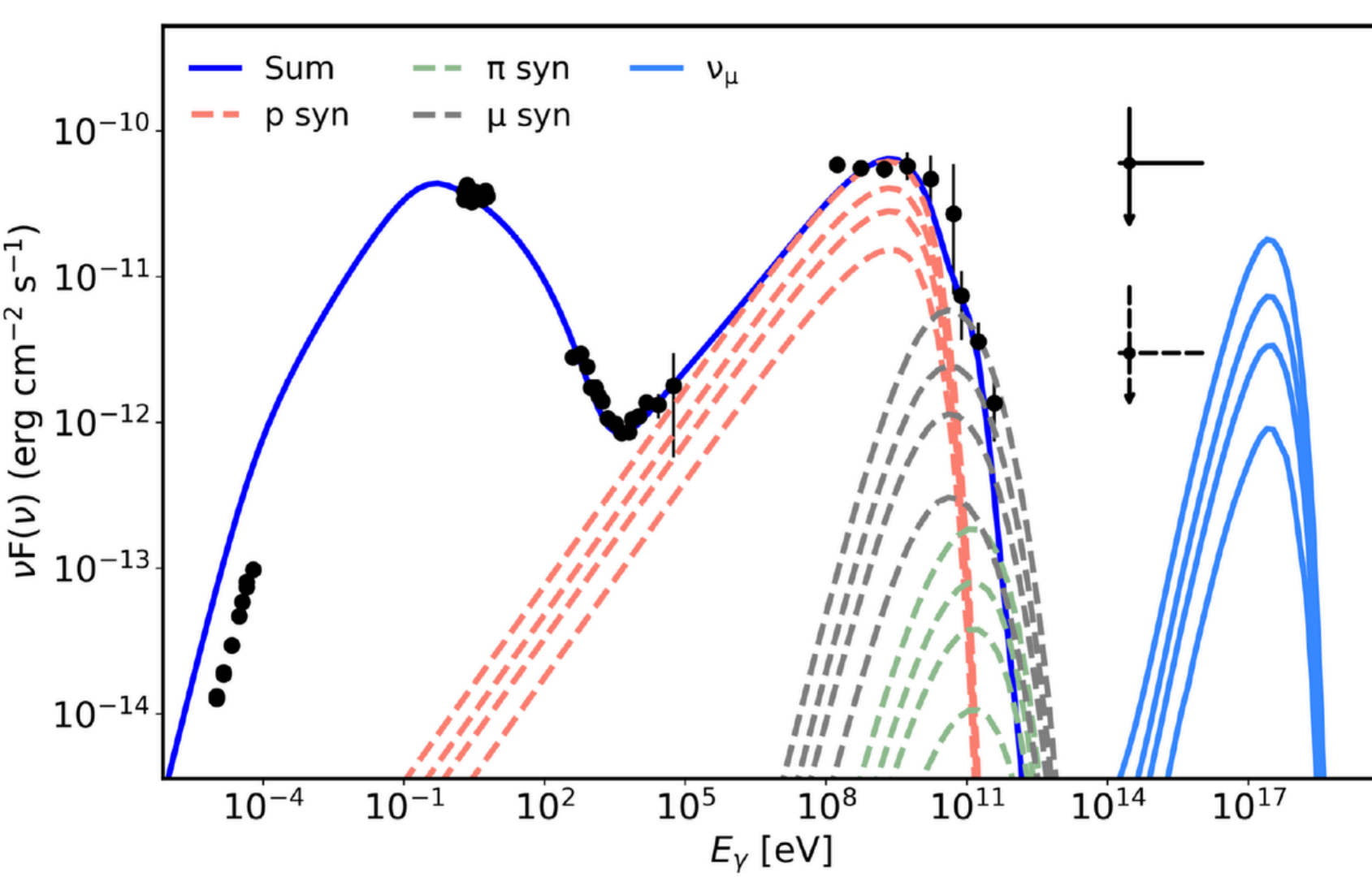


Illustration of the Unified Model of AGNs [2]



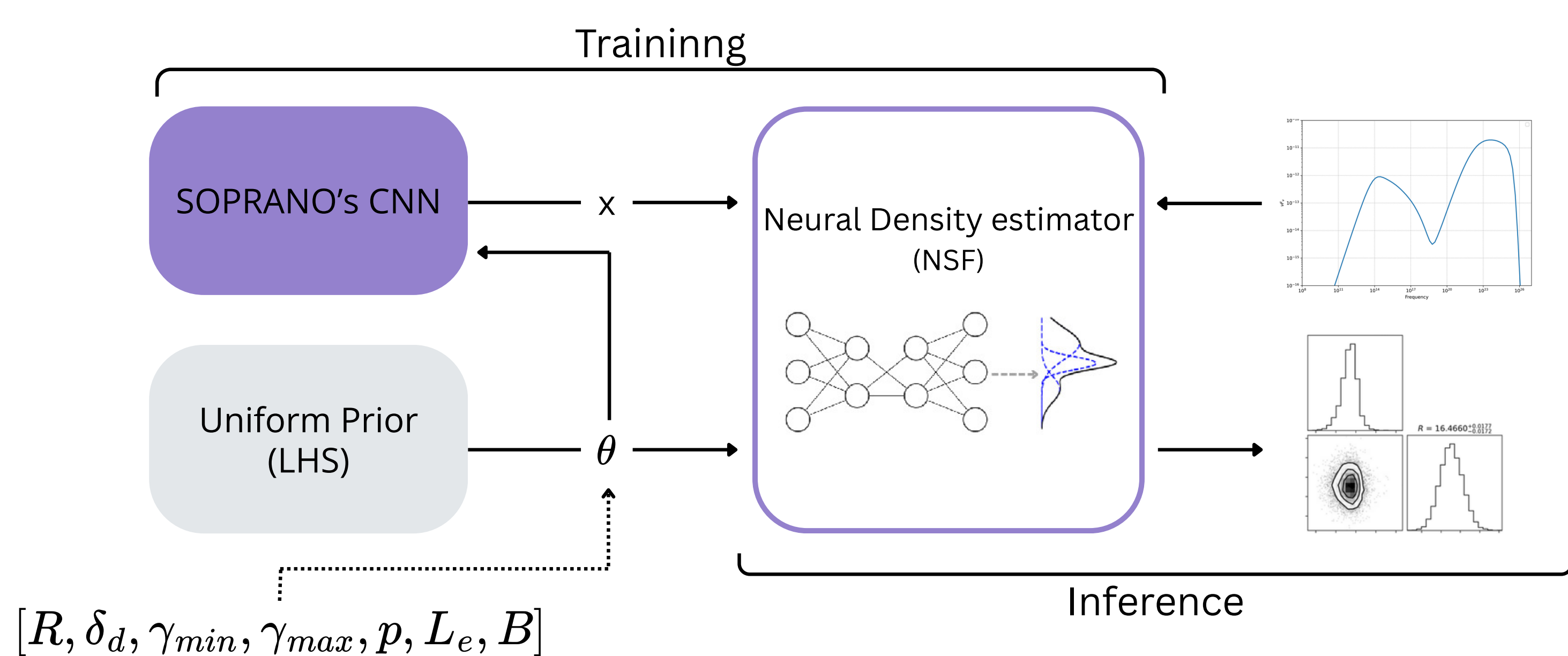
The multiwavelength SED of TXS 0506+056 during the neutrino emission in 2017 modeled within the lepto-hadronic scenario [7]

Several numerical tools—such as JetSet [3,4,5], agnpy [6] and SOPRANO [7]—have been developed to model the multiwavelength spectral energy distribution (SED) of blazars. While effective, these tools can be computationally demanding. To overcome this, recent studies have applied deep learning techniques trained to approximate spectral outputs efficiently [8].

In this project, we use Simulation-Based Inference (SBI) to recover the physical parameters of the Synchrotron-Self Compton (SSC) model that best reproduce observed SEDs, offering a fast and scalable alternative to traditional fitting techniques.

2 SBI Model

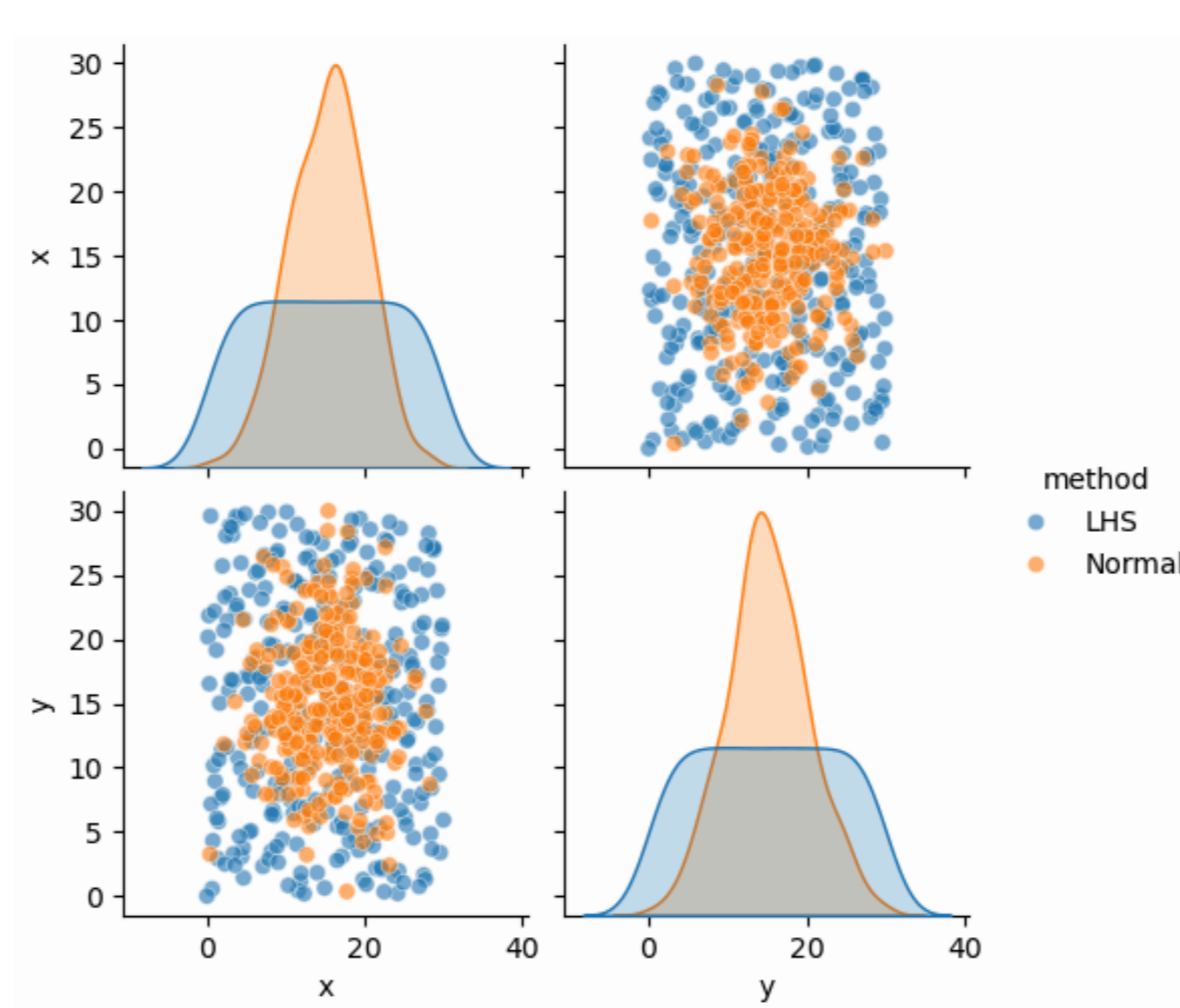
Simulation-Based Inference (SBI) has emerged as a likelihood-free artificial intelligence method to speed up SED modeling. This method does not require access to the analytical likelihood function and can approximate it, or even directly the posterior, usually by training a neural network estimator on simulated datasets [9]. Once trained, it enables the recovery of the posterior distribution for parameter estimation. Such models have proven to be powerful tools in recent works, particularly in cases where the analytical form of the likelihood function is either intractable or computationally prohibitive [10].



3 Data Generation

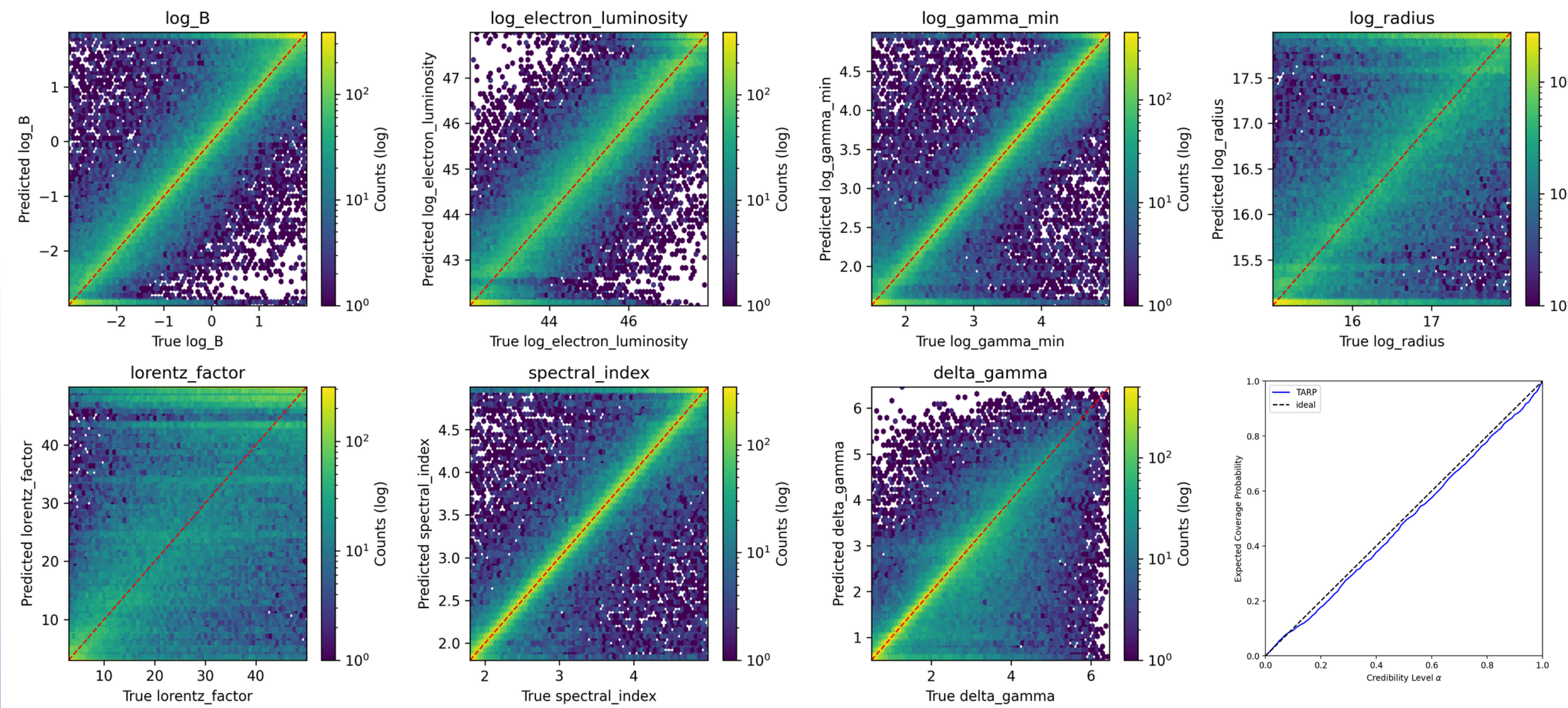
The Latin-Hypercube Sampling (LHS) statistical method [11] was used to generate random SED parameter combinations. This technique ensures that all regions of the parameter space will be uniformly explored, avoiding oversampling in specific areas or wasting samples on redundant values. Then, these parameters were used as input to the CNN that replicates the SOPRANO numerical code, resulting in several SEDs, one for each set of parameters.

Parameter	Ranges
δ_d	[3, 50] (Linear)
R	[15, 18] (Logarithmic)
$\gamma_{\min}$	[1.5, 5] (Logarithmic)
$\gamma_{\max}$	[2, 8] (Logarithmic)
p	[1.8, 5.0] (Linear)
L_e	[42, 48] (Logarithmic)
B	[-3, 2] (Logarithmic)
z	[0.001, 10] (Linear)

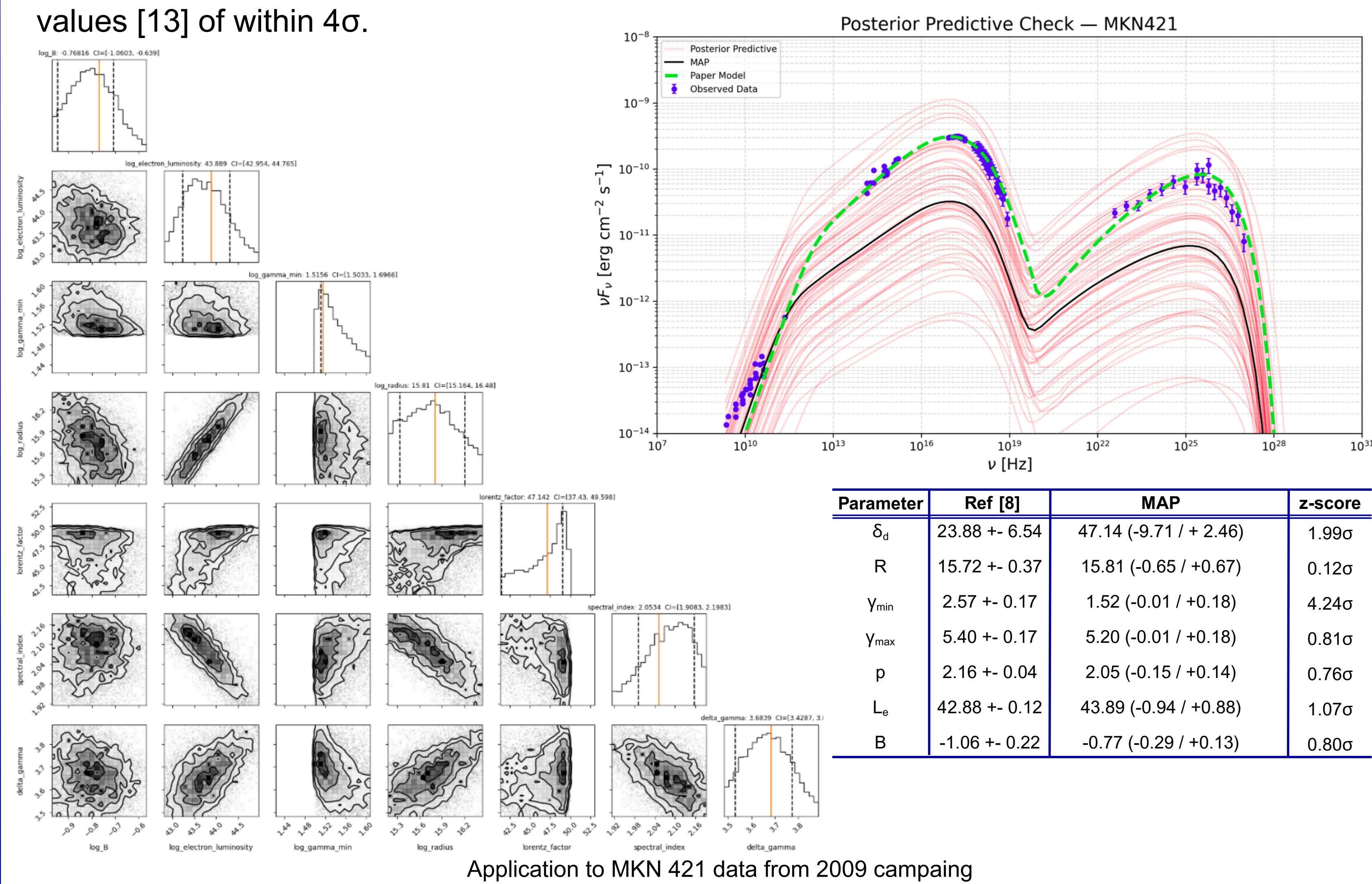
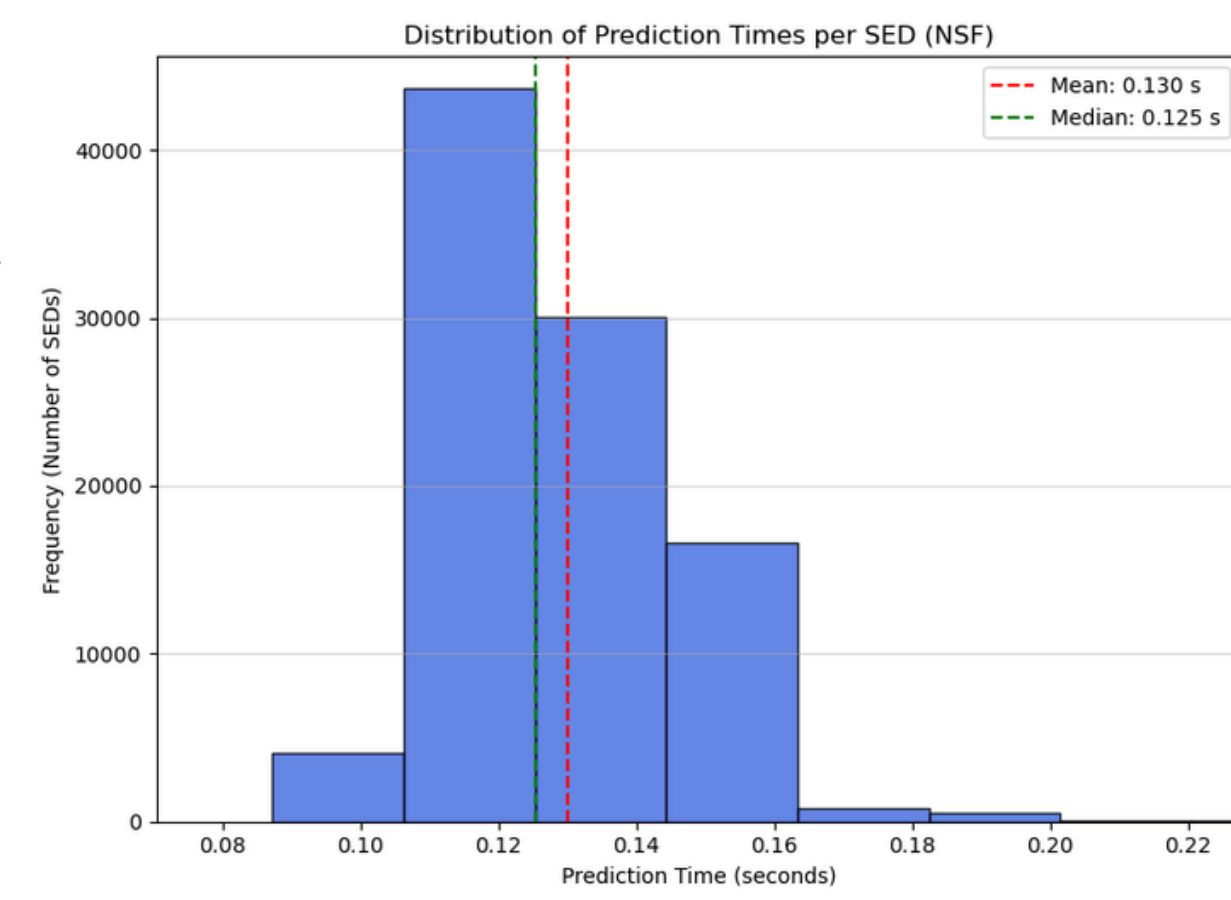


4 Results

We trained an NPE model on 955,660 synthetic one-zone SSC spectra generated with SOPRANO's CNN API. To better approximate real observational data, realistic noise was injected following [12], and flux gaps were introduced across 7 instrument bands spanning radio to γ -rays (Radio, WISE, OAGH, Swift-UVOT, Swift-XRT, NuSTARS, Swift-BAT, Fermi-LAT, and MAGIC/CTAO-South). Optuna hyperparameter optimization was used to tune the NSF density estimator and embedding network. The panels below show true versus MAP-predicted values for each parameter on the 95k-SED test set, color-coded by density.



- The model recovers all 7 SSC parameters with relative errors below 4%, except for the Lorentz factor (~16%), whose degeneracy in static one-zone models is expected.
- Mean inference time is 0.130 s/SED — several orders of magnitude faster than MultiNest (>2 hours). Posterior calibration was validated via SBC rank statistics and TARP analysis, yielding an Expected Coverage Probability closely following the ideal diagonal (ATC ≈ -0.013 , KS p-value ≈ 0.999).
- Applied to the 2009 MKN 421 multiwavelength campaign, all inferred parameters are consistent with the reference values [13] of within 4 σ .



Application to MKN 421 data from 2009 campaign

5 Conclusion and Future

We have developed a Simulation-Based Inference (SBI) model to fit Blazar SEDs, trained with synthetic spectra from the SOPRANO numerical code, focusing on Synchrotron Self-Compton (SSC) process. Our next steps include enhancing the model by, refining the performance of the inference parameters with Optuna, specially on real blazar data, such as MKN 421, and comparing its performance with Nested Sampling fitting methods. Ultimately, this approach could be implemented into the Markarian Multiwavelength Data Center (MMDC) [13], providing a robust alternative to traditional numerical fitting methods.

Contact email: marcusvaliati98@gmail.com

6 References and Acknowledgements



We would like to acknowledge the financial support from CAPES



Extended 2HDMs and Phenomenology

Cecília Kemiác

M.Sc. in Particle Physics

B.Sc. in Computer Science | B.Sc. in Physics

UFCG - Federal University of Campina Grande - PB, Brazil

Advisor: Diego Cogollo

July 2026

BSM Physics - 2HDM + $U(1)'$ + Singlet

Gauge symmetry constrains the Yukawa structure of 2HDM models, fixing which couplings are allowed.

Type-I 2HDM & Scalar Mixing

- ▶ Type-I 2HDM, free of tree-level FCNCs
- ▶ New singlet–doublet mixing and its phenomenological consequences

FCNC Models

- ▶ Lesser explored variants that generate tree-level FCNCs.
- ▶ Phenomenological validation working on observables such as Meson mixing and rare decays at tree level.

Paulo Areyuna

PhD student from Chile

I grew up in La Serena



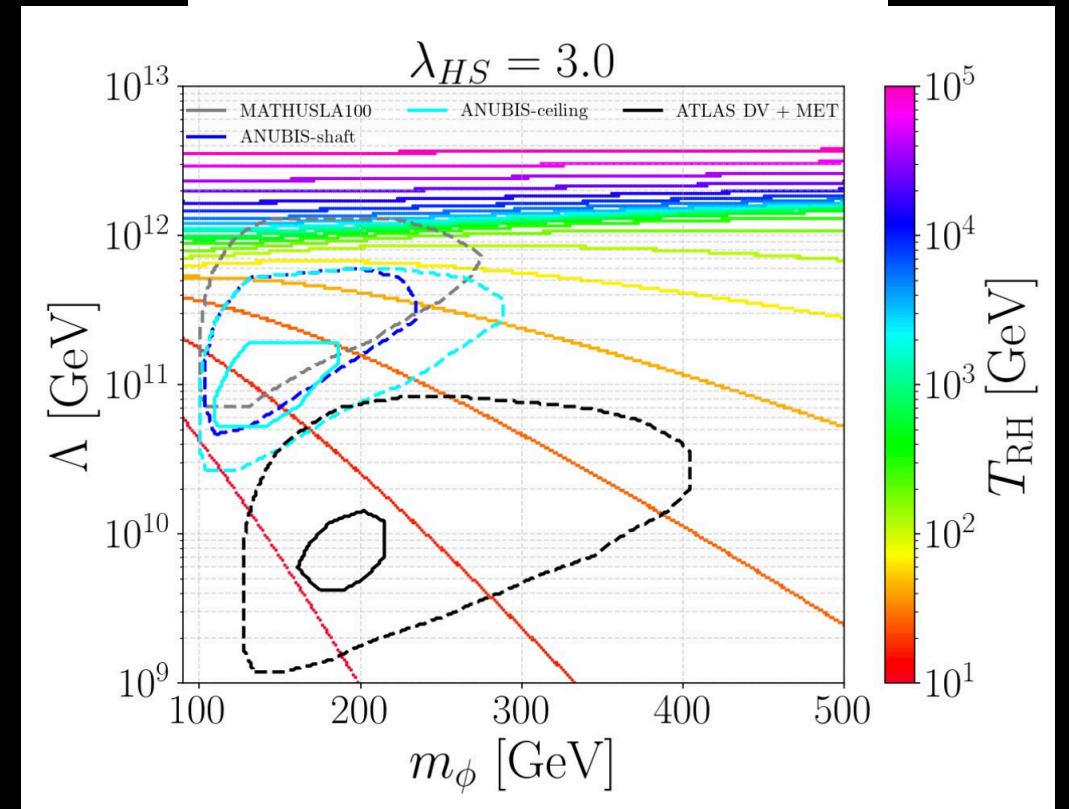
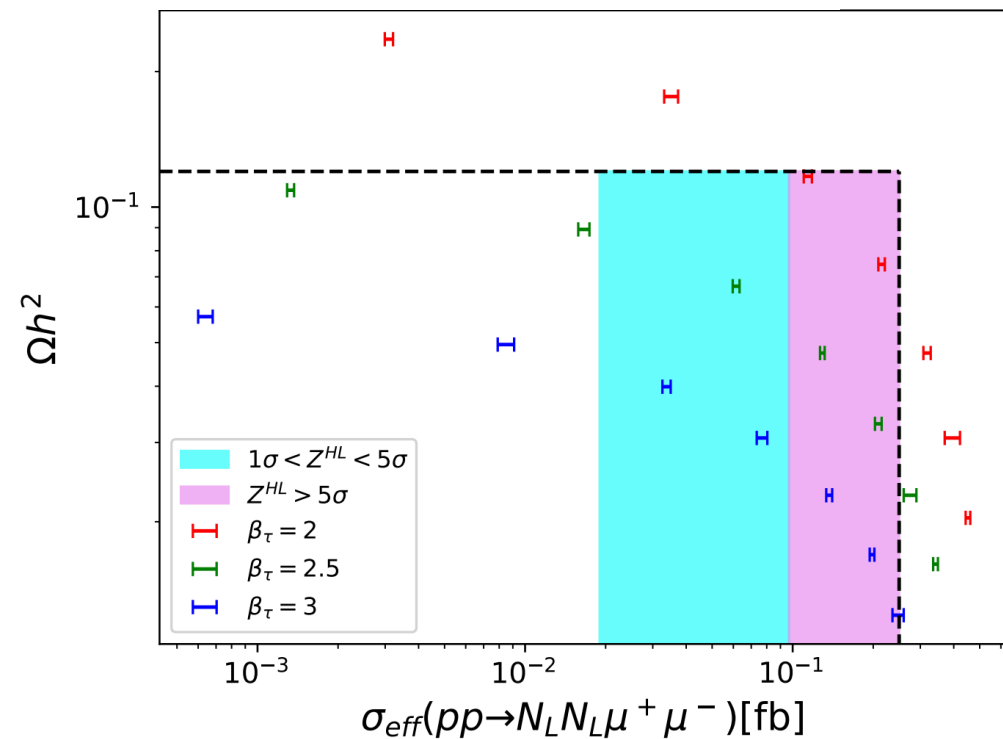
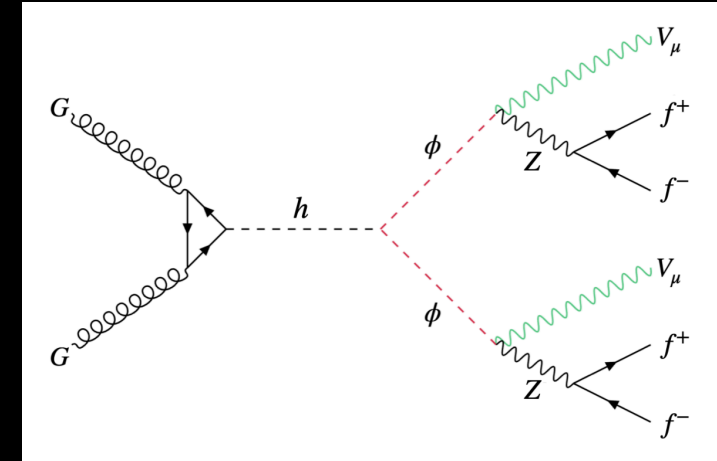
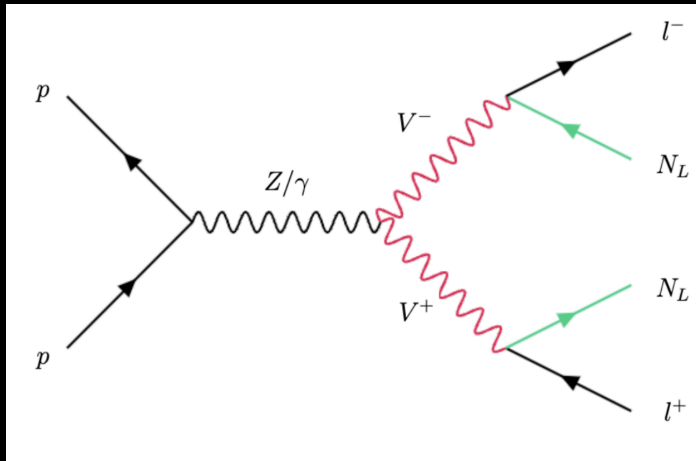
Currently living in Santiago



What can we learn about Cosmology with Colliders?

MSc research: The Vector Scotogenic Model

Current work: The dark-axion portal to Vector DM



Current research: LLPs • Freeze-in Dark Matter • Reheating



15th IDPASC Summer School

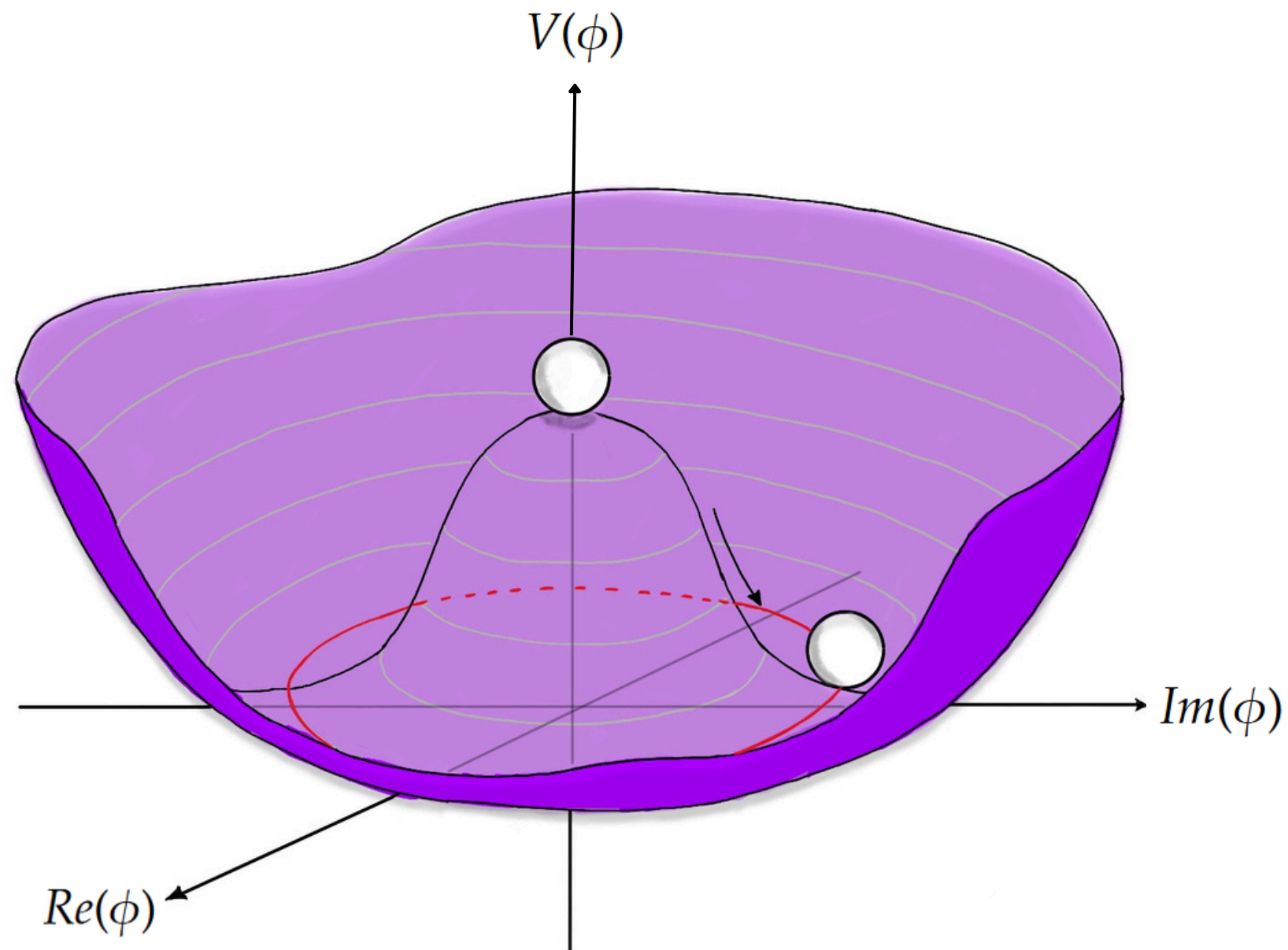
Higgs Mechanism

Beyond the Standard Model

Raphael Augusto de P. Guila
Bruno Carneiro da Cunha

The infinite minimums of the Higgs field

$$\mathcal{L} = \partial_\mu \phi^\dagger \partial^\mu \phi + \mu^2 \phi^\dagger \phi - \lambda (\phi^\dagger \phi)^2$$

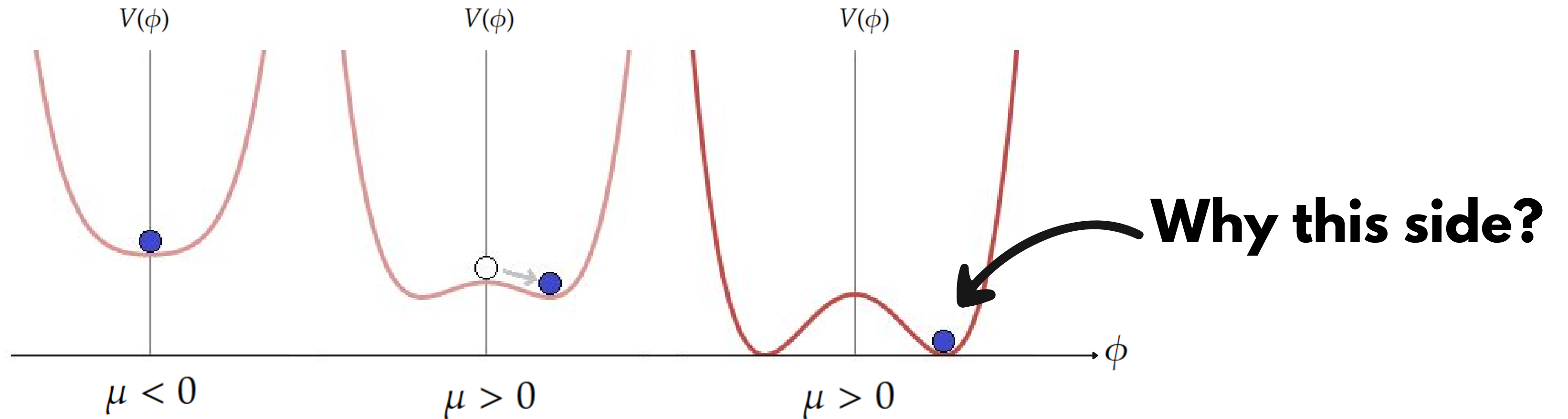


infinite possibilities!

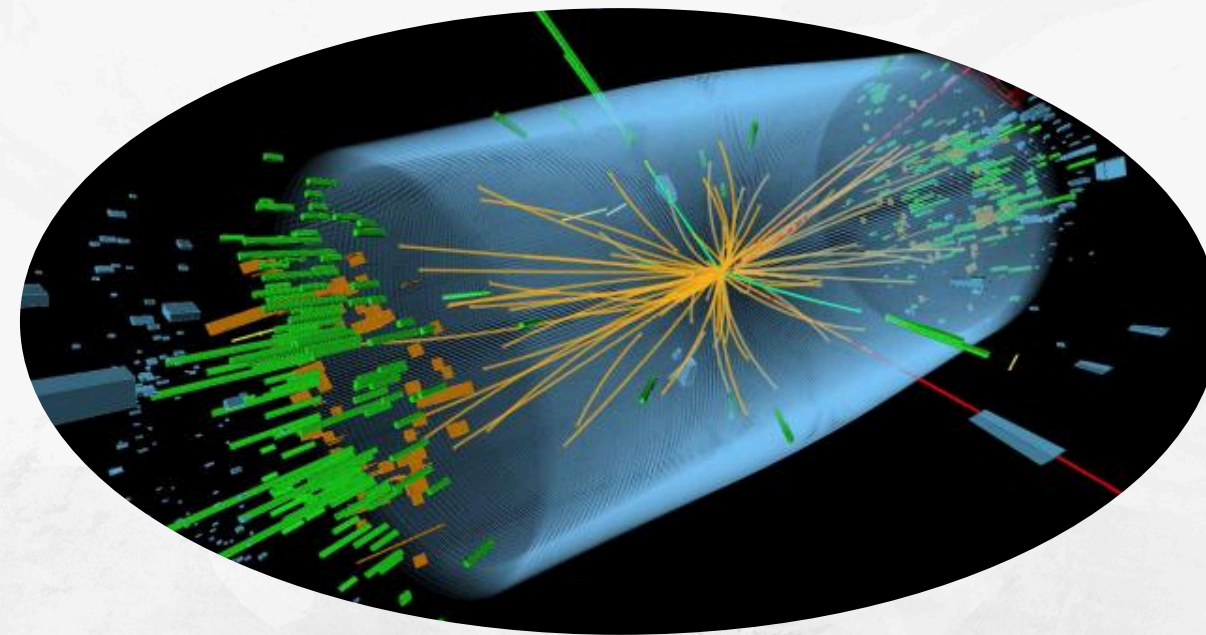
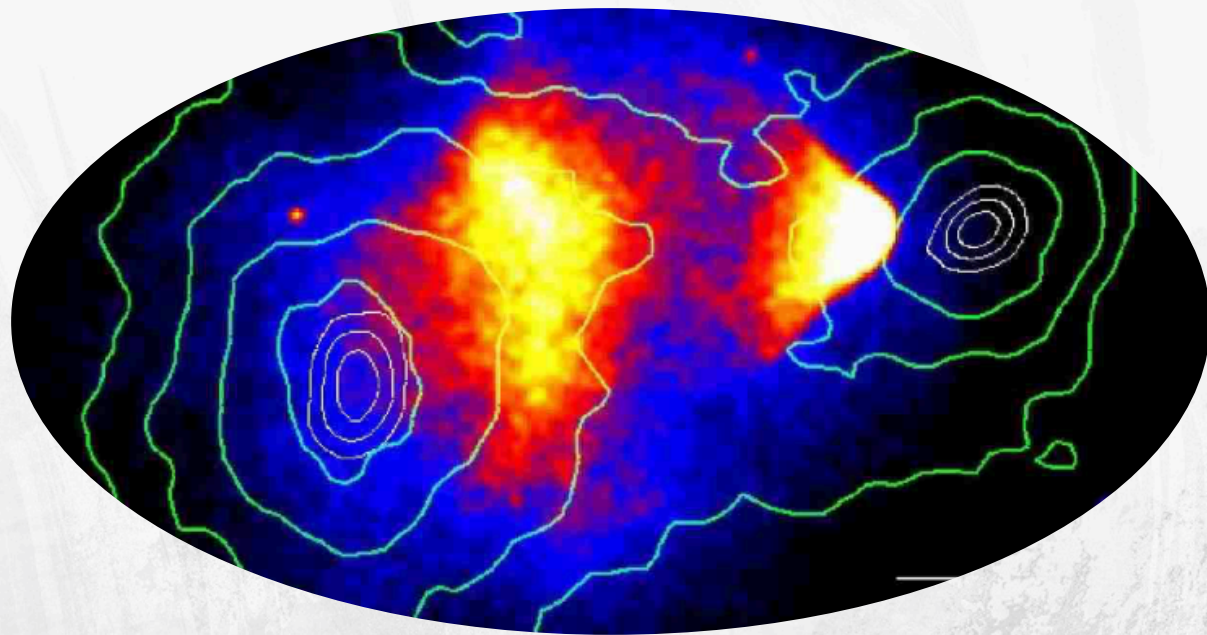
$$\phi_{min} = \sqrt{\frac{\mu^2}{2\lambda}} e^{i\varphi}$$

Why Higgs choose this minimum among others?

$$V(\phi) = -\mu^2 \phi^\dagger \phi + \lambda (\phi^\dagger \phi)^2$$



Thanks :)



PRESENT LIMITS ON SIMPLIFIED SPIN-1 DARK MATTER SCENARIOS

Phd student: Ricardo César Silva Rêgo

Phd supervisor: Farinaldo da Silva Querioz

Project overview

Current benchmarks

Objective: Go beyond current benchmarks for the spin-1 DM simplified models

Reinterpret observed limits from ATLAS and CMS using a semi-analytical rescaling method based on the code package **DMWG-couplingScan**.

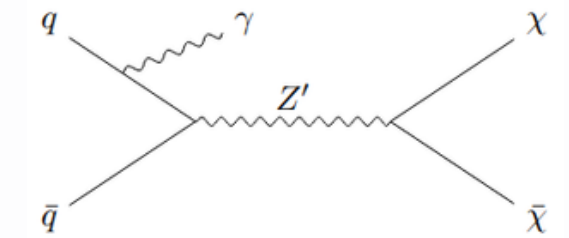
$$\begin{aligned}\mathcal{L}_{\text{vector}} &= -g_\chi Z'_\mu \bar{\chi} \gamma^\mu \chi - g_q \sum_q Z'_\mu \bar{q} \gamma^\mu q \\ &\quad - g_\ell \sum_\ell Z'_\mu \bar{\ell} \gamma^\mu \ell - \frac{g_\nu}{2} \sum_\ell Z'_\mu \bar{\nu}_\ell \gamma^\mu \nu_\ell \\ \mathcal{L}_{\text{axial-vector}} &= -g_\chi Z'_\mu \bar{\chi} \gamma^\mu \gamma_5 \chi - g_q \sum_q Z'_\mu \bar{q} \gamma^\mu \gamma_5 q \\ &\quad - g_\ell \sum_\ell Z'_\mu \bar{\ell} \gamma^\mu \gamma_5 \ell + \frac{g_\nu}{2} \sum_\ell Z'_\mu \bar{\nu}_\ell \gamma^\mu \gamma_5 \nu_\ell,\end{aligned}$$

- Set of free parameters:
 $\{m_{Z'}, m_\chi, g_\chi, g_q, g_\ell\}$
- No interactions between the Z' and SM bosons, or between the DM particle and SM particles directly (Z' -portal).
- Universal couplings for the quarks (g_q) and leptons (g_ℓ).

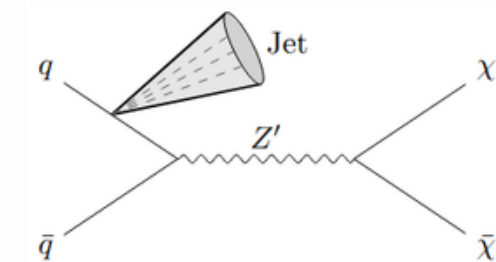
- V1: Vector model with couplings only to quarks: $g_\chi = 1.0, g_q = 0.25, g_\ell = 0$.
- V2: Vector model with a small couplings to leptons: $g_\chi = 1.0, g_q = 0.1, g_\ell = 0.01$.
- A1: Axial-vector model with couplings only to quarks: $g_\chi = 1.0, g_q = 0.25, g_\ell = 0$.
- A2: Axial-vector model with equal couplings to quark and leptons: $g_\chi = 1.0, g_q = g_\ell = 0.1$.

Signatures considered

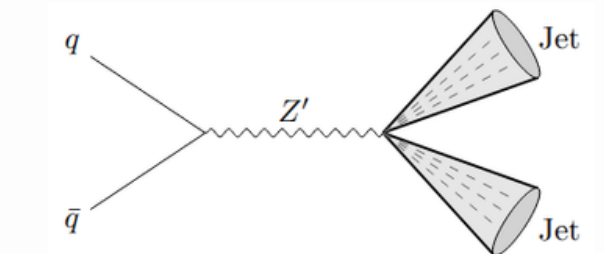
- Monophoton + MET searches:



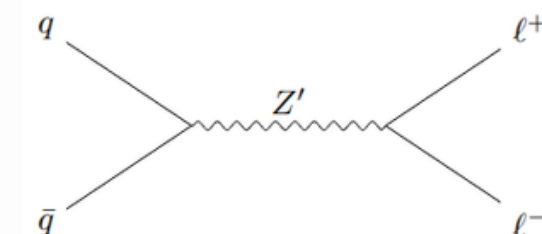
- Monojet + MET searches:



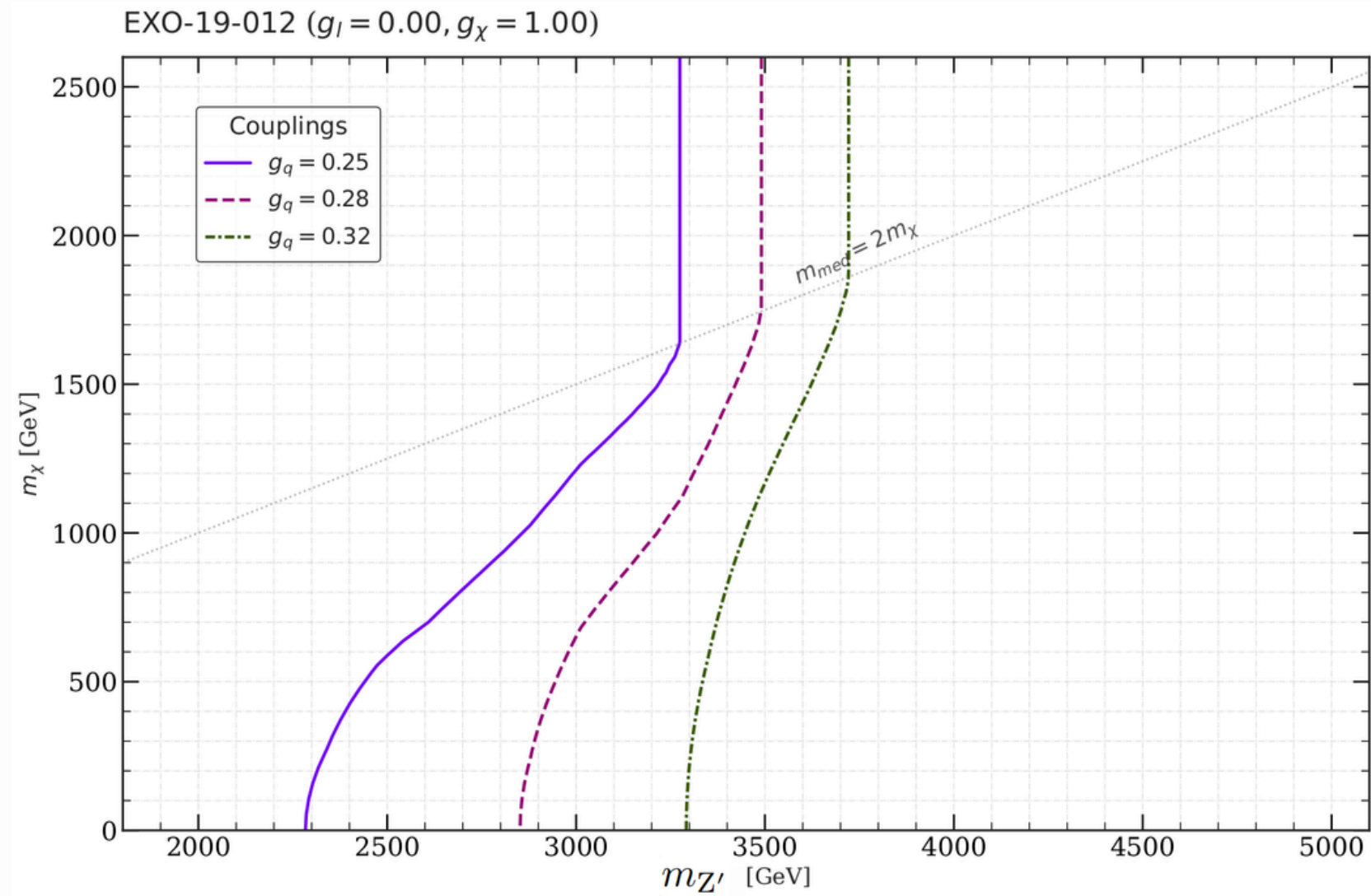
- Dijet searches:



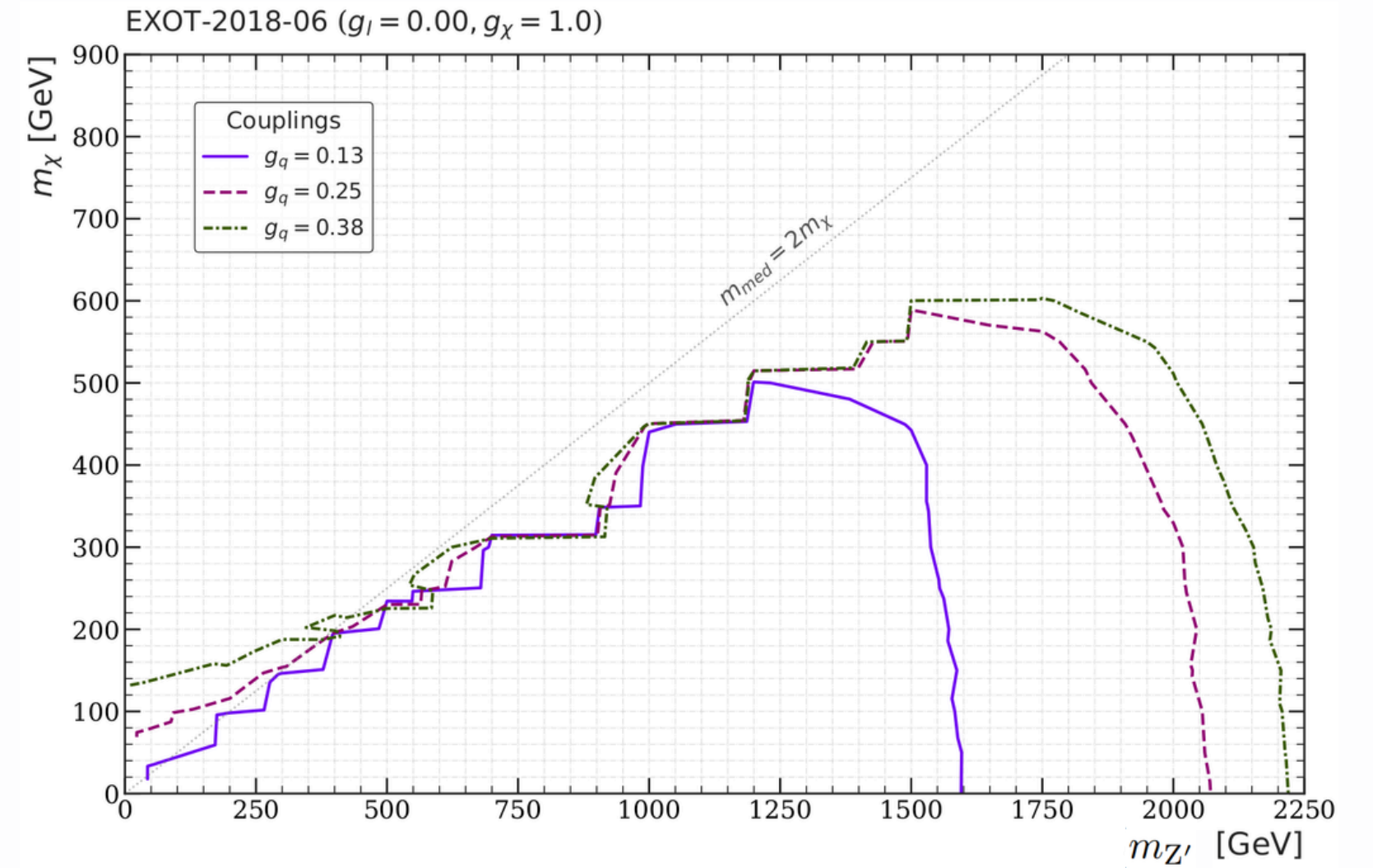
- Dilepton searches:



Preliminary results



Dijet search
(Analysis: EXO-19-012)



Monojet + MET search
(Analysis: EXOT-2018-06)

Three-body dynamics of Exotic Hadrons

Ryan Issa Sabha de Oliveira

Institute of Physics, University of São Paulo (IFUSP)

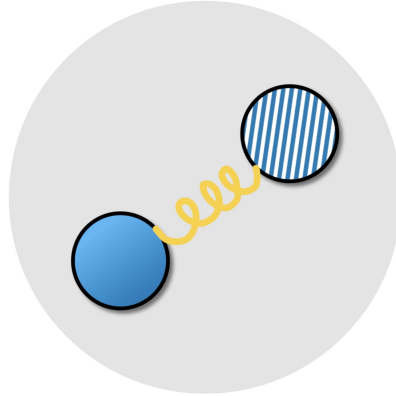
Supervisor: Prof. Alberto Martínez Torres

15th IDPASC Summer School

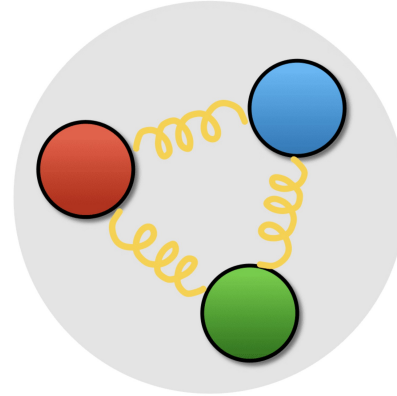
Why Exotic Hadrons?

~~According to the conventional quark model:~~

Meson



Baryon

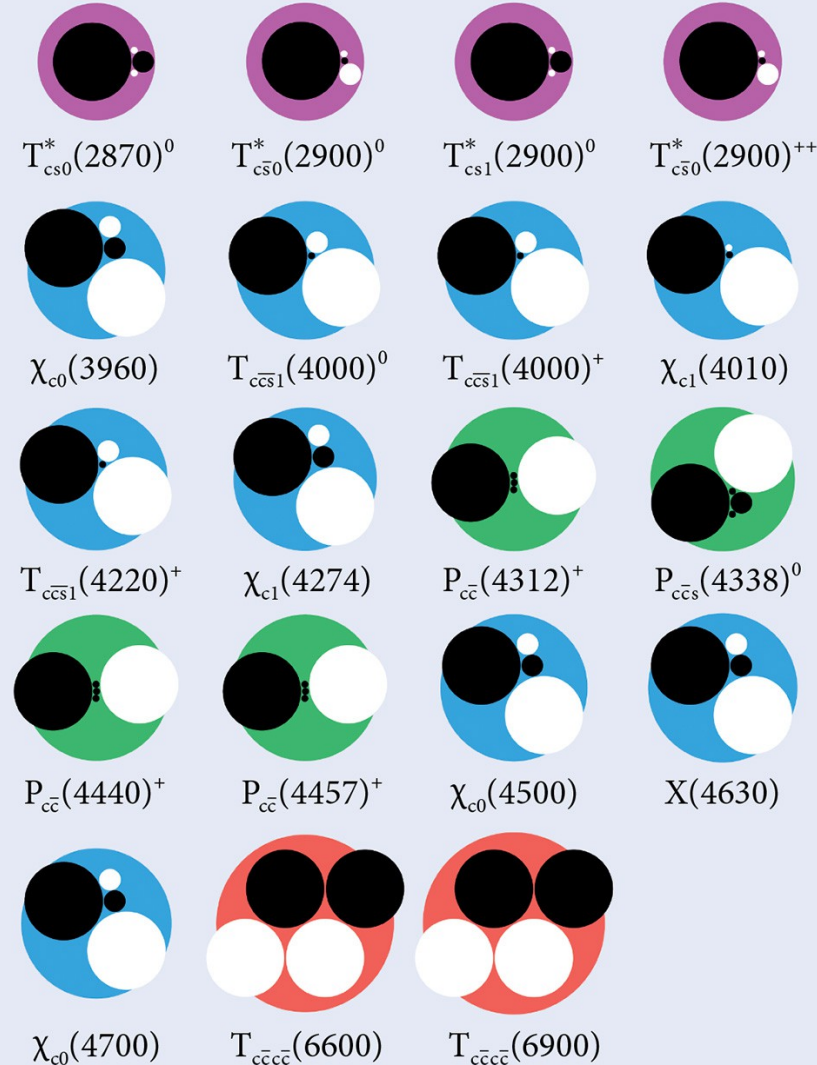


Can all hadrons be described this way?

The rise of Exotic Hadrons

During the last two decades, experiments such as LHCb have discovered dozens of exotic hadrons.

But what is their internal structure?



My project: *Studying exotic hadrons of three body nature*

Effective Lagrangians

Two-body interactions (Bethe-Salpeter equations)

Three-body dynamics (Faddeev equations)

Dynamically generated exotic hadrons



My project: *Studying exotic hadrons of three body nature*

Effective Lagrangians

Two (ons)
T)

Our goal is to understand whether three-body interactions can explain some of the exotic hadrons observed experimentally.



Dynamically generated exotic hadrons

Thank you!

Ryan Issa Sabha de Oliveira

E-mail: ryanissasabha@usp.br.

About me

Telmo Aguilar

aguilartelmo@gmail.com

Where I'm from



Where I study



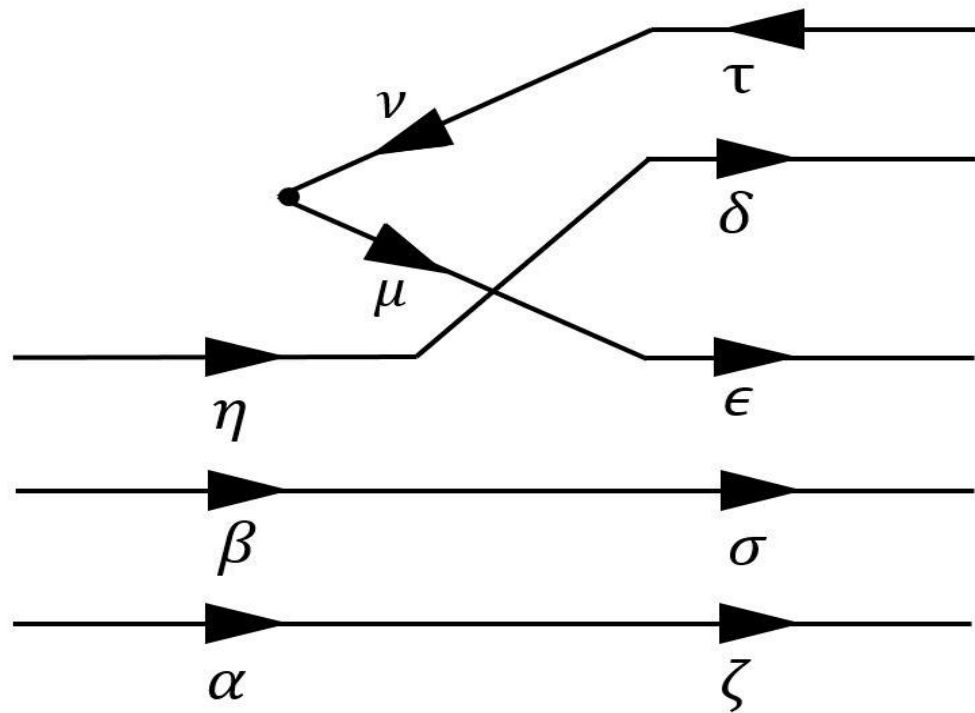
I did my undergrad
at Escuela
Politécnica
Nacional



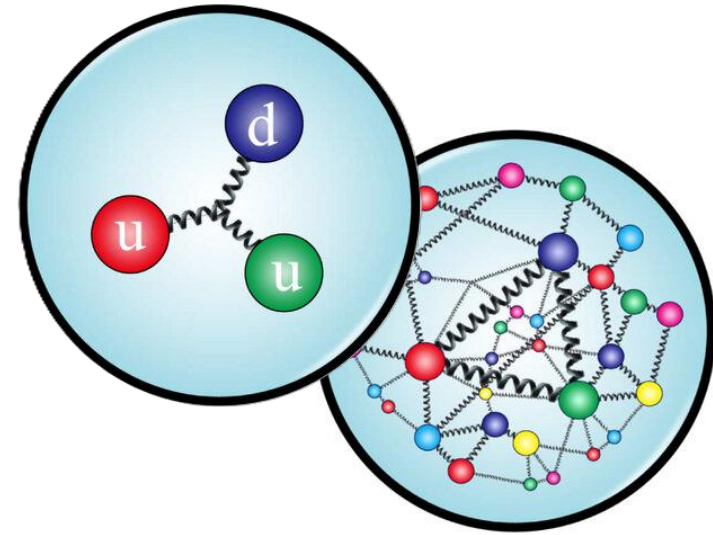
I am doing my
masters at
Universidad San
Francisco de Quito

About my research

Strong decays



Baryon spectra



$$V_{ij}^{q\bar{q}}(r) = -\frac{\kappa}{r} + \lambda r - \Lambda + \frac{\kappa'}{m_i m_j} \frac{\exp\left(-r^2/r_0^2\right)}{r_0^3} \vec{\sigma}_i \cdot \vec{\sigma}_j$$

Characterization of polynomial structures associated with q -deformed quantum potentials via the Nikiforov–Uvarov method.

Viviane Leite (Master's student)
Advisor: Dr. Francisco Brito (UFCG)
Collaborator: Amílcar Branquinho (UC)

Second-order
differential equations



Generalized
hypergeometric
equations



Theory of orthogonal
polynomials



Universidade Federal
de Campina Grande



DEPARTAMENTO DE MATEMÁTICA
FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE DE COIMBRA



q-deformed Pöschl–Teller

$$V_{PT}(r) = -V_1 \operatorname{sech}_q^2(\alpha r) + V_2 \operatorname{csch}_q^2(\alpha r)$$

q-deformed Woods–Saxon

$$V_{WS}(r) = -\frac{V_0}{1 + q e^{\frac{r-R}{a}}}$$

q-deformed Eckart

$$V_E(r) = V_1 \coth_q(\alpha r) - V_2 \operatorname{csch}_q^2(\alpha r)$$

Centrifugal term



Exact solutions unavailable



Approximation techniques (**e.g.,
Pekeris, Greene–Aldrich**)

Research problem:

How does the q-deformation of quantum potentials influence the orthogonal polynomials obtained through the Nikiforov–Uvarov method and their analytical solutions?

Photons, jets and missing momentum from a two-vector dark sector

Yoxara Sánchez-Villamizar

In collaboration with:

**Yara Do Amaral C., Benjamin Fuks, Mark Goodsell,
Bertrand Laforge, José Ocariz & Farinaldo Queiroz.**

Based on: [arXiv:2606.06607](https://arxiv.org/abs/2606.06607)



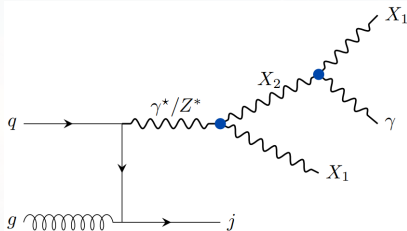
15th IDPASC Summer School • July, 2026

Two-vector dark sector and collider signature

Dark parity
 X_1, X_2 odd; SM fields even

Dimension-six portal
 hypercharge couples X_1 and X_2

Collider signature
 $pp \rightarrow X_1 X_2 + j, X_2 \rightarrow X_1 \gamma$



$\gamma + \text{jets} + E_T^{\text{miss}}$

X_1 escapes the detector; the jet gives recoil. Unlike conventional monophoton searches, the photon originates from the dark-sector decay, while the jets arise from QCD radiation.

$$E_\gamma^* = \frac{m_{X_2}^2 - m_{X_1}^2}{2m_{X_2}}.$$

Minimal two-vector EFT

$$\mathcal{L}_{\text{int}} = \frac{c_B}{\Lambda^2} B_\mu^\nu X_{1\nu}^\alpha X_{2\alpha}^\mu + \frac{\tilde{c}_B}{\Lambda^2} \tilde{B}_\mu^\nu X_{1\nu}^\alpha X_{2\alpha}^\mu$$

X_1 is stable and is the dark-matter candidate. The heavier vector X_2 decays radiatively into $X_1 \gamma$, producing a prompt photon in the benchmark region.

Backgrounds and limitations

Simulated: $Z(\nu\bar{\nu})\gamma j$, $W(\ell\nu)\gamma j$, and $t\bar{t}\gamma$.

Not simulated: subleading prompt-photon backgrounds, expected to be strongly suppressed, and instrumental $\gamma + \text{jets}$ events with fake E_T^{miss} , which require data-driven estimates and are outside the scope of this study.

Analysis setup

$$\begin{aligned}\sqrt{s} &= 13.6 \text{ TeV}, \mathcal{L} = 139, 3000 \text{ fb}^{-1}, \\ p_T^{\nu} &> 150 \text{ GeV}, p_T^j > 100 \text{ GeV}, E_T^{\text{miss}} \geq 200 \text{ GeV}, \\ &\text{lepton veto, } b\text{-jet veto.} \\ c_B &= \tilde{c}_B = 1, \quad \Lambda = 1 \text{ TeV.}\end{aligned}$$

Signal-region strategies

single-SR: $E_T^{\text{miss}} \geq 200 \text{ GeV}$

Three exclusive SRs:

SR₁

200–350

SR₂

350–450

SR₃

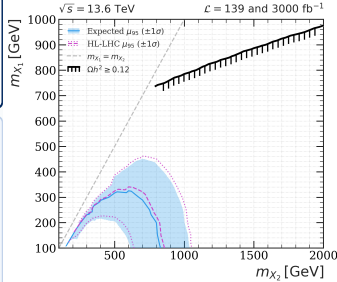
> 450

$E_T^{\text{miss}} [\text{GeV}]$

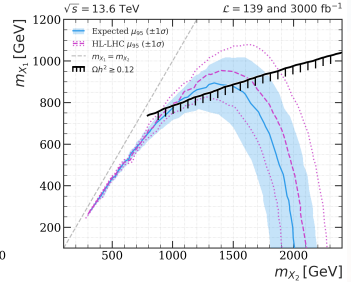
The SM background falls steeply with E_T^{miss} , whereas heavier and non-compressed signals retain a harder tail.

SR₂ and SR₃ therefore provide enhanced signal-to-background discrimination.

Inclusive single-SR



Three exclusive SRs



The three-SR strategy extends the sensitivity to significantly larger masses and covers freeze-out benchmark regions with $\Omega_{X_1} h^2 \leq 0.12$.

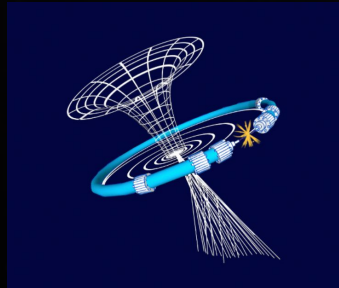
EFT caveat: the high-mass reach should be interpreted as a benchmark sensitivity, since the selected hard scales can be comparable to Λ .

VISCOUS COSMOLOGICAL MODELS

*Can this models change our
understanding of how the
Universe really works?*

Ingrid Costa,
PhD

15th IDPASC Summer School – Natal,
Brazil

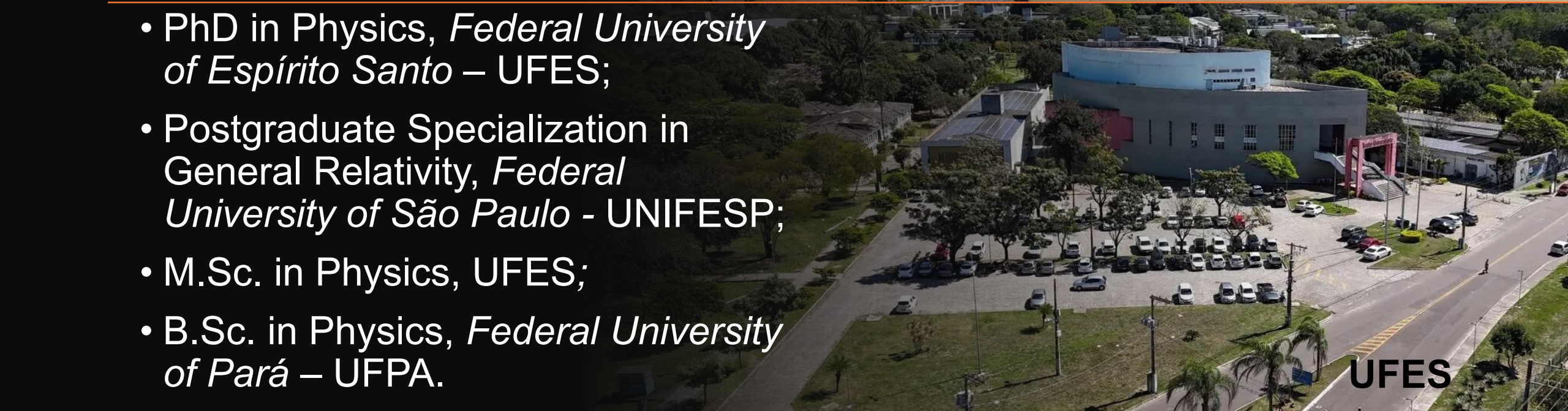


An aerial photograph of the Federal University of Pará (UFPA) campus. The image shows a large, modern building complex with a mix of white and yellow facades, surrounded by green lawns and trees. A road curves along the right side of the campus, leading to a river. The text 'ACADEMIC BACKGROUND' is overlaid in large white letters on the left side of the image.

ACADEMIC BACKGROUND

UFPA

- PhD in Physics, *Federal University of Espírito Santo* – UFES;
- Postgraduate Specialization in General Relativity, *Federal University of São Paulo* - UNIFESP;
- M.Sc. in Physics, UFES;
- B.Sc. in Physics, *Federal University of Pará* – UFPA.

An aerial photograph of the Federal University of Espírito Santo (UFES) campus. The image shows a large, modern building complex with a mix of white and blue facades, surrounded by green lawns and trees. A road curves along the right side of the campus, leading to a river. The text 'UFES' is overlaid in large white letters on the right side of the image.

UFES

A detailed visualization of the cosmic web, showing a complex network of dark matter filaments and galaxy clusters. The filaments are thin, glowing lines that connect larger, denser regions where galaxies are concentrated. The background is a deep black, making the glowing structures stand out.

RESEARCH INTERESTS

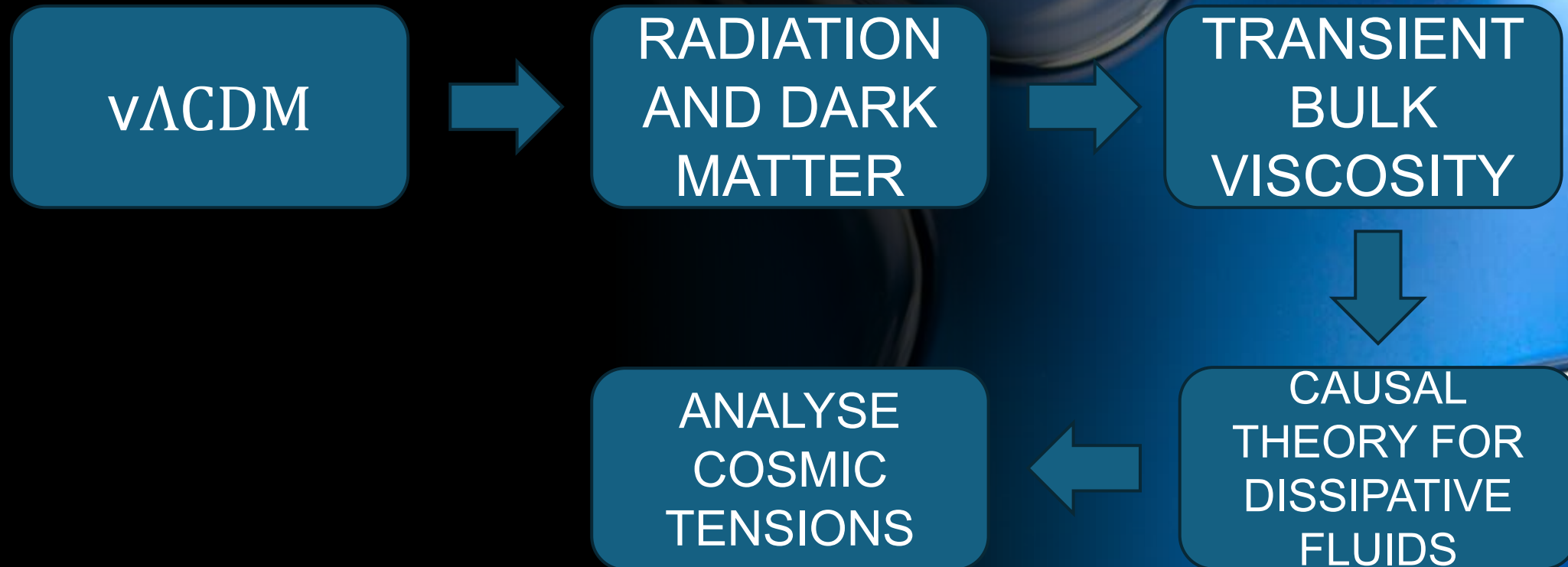
Theoretical and Observational
Cosmology, in special:

- Viscous Cosmological Models;
- Cosmological Tensions;
- Dark Matter;
- Large Scale Structure.

But also:

- Astrobiology;
- Physics Education.

CURRENT RESEARCH



A vibrant cosmic background image featuring a large, bright nebula with pink, purple, and blue hues on the left side, set against a dark space filled with distant galaxies and stars.

RESEARCH PERSPECTIVE S

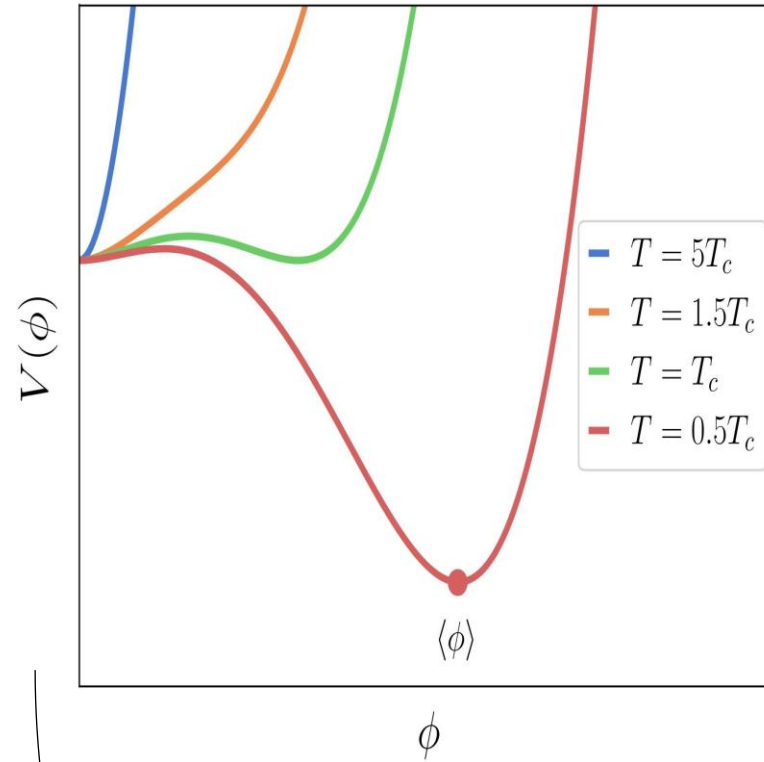
- Study the cosmological parameters in the new viscous cosmic framework;
- Analyse how cosmic tensions will behave, mainly Hubble;
- Compare these results with observational data



Thank you all!

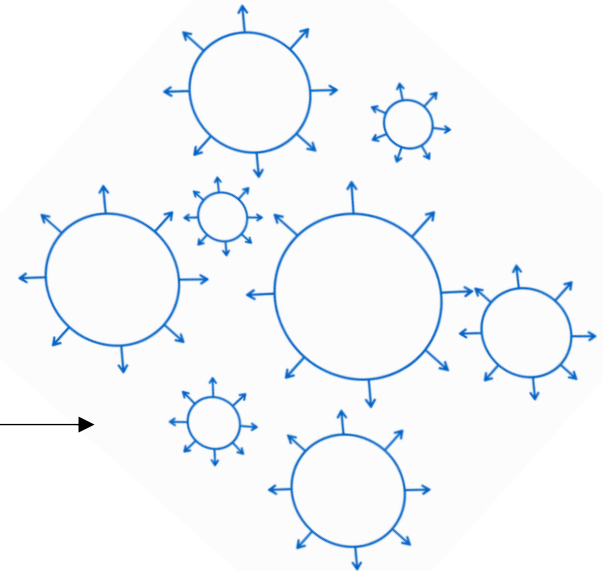
JESÚS LUQUE

- PhD student at Complutense University of Madrid
- Thesis on cosmological First Order Phase Transitions
- Special focus on the phenomenology and signals FOPTs produce



Probabilistic mechanism

The transition proceeds through bubble nucleation



SO FAR...

Particle production during FOPTs

- Efficient production for different types of interactions
- Allows for the production of very heavy particles, since momentum is not conserved
- The mechanism is efficient regardless of the velocity of the bubbles

arXiv: [2407.14592](https://arxiv.org/abs/2407.14592) [hep-ph]

FOPTs during inflation

- Two-field inflationary model: an inflaton in a Starobinsky-like potential and a spectator field
- The spectator field undergoes a phase transition that ends inflation
- The mechanism changes the inflationary predictions for n_s , r

Also working on a LISA project: Reinterpreting GW Signals from Phase Transitions in Particle Physics Model Parameter Space



Who am I & my research universe

José Luis Medina García

Physics department, University of Guanajuato

Research topics:

Ultralight Dark Matter (Boson stars & Proca stars)

UNIVERSIDAD DE
GUANAJUATO



E-mail: jlmedinagarcia@ugto.mx /
joseluismedinagarcia207@gmail.com

Orcid: [https://orcid.org/
0009-0009-2388-9600](https://orcid.org/0009-0009-2388-9600)

Research topics

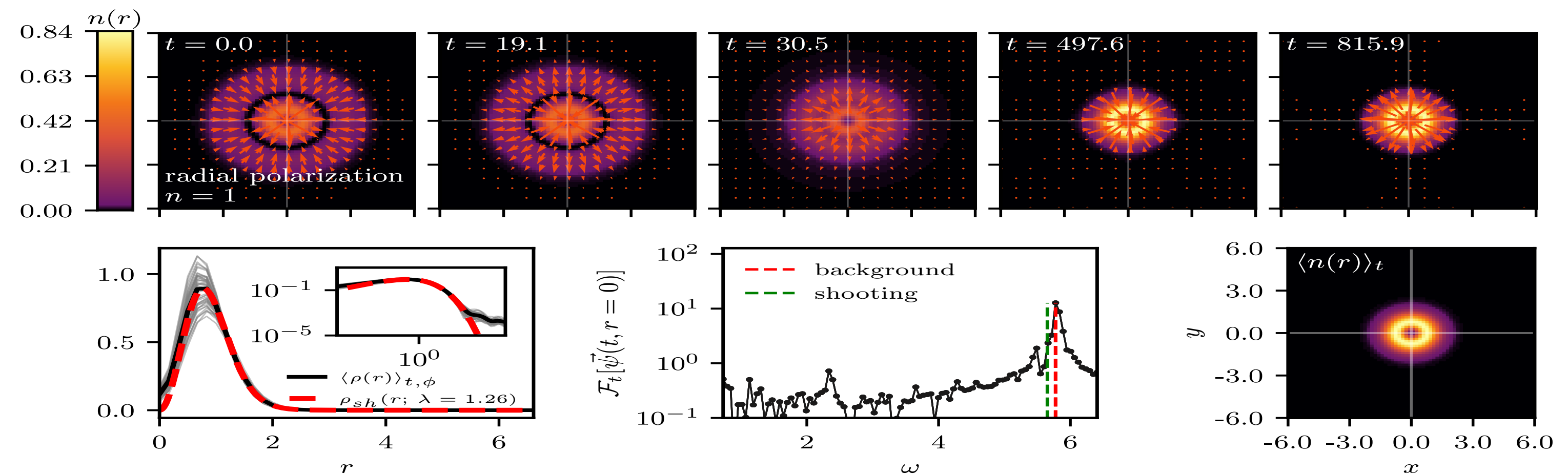
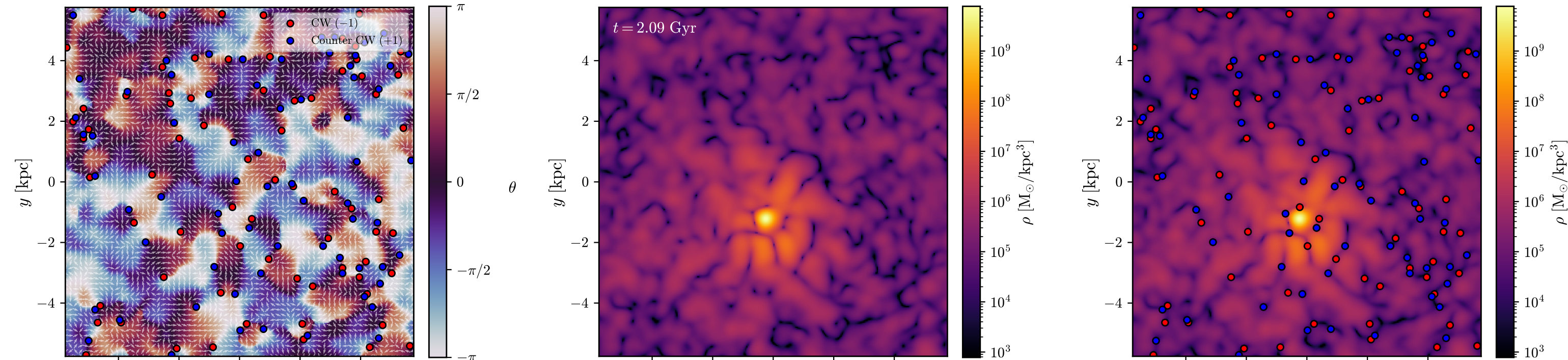
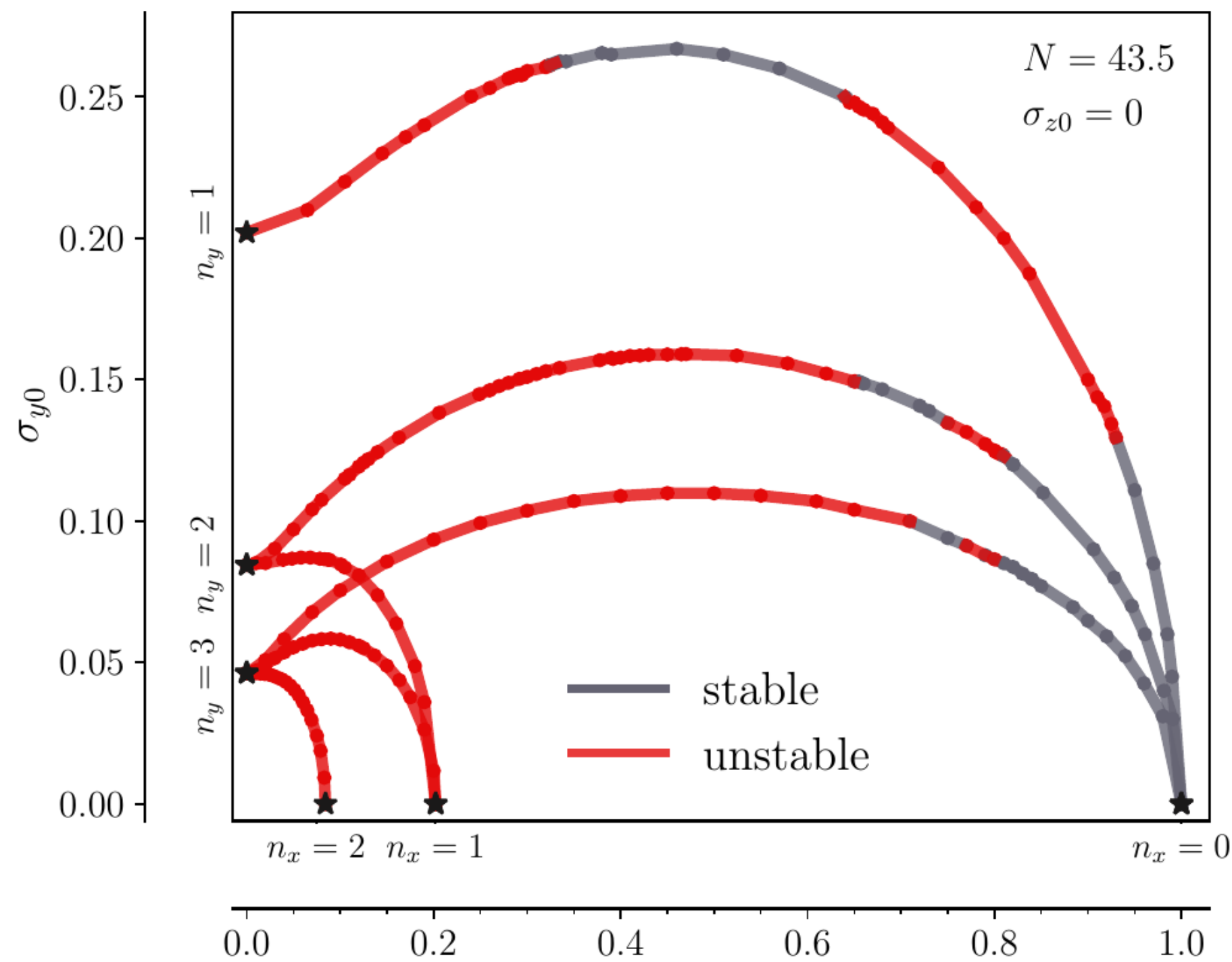
Ultralight Dark Matter (Boson stars & Proca stars)

Stability tests

Halos formation

Numerical evolutions

Linear perturbations



Amanda Guerrieri

Ph.D. Candidate in Physics • Brazilian Center for Physics Research (CBPF), Rio de Janeiro, Brazil

IDPASC 2026 Student Pitch

Research Focus

- Relativistic gravity and compact objects
- Neutron-star oscillations and stability
 - 1°) Dissipative Effects of relativistic hydrodynamics
 - 2°) Modified theories of gravity and Strong-field tests of General Relativity

Neutron stars

allow us to study matter and gravity under extreme conditions.

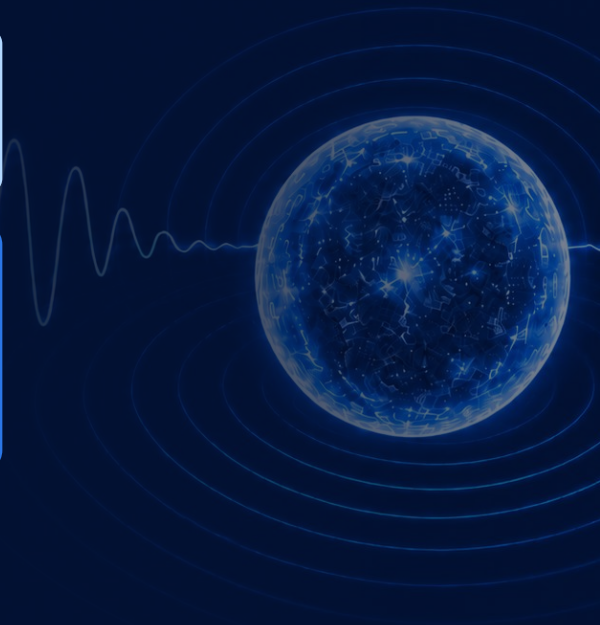
Approach

- Radial perturbation theory
- Numerical eigenvalue problems

Main Scientific Question

How do viscosity, temperature and modified gravity affect the oscillations and stability of neutron stars?

Recent works: Mendes et al., Phys. Rev. D 113 (2026) • Guerrieri et al., arXiv:2606.06600



Amanda Guerrieri

Ph.D. Candidate in Physics • Brazilian Center for Physics Research (CBPF), Rio de Janeiro, Brazil

IDPASC 2026 Student Pitch

1. Dissipative neutron stars in General Relativity

- Radial oscillations of viscous neutron stars
- Causal relativistic hydrodynamics and Israel-Stewart system of equations complement the set of equations of GR
- Viscous effects enter as first-order perturbations in the energy-momentum tensor, defined in terms of :

Bulk viscosity, shear viscosity, and heat diffusion

- **Results** : Additional non-hydrodynamic and thermal modes, which have effects on the stability analysis

Recent works:

Mendes et al., Phys. Rev. D 113 (2026) • Guerrieri et al., arXiv:2606.06600

2. Neutron stars in modified gravity

- Scalar-Gauss-Bonnet gravity
- These theories can predict a new class of neutron star solutions :

Scalarized neutron-star branches in the Equilibrium sequence of neutron stars

- Radial perturbations allow us to study the dynamical stability of these configurations
- Connection to strong-field tests of gravity

Representative papers:

Doneva & Yazadjiev (2018) • Ventagli et al. (2021)

Next step:

From radial modes to gravitational-wave observables: axial and polar perturbations, dynamical tides, and the Einstein Telescope.

Gabriel Fernandes

Fortaleza, Brazil 

PhD student at the Federal University of Ceará

Research interests

- General Relativity
- Black Hole Shadows
 - Ray Tracing
- Entropic Gravity
 - Cosmology



Gravitational Waves in Hořava-Lifshitz Theory

J. L. A. Silva¹

¹Universidade Federal de Campina Grande

IDPASC, July 2026

We study the generation and propagation of gravitational waves in Hořava-Lifshitz theory, characterized by a modified tensor dispersion relation

$$\omega^2 = k^2 + \alpha k^4. \quad (1)$$

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We begin by discussing how gravitational waves arise from general relativity, through a linearized theory, writing the metric as

$$g_{\mu\nu} = \eta_{\mu\nu} + h_{\mu\nu}, \quad (2)$$

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that is, treating it as a classical field theory of the field $h_{\mu\nu}$ existing in a flat spacetime with a Minkowski metric. From this, we see how a wave equation arises and how the choice of an appropriate gauge simplifies its form.

Next, we analyze what happens to conventional polarization states when higher-order spatial derivative corrections are taken into account.

$$\epsilon_{\mu\nu} = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & \epsilon_+ & \epsilon_\times & 0 \\ 0 & -\epsilon_\times & \epsilon_+ & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \quad (3)$$

We construct the retarded Green's function of the modified wave operator

$$h_{ij}^{TT}(x) = \int d^4y G^{ret}(x-y) J^{TT}(y), \quad (4)$$

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where G^{ret} satisfies

$$(\partial_t^2 - \nabla^2 + \alpha \nabla^4) G^{ret}(t, \vec{x}) = \delta(t) \delta^3(\vec{x}). \quad (5)$$

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And whose solution is given by

$$G^{ret}(t, r) = \Theta(t) \left[\frac{\delta(t-r)}{4\pi r} + \frac{\alpha}{8\pi r} (4\delta'' - r\delta''')(t-r) \right] + O(\alpha^2). \quad (6)$$

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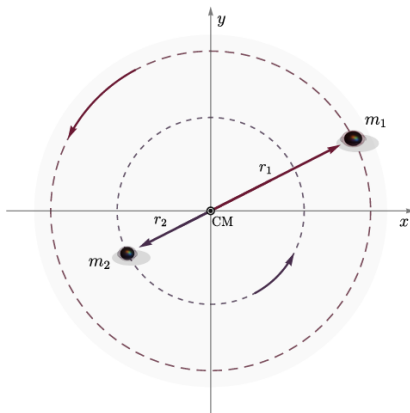
$$(\partial_t^2 - \nabla^2 + \alpha \nabla^4) G^{ret}(t, \vec{x}) = \delta(t) \delta^3(\vec{x}). \quad (5)$$

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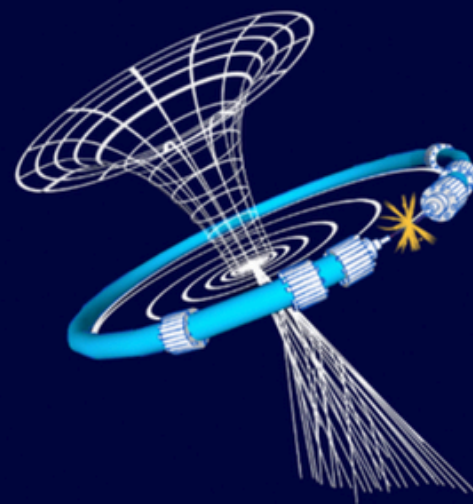
$$G^{ret}(t, r) = \Theta(t) \left[\frac{\delta(t-r)}{4\pi r} + \frac{\alpha}{8\pi r} (4\delta'' - r\delta'''(t-r)) \right] + O(\alpha^2). \quad (6)$$

We also derive the radiation zone waveform to first order in α .

Finally, we apply the formalism to a binary black hole system in a nearly circular orbit and obtain the polarization waveforms for an arbitrary observation direction.



15th IDPASC
Summer School



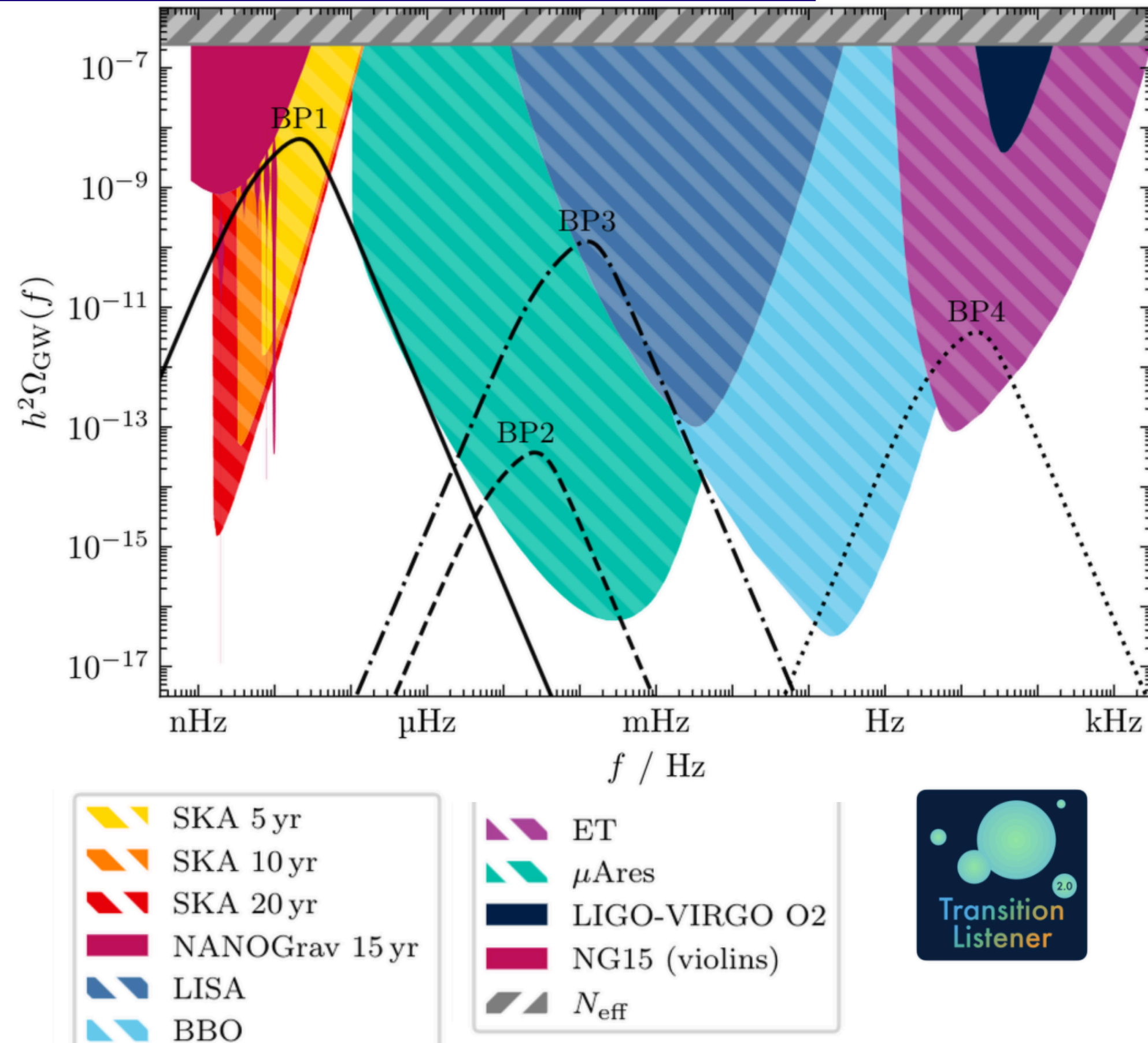
Gravitational-Wave Probes of Dark Matter Scenarios Beyond the Standard Model

Vítor Pereira

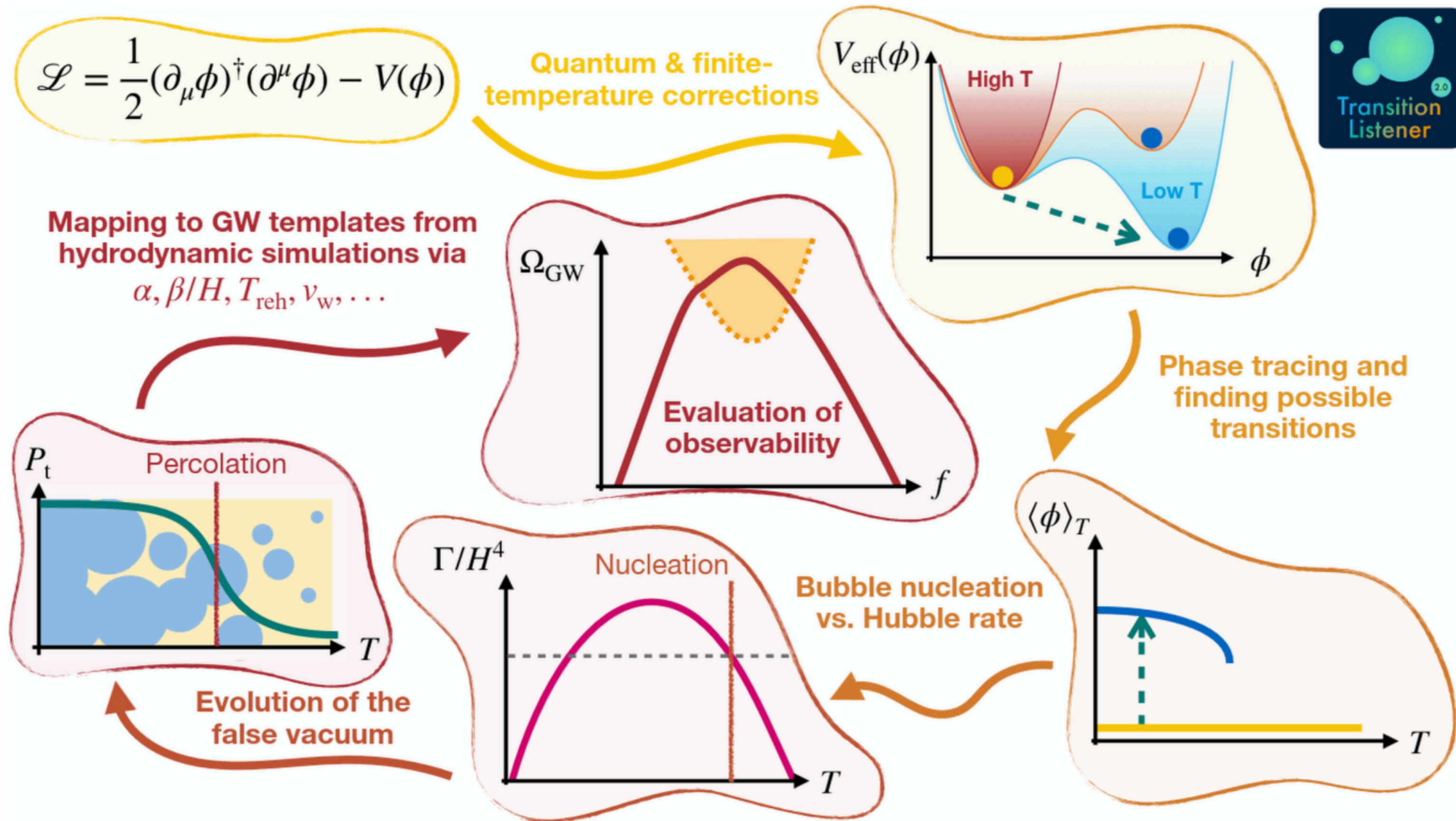
PhD Candidate

The Physical Motivation and the Gap

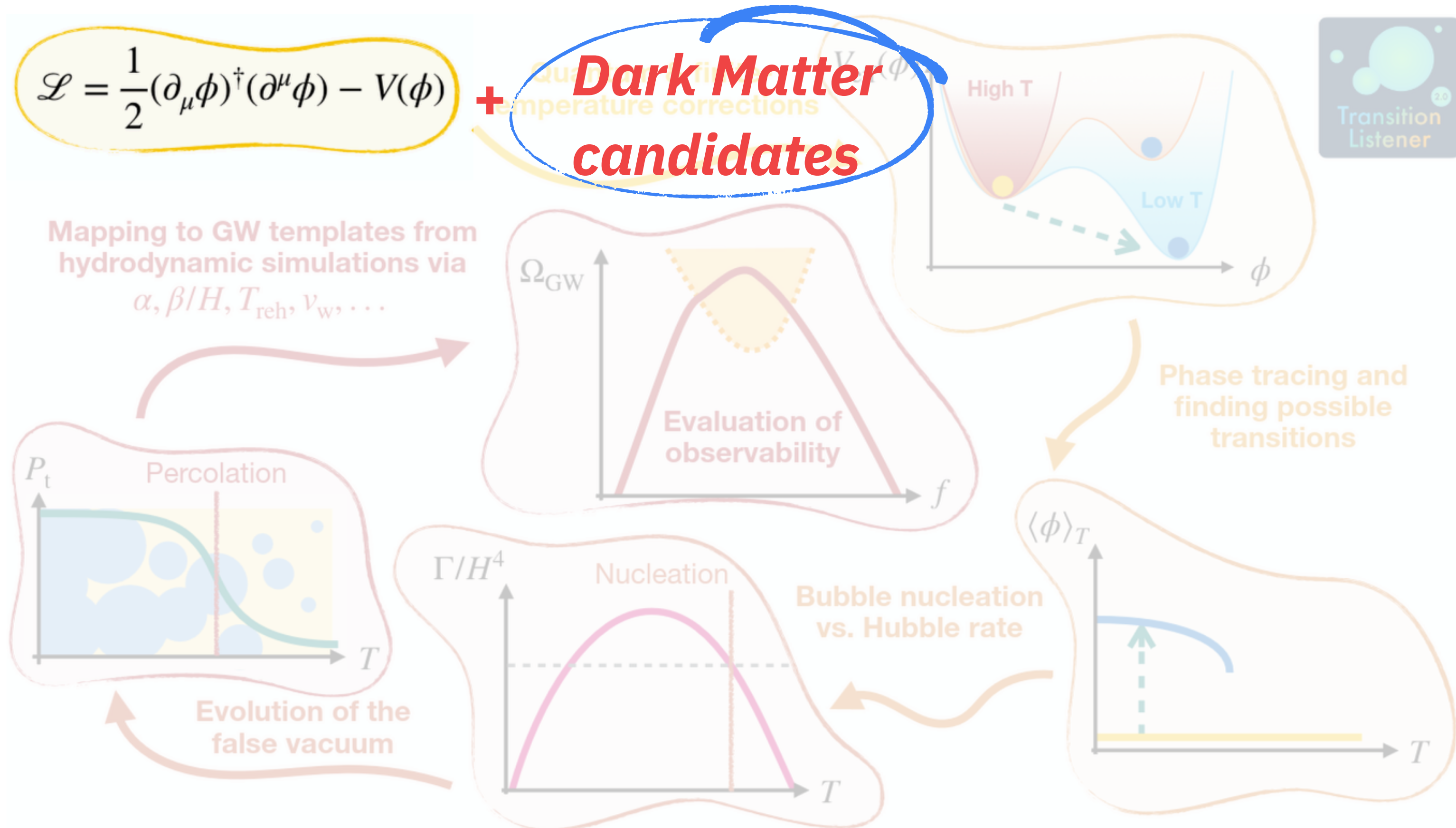
- **Fundamental Limits:** Traditional colliders are constrained by kinematic energy thresholds.
- **Direct Detection:** Limited by local dark matter densities and experiments sensibility.
- **The Unshielded Laboratory:** The early universe offers a unique environment to probe dark matter origins.
- **Observational Era:** Gravitational waves allow us to bypass these experimental limits.



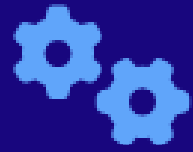
The Mechanism: Phase Transitions & Bubble Walls



The Mechanism: Phase Transitions & Bubble Walls



Next Steps & Collaboration



Current Focus

- Extending the stochastic GW framework to alternative dark matter scenarios.
- Apply different approaches to the PT and Bubble nucleation phenomena.



Colaboration

- Cosmological Phase Transitions
- Early Universe Physics
- BSM Dark Matter Candidates

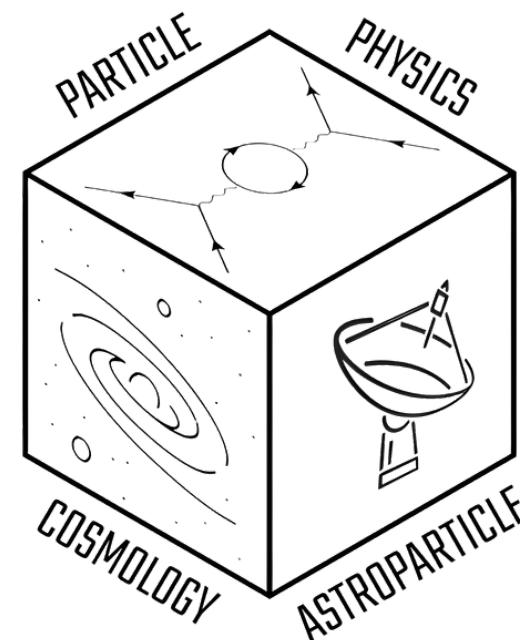


Let's Discuss

Seeking insights from researchers working on PT, EWBG, DM phenomenology and GW.



INTERNATIONAL
INSTITUTE OF
PHYSICS
Federal University of Rio Grande do Norte



Inspire HEP Profile

ANA CAROLINA OLIVEIRA

Academic Trajectory



Bachelor's Degree in Physics

- Undergraduate Research Student in the CONNIE Experiment (*Profs. Carla Bonifazi and Irina Nasteva*).
- Skipper-CCD Data Analysis.



Master's in Physics

- Development of a Convolutional Neural Network for Point-Like Event Characterization (*Profs. Carla Bonifazi and Martin Makler*).



PhD Student in Physics

- Refinement and implementation of the neural network in the experiment's analysis pipeline (*Profs. Carla Bonifazi and Martin Makler*).

2023

2025

NOW

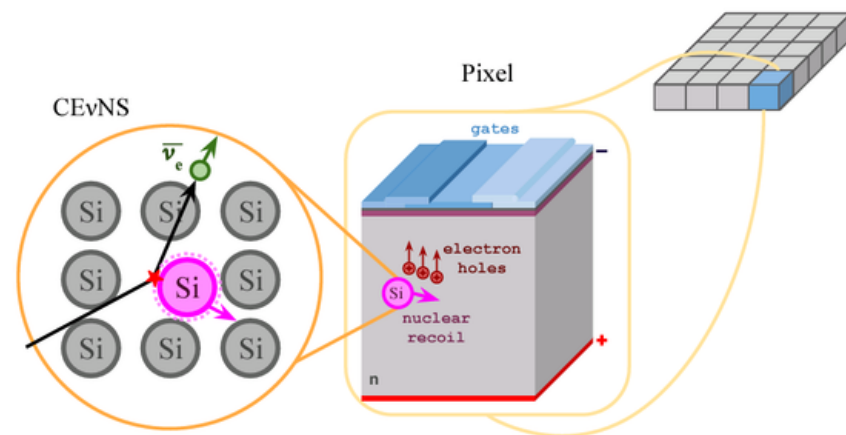


Connie Experiment

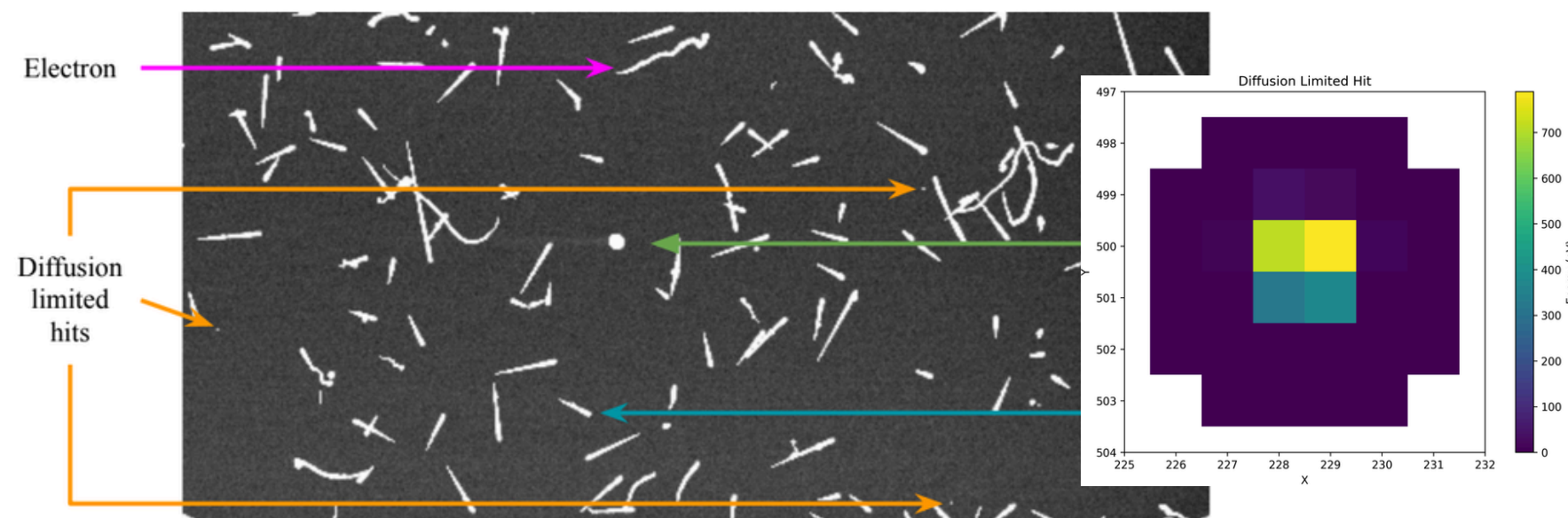


co.vNie

- The CONNIE experiment, 30 m from the Angra 2 reactor, aims to detect low-energy coherent antineutrino-nucleus scattering (CEvNS) using Skipper-CCDs.

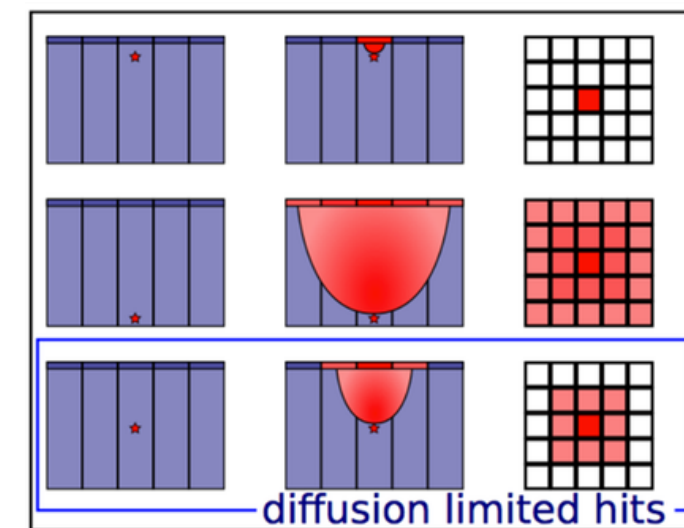


Neutrino-induced recoils generate electron-hole pairs.



The main challenge...

CEvNS candidates are characterized by their interaction depth.



Current method:
2D Gaussian fit

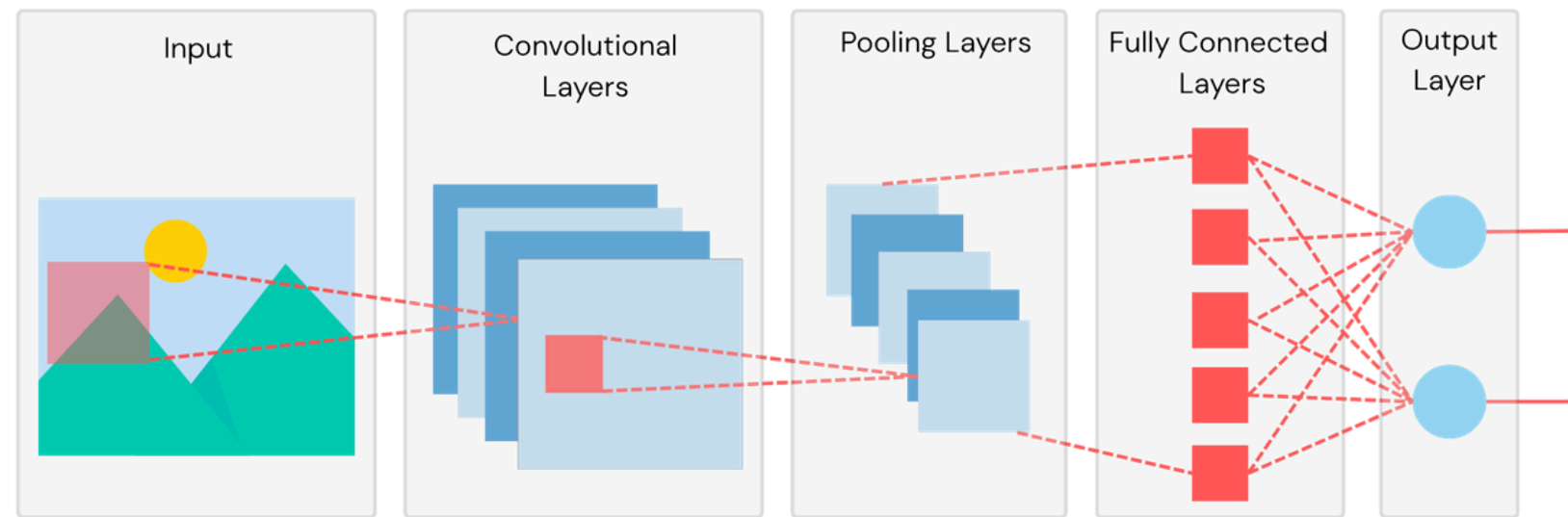
Not accurate for
few-pixel events.



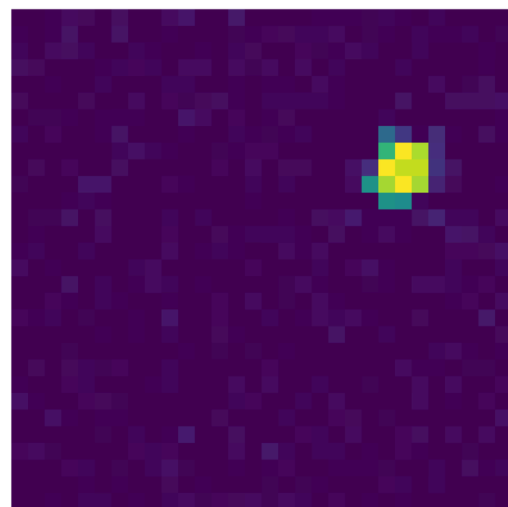
My project

Removing surface events is essential to reduce spurious events.

- We developed a CNN to reconstruct event depth from the diffusion pattern.



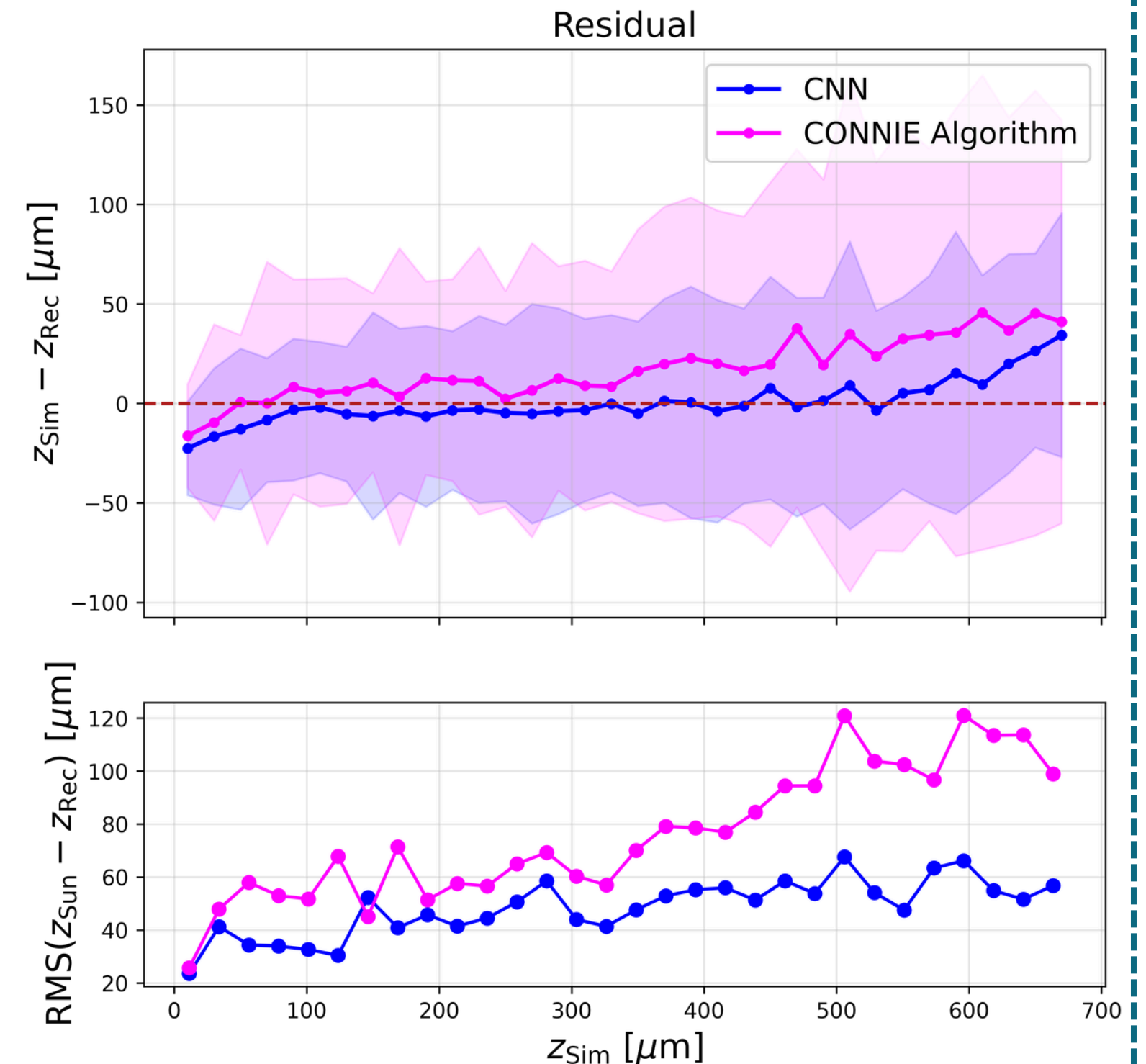
- The CNN was trained using simulated images.



We simulated approximately 39,000 images with background and a single point-like event with energies between 15 and 1015 eV.



Recent results show that the CNN is more accurate.



Thank You



Academic Background

Patrick Lemos, PhD student at CBPF

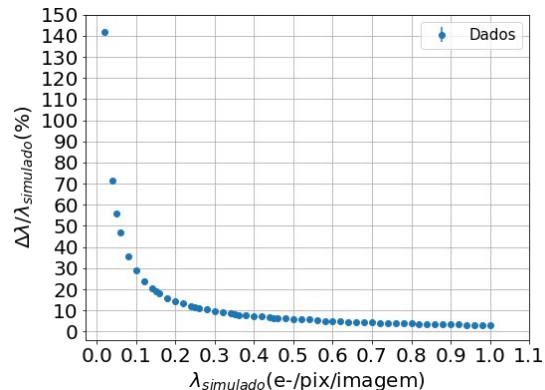
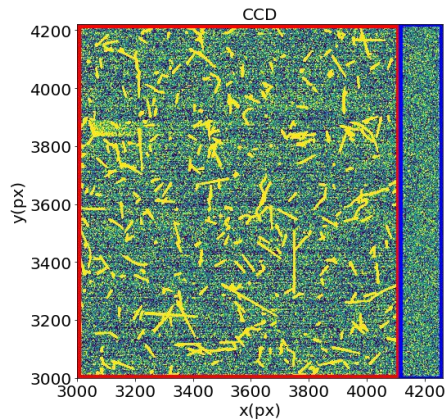
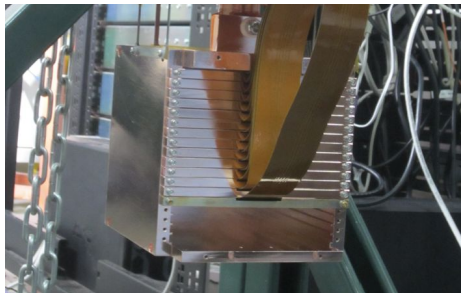
IDPASC 2026

Graduation

Bachelor's Degree in Physics (UFRJ) (2019–2023): CI in the CONNIE experiment (Coherent Neutrino-Nucleus Interaction Experiment) under the supervision of Carla Bonifazi (Cnpq) and Irina Nasteva (Faperj).

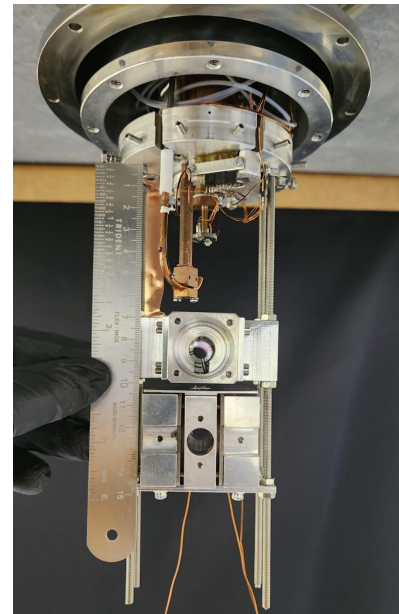
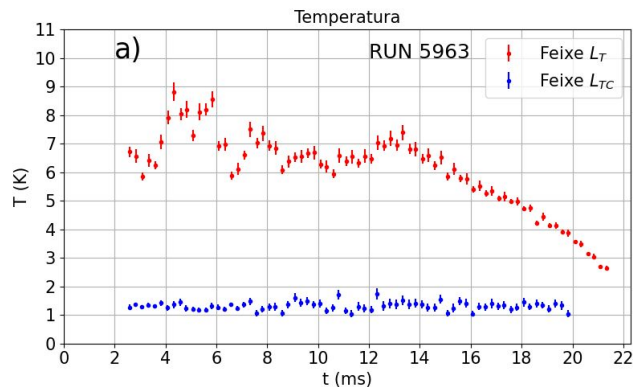
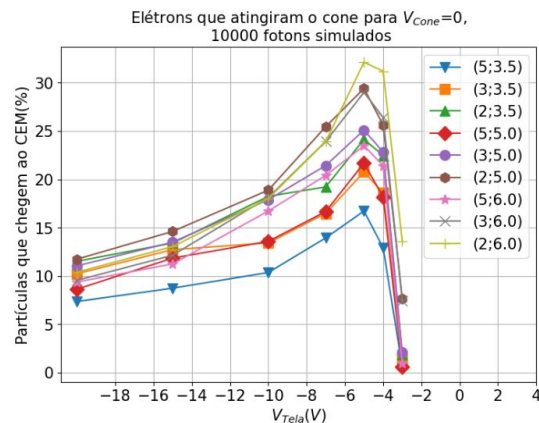
Project: Characterization of the muon flux in the experiment's detectors.

Work performed: Simulation of muon tracks in the detectors, selection of muon events, and simulations of readout noise and dark current in the detectors.



Master's Degree

- Master's Degree in Physics (UFRJ) (2024–2025): LASER Laboratory (Laboratório de Super Espectroscopia do Rio de Janeiro) under the supervision of Rodrigo Lage Sacramento.
- Project: Experimental apparatus for 1S-2S spectroscopy of hydrogen.
- Development: Cryostat assembly of the apparatus to perform 1S-2S spectroscopy of H, analysis of atomic beams, simulation of the experiment's detection efficiency.

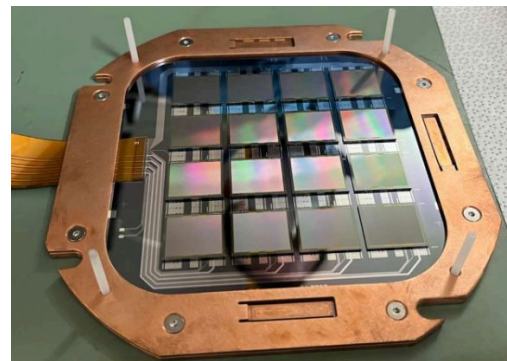
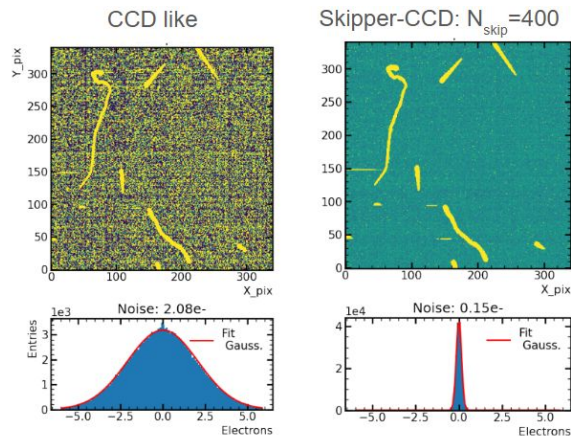


PhD (Set 2025-Jul 2026)

CONNIE/DarkBeaTS/Oscura Experiments. Advisor: Carla Bonifazi.

Project: Use of Skipper CCD sensors for nuclear reactor neutrino physics and the search for dark matter candidates.

Work in progress: Analysis of data collected by the MCM (Multi-Module Chip) module from the CONNIE and DarkBeaTS experiments.

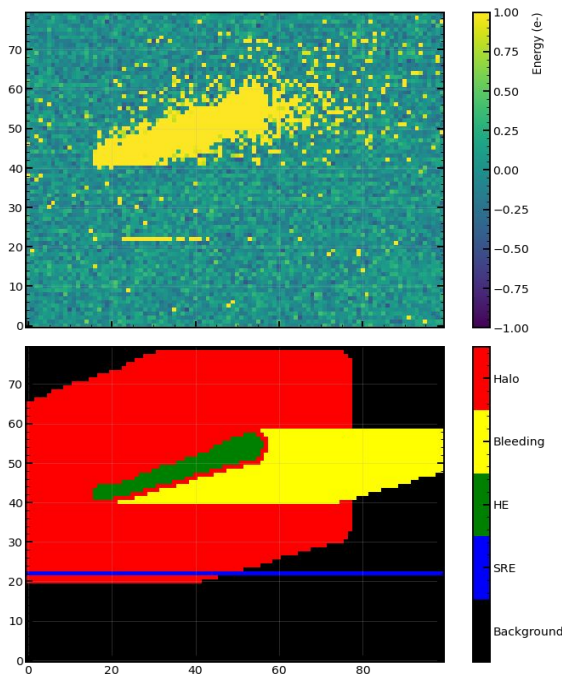
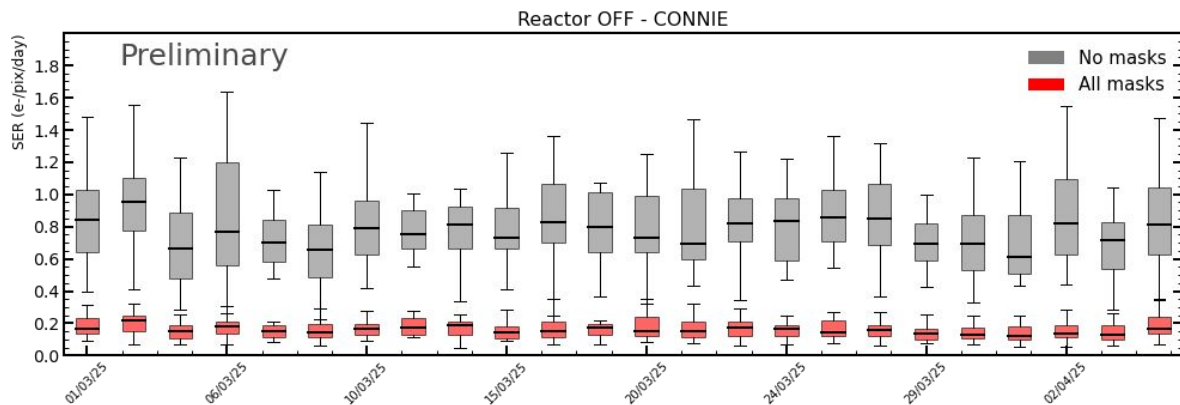


PhD (Set 2025- Jul 2026)

CONNIE/DarkBeaTS/Oscura Experiments. Advisor: Carla Bonifazi.

Project: Use of Skipper CCD sensors for nuclear reactor neutrino physics and the search for dark matter candidates.

Work in progress: Noise characterization and development of masks.



Thank you

- email: patricklemos@cbpf.br

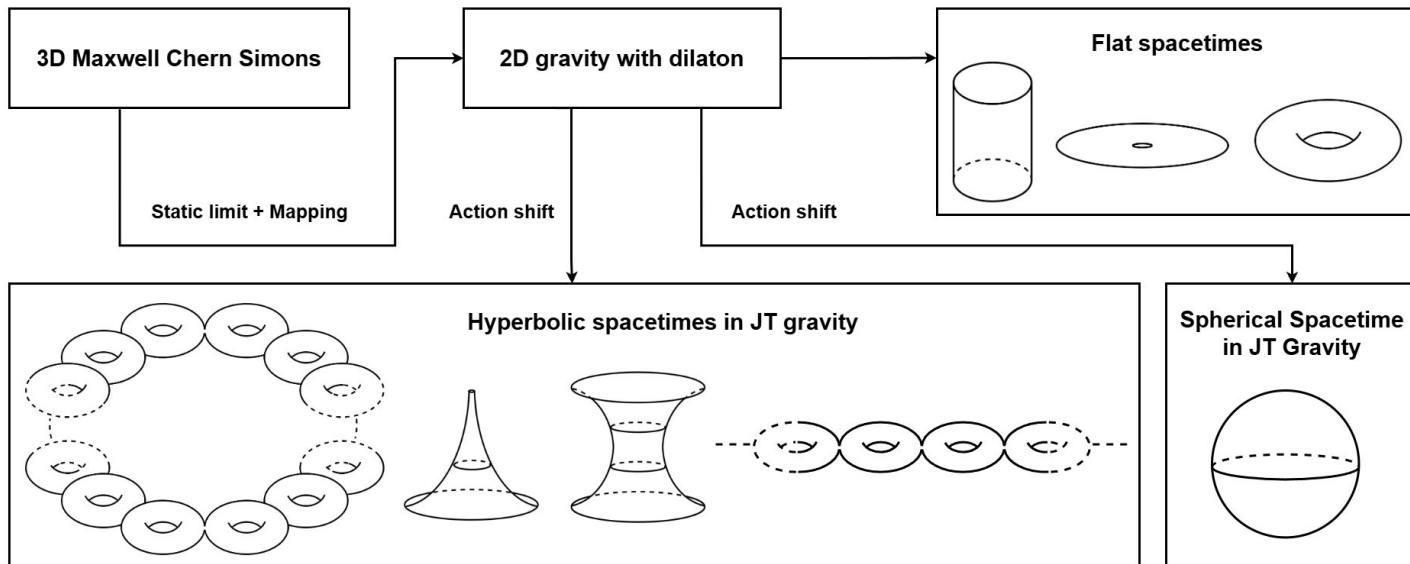


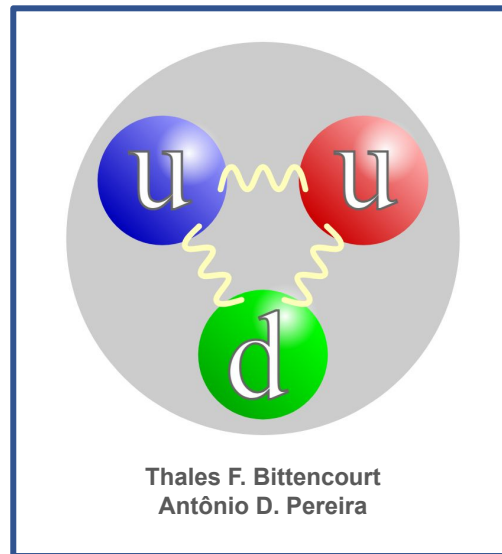
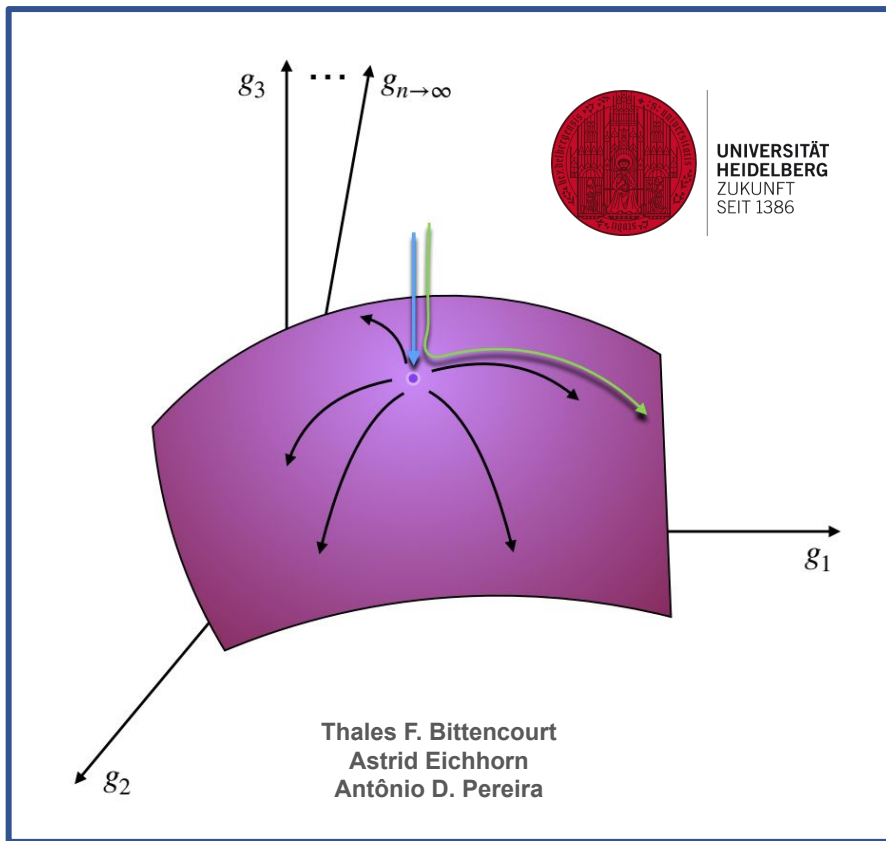
Chinese Journal of Physics

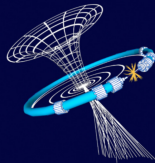
Volume 98, December 2025, Pages 368-383

Thales F. Bittencourt

Rodrigo F. Sobreiro







Advances in Light Detection Techniques for Neutrino Experiments

Aroldo Moreira

Instituto Tecnológico de Aeronáutica

IDPASC 2026

My Background

Bachelor's Degree in Physics

Universidade Federal de Minas Gerais – UFMG



MSc Student in Particle Physics

Instituto Tecnológico de Aeronáutica – ITA

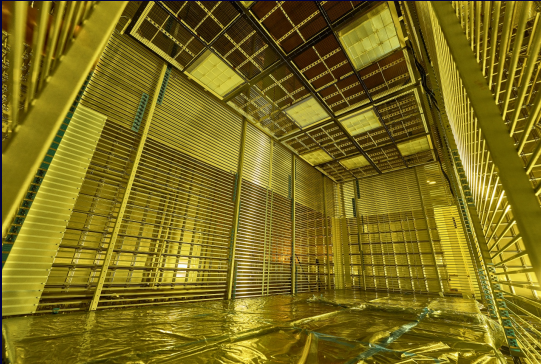


Member of the DUNE Collaboration

Deep Underground Neutrino Experiment



My Research: Photon Detection in ProtoDUNE-VD



ProtoDUNE-VD detector at CERN

Context

ProtoDUNE-VD tests detector technologies for the DUNE experiment.

My Work

Improve photon-signal reconstruction, waveform processing and detector-response analysis.

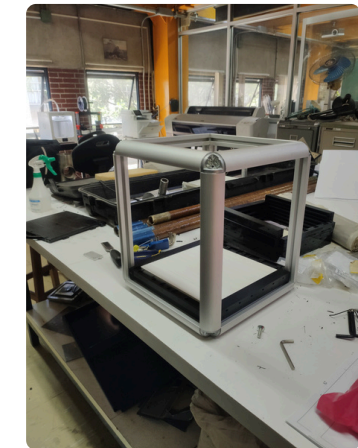
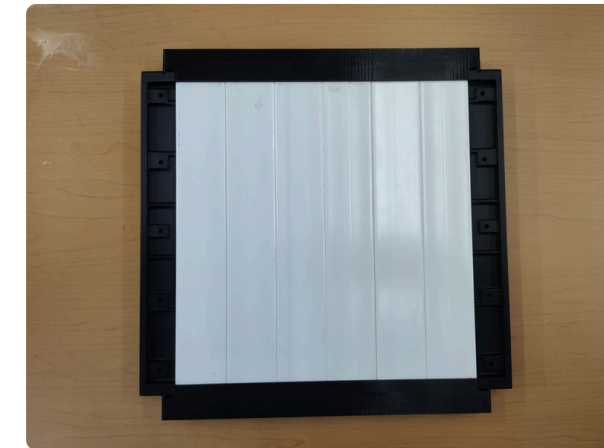
Francisco Jose Santiago-Martinez

- **M.Sc. in Physical Sciences**
IF-UNAM, expected 2026
- **B.Sc. in Physics**
FC-UNAM
- **Teaching Assistant**
Nuclear and Subnuclear Physics, FC-
UNAM



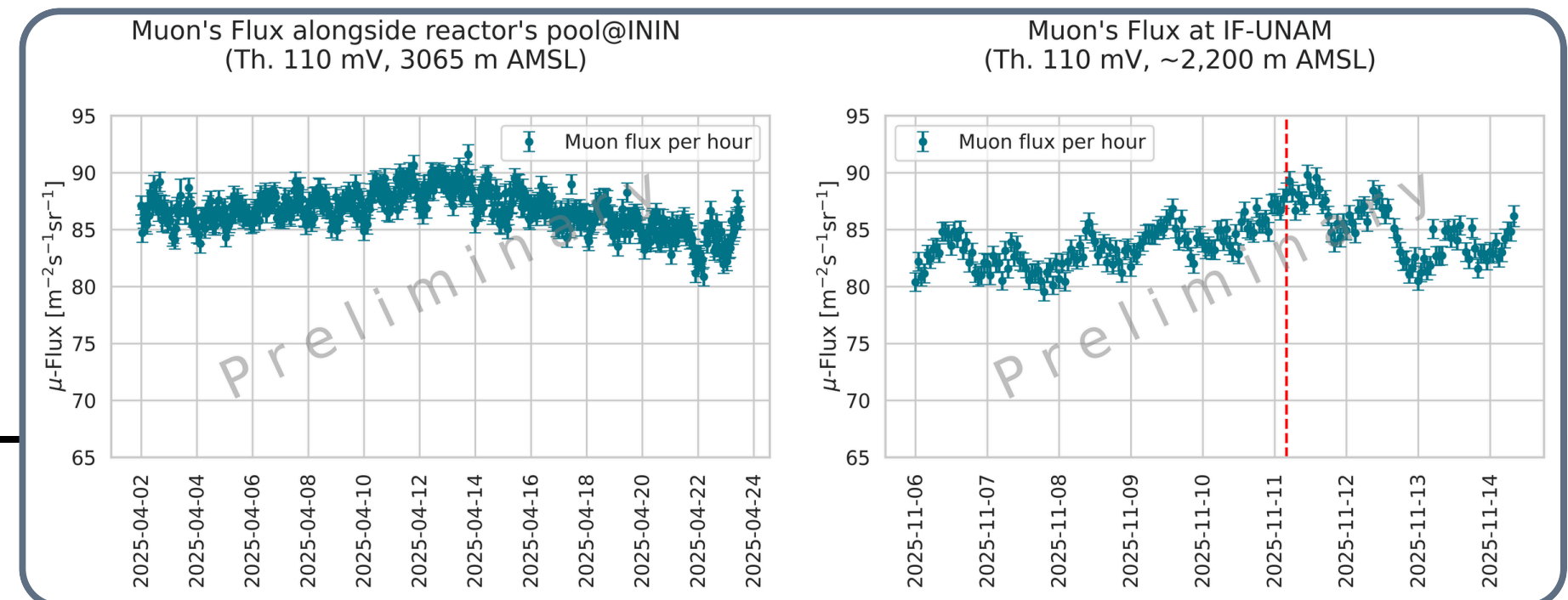
Current Research

- Cosmic Rays Cube Detector @ IFUNAM
 - Geant4 simulation of the CRC detector
(Smith-Duller & $\cos^2\theta$ muon generator)
 - Estimation of Muon-Induced Backgrounds
at the National Institute of Nuclear
Research (ININ, Mexico)
 - Measurement of Atmospheric Muon flux at
Mexico City
 - Structural design, 3D printing of detector
 housings, and system assembly for the CRC



Other work

- Measurement of gamma ray ambient
background using NaI/PMT and HpGe.



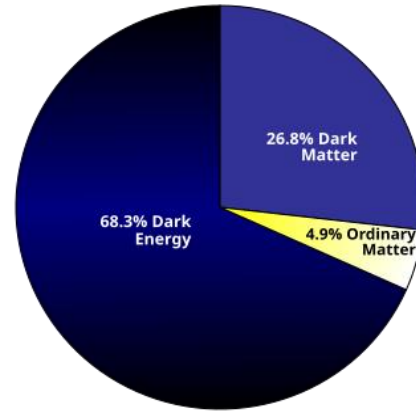


**Thanks for
your attention
:)**

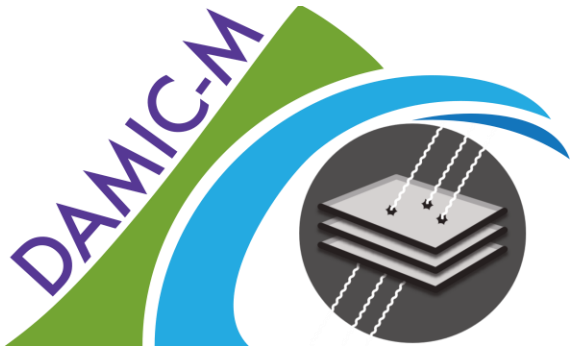
Hello ! I am Harrys, a 1st year PhD student at LPNHE in Paris (France)



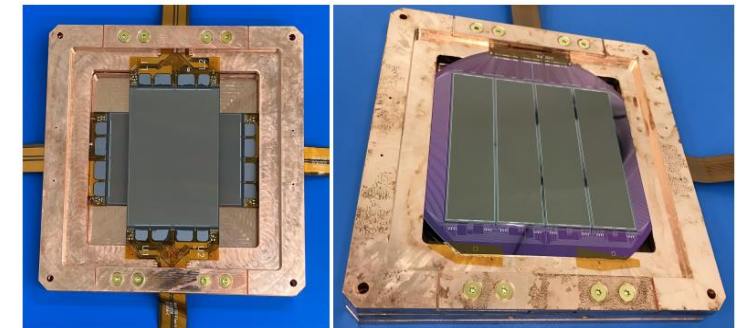
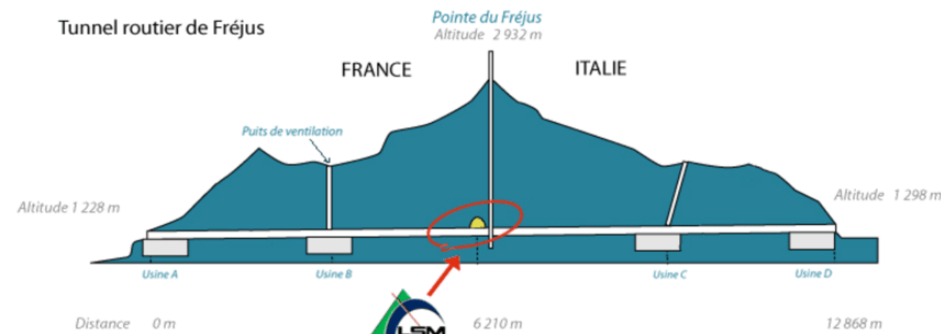
Looking for Dark Matter using CCDs



Distribution of energy and matter in the Universe



DAMIC-M (Dark Matter In Ccds in Modane)



Charged Coupled Devices (CCDs)



Stony Brook
University

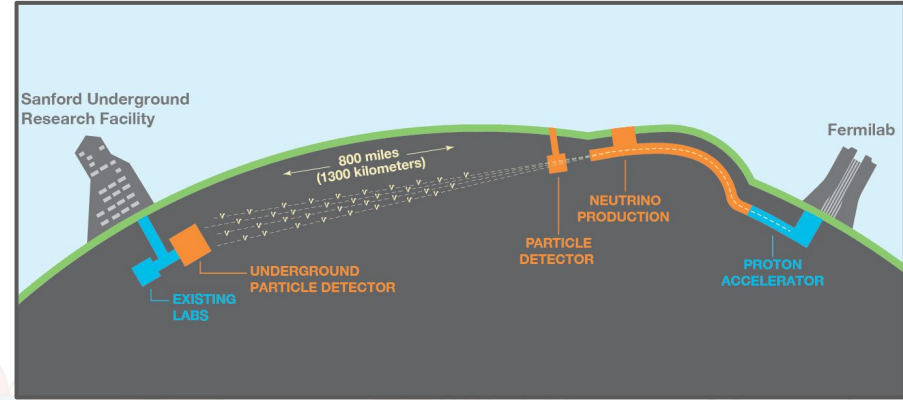


MONTE CARLO MODELING OF A 2-TON LIQUID ARGON TEST APPARATUS FOR SCINTILLATION DETECTOR R&D

S. Araújo (UFPel), F. Marinho (ITA), W. Shi (SBU)

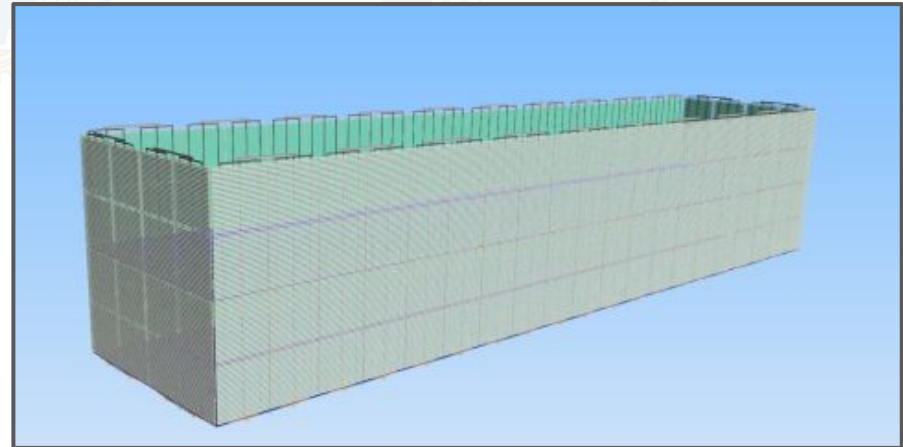
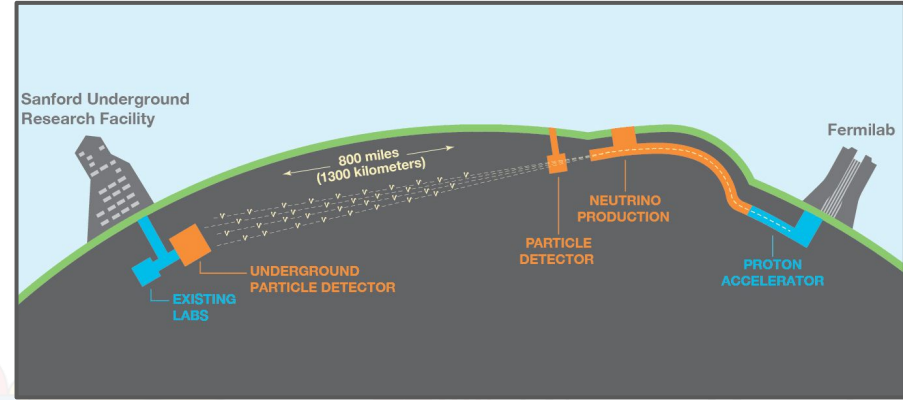
Deep Underground Neutrino Experiment (DUNE)

- One of the largest neutrino experiments.
- It aims to answer some of the biggest questions:
 - * Why the universe have more matter than antimatter? How neutrinos behave?



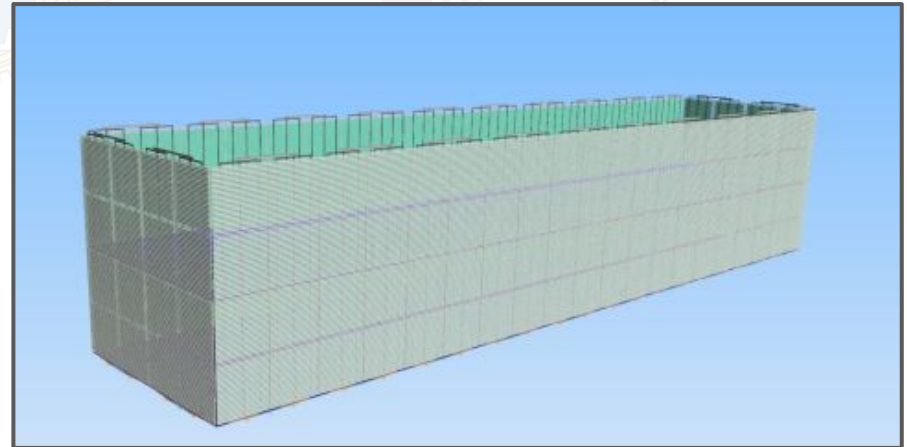
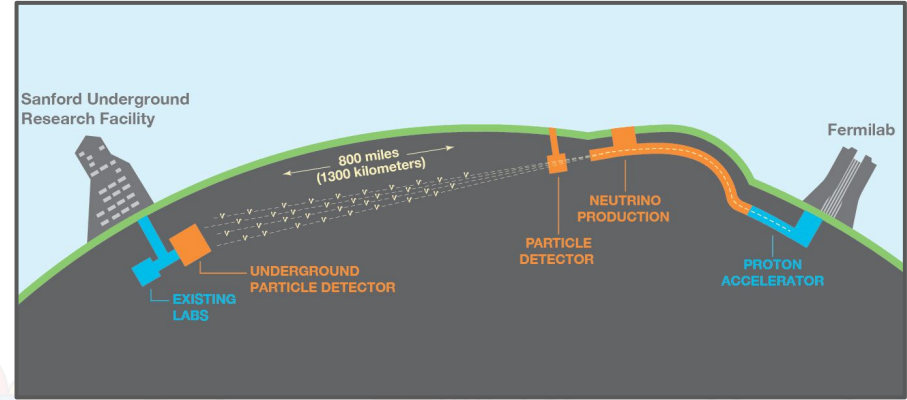
Deep Underground Neutrino Experiment (DUNE)

- One of the largest neutrino experiments.
- It aims to answer some of the biggest questions:
 - * Why the universe have more matter than antimatter? How neutrinos behave?
- It will use detectors based on Liquid Argon Time Projection Chamber - LArTPC.
- TPC reconstructs: 3D trajectories of charged particles produced in the interactions.
- Photon Detection System - PDS records: Scintillation light produced in LAr.



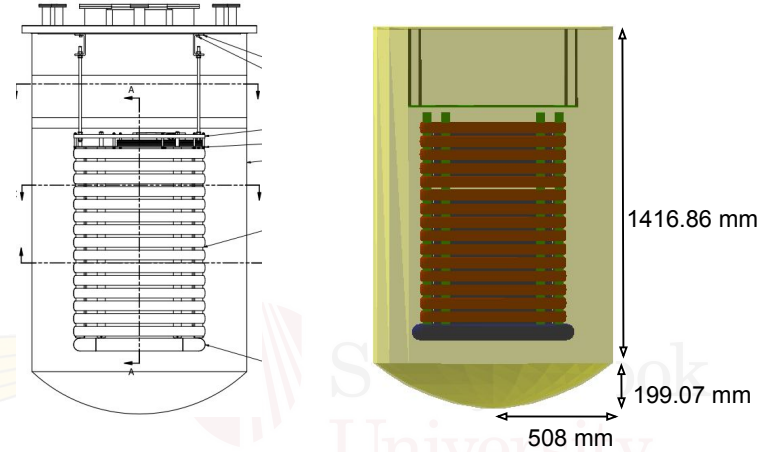
Deep Underground Neutrino Experiment (DUNE)

- One of the largest neutrino experiments.
- It aims to answer some of the biggest questions:
 - * Why the universe have more matter than antimatter? How neutrinos behave?
- It will use detectors based on Liquid Argon Time Projection Chamber - LArTPC.
- TPC reconstructs: 3D trajectories of charged particles produced in the interactions.
- Photon Detection System - PDS records: Scintillation light produced in LAr.
- Light collection efficiency is important for detector performance, DUNE is:
 - * Developing new PD concepts as APEX.
- Aluminium Profiles Embedded X-ARAPUCA:
 - * Aims to increase this efficiency by integrating photon detectors into the field cage (FC).



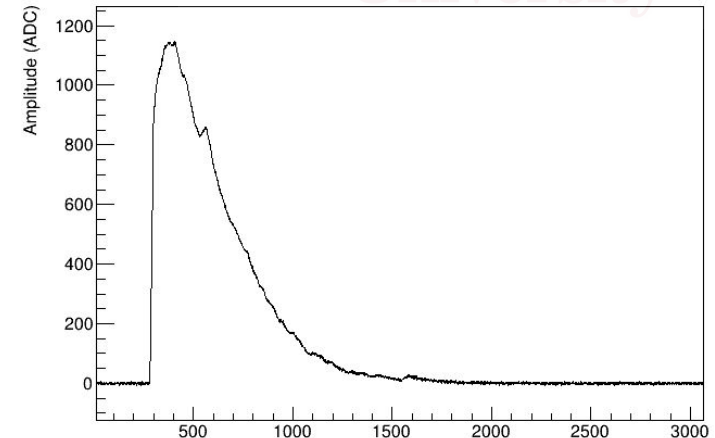
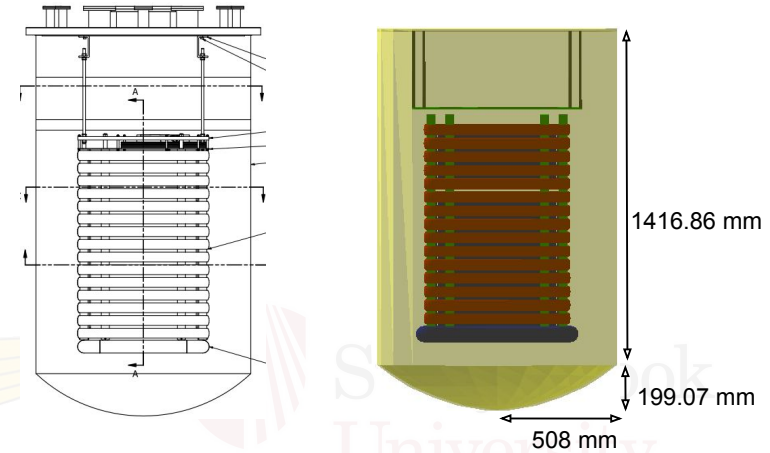
Realistic Geant4 Model for APEX Studies

- To evaluate APEX concept, we developed:
 - * Realistic G4 model 2TON detector: complete detector geometry, cryostat, LAr volume, FC and APEX module.
- To reproduce the detector's behavior, we implemented:
 - * Optical properties of LAr, using parameters by LArSoft.
 - * Material reflectivities and PTP wavelength shifter.
- Then, the simulation reproduces the detector response.



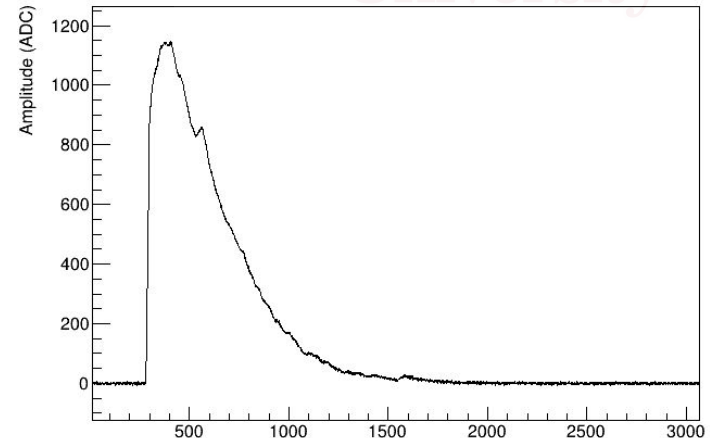
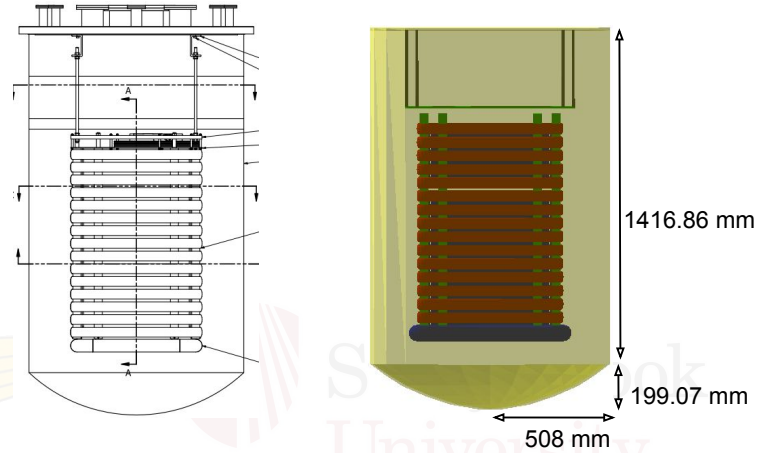
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- The graph shows a simulated signal obtained from scintillation light detection.
- This realistic simulation provides:
 - * Virtual platform to evaluate and optimize the APEX concept before its implementation in DUNE.



Realistic Geant4 Model for APEX Studies

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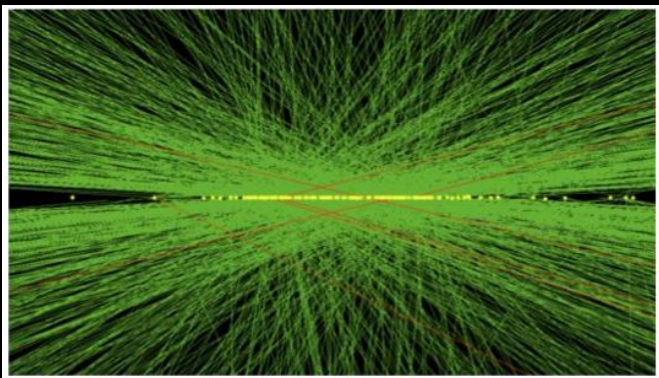


Thank you!

Experimental characterization and computational simulation of hybrid TI-LGADs for timing detection for CMS Precision Proton Spectrometer High-Lumi LHC upgrade

Valéria Vale, PhD student at Brazilian Center for Physics Research (CBPF)

The HL-LHC will have **~200 interactions per beam crossing**, where 10~15%, composed by multiple interactions separated by ~150ps.

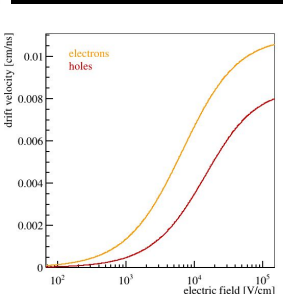
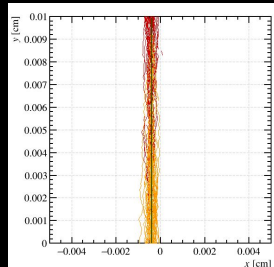
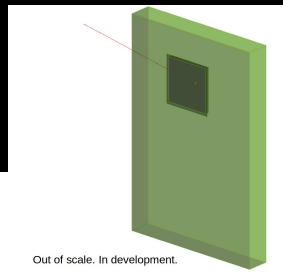


Hartmut F-W Sadrozinski et al 2018 Rep. Prog. Phys. 81 026101

My work aims to **simulate, characterize and calibrate hybrid TI-LGADs** for timing information aiming with resolution of **~ 10 ps!**

1. Computational simulation of the sensor's response with:

- Allpix Squared (AP2);
- COMSOL;
- Garfield++;
- ROOT;
- Geant4

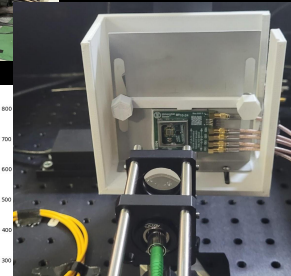
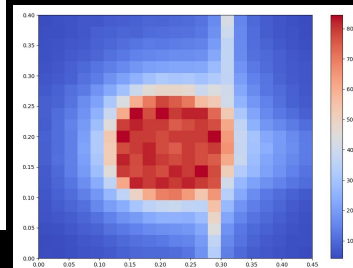


2. The experimental characterization

performed using

- pulsed infrared lasers;
- radioactive sources;

to study the sensor's response to traversing particles



Luca Pimenta

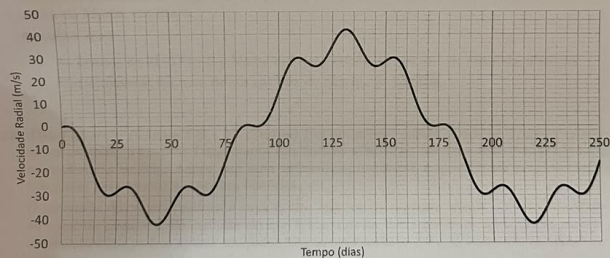




20. Problema em dobro (Classe C2 - 18 pontos) Existem alguns sistemas planetários que possuem mais de um exoplaneta detectável pela análise de uma única curva de velocidade radial.

Considere uma estrela orbitada por dois exoplanetas em órbitas circulares, coplanares e edge-on. A massa da estrela (M) é aproximadamente igual à do sol, e ambos os planetas têm massa $m \ll M$. Além disso, os planetas não interferem significativamente na órbita um do outro.

Com base na curva de velocidade radial da estrela, determine a razão η entre a massa do planeta mais pesado e a do mais leve.



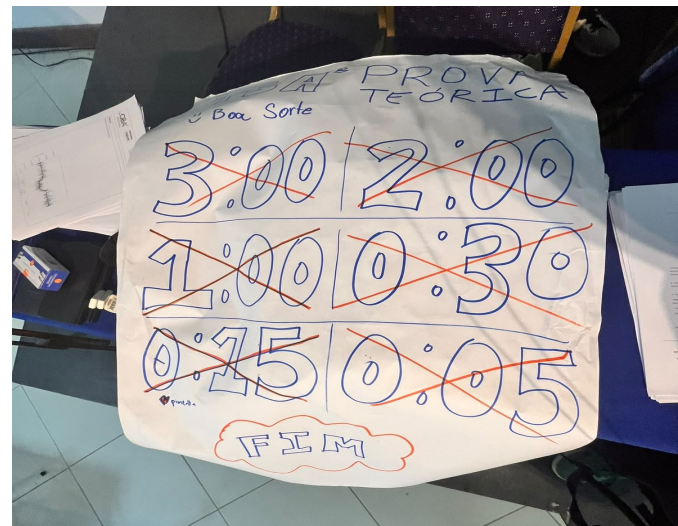
Curva de velocidade radial

- a) $\eta = 1,9$ b) $\eta = 3,3$ c) $\eta = 5,1$ d) $\eta = 6,0$
e) $\eta = 7,0$ f) $\eta = 8,2$ g) $\eta = 10,0$ h) $\eta = 11,5$

21. Amigo, estou ali (Classe C3 - 20 pontos) No emocionante final de Toistóri, o cangaceiro Udison foge das prateleiras de brinquedo e se torna livre para viver suas aventuras no sertão. Apesar da nova vida, ele sempre observa o céu à procura de seu amigo Bus Ligthysson. Um certo dia, Bus encontra-se à mesma distância que uma estrela de paralaxe $\pi = 0,5''$ e apresenta um movimento próprio $\mu = 5,4 \cdot 10^{-7}$ rad/ano.

Nesse mesmo instante, Udison verifica que, à medida que a distância entre ambos diminui a uma taxa $v_r = \Delta r / \Delta t$, o movimento próprio de Bus aumenta a uma taxa $\Delta \mu / \Delta t = 4,2 \cdot 10^{-13}$ rad/ano², medida no momento de observação.

Para te ajudar, Considere que as seguintes considerações são válidas:



Interests for the future

Cosmology instrumentation

Space habitats

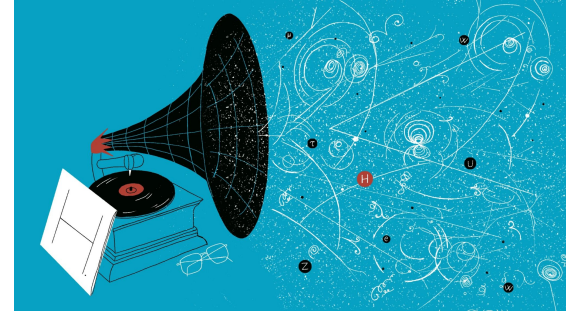
Dynamic control for satellites

Search for non-resonant production of Higgs pairs in the $HH \rightarrow b\bar{b}\tau\tau$ channel at ATLAS with a focus on modeling ZZ and $t\bar{t}$ background

Msc Degree Gabriel Oliveira

Advisor Dr Marco Leite

Why Study Di-Higgs?

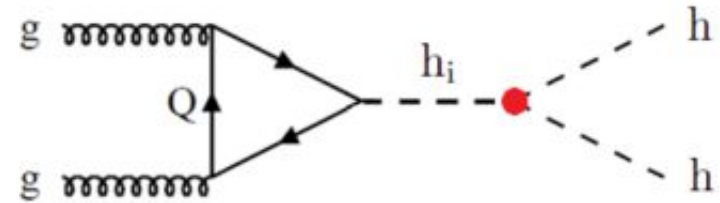


- The Higgs field plays a central role in electroweak symmetry breaking and in the generation of the masses of elementary particles.
- we study the self-coupling of the Higgs field (λ_{HHH}).
- Measuring λ_{HHH} deepens our understanding of the origin of mass, and even has implications for baryogenesis in the early universe.

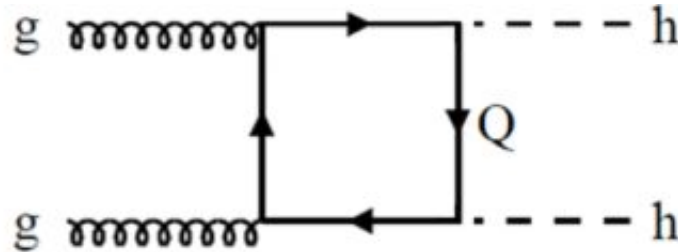
How to Measure the Self-Coupling?



- There are several perturbative orders: LO, NLO, and NNLO.
- This work is performed at LO, where about 90% of the production is dominated by ggF .
- It is described by these two diagrams: the triangle diagram and the box diagram.
- When the diagrams are summed, a destructive interference occurs.
- This cancellation makes Higgs pair production an extremely rare process at the LHC, with a cross section of about ~ 31 fb.



(a) Triangle diagram.



(b) Box diagram.

Branching Ratios BR

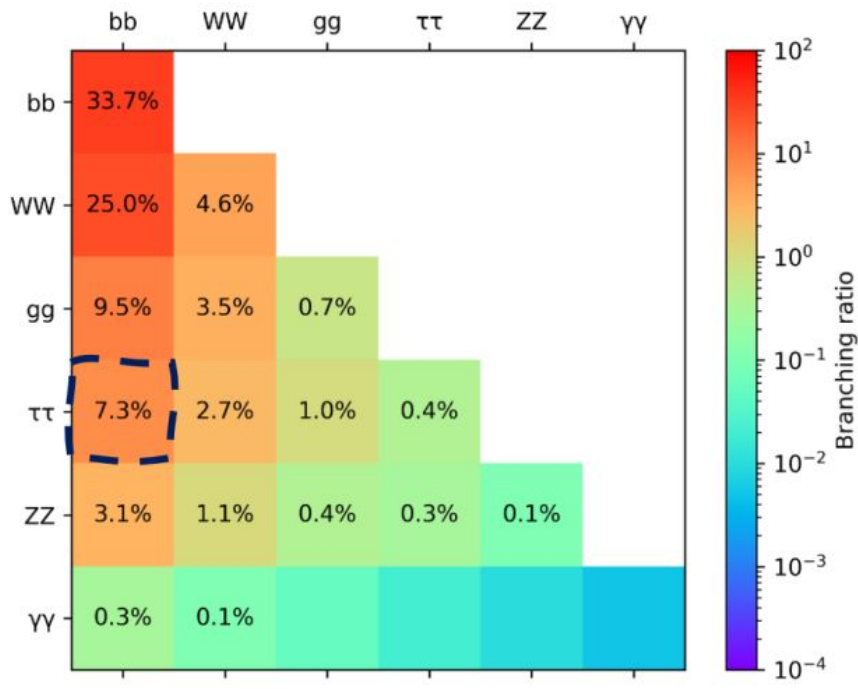
- All decay channels and probabilities
- How do we calculate the probability of a specific final state for Higgs pair (HH) production?

Identical channels(e.g: $HH \rightarrow b\bar{b}b\bar{b}$):

$$BR(HH \rightarrow XX) = [BR(H \rightarrow X)]^2$$

Different channels(e.g: $HH \rightarrow b\bar{b}\tau\tau$):

$$BR(HH \rightarrow XY) = 2 \cdot BR(H \rightarrow X) \cdot BR(H \rightarrow Y)$$



Why the $b\bar{b}\tau\tau$ Channel?

$b\bar{b}b\bar{b}$ Channel

✓ **Advantage:** By far the largest branching fraction ($\sim 34\%$).

✗ **Disadvantage:** Fully hadronic final state, heavily contaminated by huge QCD multijet backgrounds. Separating signal from background is extremely challenging.

$b\bar{b}\gamma\gamma$ Channel

✓ **Advantage:** Very clean final state due to excellent photon energy resolution in the detectors, allowing precise reconstruction of the Higgs mass peak.

✗ **Disadvantage:** Extremely small branching fraction ($\sim 0.26\%$), which severely limits statistical power.

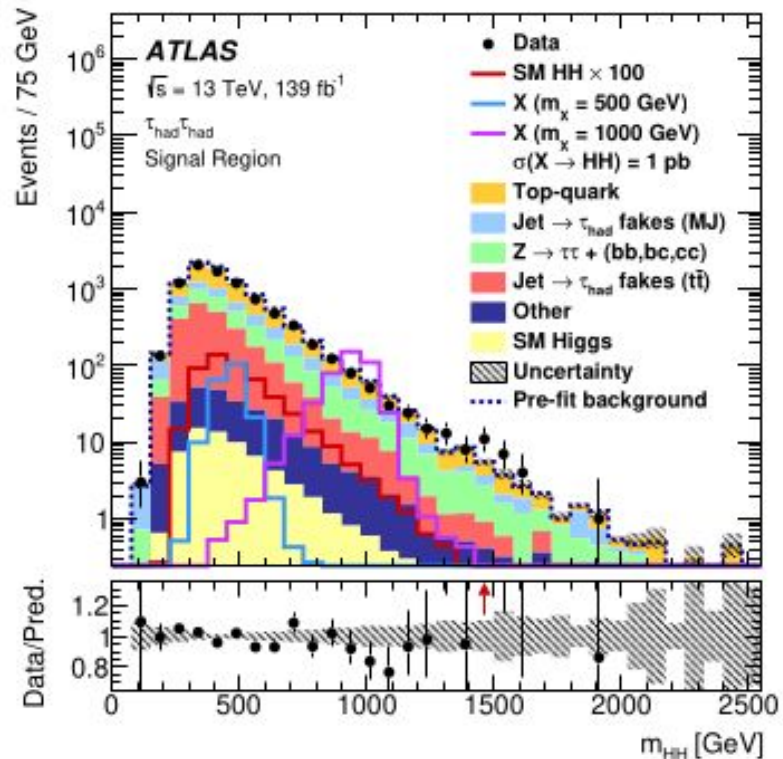
$b\bar{b}\tau\tau$ Channel

✓ **Advantage:** Still a relatively large branching fraction, but with much better background suppression compared to the fully hadronic case. The presence of tau leptons helps significantly with triggering and early event selection, since they provide cleaner signatures than jets alone.

✗ **Disadvantage:** Irreducible backgrounds such as ZZ , fake tau signatures, and the presence of neutrinos in tau decays, which complicate full event reconstruction.

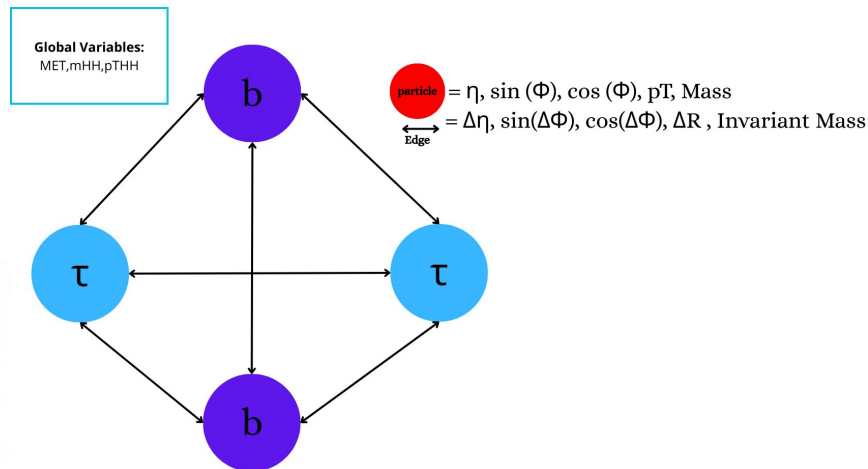
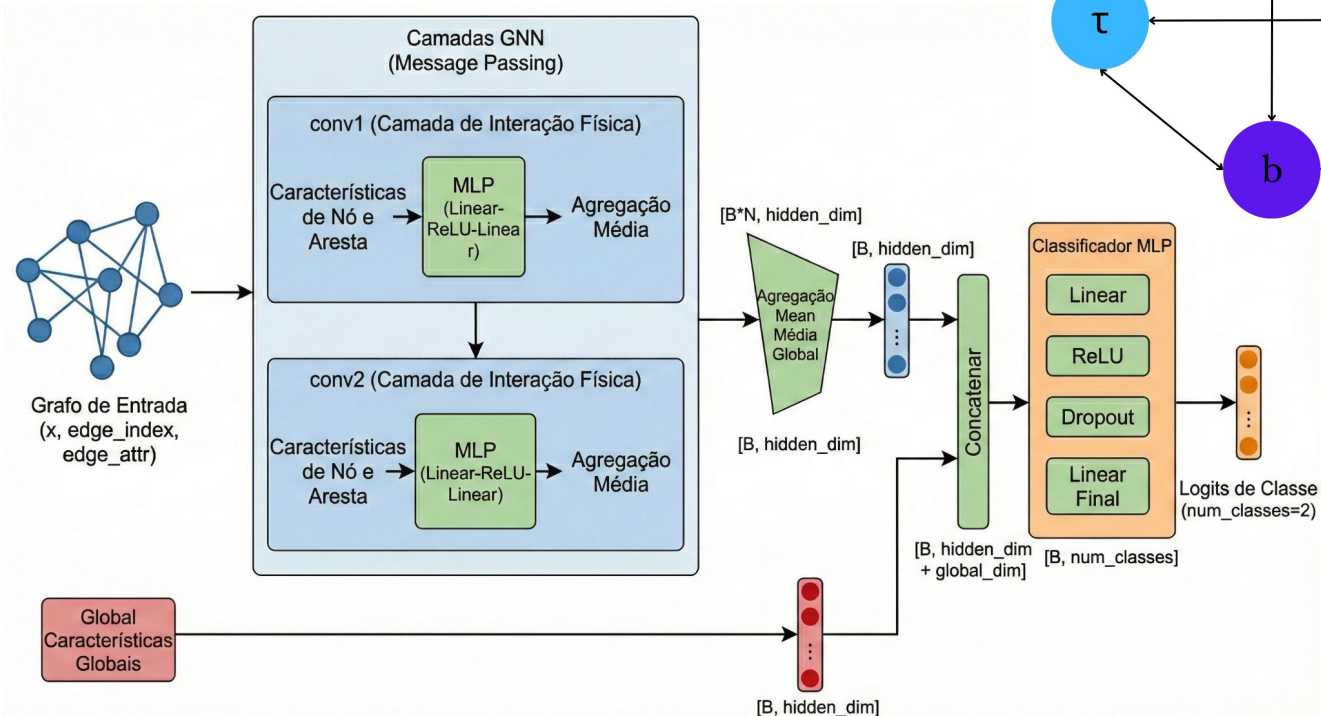
Main Backgrounds

The $b\bar{b}\tau\tau$ channel has several backgrounds, with the main ones being $t\bar{t}$ production ($t\bar{t} \rightarrow b\bar{b}\tau\tau$) and the irreducible ZZ background.



Separation technique

Foi utilizada uma arquitetura do tipo GNN para separar sinal e fundo.

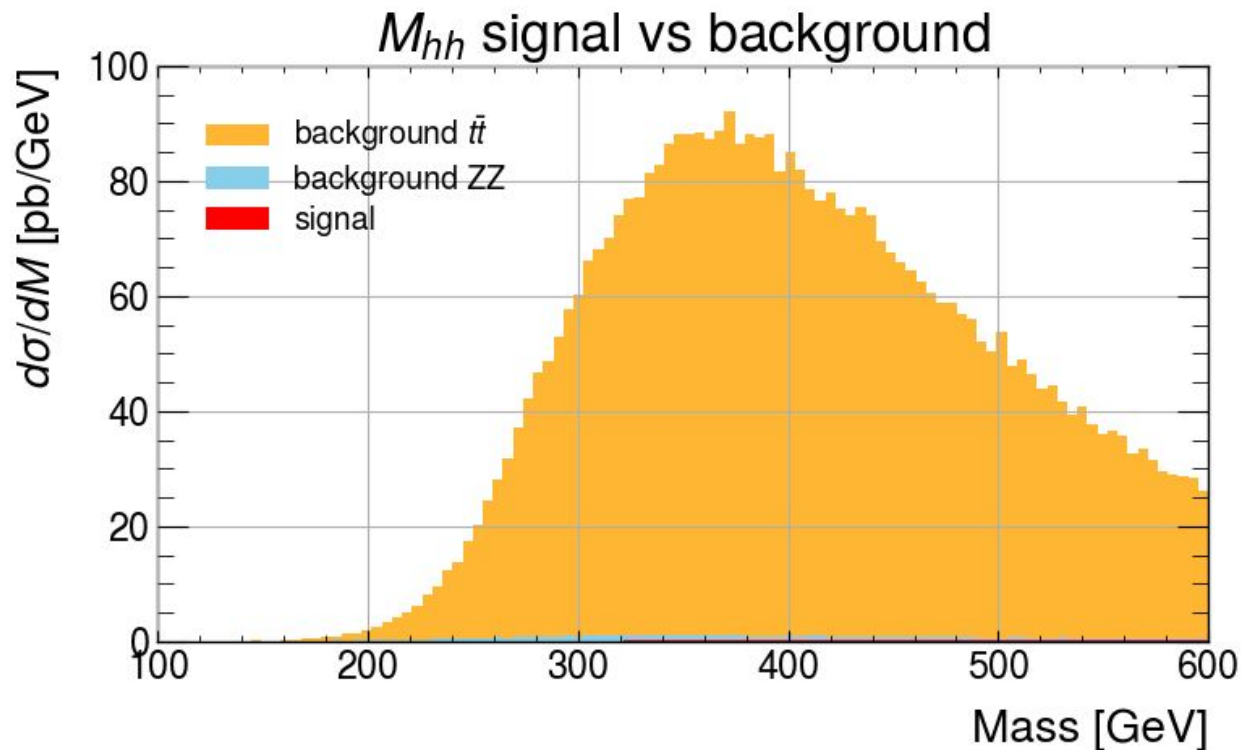


Results

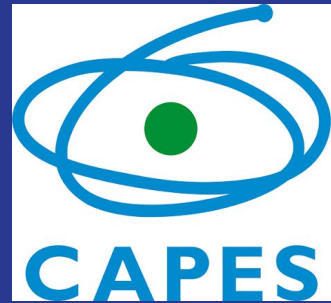
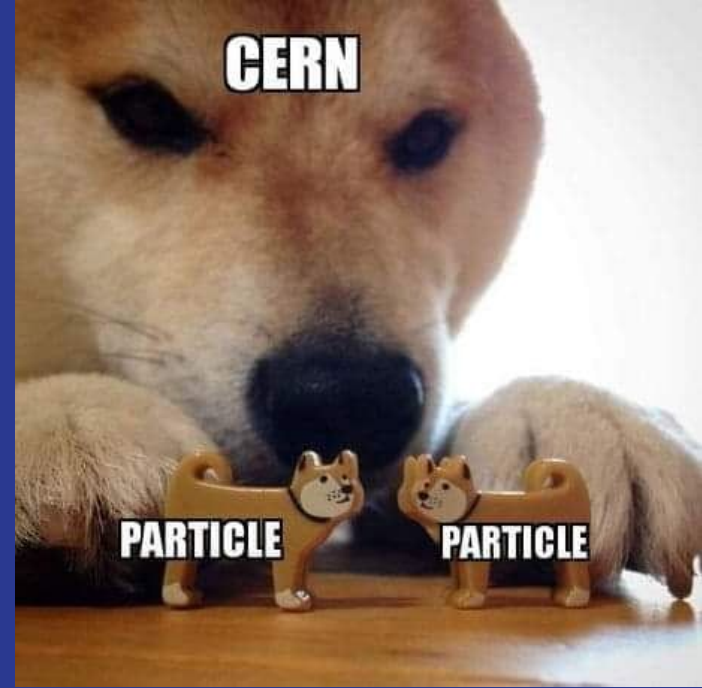
Rejeição $t\bar{t}$: 99,99%

Rejeição ZZ: 99,53%

Rejeição Sinal: 59,74%



Thank You !



Azimuthal Asymmetries in the Muon Density of Extensive Air Showers with the UMD

Lautaro Silva ^{1, 2}

Juan Manuel Figueira ^{2, 3}

Federico Sánchez ^{2, 3}

¹ Universidad de Buenos Aires - Argentina

² Instituto de Tecnologías en Detección y Astropartículas - CNEA

³ CONICET - Argentina

15th IDPASC Summer School
Natal, Brazil
20-29 July 2026

ITeDA

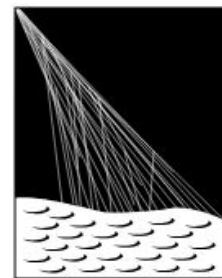
Instituto de Tecnologías en
Detección y Astropartículas



UNSAM

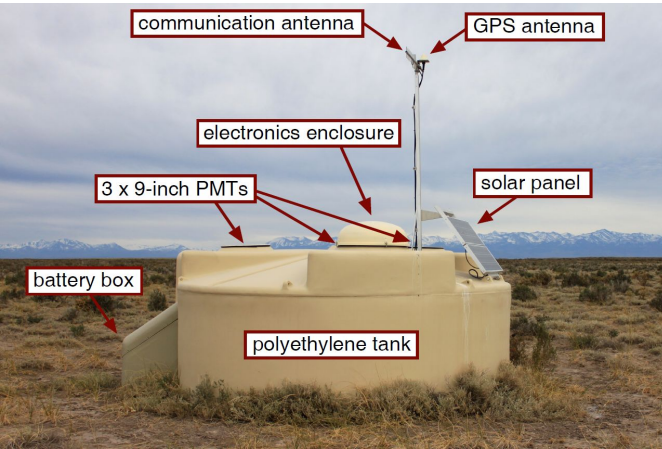


universidad de buenos aires - exactas
departamento de Física



PIERRE
AUGER
OBSERVATORY

Pierre Auger Observatory: Detectors



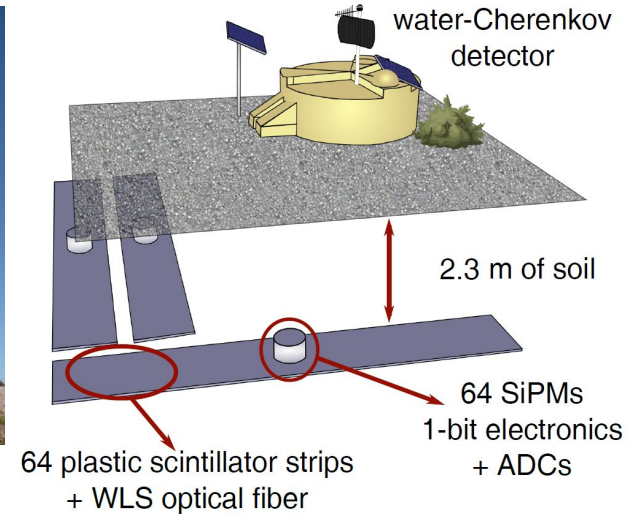
Surface Detector (SD):

- 1660 Water Cherenkov detectors that cover 3000 km²



Fluorescence Detector (FD):

- 24 fluorescence telescopes that measure the longitudinal development of the Extensive Air Shower



Underground Muon Detector (UMD):

- Plastic scintillators buried to measure the muonic component of Extensive Air Showers

Azimuthal Asymmetry Studies

The geometric view of the Extensive Air Showers as they hit the Observatory

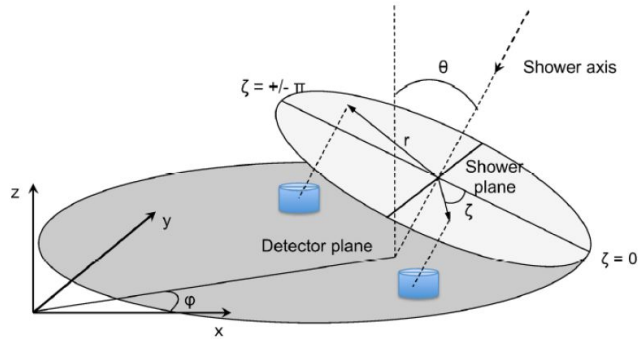


Figure 2.1: Geometry of an EAS. From [35].

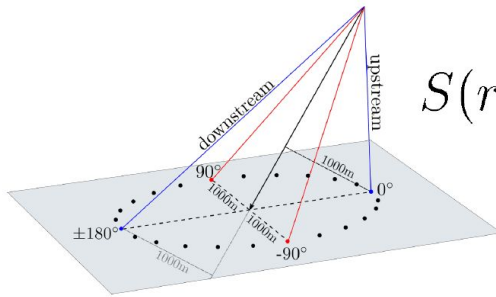


Figure 4.2: A schematic of a dense ring on the ground containing 24 stations. All stations are located at a distance of 1000m from the shower core when projected into the shower plane. The angles listed show the values of ζ the corresponding coloured stations would have when projected into the shower plane. Modified from [81].

$$S(r, \psi) = \bar{S} (1 + \alpha(r) \cos \psi)$$

The late-early asymmetry we study

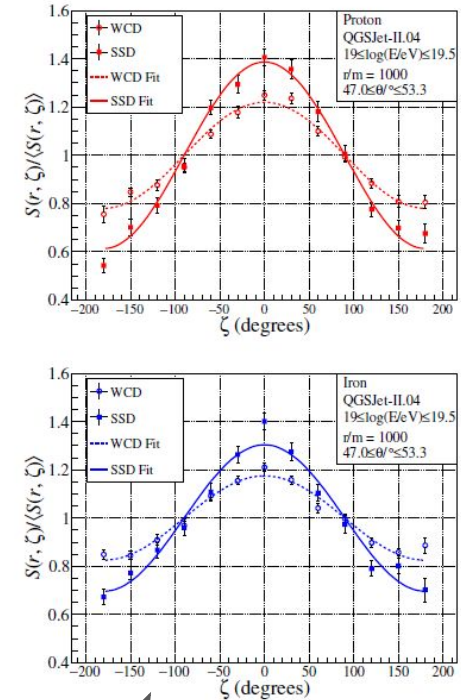


Figure 4.3: The normalised signal of a dense ring of WCD/SSD detectors at 1000 m in the shower plane, averaged over many showers, for proton primaries (top) and iron primaries (bottom). The magnitude of the asymmetry in the SSD signals is larger for both primaries

What we measure!

ACE - LENSING EMULATOR

Accurate cosmological emulator for the probability distribution function of gravitational lensing of point sources.

Özgen **Tunç** Türker · PhD Candidate · UFES, Brazil

Supervisor: Valerio Marra

20 July 2026



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20 July 2026



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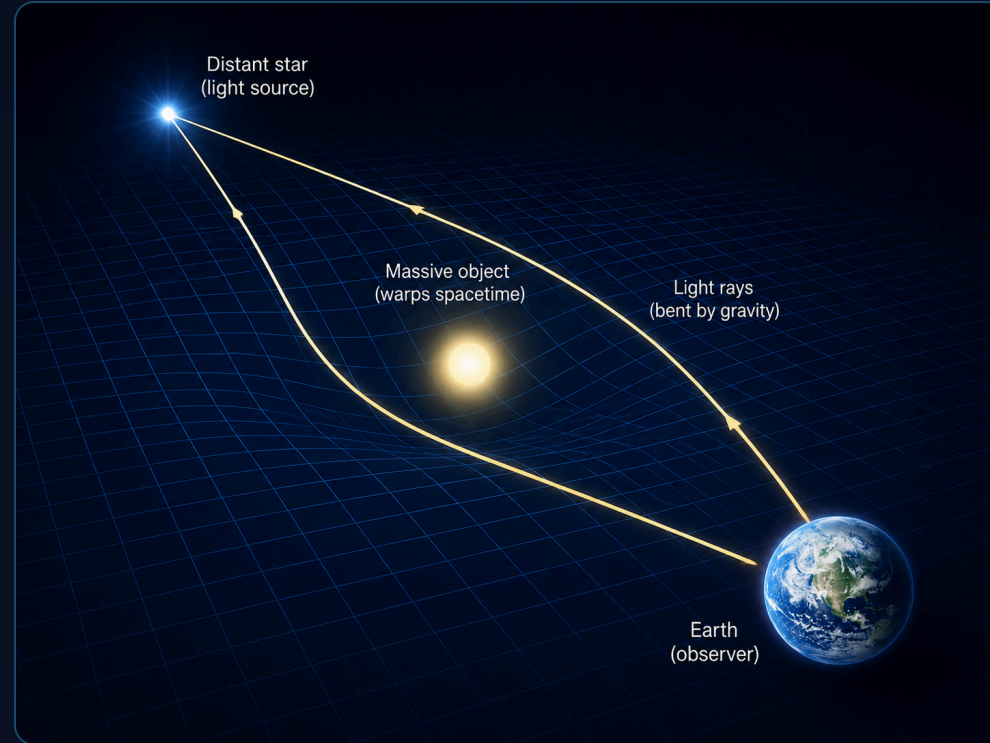
Özgen **Tunç** Türker · PhD Candidate · UFES, Brazil

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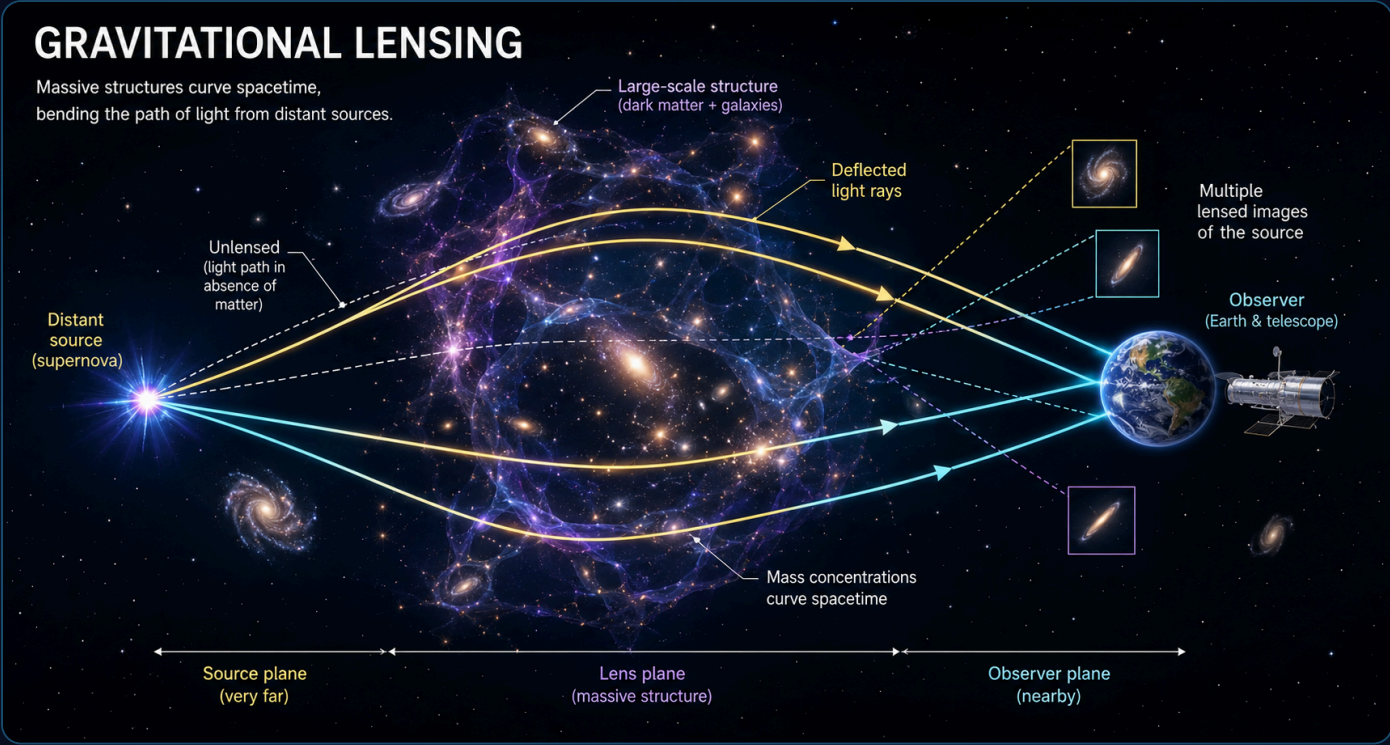
20 July 2026



GRAVITATIONAL LENSING



GRAVITATIONAL LENSING



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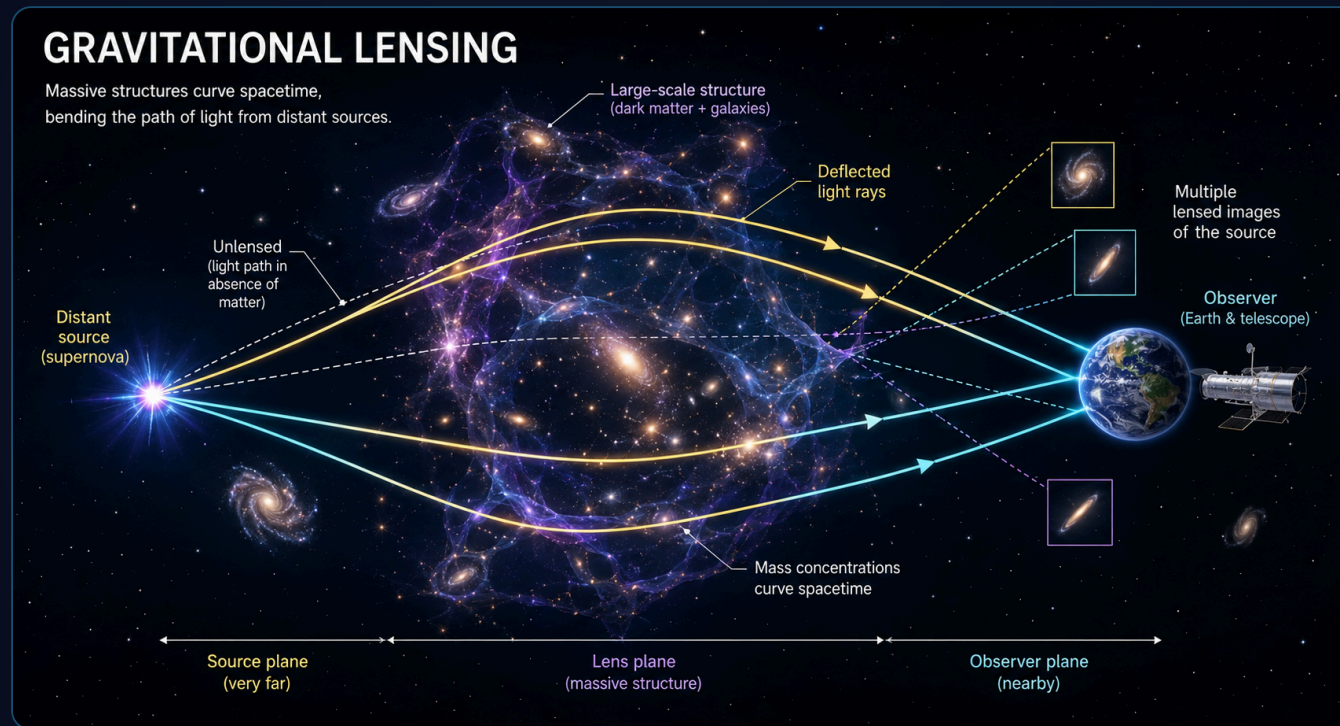
20 July 2026



PROBLEM

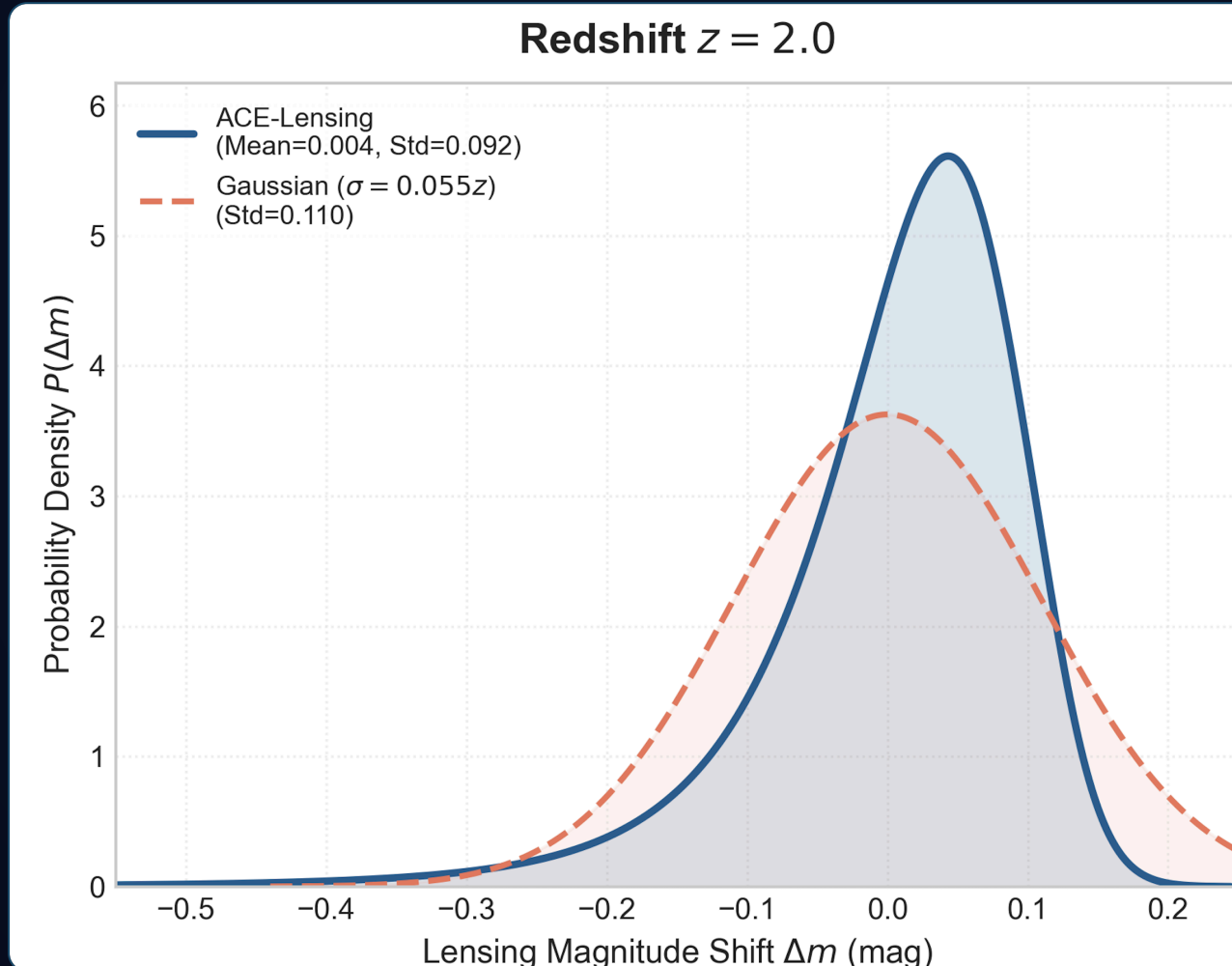
NOISE OR MEANINGFUL DATA?

Gravitational lensing **distorts** the light from distant objects.

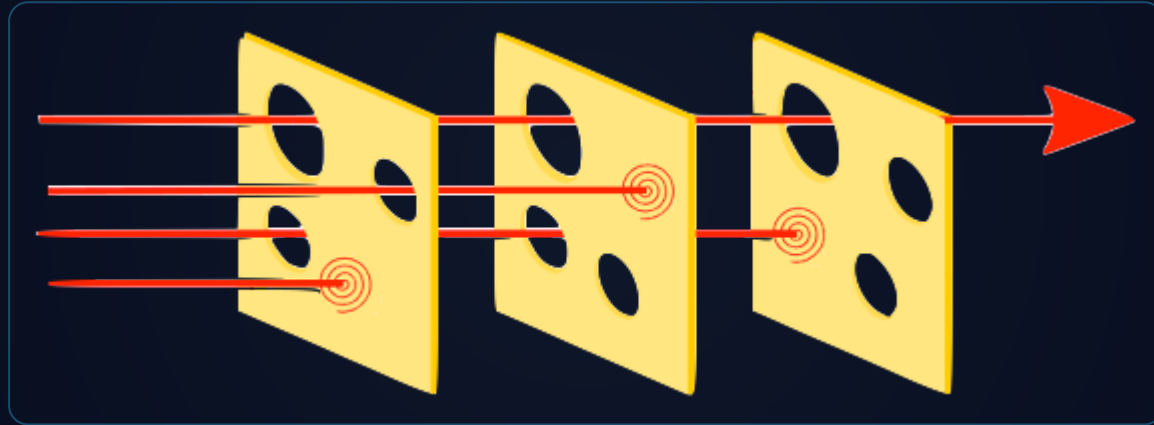


How does this lensing effect depend on cosmology?

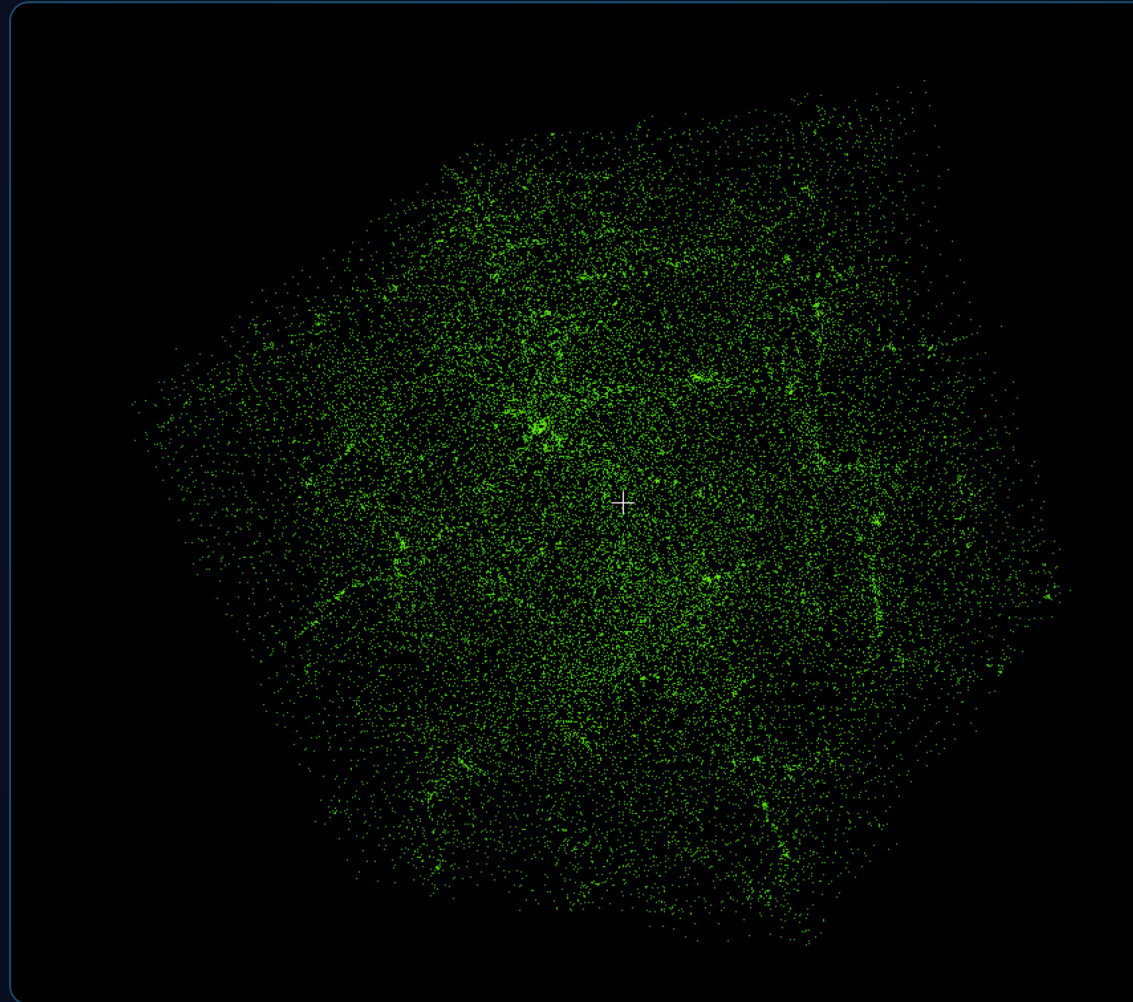
GAUSSIAN TREATMENT



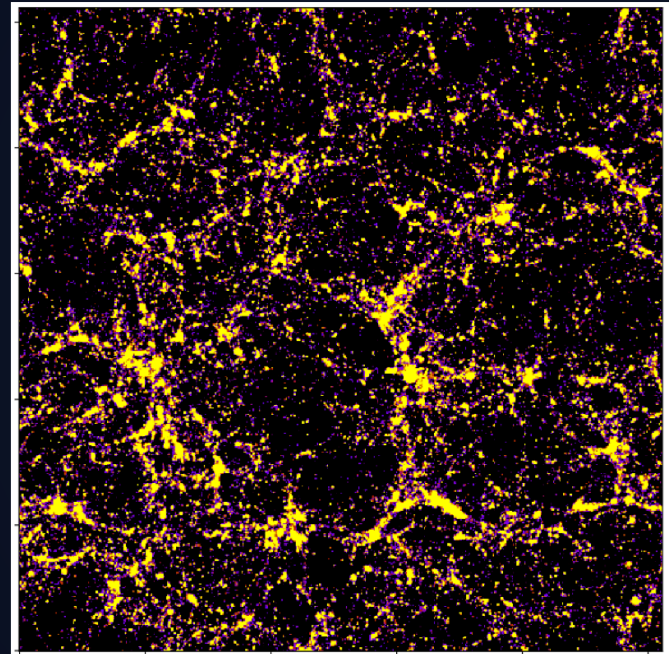
THEORETICAL MODELING



SIMULATIONS



SIMULATIONS



METHODOLOGY

SIMULATIONS

24 hrs

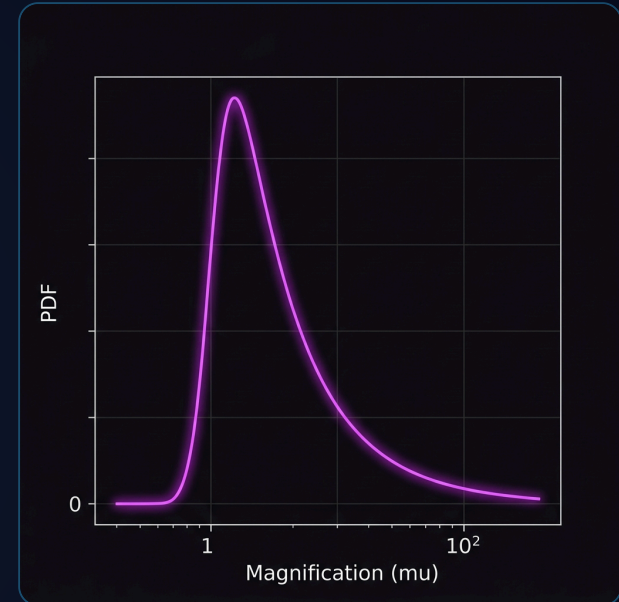
Cost of one N-body
simulation

1.7k

Supernovae in Pantheon+

1M+

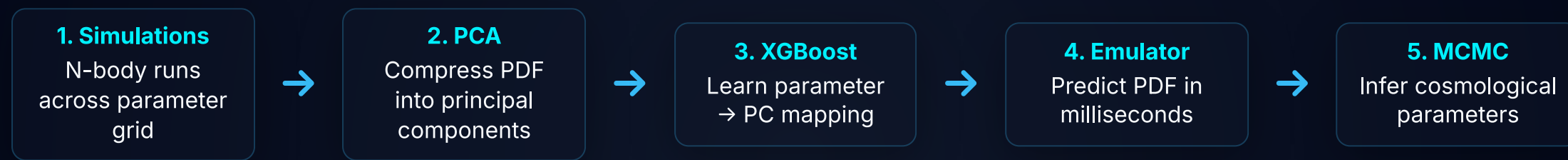
Likelihood calls in MCMC



APPROACH & REASONING

HOW DID WE TACKLE IT?

Instead of calling the simulation directly, we **train a machine learning emulator** that learns the mapping from cosmological parameters → lensing PDF. This replaces a **24-hour simulation** with a **millisecond prediction**.



METHODOLOGY

EMULATOR

PARAMETERS

$\Omega_m \rightarrow (0.2 - 0.4)$

$h \rightarrow (0.6 - 0.8)$

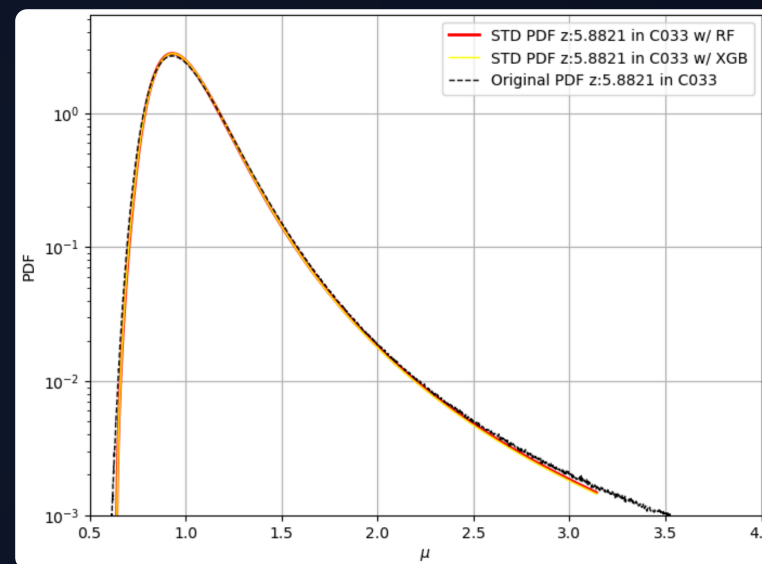
$w \rightarrow (-1.5 - -0.7)$

$\sigma_8 \rightarrow (0.7 - 0.9)$

$z \rightarrow (0.3 - 6)$



STATISTICS



70

Different cosmologies

1.5k

PDFs

APPROACH

EMULATOR

PARAMETERS

$\Omega_m \rightarrow (0.2 - 0.4)$

$h \rightarrow (0.6 - 0.8)$

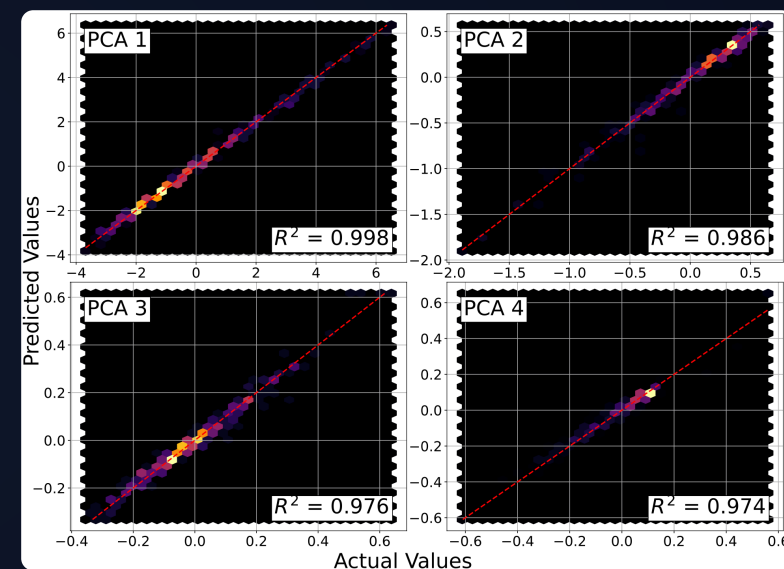
$w \rightarrow (-1.5 - -0.7)$

$\sigma_8 \rightarrow (0.7 - 0.9)$

$z \rightarrow (0.3 - 6)$



4 PCA COMPONENTS



70

Different cosmologies

1.5k

PDFs

REASONING

TRADITIONAL METHODS VS EMULATOR-BASED METHOD

	Traditional Methods	Emulator-Based Method
Use Case	Detailed modeling	Fast parameter estimation
Computational Cost	High	Low
Speed	Slow	Fast
Flexibility	Depends on simulation or model	High
Accuracy	High	High

REASONING

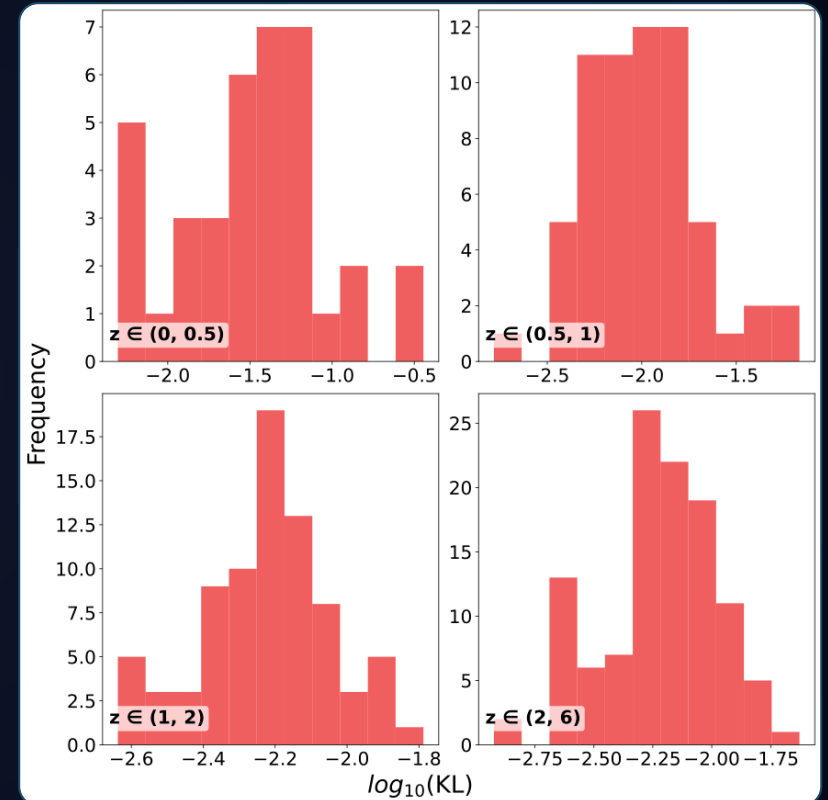
WHY XGBOOST + PCA?

WHY PCA FIRST?

- ◆ Lensing PDFs are **high-dimensional** vectors
- ◆ PCA compresses them into **4 components** capturing **99%** of variance
- ◆ Predict components independently

WHY XGBOOST?

- ◆ Handles **non-linear** parameter dependencies well
- ◆ Fast to train and predict
- ◆ Robust with **limited training data** (simulation budget)



ACE-LENSING

ACE-Lensing is a full end-to-end pipeline: from N-body simulation outputs to cosmological parameter inference.

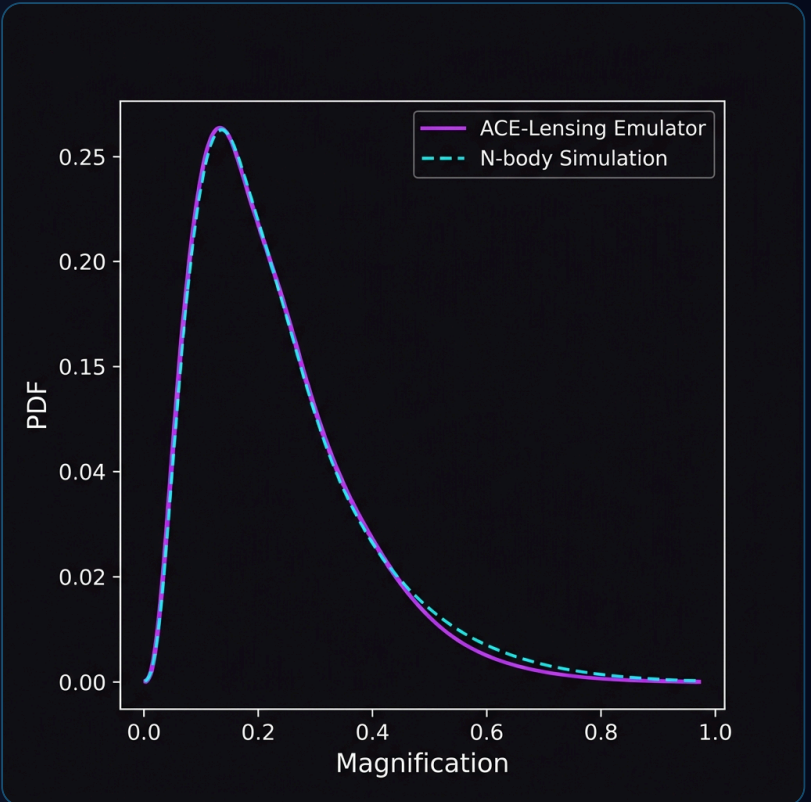
Input: Cosmological parameters (Ω_m , σ_8 , w , h)



ACE-Lensing: XGBoost + PCA emulator



Output: Magnification PDF in **~1 ms**



MCMC LIKELIHOOD MODELS

1. GAUSSIAN (FIXED)

$$\mathcal{L}_i = \mathcal{N}(\Delta\mu_i; 0, \sigma_i^2)$$
$$\sigma_i^2 = \sigma_{\text{int}}^2 + \sigma_{\text{meas},i}^2 + \sigma_{\text{lens,fid}}^2(z_i)$$

2. GAUSSIAN (ACE)

$$\mathcal{L}_i = \mathcal{N}(\Delta\mu_i; 0, \sigma_i^2(\theta))$$
$$\sigma_i^2(\theta) = \sigma_{\text{int}}^2 + \sigma_{\text{meas},i}^2 + \sigma_{\text{lens}}^2(z_i, \theta)$$

3. EDGEWORTH EXPANSION

$$p(\Delta\mu_i) \approx \mathcal{N}(\Delta\mu_i; 0, \sigma_i^2) \left[1 + \frac{\kappa_3}{6\sigma_i^3} H_3 \left(\frac{\Delta\mu_i}{\sigma_i} \right) + \frac{\kappa_4}{24\sigma_i^4} H_4 \left(\frac{\Delta\mu_i}{\sigma_i} \right) \right]$$
$$\sigma_i^2 = \sigma_{\text{int}}^2 + \sigma_{\text{meas},i}^2 + \sigma_{\text{lens,fid}}^2(z_i)$$

4. FULL CONVOLUTION

$$\mathcal{L}_i = \int \mathcal{N}(\Delta\mu_i - \delta\mu; 0, \sigma_{\text{int}}^2 + \sigma_{\text{meas},i}^2) p_{\text{ACE}}(\delta\mu | z_i, \theta) \text{d}(\delta\mu)$$

THANK YOU

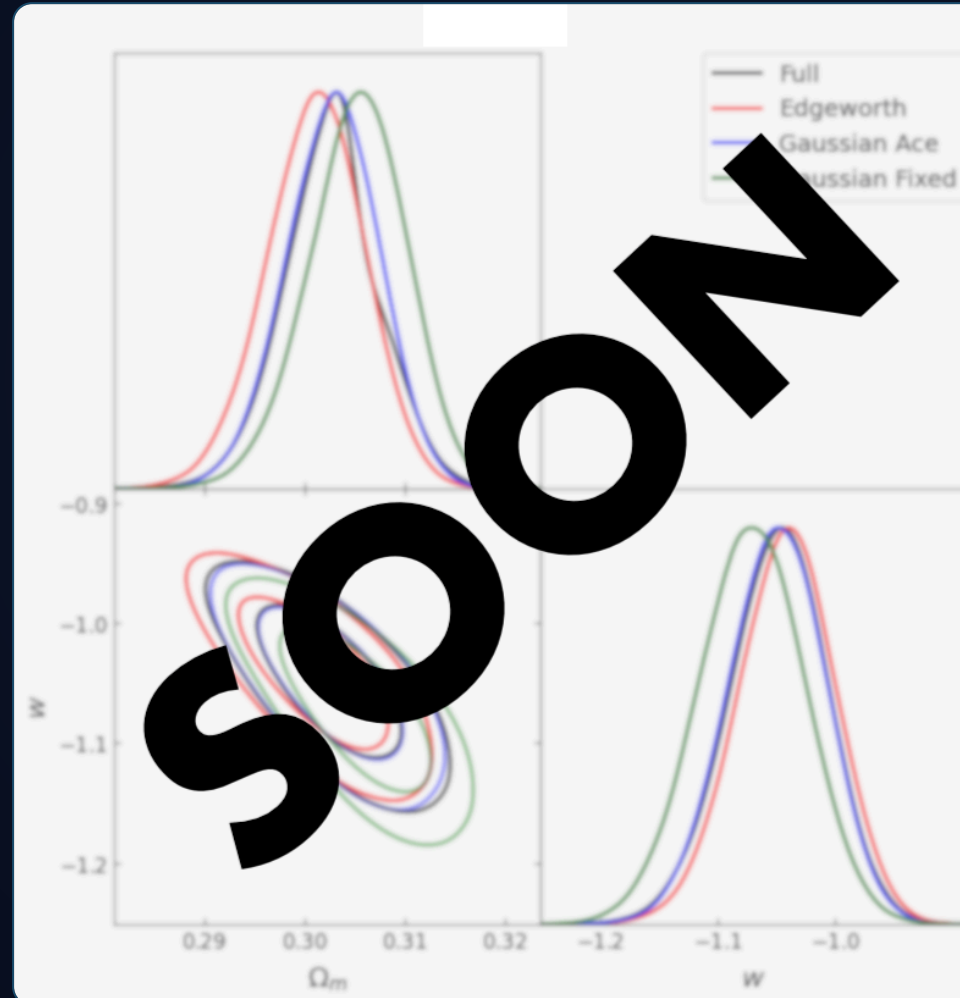
Questions?

Tunç Türker

tuncturker.work@gmail.com

CONCLUSION

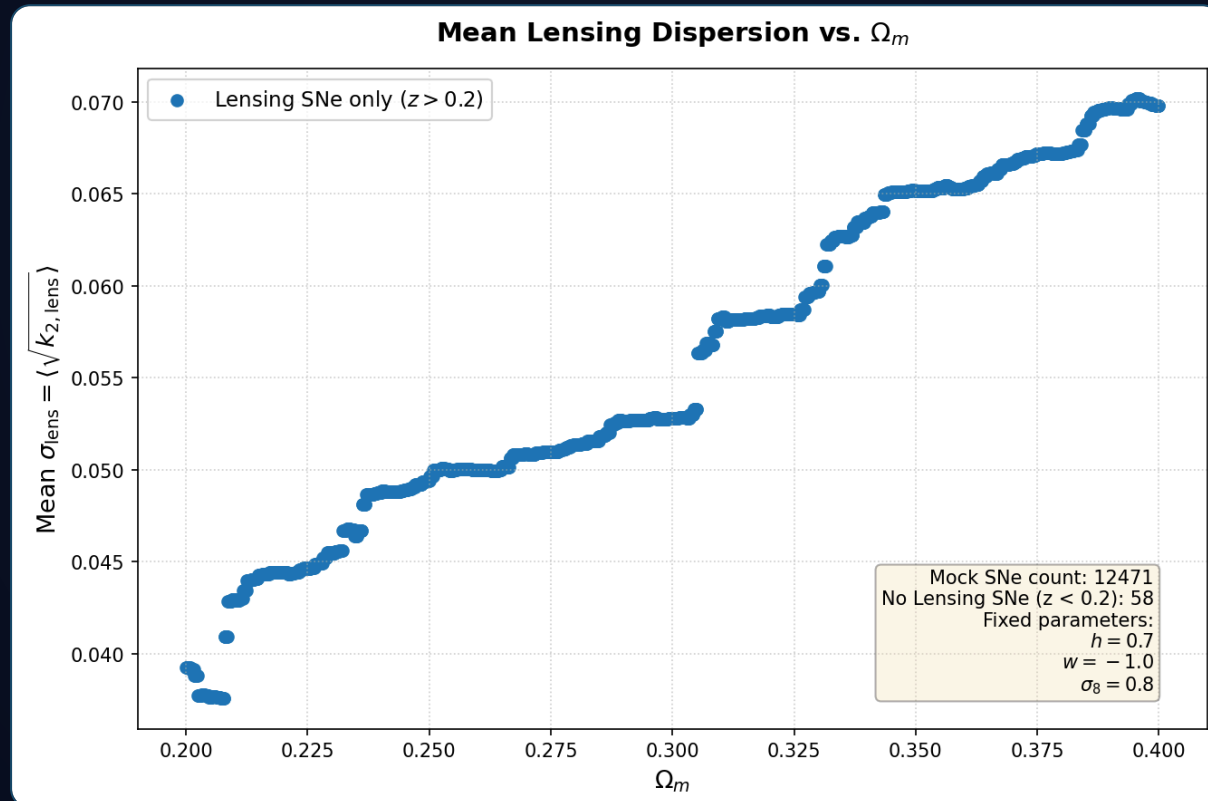
RESULTS



NOW

PROBLEM TO SOLVE

Decision Tree Discretization



<https://ohulelo.github.io/presentation/idpasc15.html>

Alexander Cerviño



CNN-based reconstruction of IACTS events

- Convolutional neural networks (CTLearn) to reconstruct Cherenkov gamma-ray events.
- Particle classification (gamma/hadron), energy, and arrival direction.



LST-1 On-site analysis

- Reprocessing of LST-1 data with LST-On-site Analysis, the official analysis pipeline.
- Data available the day after they are taken



Indirect dark matter searches

- Involved in DM indirect searches projects
- Currently developing of Gammapy's dark matter module



Angular Analysis of $B^0 \rightarrow K^{*0} (892) \mu^+ \mu^-$ Decay Channel and Simulation of RPC Detector

IDPASC School

Student: Thiago de Andrade Rangel Monteiro

20 de julho de 2026



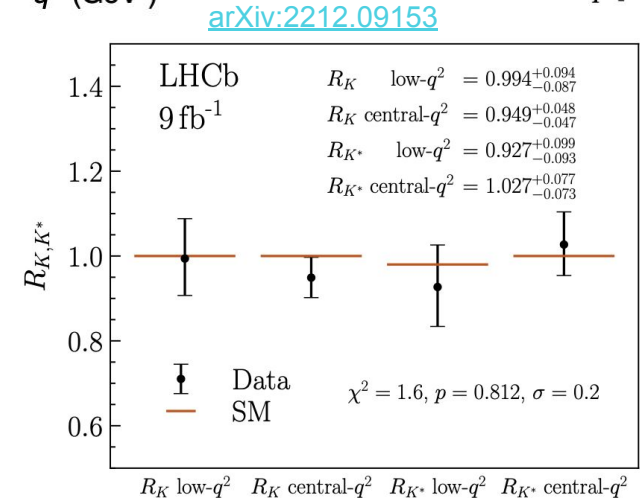
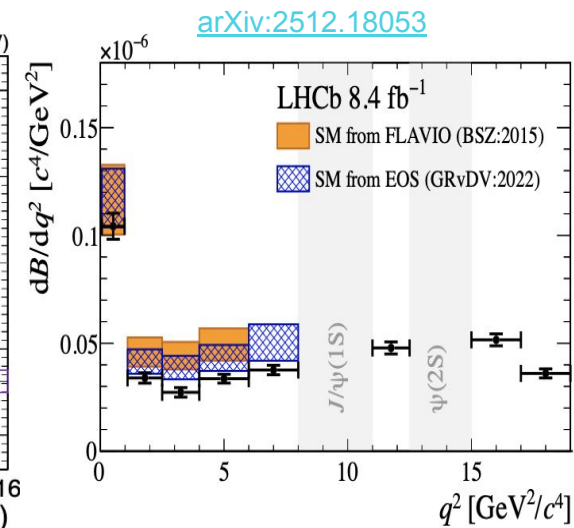
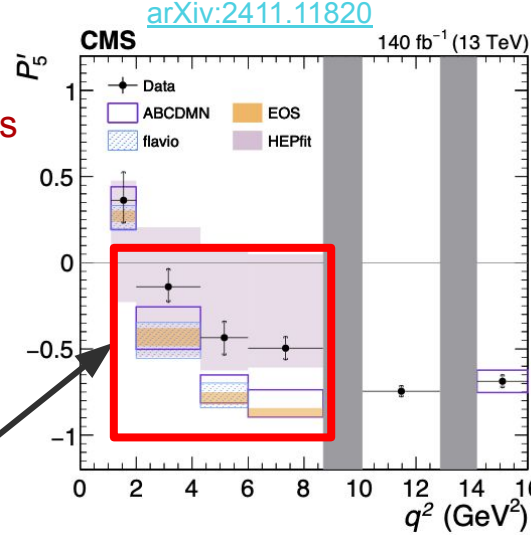
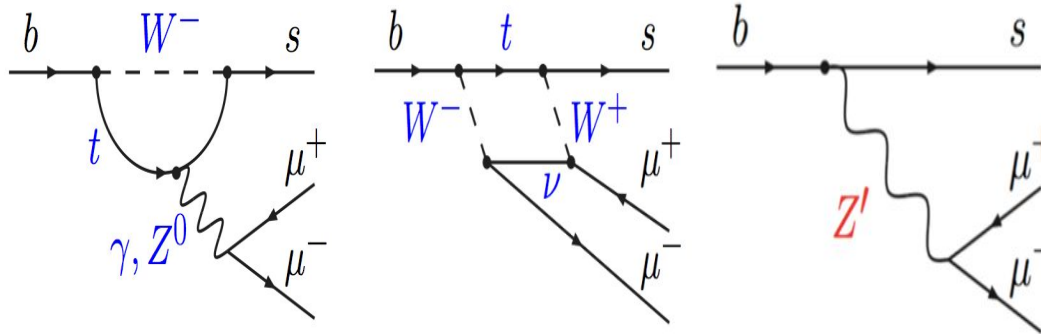
Flavour Anomalies $b \rightarrow s \ell^+ \ell^-$

FCNC process in SM -- $\text{BF} \lesssim 10^{-6}$

- ❑ Highly sensitive to **New Physics**
- ❑ (indirect tests of NP @TeV)
 - SUSY
 - Lepto Quarks
 - Heavy gauge bosons

From Feynman Diagrams to the exp. observables:

- ❑ Lepton Flavour Universality test
- ❑ Differential Decay Rate
- ❑ **Angular Observables**



Angular Decay Rate

Considering the **formulation of Effective Field Theory** we can **describe the decay rate** of this process in **function of three angular variables**, related to the topology of the decay, and the **squared invariant mass of the dimuon system**.

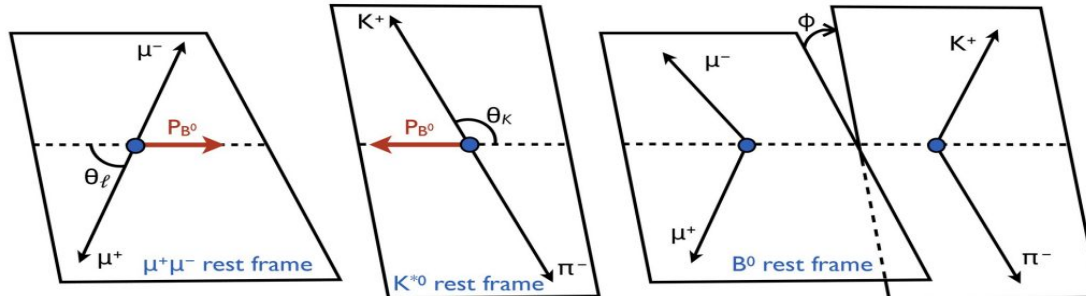
$$\frac{1}{d(\Gamma + \bar{\Gamma})/dq^2} \frac{d^3(\Gamma + \bar{\Gamma})}{d\vec{\Omega}} \Big|_P = \frac{9}{32\pi} \left[\frac{3}{4}(1 - F_L) \sin^2 \theta_K + F_L \cos^2 \theta_K + \right. \\ \left. + \frac{1}{4}(1 - F_L) \sin^2 \theta_K \cos 2\theta_l \right. \\ \left. - F_L \cos^2 \theta_K \cos 2\theta_l + S_3 \sin^2 \theta_K \sin^2 \theta_l \cos 2\phi \right. \\ \left. + S_4 \sin 2\theta_K \sin 2\theta_l \cos \phi + S_5 \sin 2\theta_K \sin \theta_l \cos \phi \right. \\ \left. + \frac{4}{3} A_{FB} \sin^2 \theta_K \cos \theta_l + S_7 \sin 2\theta_K \sin \theta_l \sin \phi \right. \\ \left. + S_8 \sin 2\theta_K \sin 2\theta_l \sin \phi + S_9 \sin^2 \theta_K \sin^2 \theta_l \sin 2\phi \right]$$

fraction of longitudinal polarisation of the K^*

forward-backward asymmetry of the dilepton system

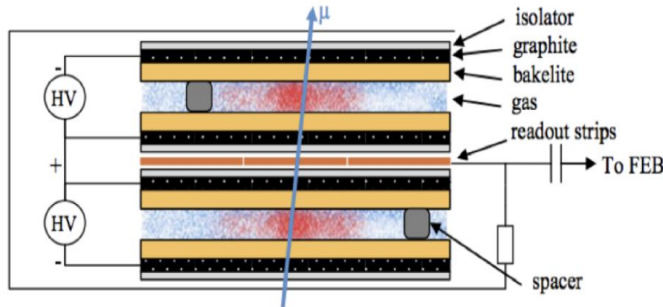
$$P_1 = \frac{2S_3}{(1 - F_L)} = A_T^{(2)} \\ P_2 = \frac{2}{3} \frac{A_{FB}}{(1 - F_L)} \\ P_3 = \frac{-S_9}{(1 - F_L)} \\ P'_{4,8} = \frac{2S_{4,8}}{\sqrt{F_L(1 - F_L)}} \\ P'_5 = \frac{S_5}{\sqrt{F_L(1 - F_L)}} \\ P'_6 = \frac{-S_7}{\sqrt{F_L(1 - F_L)}}$$

□ Cleaner observables since the leading order form factors are cancelled.

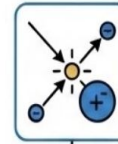




Resistive Plate Chambers (RPC) Detector



- The Resistive Plate Chamber (RPC) is a gaseous detector, and its high speed and time resolution make it **crucial for trigger systems in muon detection**.



Ionização Primária

Energia da colisão ioniza o gás, criando os primeiros pares elétron-íon.



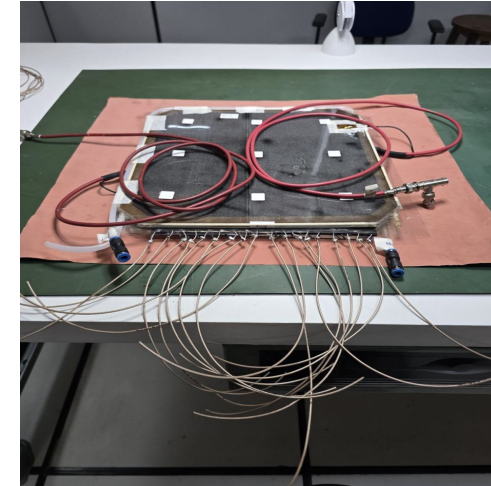
Avalanche Eletrônica

Reação em cadeia (cascata) multiplica a carga exponencialmente.



Indução do Sinal

Geração de um pulso elétrico rápido e preciso nas tiras de leitura.

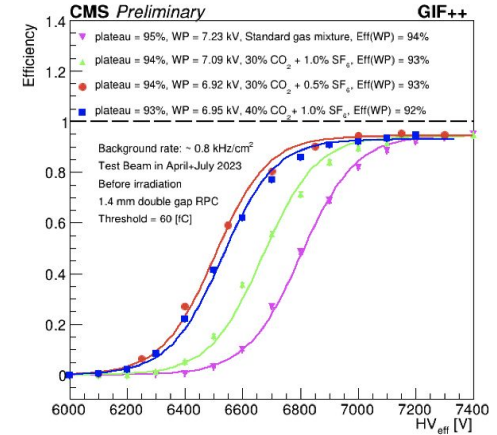
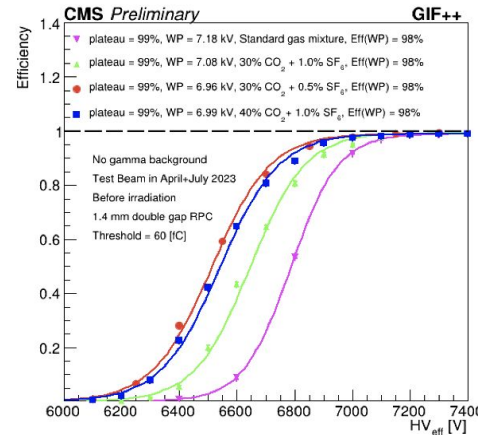
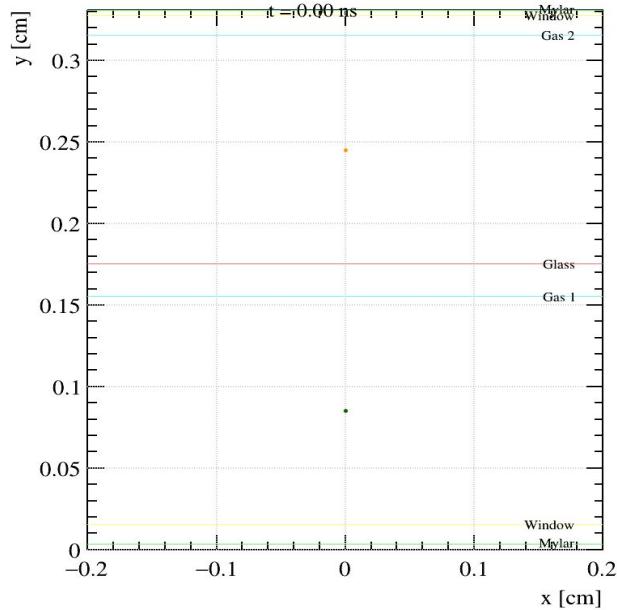


Gas components (%)	C ₂ H ₂ F ₄	CO ₂	i-C ₄ H ₁₀	SF ₆	GWP* _{MIX}
GWP	1430	1	3	22800	
Density (g/L)	4.7	1.98	2.7	6.61	
STD	95.2	0	4.5	0.3	1486
30% CO ₂ + 1.0 % SF ₆	64	30	5	1	1529
30% CO ₂ + 0.5 % SF ₆	64.5	30	5	0.5	1337
40% CO ₂ + 1.0 % SF ₆	54.5	40	5	1	1353

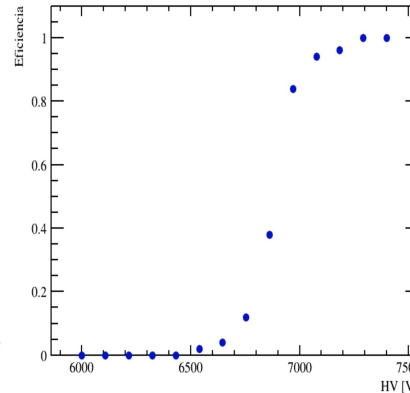
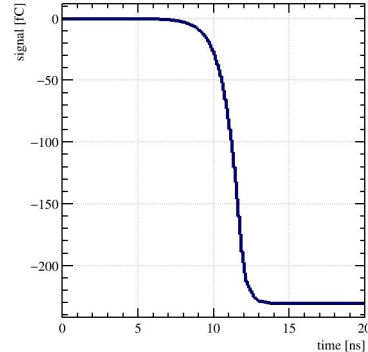
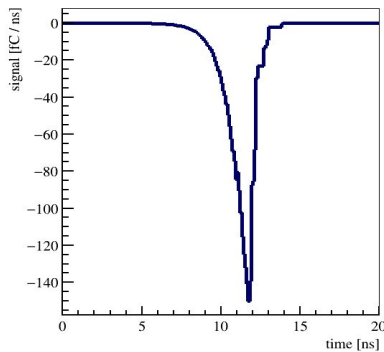
- The European Union has established **targets to reduce greenhouse gas** (GHG) emissions by 55% by 2030 **and achieve net-zero emissions by 2050**. The European Green Deal.
- The **use of fluorinated gases** (F-gases), such as C₂H₂F₄, is **strictly regulated** due to their high Global Warming Potential (GWP).



Simulation of RPC Detector

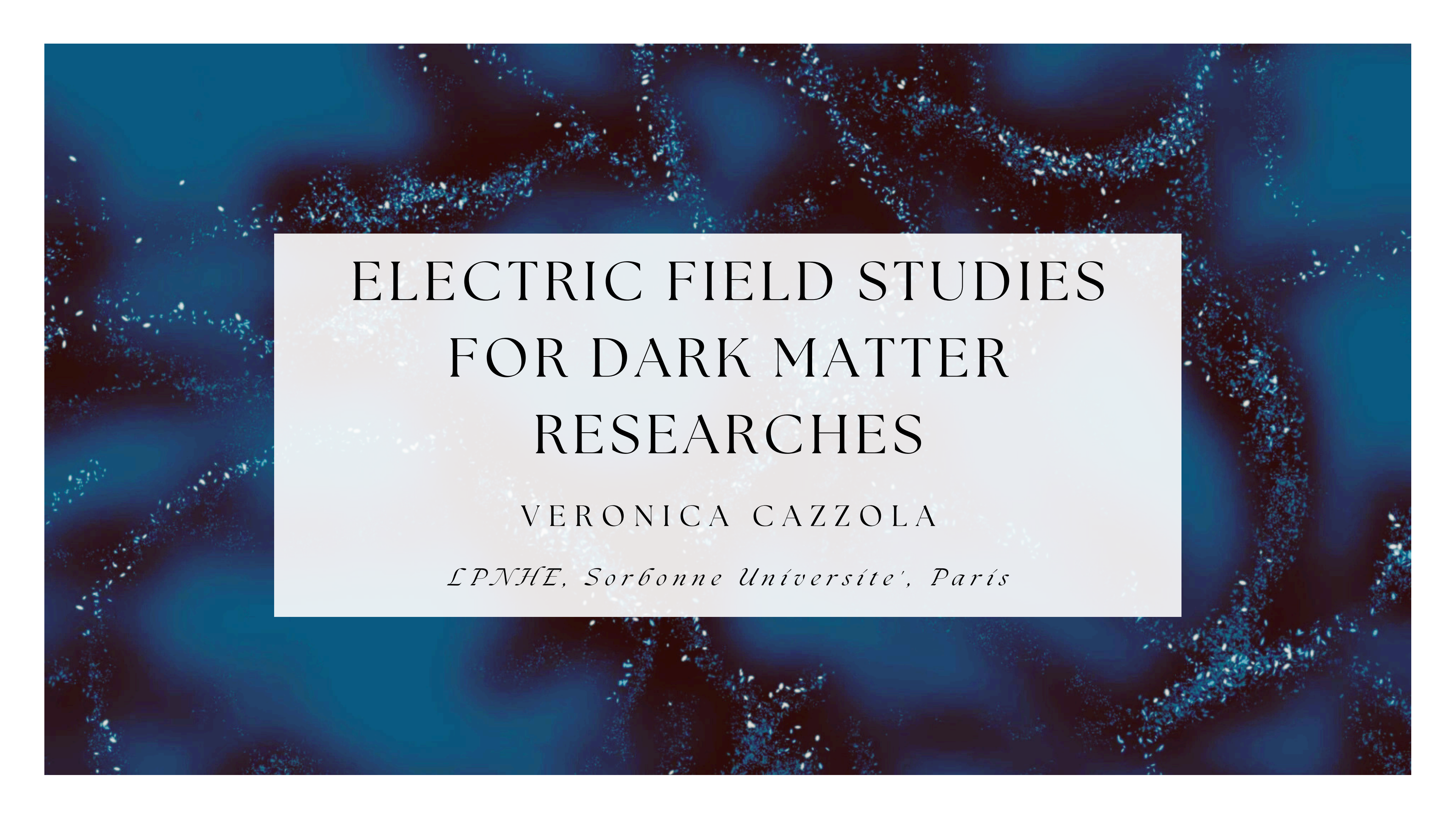


- Different Working Points (WP) in different mixtures:
 - The addition of CO_2 tends to lower the WP, as it reduces the gas density.
 - SF_6 has a high electronegativity, tending to increase the WP of the mixture.



Simulations can help evaluate different gas mixtures and proportions, saving researchers time and money while contributing to the reduction of atmospheric emissions.

Thanks for the Attention !!!



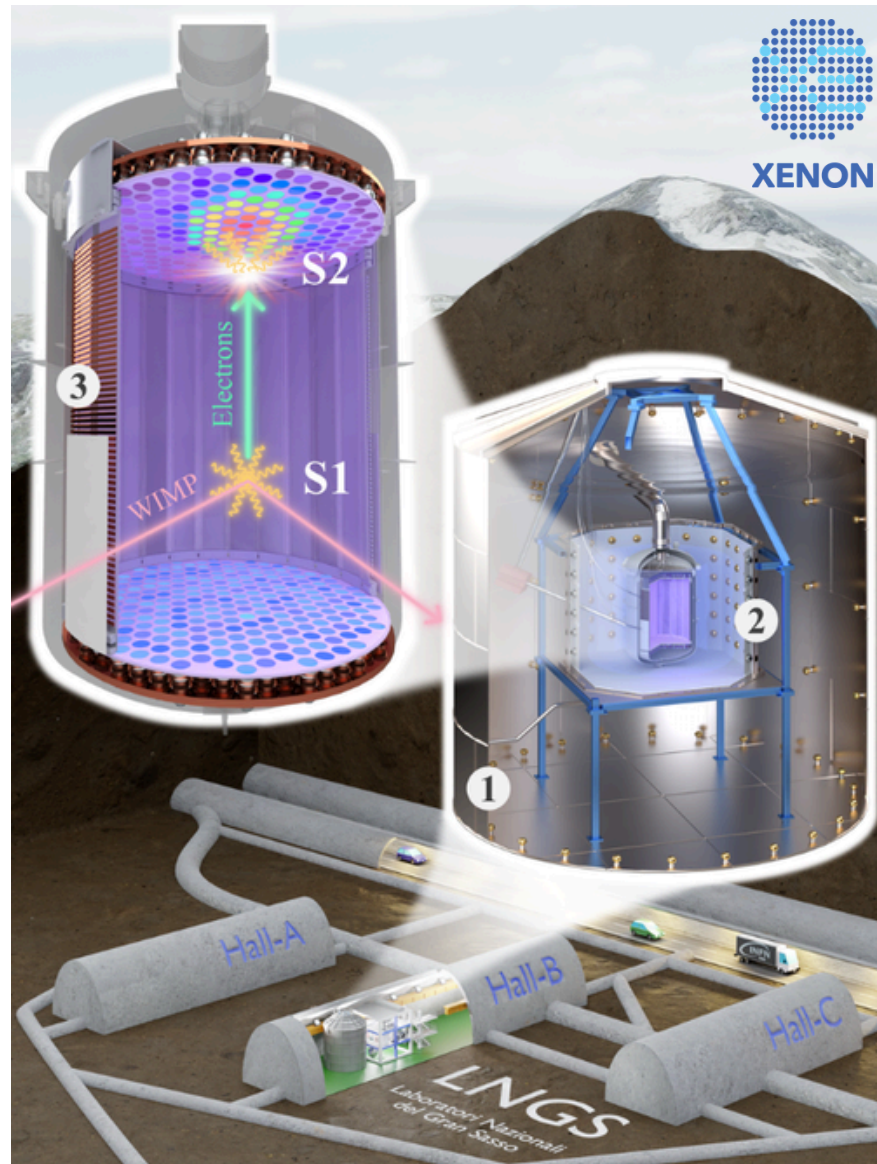
ELECTRIC FIELD STUDIES FOR DARK MATTER RESEARCHES

VERONICA CAZZOLA

LPNHE, Sorbonne Université', Paris

COLLABORATIONS AND PROJECTS

XENONnT



XLZD



XeLab

Xe-Lab

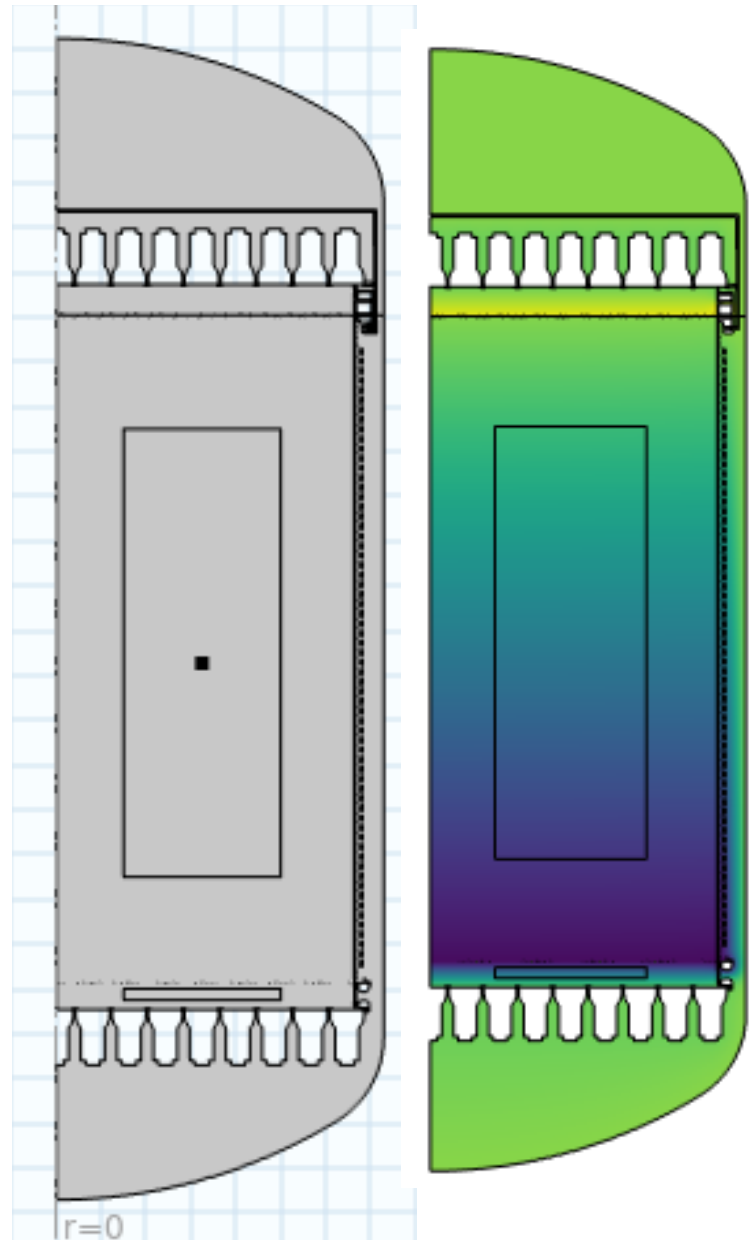


- *DM direct detection*
- *Dual phase Xe TPC*

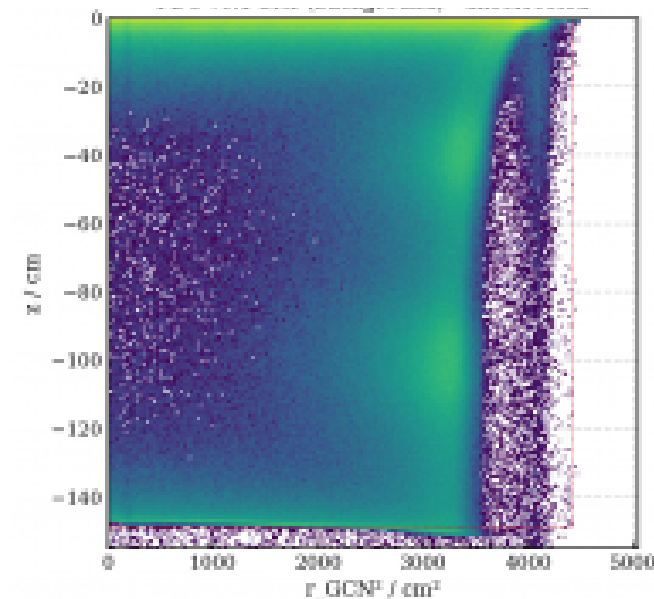
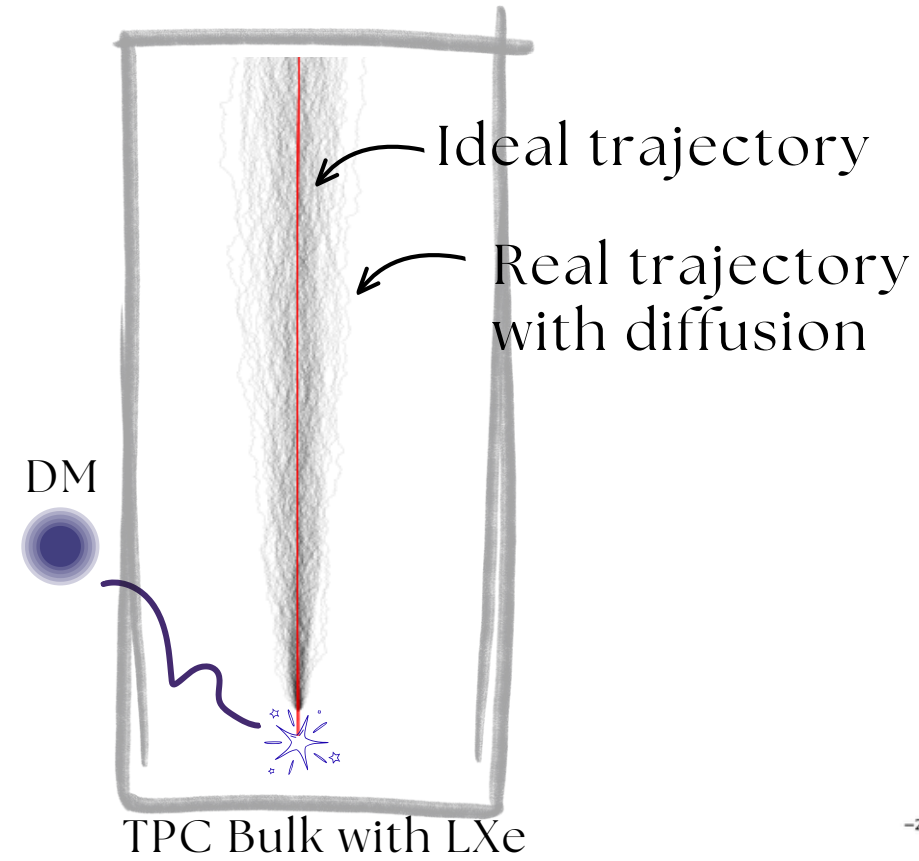
- *R&D project*
- *Hosted at LPNHE, Sorbonne*
- *Prototype for bigger experiment*

1. Electric drift field simulations for XENONnT

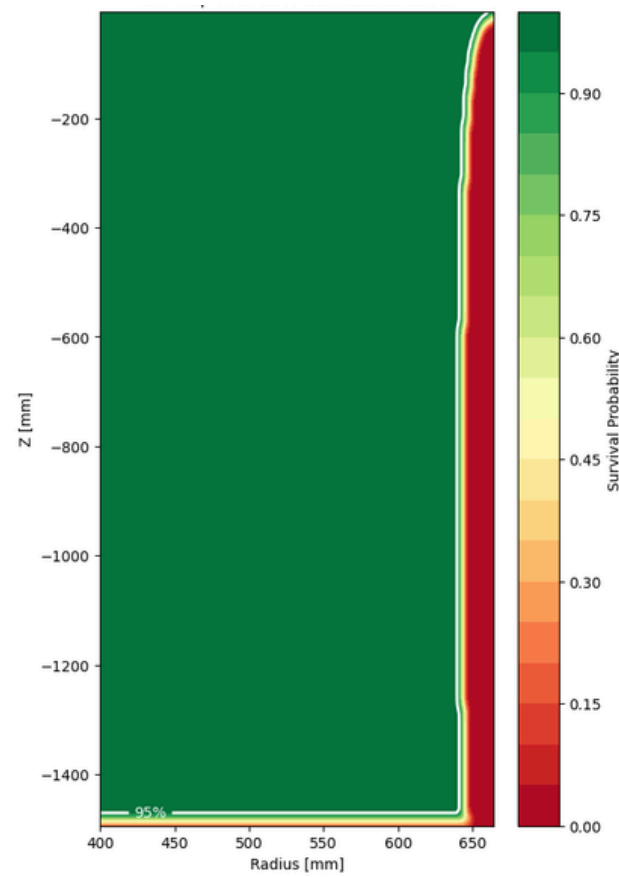
- *Geometry studies and parameters optimizations using COMSOL*



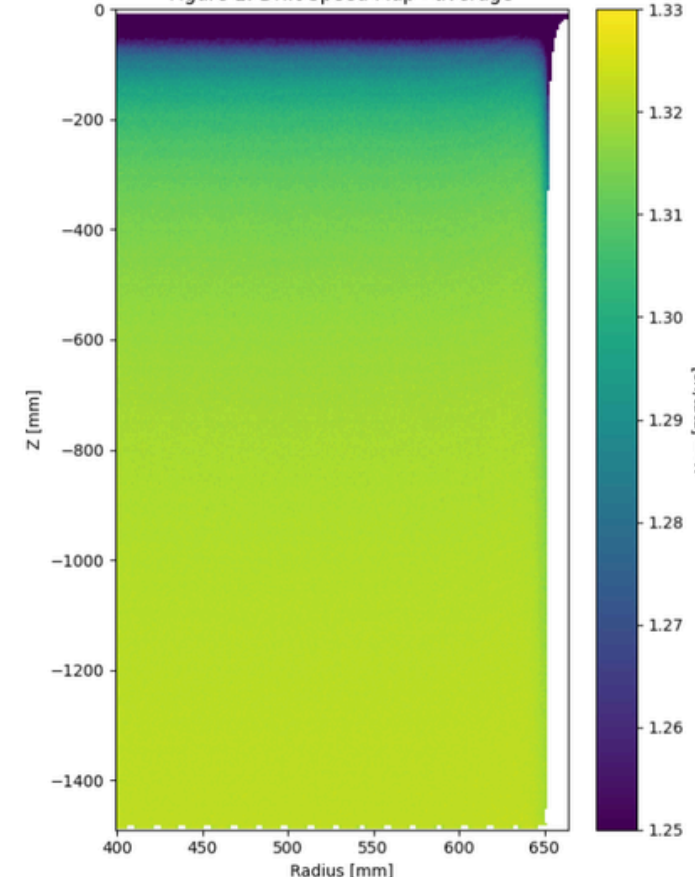
- *Drift properties studies*



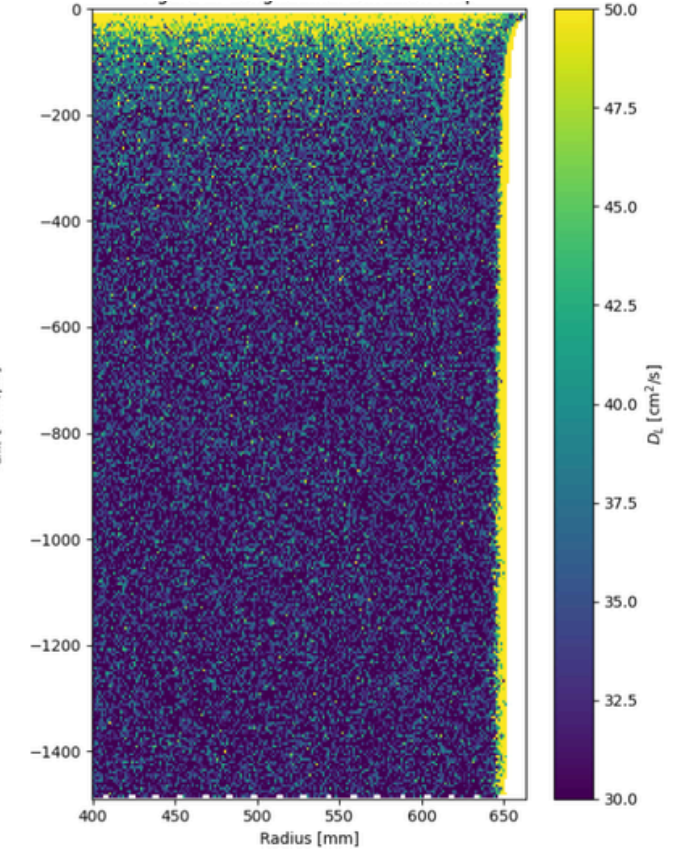
Field corrections



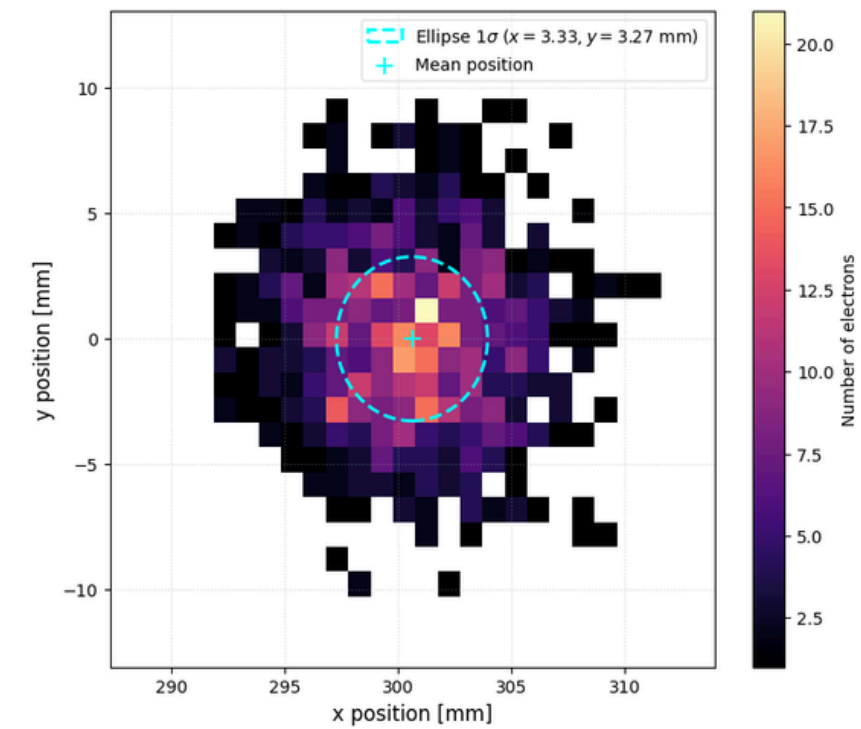
CIV and survival probability



Velocity and drift time



Longitudinal and transverse diffusion coeff.

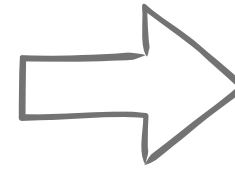


Final position distribution
→ spread

2. Electrodes study at XeLab

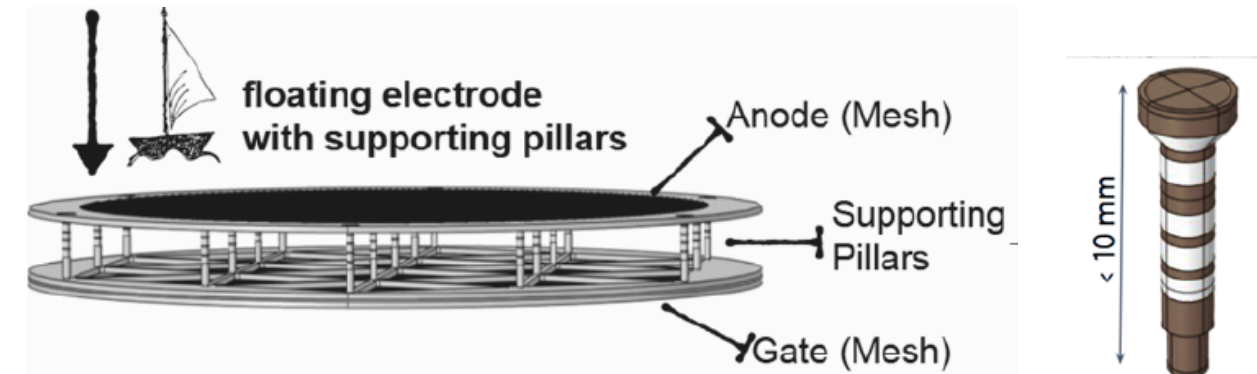
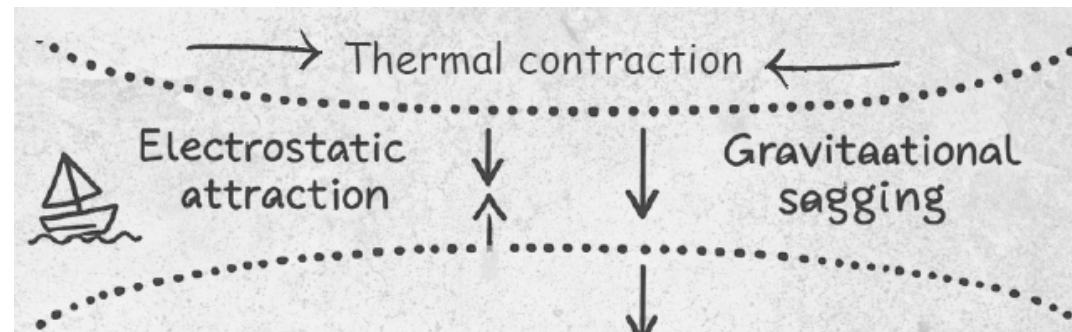
Sagging and deformations

- Worse energy and spatial resolution
- Uncorrect signal reconstruction
- Micro discharges (hot spots)

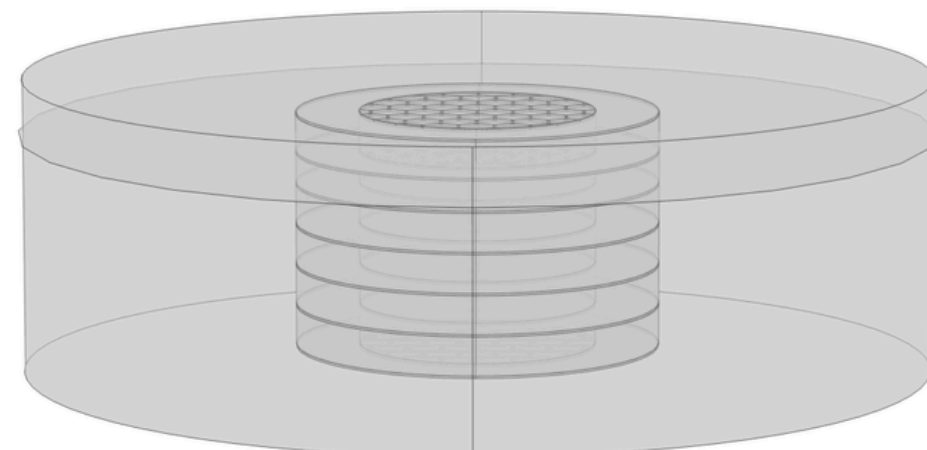


New electrodes design

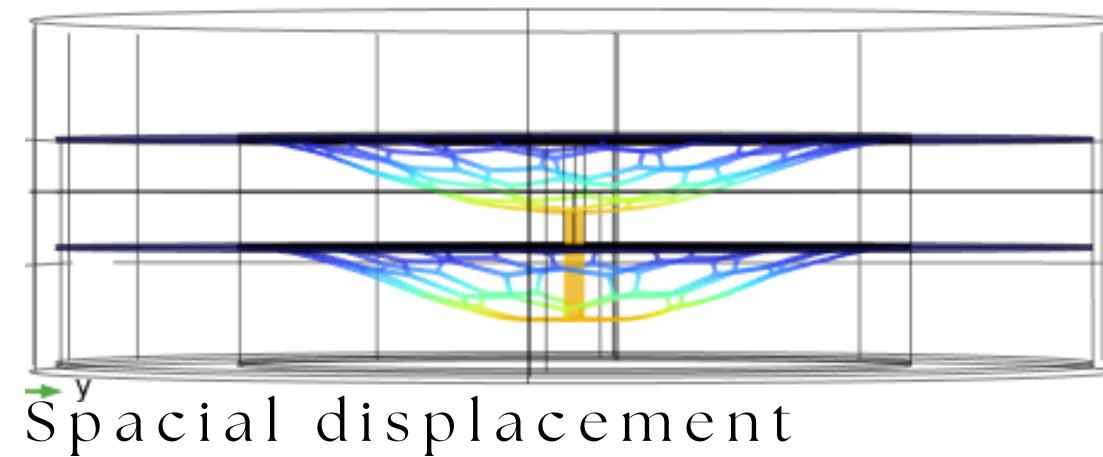
- Gate-Anode distance fixed
- Uniform V and E over mesh
- Mechanical stability



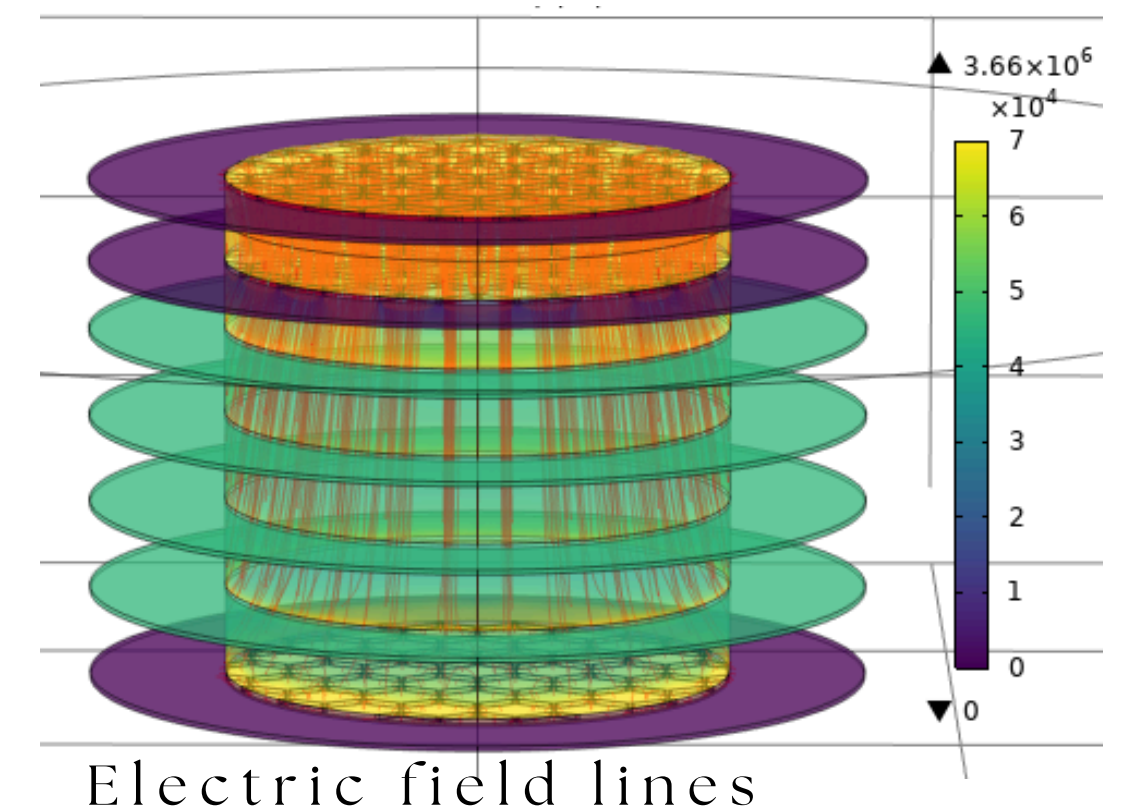
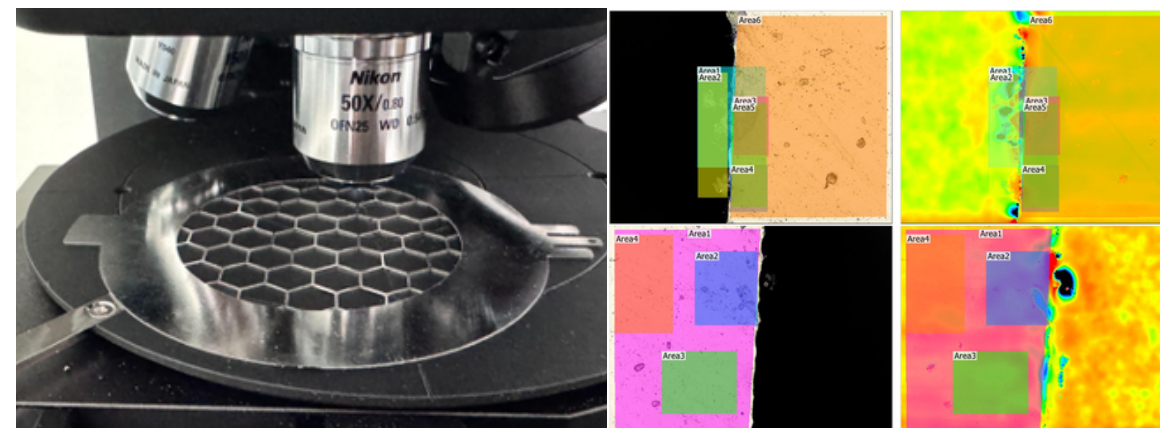
• *Mechanical and electrostatics studies using COMSOL*



Design



Spatial displacement



Electric field lines

• *Impurities analysis*

LUCIA ANGEL

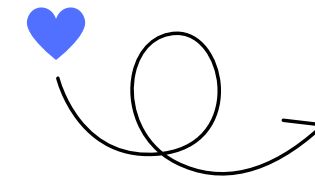


Colombian Ph.D. student at IIP-UFRN in Natal, Brazil with sandwich period at University of Oslo (UiO), Norway.

Supervisors:

- Farinaldo da Silva Queiroz and Torsten Bringmann

INSPIRE HEP



Background:

- Indirect detection searches (member of CTAO collaboration)
- BBN to constraint new physics
- Light dark sectors

Current projects:

- Limits on dark matter Operators dim 7 and 8 with CTAO sensitivity
- Cosmological constraints for DM candidates produced from exponential growth mechanism (UiO)
- Experimental setup to produce Dark photons for 1st time in Latin America (CERN, Unicamp, Liverpool U.)
- Search for light dark sector in reactor neutrino experiments (MPIK and UFRJ)



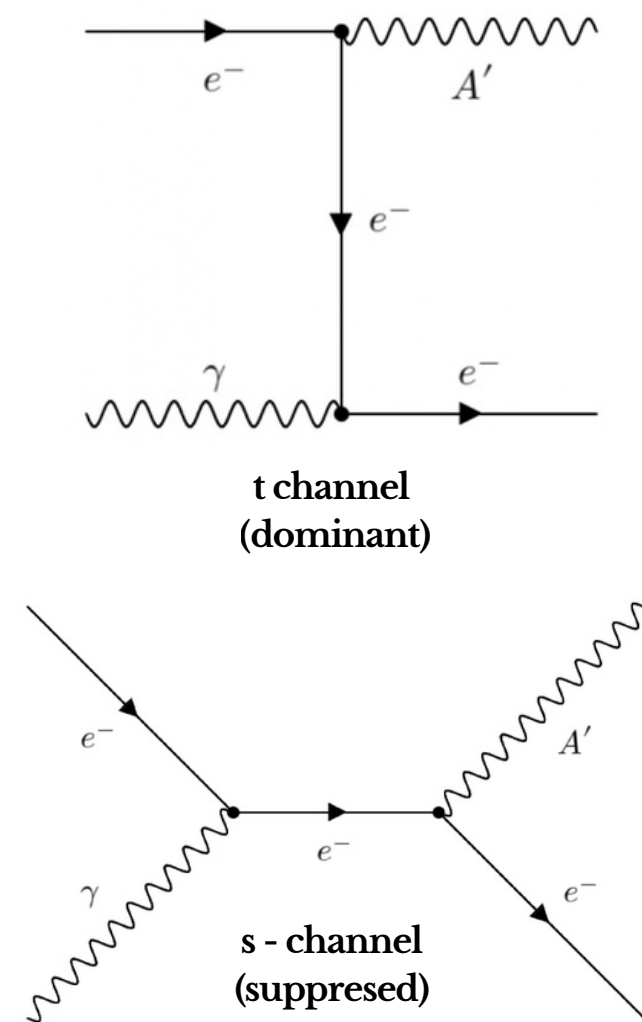
UNIVERSITY
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A SEARCH FOR DARK SECTORS USING LASERS

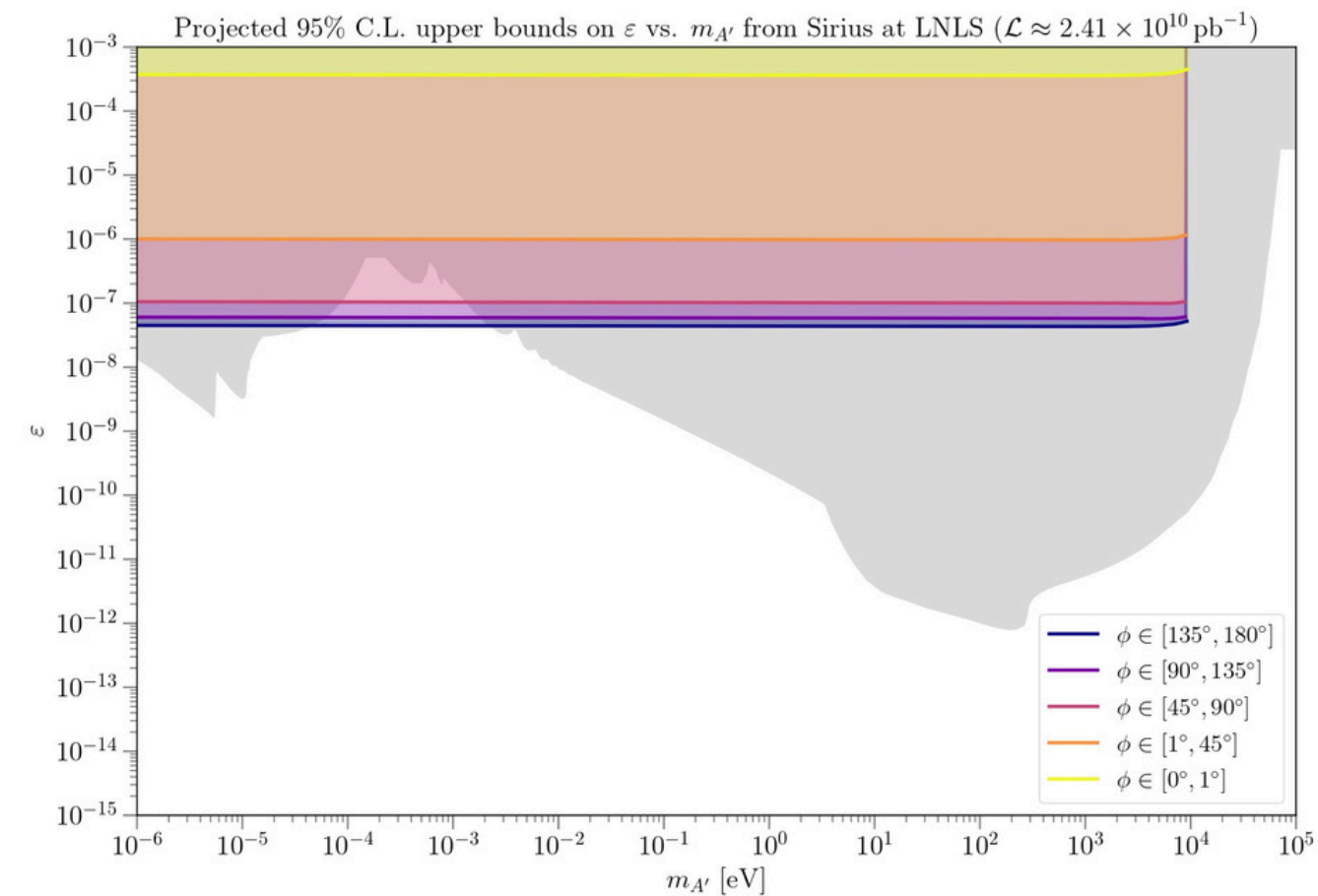


Lucia Angel*, Farinaldo Queiroz, Guillermo Gambini, Gianluigi Casse, Juri Smirnov, Venelin Kozhuharov

Dark Inverse Compton Scattering



Sensitivity



A full version of this work is available here:
<https://arxiv.org/pdf/2603.00247>



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THANK YOU FOR LISTENING



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