



# MITP Summer School 2024

WhatsApp-Gruppe



# MITP WIFI HOTSPOT

SSID: MITPSCHOOL

puXMUh52gNom

Laura Batini 

PHD STUDENT

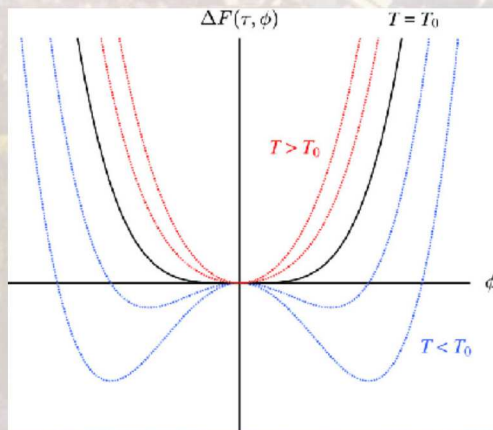
 University of Milan  
and Heidelberg



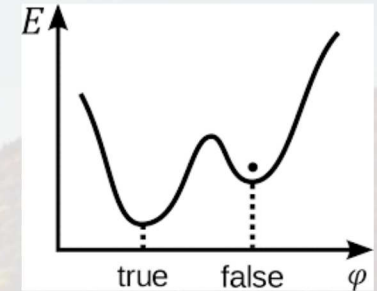
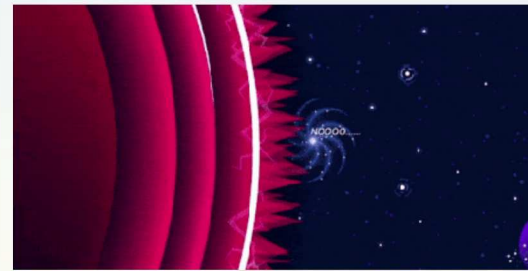
- PhD at Heidelberg University, Institut für Theoretische Physik
- Research: Non-equilibrium dynamics in quantum many-body systems

*ITP*  
↓

### Second order phase transition



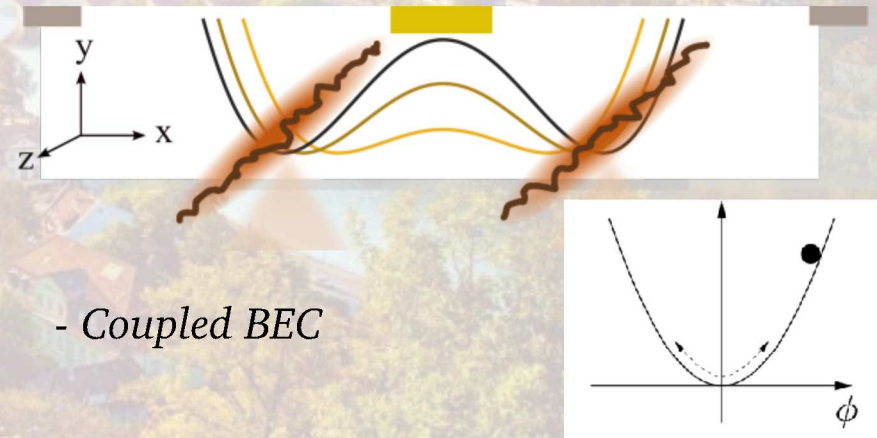
- Critical dynamics
- Effective potential



### False vacuum decay

- Applications in high energy, cosmology, ...

### Non-equilibrium Instabilities



- Coupled BEC

# Esau Cervantes

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## *Interests*

- Cycling;
- Longevity;
- Sport;
- Languages: Fluent English/German, learning Polish;
- Mindfulness;
- Meditation.

## *Hobbies*

- Reading: recently Schopenhauer, and Sapolsky;
- Bike trips (mountain if possible);
- Long walks;
- Gym;
- Tool (band);
- Films (favs: fight club, matrix)



Contact: [esau.cervantes@ncbj.gov.pl](mailto:esau.cervantes@ncbj.gov.pl)

# Research



NATIONAL  
CENTRE  
FOR NUCLEAR  
RESEARCH  
ŚWIERK



- Dark Matter Relic abundance beyond kinetic equilibrium (2103.01944);
- Dynamics of Self Interacting (cannibal) Dark Matter and its pheno.;
- Evolution of systems **out** of thermodynamic equilibrium;
- Non-standard cosmologies

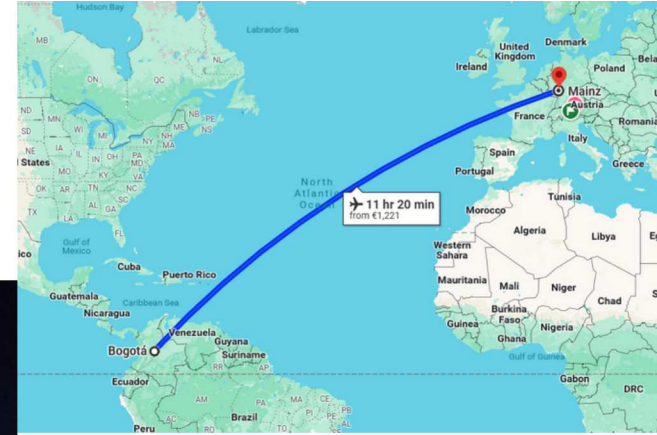
Contact: [esau.cervantes@ncbj.gov.pl](mailto:esau.cervantes@ncbj.gov.pl)

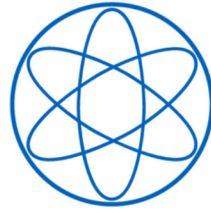
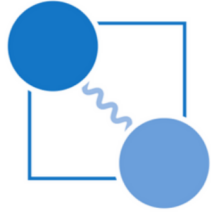
Supervisor: Andrzej Hryczuk ([andrzej.hryczuk@ncbj.gov.pl](mailto:andrzej.hryczuk@ncbj.gov.pl))



# PABLO FIGUEROA

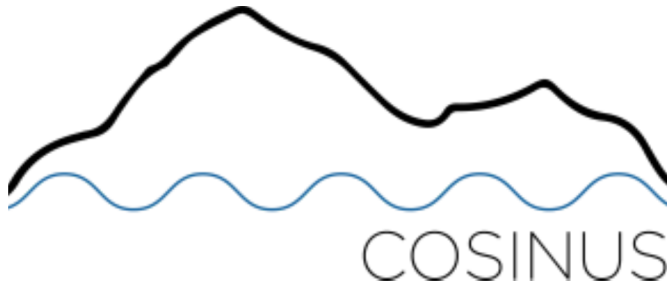
MSC. PHYSICS LMU, MUNICH





# **NREFT'S AT FINITE T FOR DM SELF INTERACTIONS VIA LIGHT MEDIATORS**

**MSC. THESIS @ T30F, SUPERVISOR: PROF. N. BRAMBILLA**



# **DM-ELECTRON INTERACTIONS AT CRYOGENIC LIGHT DETECTORS**

**WORKING STUDENT @ COSINUS , MPP**



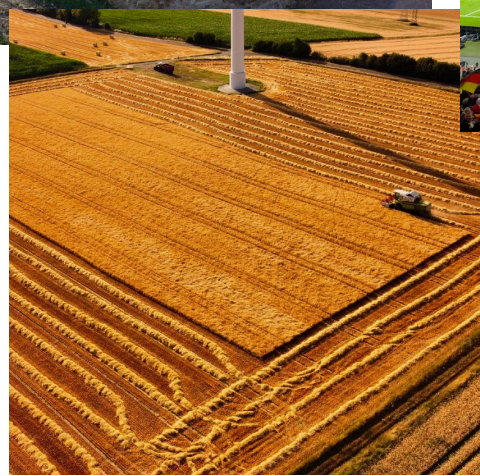
# **DIRECT DETECTION OF LIGHT DARK MATTER**

**BSC. THESIS**



# MITP Icebreaker

Christopher Gerlach



## History



## Football

## Photography

Honorable mentions:  
Politics  
Italian

# MITP Icebreaker

Christopher Gerlach

**2017-20** BSc

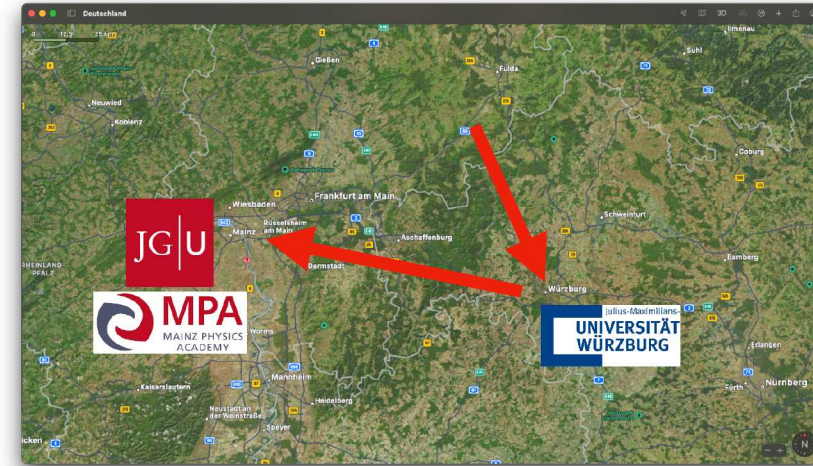
@ JMU Würzburg

**2020-23** MSc (+ X-Track)

@ JGU Mainz

**Since September 23** PhD in

THEP @ JGU Mainz



## Research Interests:

- BSM in Early Universe
- GW Phenomenology from new physics sources
- Cosmic Perturbation Theory & Initial Conditions
- Statistical methods & simulations
- Tensions



**Luis Gil** [he/him]  
/loo-ees hill/



Born and raised in **Sevilla, Spain**

Best known for flamenco and *La Macarena*



**BSc & MSc in Physics** (now also **PhD**)  
at Universidad de Granada, Spain



**Things I love:**

- East Asian cuisine
- Beers on a random Tuesday
- Language and niche music exchanges



**Things I hate:**

- Fixing errors in Mathematica
- Wednesdays after beers on a random Tuesday



We are 13 seniors, 14 juniors or postdocs and 14 PhD students.

Our research covers:

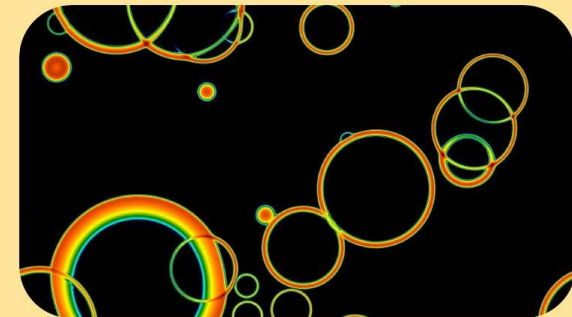
- **Formal aspects of QFT and EFTs**
- Experimental neutrino and collider physics
- Particle and astroparticle phenomenology
- Cosmology
- Non-perturbative QCD



## We\* are currently studying...

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- The application of EFTs to thermal field theory
- What can we learn from SM (BSM) at finite temperature?



(\* ) In collab. with: Mikael Chala, [Juan Carlos Criado](#), Javier López Miras and José Santiago

# Icebreakers MITP Summer School Mainz 2024

Name: Adam Gonstal, from Poland

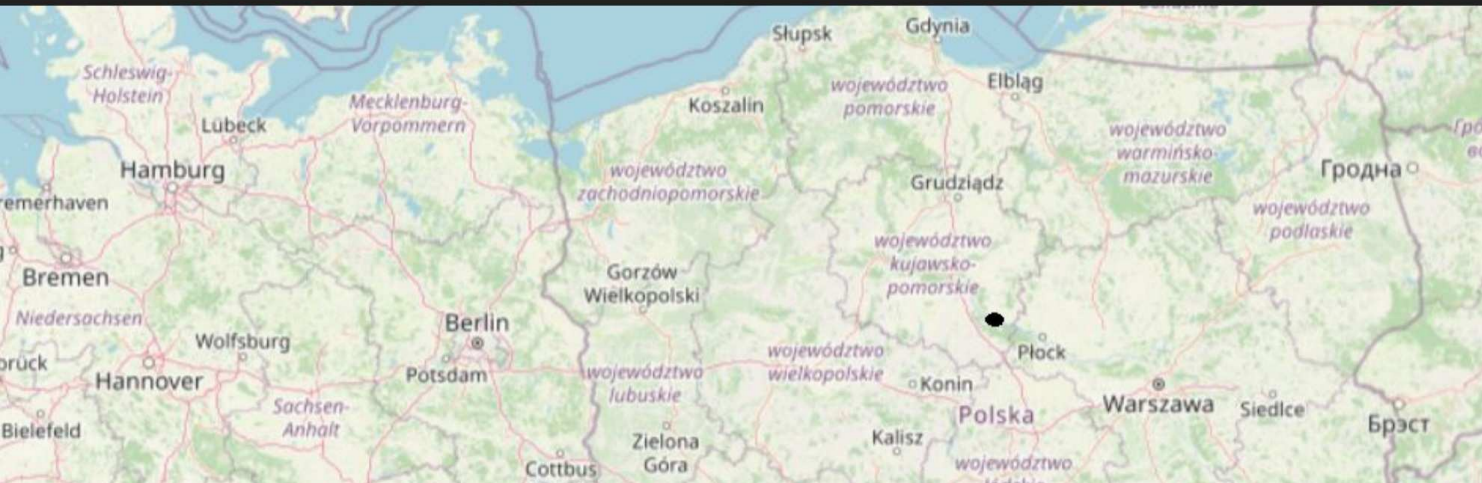
What are my hobbies:

Anything Fantasy related.

Tabletop RPGS

Japanese Culture and learning Japanese

Sports (Mostly Running)

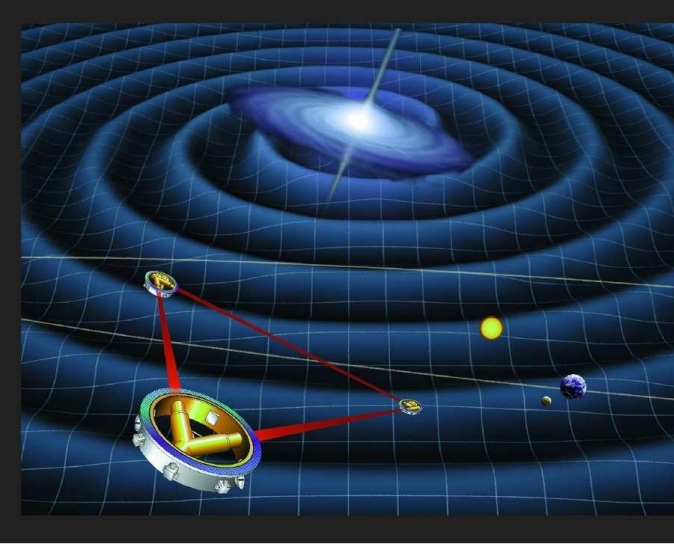


My hometown (black dot)

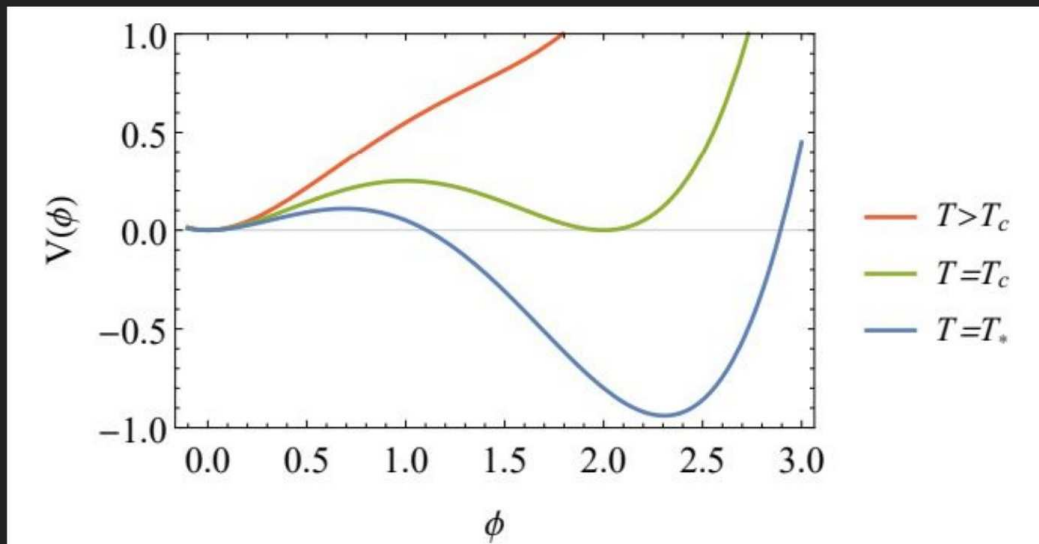
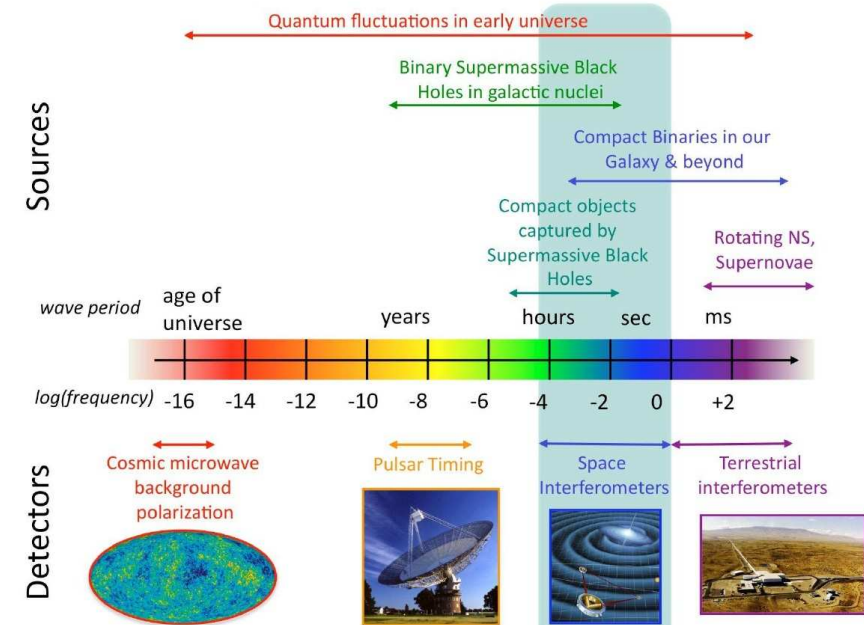
1st physics year PHD student at University of Warsaw supervisor: Marek Lewicki

Working on prospects of detection and reconstruction of parameters of gravitational waves, in the LISA.

We consider signal coming from in the early Universe made by first order phase transition.



### The Gravitational Wave Spectrum





# Jelle Groot

26 years old

2nd Year PhD student at the University of Amsterdam

## Hobbies:

- Playing and watching football
- Playing chess
- Music: Attending concerts!



Bonus:  
a picture of my two cats!





# Jelle Groot

2nd Year – UvA – Supervisor: Jordy de Vries

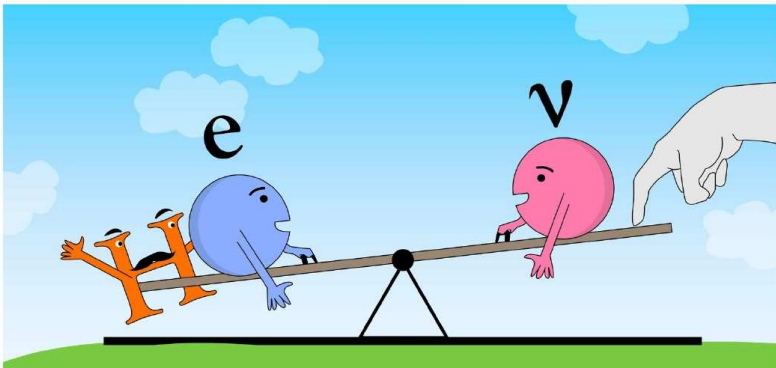
## Sterile Neutrino Phenomenology

### Current Work:

- (Future) Far-Detector Searches



- Neutrinoless Double-Beta Decay



### Solutions to SM puzzles!

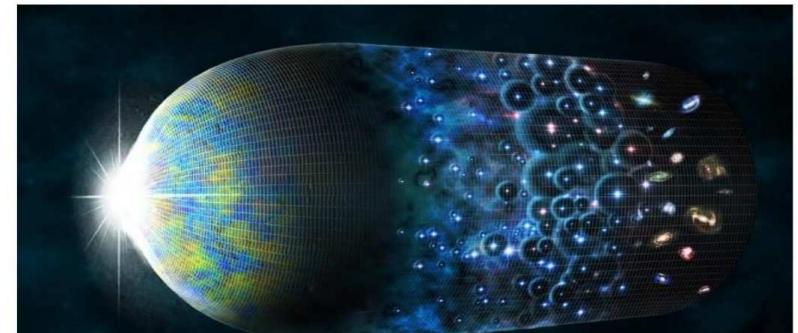
- SM neutrino mass problem
- Baryon asymmetry of the Universe
- Dark matter candidate

### Methods:

- Left-Right symmetric BSM models
- EFT Techniques
- Collider Simulations

### Future Work:

- Phenomenology of sterile neutrinos in the early universe!

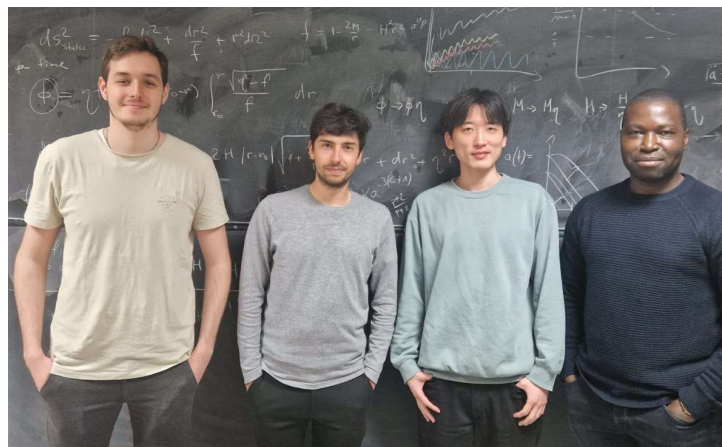




# Mathieu Gross

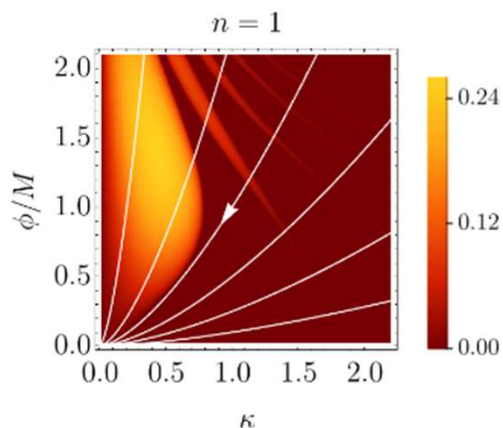


My team in orsay:



## How to transfer the energy from the inflaton to the (dark) matter?

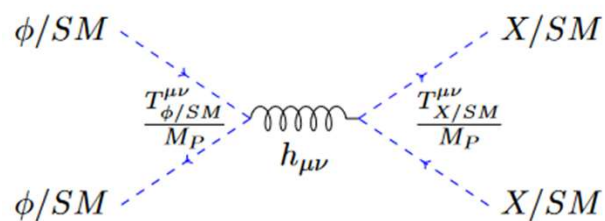
Preheating/non linear physics



Instability phenomenon

[arXiv:1608.01213[astro-ph.CO]]

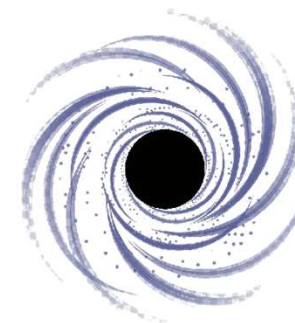
Perturbative reheating



Particle physics

arXiv:2112.15214v2

Alternative scenarios



Primordial black  
hole/modified theories

Specific focus on « minimal processes » related to gravity <https://inspirehep.net/authors/2687690>



Tushar Gupta



Tushar Gupta



Tushar Gupta  
तुषार गुप्ता



Tushar Gupta  
तुषार गुप्ता





Tushar Gupta  
तुषार गुप्ता

Devanagari script  
Used in Sanskrit,  
Hindi, Nepali etc.





Tushar Gupta  
तुषार गुप्ता

Devanagari script  
Used in Sanskrit,  
**Hindi**, Nepali etc.

# INDIA



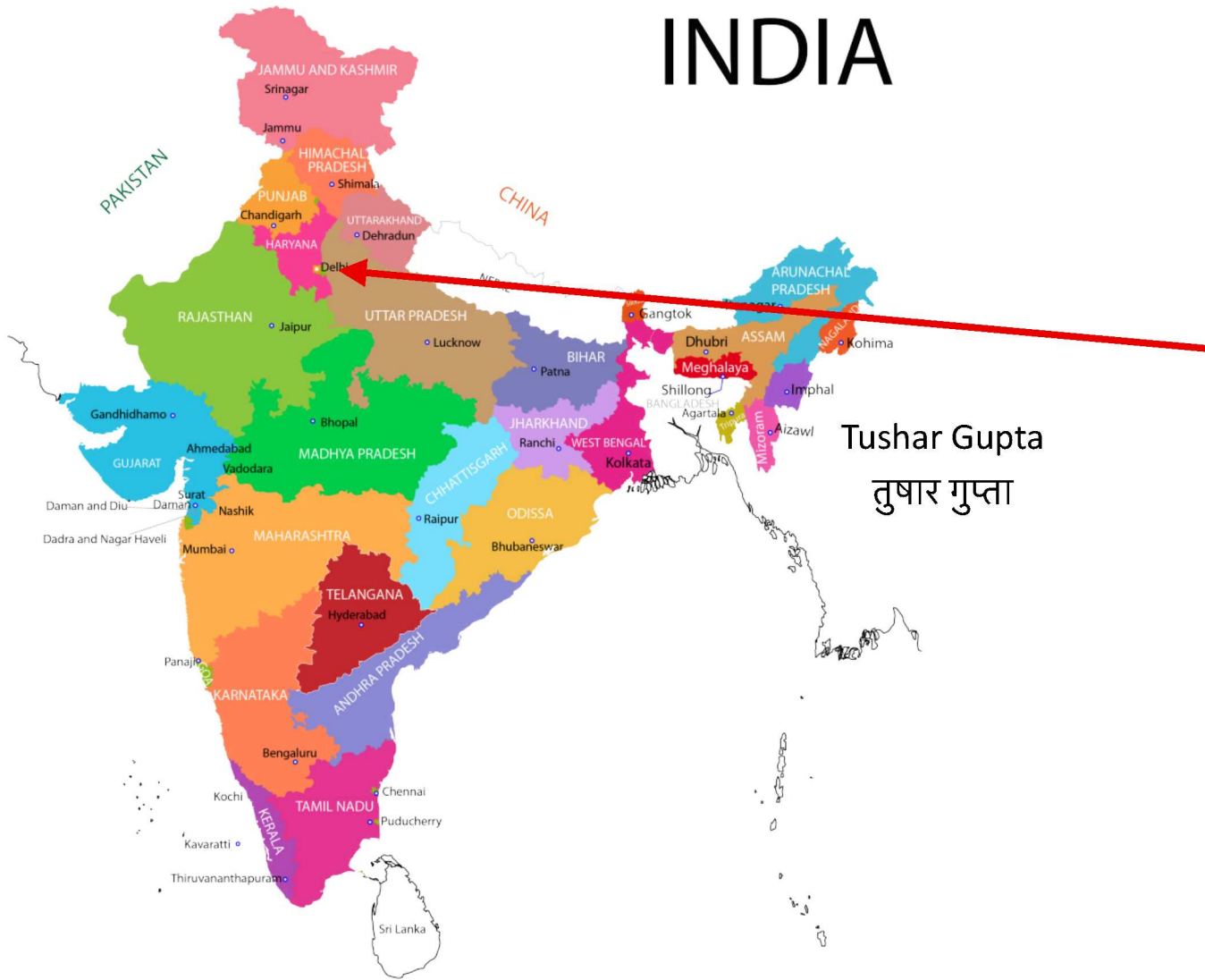
Tushar Gupta  
तुषार गुप्ता

# INDIA



Tushar Gupta  
तुषार गुप्ता

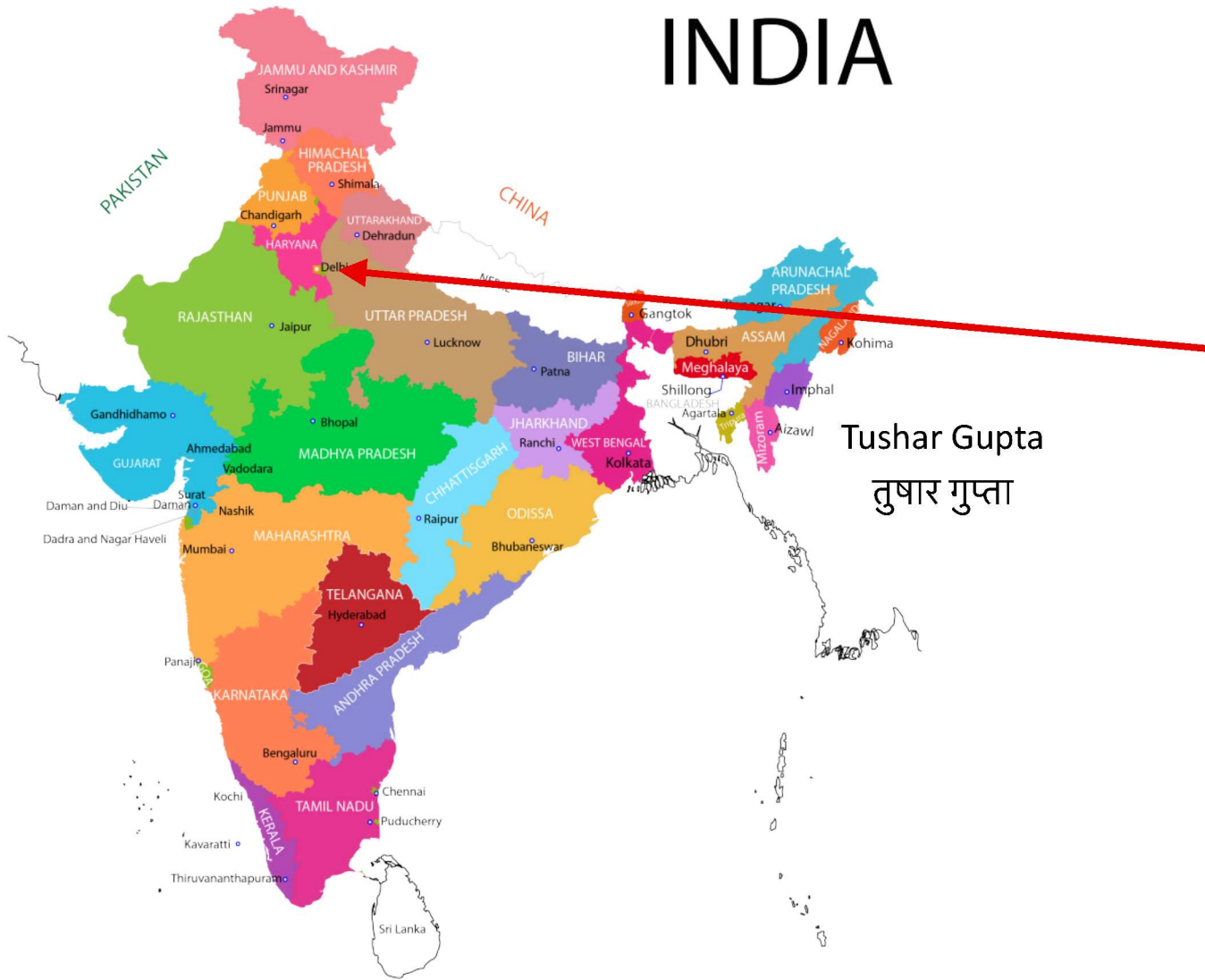
# INDIA



Ghaziabad, Uttar Pradesh

Tushar Gupta  
तुषार गुप्ता

# INDIA



Ghaziabad, Uttar Pradesh

Tushar Gupta  
तुषार गुप्ता

Let's just say  
that it is near  
Delhi (the  
capital)



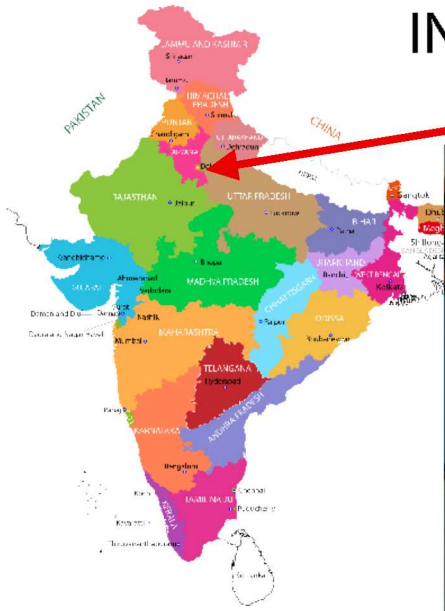
# INDIA

Ghaziabad, Uttar Pradesh



# INDIA

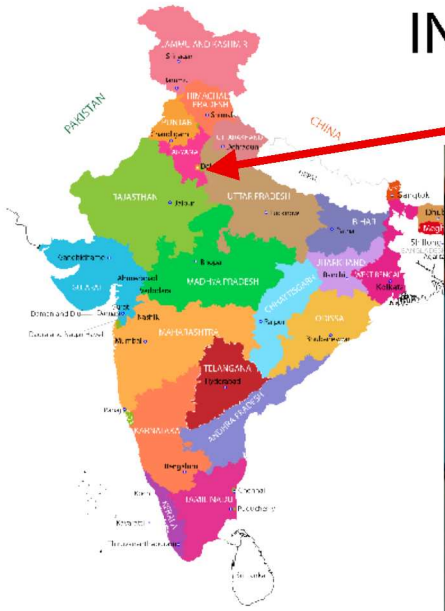
Ghaziabad, Uttar Pradesh



INDIA

Me

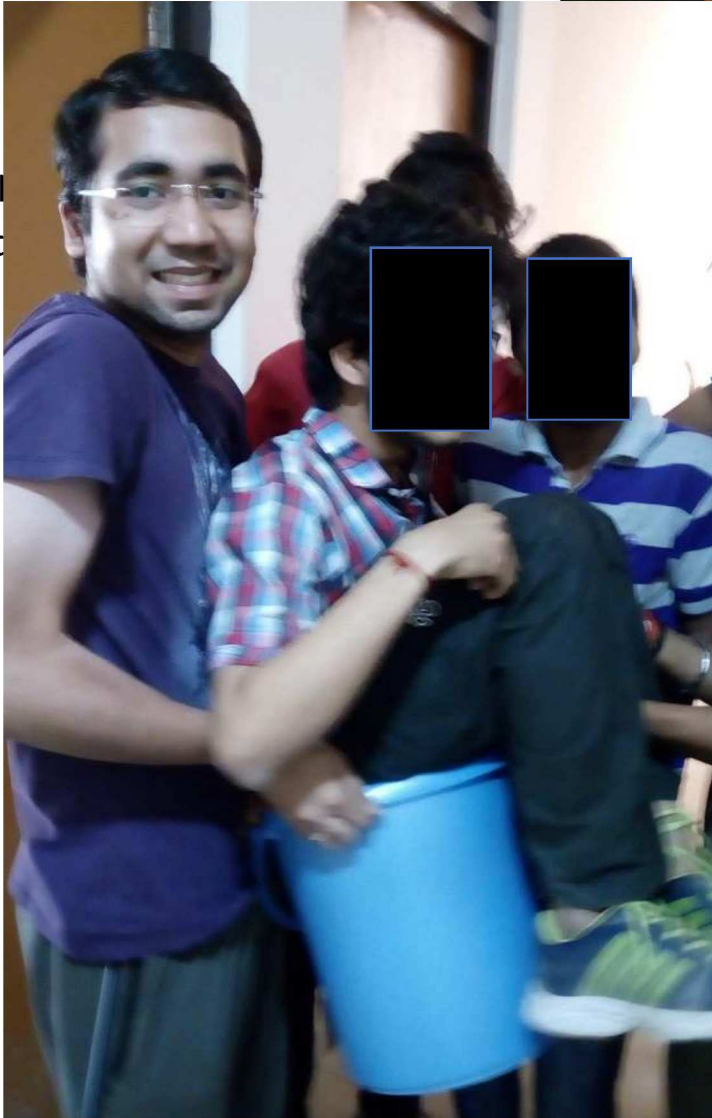
Ghaziabad, Uttar Pradesh





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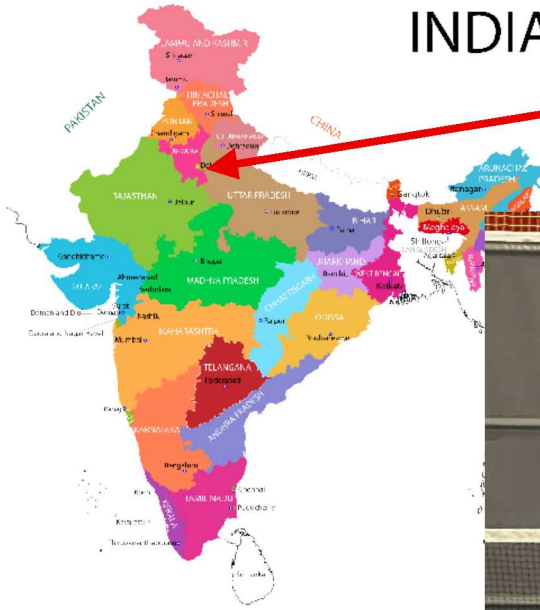
Ghaziabad



INDIA

Ghaziabad, Uttar Pradesh

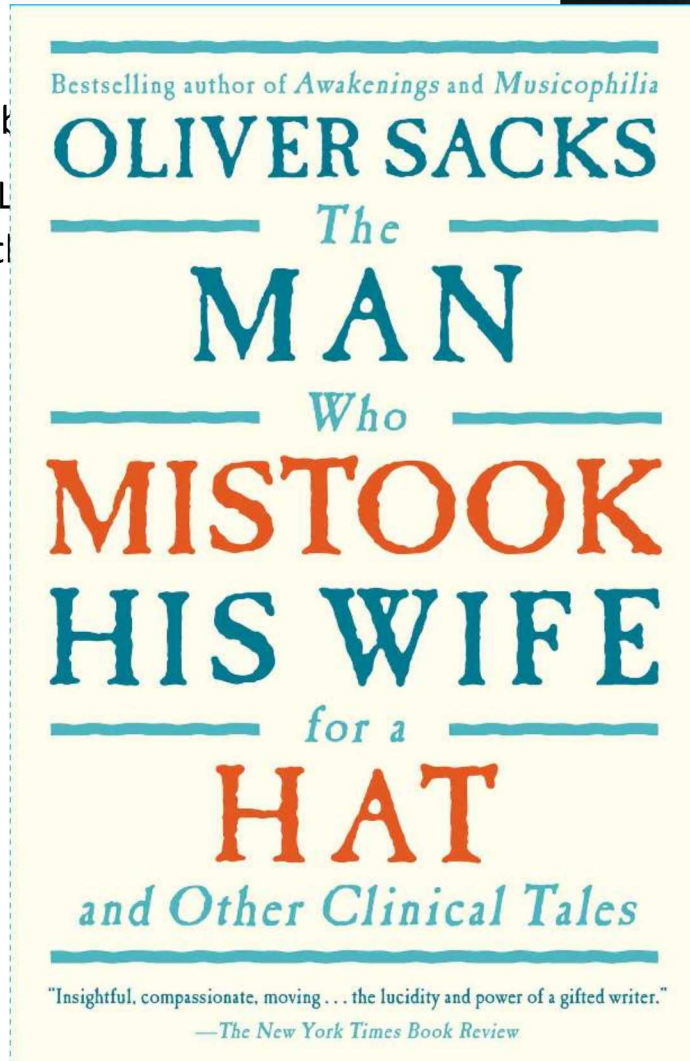
Let's just say





INDIA

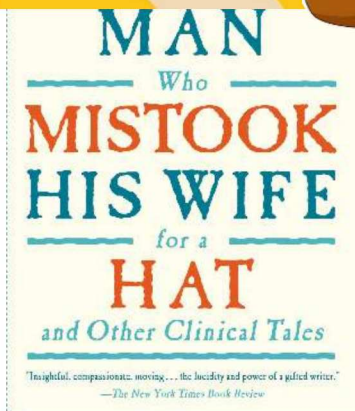
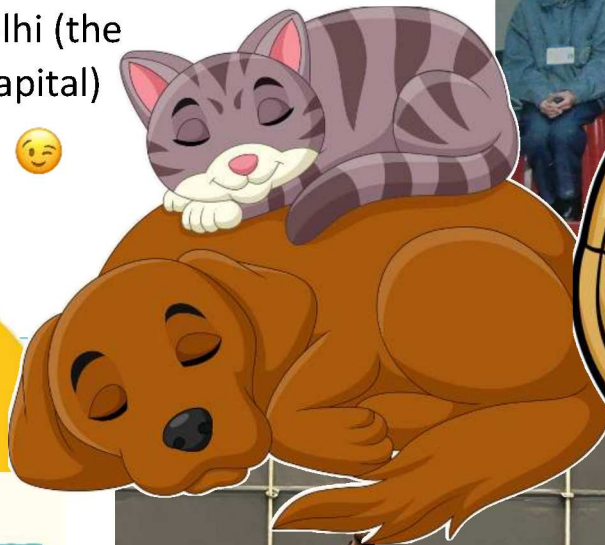
Ghaziabad



# INDIA

Ghaziabad, Uttar Pradesh

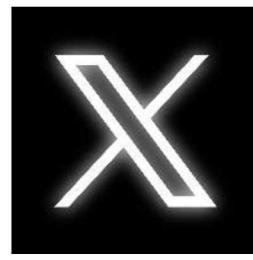
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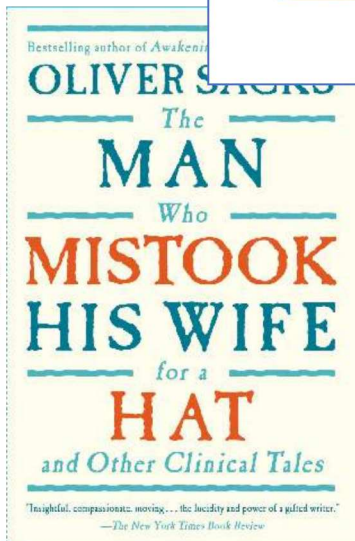
# INDIA

Ghaziabad, Uttar Pradesh

Let's just say  
that it is near  
Delhi (the



@itsetushar





Tushar Gupta

Tushar Gupta  
University of Helsinki





Tushar Gupta  
University of Helsinki

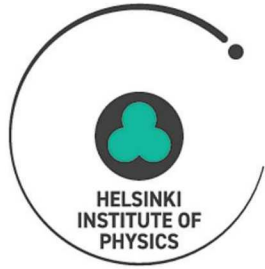
**HELSINGIN YLIOPISTO**  
**HELSINGFORS UNIVERSITET**  
**UNIVERSITY OF HELSINKI**



**HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI**

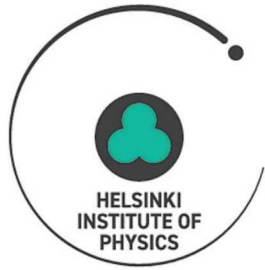
Tushar Gupta  
University of Helsinki





Supervisors:  
Katri Huitu  
Matti Heikinheimo

Tushar Gupta



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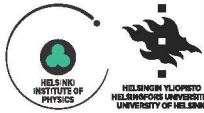
For the past two years I have been  
working on SUSY Dark Matter  
Phenomenology

Tushar Gupta



Supervisors:  
Katri Huitu  
Matti Heikinheimo

For the past two years I have been working on SUSY Dark Matter Phenomenology



**No-go for freeze-in DM in right-handed neutrino extended MSSM**  
Tushar Gupta,<sup>1a</sup> Matti Heikinheimo,<sup>a</sup> Katri Huitu,<sup>a</sup> and Harri Waltari<sup>b</sup>

<sup>a</sup>Department of Physics, and Helsinki Institute of Physics, University of Helsinki, P.O. Box 64, 00014 Helsinki, Finland  
<sup>b</sup>Department of Physics and Astronomy, Uppsala University, P.O. Box 516, 75180 Uppsala, Sweden  
<sup>†</sup>tushar.gupta@helsinki.fi

**Summary**

We investigate the possibility of saturating the relic density bound with light higgsinos. When the minimal supersymmetric Standard Model is extended with right-handed neutrino superfields and the seesaw scale is very low, right sneutrinos can be produced via the freeze-in mechanism. In such a case we can have essentially two independent sources for dark matter, the traditional freeze-out of higgsinos and the freeze-in of right-handed sneutrinos. The heavier of these two will decay to the lighter species with a delay. We have ruled out such a scenario for all seesaw models as the lifetime of sterile neutrino, produced via Dodelson-Widrow mechanism, exceeds the age of the universe and will contribute to the relic density.

**Why**

Natural supersymmetry prefers a light higgsino while other superpartners can be heavier. This motivates us to explore other weakly interacting massive particle (WIMP) alternatives.

**Freeze-out component**

We get a Higgsino-like neutralino which can either be stable or decays to RH neutrinos. Large part of parameter space has already been excluded by experiments. However, constraints can be evaded if sneutrino is our DM.

**Freeze-in component**

So far work on Dirac neutrinos with FIMP#1[5]

**Dodelson-Widrow mechanism**

The dominant mechanism for sterile neutrino dark matter generation is oscillations between active and sterile neutrinos known as the Dodelson-Widrow mechanism [6].

$$\Omega h^2 \approx 0.12 \left( \frac{m_N}{1 \text{ keV}} \right)^2 \left( \frac{\sin^2 2\theta}{7.3 \times 10^{-4}} \right)^{1.38}$$

**Results**

We have shown that irrespective of sterile neutrino mass or choice of Yukawa coupling, there is always overproduction in the otherwise viable parameter space.

**Conclusion**

- In type-I seesaw, it is impossible to suppress mixing ( $\theta$ ) while keeping the neutrino mass spectrum viable.
- In linear seesaw, we can suppress this mixing by making sterile neutrino more massive. But it leads to high freeze-in contribution.
- In inverse seesaw, we see that it is essentially a type-I seesaw once we integrate out sneutrinos and singlet neutrinos.

**References**

- [1] P. Minkowski, Phys. Lett. B 67 (1977), 421-428
- [2] J. Schechter and J. W. F. Valle, Phys. Rev. D 22 (1980), 2207
- [3] D. Wyler and L. Wolfenstein, Nucl. Phys. B 218 (1983), 205-214
- [4] R. N. Mohapatra and J. W. F. Valle, Phys. Rev. D 34 (1986), 1642
- [5] K. Y. Choi, J. Kim and O. Seto, Phys. Dark Univ. 22 (2018), 96-100
- [6] S. Dodelson and L. M. Widrow, Phys. Rev. Lett. 72 (1994), 17-20

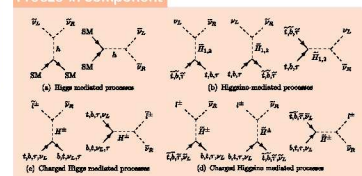
**Properties**

- Will have both independent freeze-in and freeze-out contribution.
- Heavier species will eventually decay into lighter species.
- A sterile sneutrino would evade all direct detection constraints.

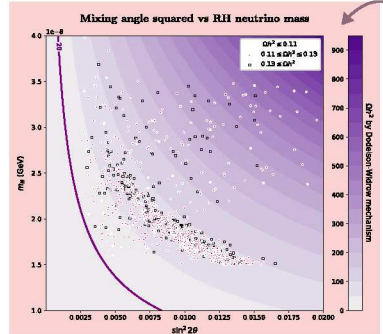
**Four possible models!**

$W_{\text{Dirac}} = y^c Q H_u U^c + y^d Q H_d D^c + y^e L H_1 E^c + \mu H_u H_d + y^f L H_u N^c$	$m_{\nu} = y^c y^d \sin \beta$	$M^2 = 0$
$W = W_{\text{Dirac}} + \frac{1}{2} M_{R1} N_1^c N_1^c$	$m_{\nu} \approx \frac{(y^c y^d \sin \beta)^2}{2M_{R1}}$ , $m_N \approx M$	Lepton number violating mass term $M^2$
$W_{12} = W_{\text{Dirac}} + M_{R1} N_1^c N_2^c + y^g L_1 H_1 S + y^g L_2 H_2 S$	$m_{\nu} \approx \frac{y^c y^d \sin^2 \beta}{2M_{R1}}$	
$W_{12} = W_{\text{Dirac}} + M_{R1} N_1^c N_2^c + \frac{1}{2} \mu S^2$	$m_{\nu} \approx \frac{(y^c y^d \sin \beta)^2}{\sqrt{2} M_{R1}} + \mu \epsilon$	

**Freeze-in component**



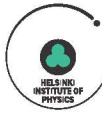

**Mixing angle squared vs RH neutrino mass**





Supervisors:  
Katri Huitu  
Matti Heikinheimo

For the past two years I have been working on SUSY Dark Matter Phenomenology

## No-go for freeze-in DM in right-handed neutrino extended MSSM

Tushar Gupta,<sup>1a</sup> Matti Heikinheimo,<sup>a</sup> Katri Huitu,<sup>a</sup> and Harri Waltari<sup>b</sup>

<sup>a</sup>Department of Physics, and Helsinki Institute of Physics, University of Helsinki, P.O. Box 64, 00014 Helsinki, Finland

<sup>b</sup>Department of Physics and Astronomy, Uppsala University, P.O. Box 516, 75180 Uppsala, Sweden

<sup>†</sup>tushar.gupta@helsinki.fi

### Summary

We investigate the possibility of saturating the relic density bound with light higgsinos. When the minimal supersymmetric Standard Model is extended with right-handed neutrino superfields and the seesaw scale is very low, right sneutrinos can be produced via the freeze-in mechanism. In such a case we can have essentially two independent sources for dark matter, the traditional freeze-out of higgsinos and the freeze-in of right-handed sneutrinos. The heavier of these two will decay to the lighter species with a delay. We have ruled out such a scenario for all seesaw models as the lifetime of sterile neutrino, produced via Dodelson-Widrow mechanism, exceeds the age of the universe and will contribute to the relic density.

### Why

Natural supersymmetry prefers a light higgsino while other superpartners can be heavier. This motivates us to explore other weakly interacting massive particle (WIMP) alternatives.

### Freeze-out component

We get a Higgsino-like neutralino which can either be stable or decays to RH neutrinos. Large part of parameter space has already been excluded by experiments. However, constraints can be evaded if sneutrino is our DM.

### Freeze-in component

Freeze-in mechanism comes to the rescue. But it requires coupling between DM and thermal bath to be below  $10^{-7}$  or so. Such couplings exist naturally in electroweak scale seesaw models if the MSSM is extended with sterile neutrino superfields.

### Properties

- Will have both independent freeze-in and freeze-out contribution.
- Heavier species will eventually decay into lighter species.
- A sterile sneutrino would evade all direct detection constraints.

### So far work on Dirac neutrinos with FIMP#1[5]

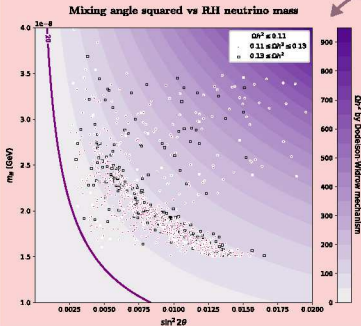
There is extremely small mass splitting between the CP-even and CP-odd states generated by  $M^2$  term.  
Hence, the particle created as a (anti)neutrino will remain nearly as a (anti)neutrino for a long period.  
 $A_{\nu\nu} - y' \mu u$  term mix left- and right-handed sneutrinos.  
 $A_{\nu\nu}$  is vanishingly small which leads to negligible mixing between left- and right-handed sneutrinos.

### Dodelson-Widrow mechanism

The dominant mechanism for sterile neutrino dark matter generation is oscillations between active and sterile neutrinos known as the Dodelson-Widrow mechanism [6].

$$\Omega h^2 \approx 0.12 \left( \frac{m_N}{1 \text{ keV}} \right)^2 \left( \frac{\sin^2 2\theta}{7.3 \times 10^{-4}} \right)^{1.38}$$

### Mixing angle squared vs RH neutrino mass



### Results

We have shown that irrespective of sterile neutrino mass or choice of Yukawa coupling, there is always overproduction in the otherwise viable parameter space.

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My poster in IDM 2024

Tushar Gupta



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working on SUSY Dark Matter  
Phenomenology

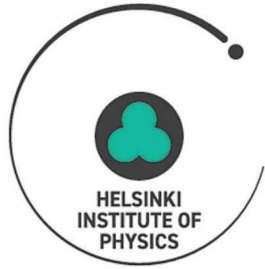




Supervisors:  
Katri Huitu  
Matti Heikinheimo

For the past two years I have been  
working on SUSY Dark Matter  
Phenomenology

But my recent new projects are on BBN cosmology and early universe stuff! 🤔



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If anyone of you are working on this (or wish to work), I will be most happy to discuss! 🍷🙌

Tushar Gupta



Supervisors:  
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If anyone of you are working on this (or wish to work), I will be most happy to discuss! 🥳🙌

Discuss = me mostly listening 🙄🙄

PS: I am also interested in CMB spectral distortion and anisotropies!!🙄🙄

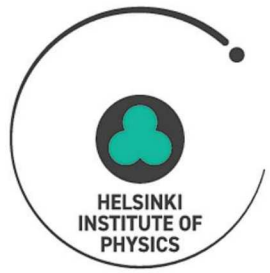
Tushar Gupta

# BONUS

Tushar Gupta



HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI



# BONUS

Tushar Gupta



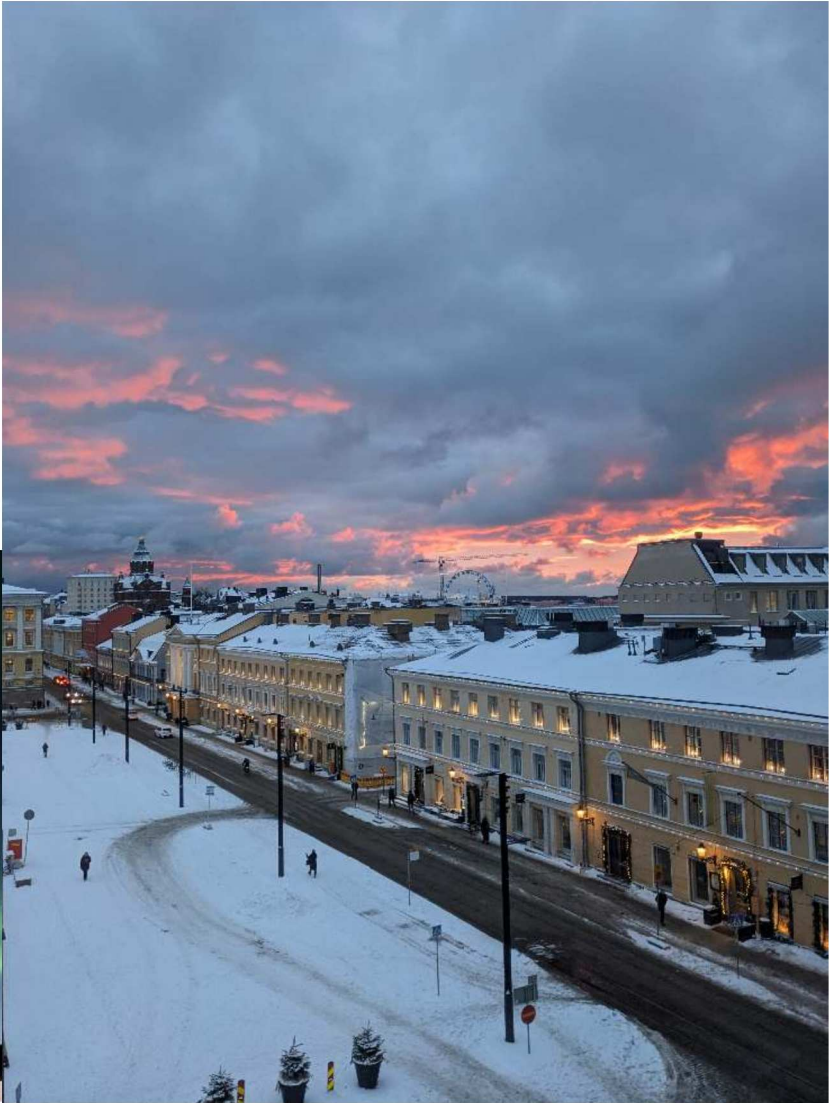




HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI

**BONUS**

Tushar Gupta

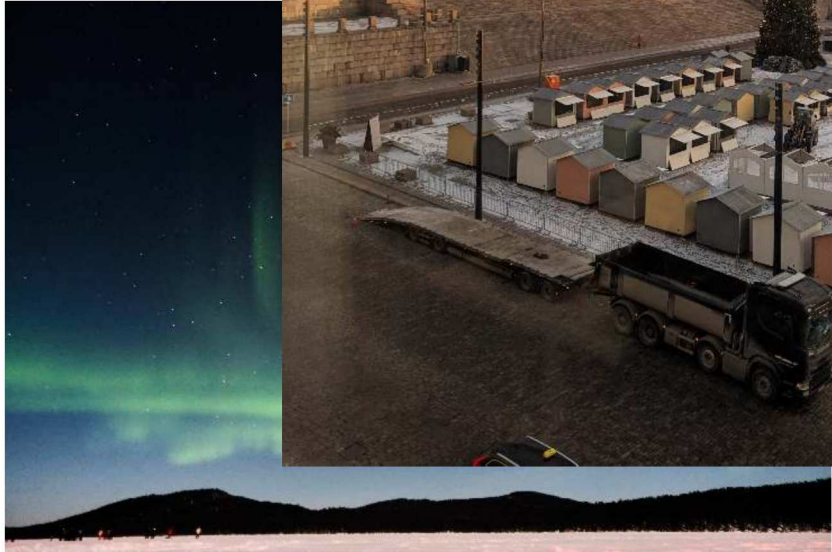




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HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI

BONUS

Tushar Gupta

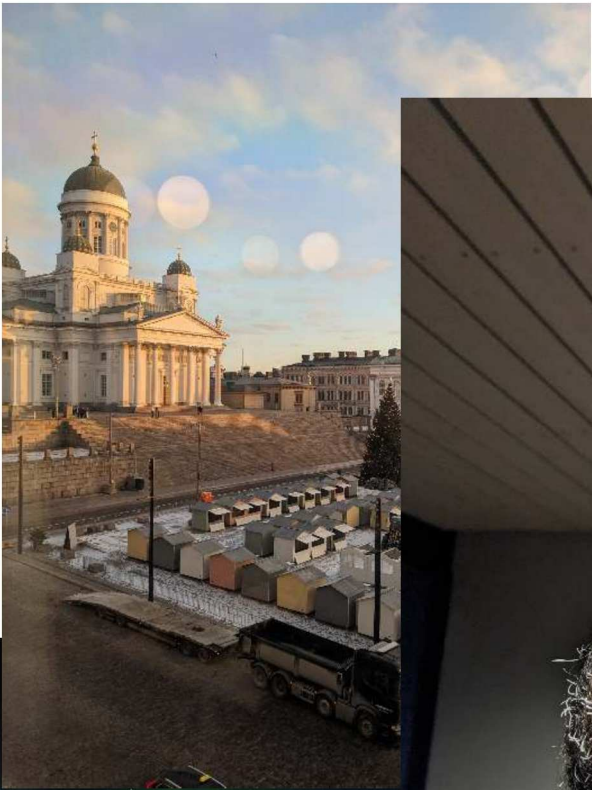




HELSINGIN YLIOPISTO  
HELSINGFORS UNIVERSITET  
UNIVERSITY OF HELSINKI

BONUS

Tushar Gupta



## ABOUT ME

01 Originally from Perth, Western Australia but now reside in Melbourne, Victoria.

02 Played guitar since I was 12 years old. Played in many bands since I was a teenager.

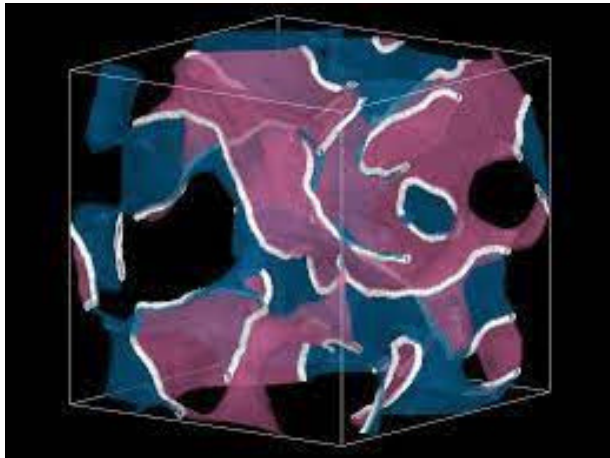
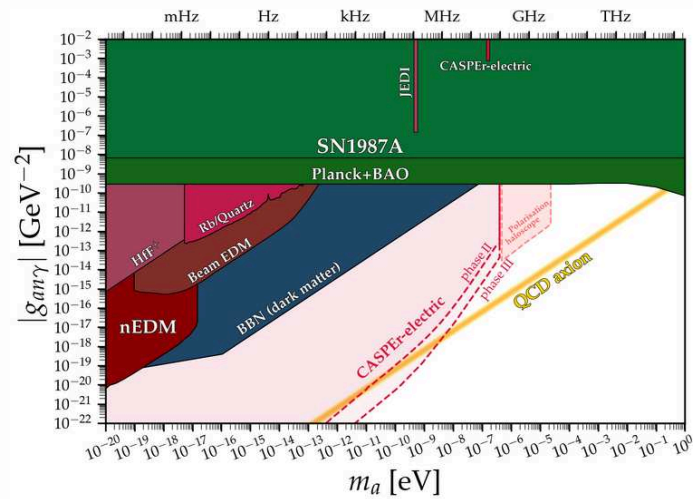
03 Passionate about punk, hardcore and metal music as well the history of these genres.

04 Enjoy seeing live music (and moshing).

05 Recently started to get an appreciation for photography (street, fashion, portrait and music)

06 I enjoy film.





## PHYSICS AND I

- PhD @University of Melbourne: April 2023 - Present
- Axion physics, DFSZ model, “cosmological domain wall problem”.
- Paper published in *Journal of High Energy Physics*, “Classification of three-family flavoured DFSZ axion models that have no domain wall problem”.
- Phenomenological analysis of one class of predictive DFSZ model.
- Solutions to axion quality problem.

# My hobbies

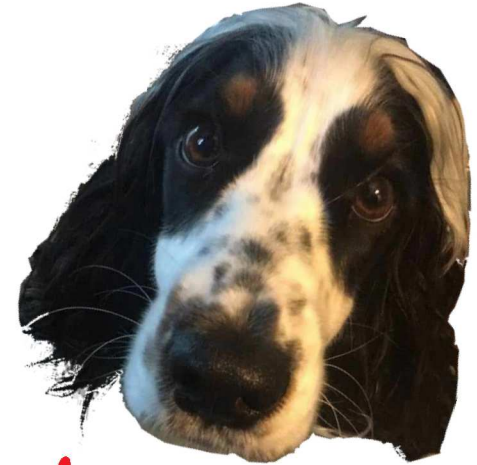
Music



Margaux Jomain



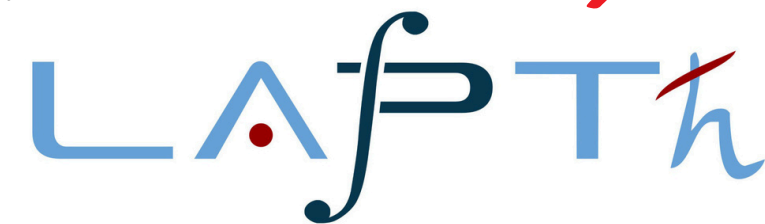
Sport



My dog

# My work

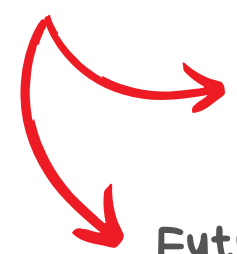
Supervisors: Cedric Delaunay ✨  
Genevieve Belanger



Particle Physics

Cosmology

Mathematical Physics



s-wave light Dark Matter model: Detectable with Indirect Detection, escaping CMB constraints ?

Futur project: Cosmological Constraints on new light scalar field

Margaux Jomain

# Hi!

- I am **Nidhi Sudhir Kandathpatinharuveetil!**
- From **Kerala** a **Southern Indian** state.
- Hobbies:
  - **Badminton**
  - Reading (Thrillers)    - Sketch n Paint
  - Biking, Hiking etc





# Research

- **University:** U. of Wisconsin-Madison (w/ Daniel Chung)
- **Research:** At the intersection of high energy particle theory and cosmology.
  - **Particle production in early universe cosmology:** Understanding **topological** contributions to particle production in the long wavelength limit for simple dispersion relations ( $\omega^2 \approx k^2 + \eta^n$ ) with applications to early universe cosmology. This is achieved using **Stokes phenomenon**  $\rightarrow$  WKB approximation of particle mode functions (with time dependent dispersion relations) undergo discrete jumps across certain boundaries in the complexified time plane.
  - **Non-perturbative aspects of quantum gravity:** **Euclidean saddle** point contributions to **Lorentzian path integrals** in axion gravity using Picard-Lefschetz theory.

# Who am I ?

Jean Kimus - ULB

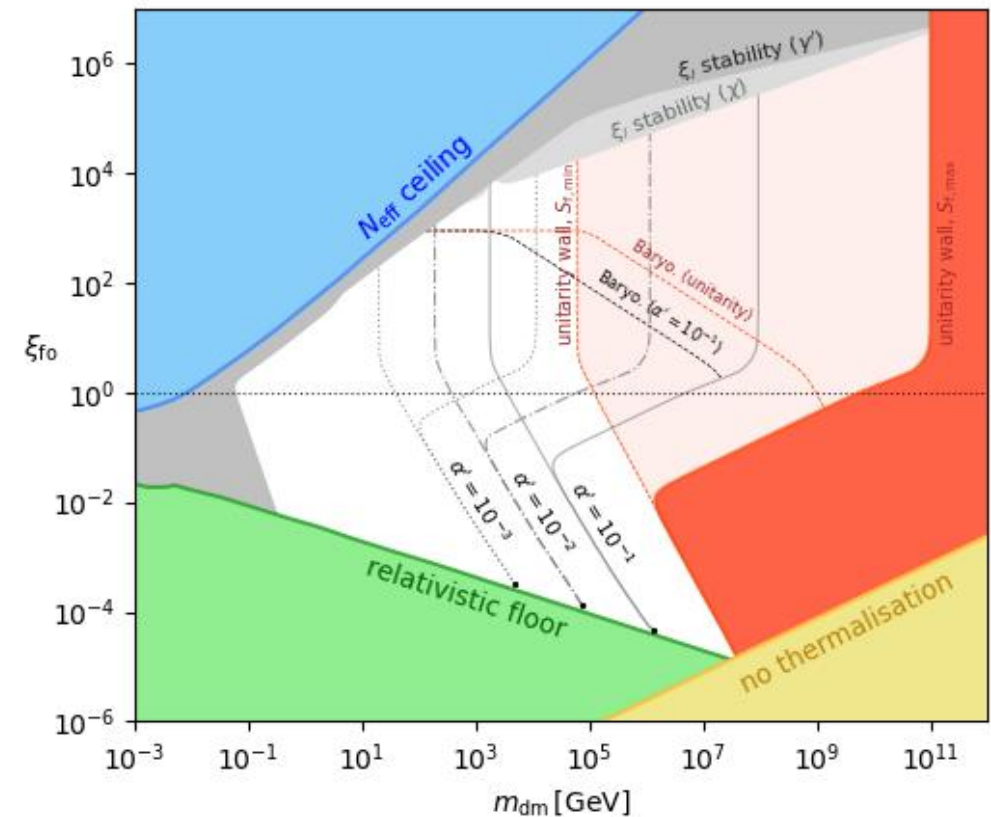
- I work in **Brussels**
- I do **physics** (and I love it)
- Other interests:
  - Music (classical, jazz, rock, ...)
  - Reading
  - Geography and history
  - Sciences in general
  - Languages
  - ...



# What do I do ?

Jean Kimus - ULB

- PhD in **Université Libre de Bruxelles (ULB)**, in **particle physics** and **cosmology**
- **Dark matter** scenarios and constraints
- Connection with post-inflationary **reheating**
- Use of **Machine Learning** techniques to solve Boltzmann equations



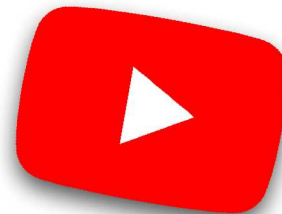
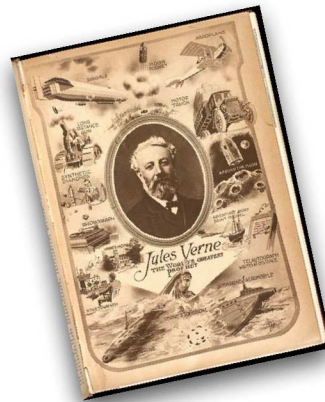
# DANIIL KRICHEVSKIY

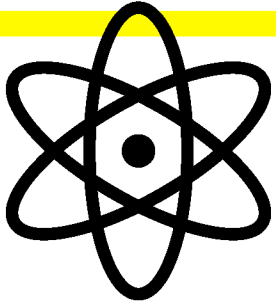
I am interested in

- football
- music
- chess
- books
- youtube (science, history, politics etc)



THE  
BEATLES





# MAIN INTEREST - PHYSICS

## 2021 - 2023 MSc in Theoretical Physics, Bern

Non-relativistic CFT: Fermi gas in a harmonic trap (2311.14793)

Supervisor: Susanne Reffert



## 2023 - ... PhD in Dark Matter Physics, Stavanger

Different aspects of strongly interacting massive particles

Supervisor: Helena Kolesova



- Name: Shayarneel Kundu (Neel is fine!)
- Hobbies (that I am not good at): Climbing, Basketball, Lifting, Chess
- Hobbies (that I am good at): Consuming Fiction!
  - Top 3 Movies: Three Idiots, Lagaan, Spiderman: Across the Spiderverse
  - Top 3 Shows: Brooklyn Nine-Nine, ATLA, Blue Eye Samurai
  - Top 3 Books: Fahrenheit 451, Metamorphosis, The Kite Runner
  - Top 3 Series: Percy Jackson and the Olympians, How to Train Your Dragon, Pirates of the Caribbean

- Name: Shayarneel Kundu (Neel is fine!)
- Affiliation: SLAC, Stanford University
- Projects:
  - Observables for Continuous Spin Particles
  - Scattering Amplitudes for Continuous Spin Particles
- Interests -
  - QFT (Non-perturbative effects)
  - Particle Phenomenology
  - Particle Astrophysics and Dark Matter Signatures
  - Early Universe Cosmology (Would any of you have guessed?)



*My name:*

*Javier López Miras*

*you can call me Javi :)*

*My place(s):*

*Granada (Spain)*

*Almería (Spain)*

*My education:*

*BSc and MSc in Physics*

*My hobbies:*

*Volleyball (and beachvolley)*

*Pub games*

*Learning random facts*

*... and yes, I love tapas and siesta*



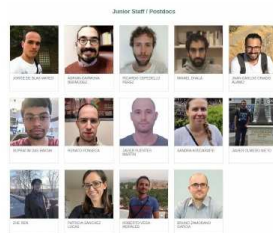
# About Universidad de Granada FTAE (High Energy Theory Group)...

1. Formas aspects and precise calculations in QFT
2. Lattice and hadron physics
3. Collider phenomenology and model building
- 4. Effective Field Theories**
5. Flavour Physics
6. Neutrino Physics
7. Astroparticle Physics
8. Gravity and cosmology

*My research...*

On-shell matching

3dEFTS for thermal QFT



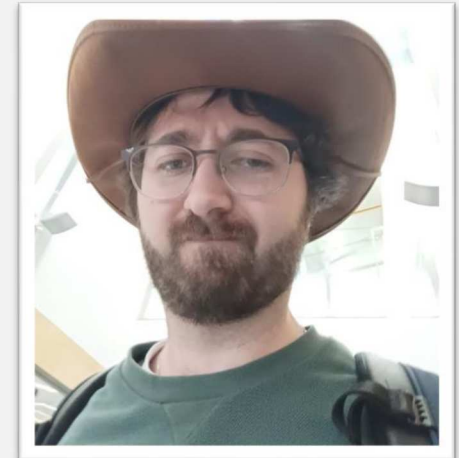
# About me (Álvaro)



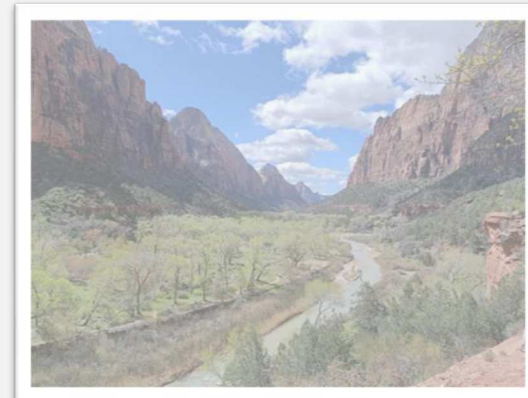
# About me (Álvaro)



# About me (Álvaro)



# About me (Álvaro)



/// Collection 411

👁️ Wantlist 13

# About me (Álvaro)



And the usual suspects:



Collection

411



Wantlist

13

# About my work

3rd year PhD student @



Advisors: L. Merlo & J. M. No

Interests: • BSM pheno  
• Thermal field theory



# About my work

3rd year PhD student @



Advisors: L. Merlo & J. M. No

Interests: • BSM pheno  
• Thermal field theory



arXiv:2308.09206

Early Universe hypercharge breaking and neutrino mass generation

S. López-Zurdo,<sup>\*</sup> A. Lozano-Onrubia,<sup>†</sup> L. Merlo,<sup>‡</sup> and J. M. No<sup>§</sup>  
*Departamento de Física Teórica and Instituto de Física Teórica UAM/CSIC,  
Universidad Autónoma de Madrid, Cantoblanco, 28049, Madrid, Spain*



# About my work



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*Departamento de Física Teórica and Instituto de Física Teórica UAM/CSIC,  
Universidad Autónoma de Madrid, Cantoblanco, 28049, Madrid, Spain*

Ongoing projects:

- Extended scalar sectors & CP violation
- Thermal field theory

Coming projects:

- ALPs
- EFTs and unitarity bounds
- ...

# About my work



arXiv:2308.09206

3rd year PhD student @



Advisors: L. Merlo & J. M. No

Interests: • BSM pheno  
• Thermal field theory

Early Universe hypercharge breaking and neutrino mass generation

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- EFTs and unitarity bounds
- ...

## Interested? Let's talk!

Hi!  
My name is Henda.

## MY HOBBIES AND INTERESTS:



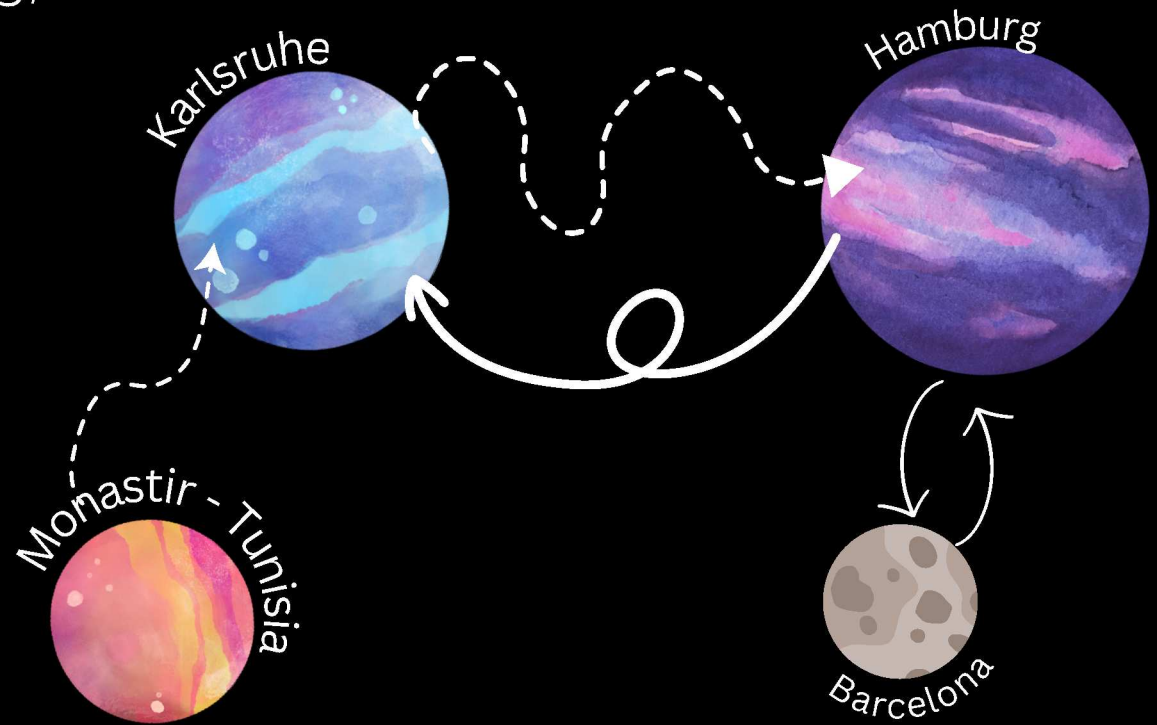
Illustrating/Painting



Being outdoors: hiking, running, biking,



Guilty pleasure for reality TV and youtube video essays.



# MY RESEARCH INTERESTS



Master thesis supervised by  
Bibhushan Shakya and  
Geraldine Servant:

Particle production from  
First-Order Phase transitions

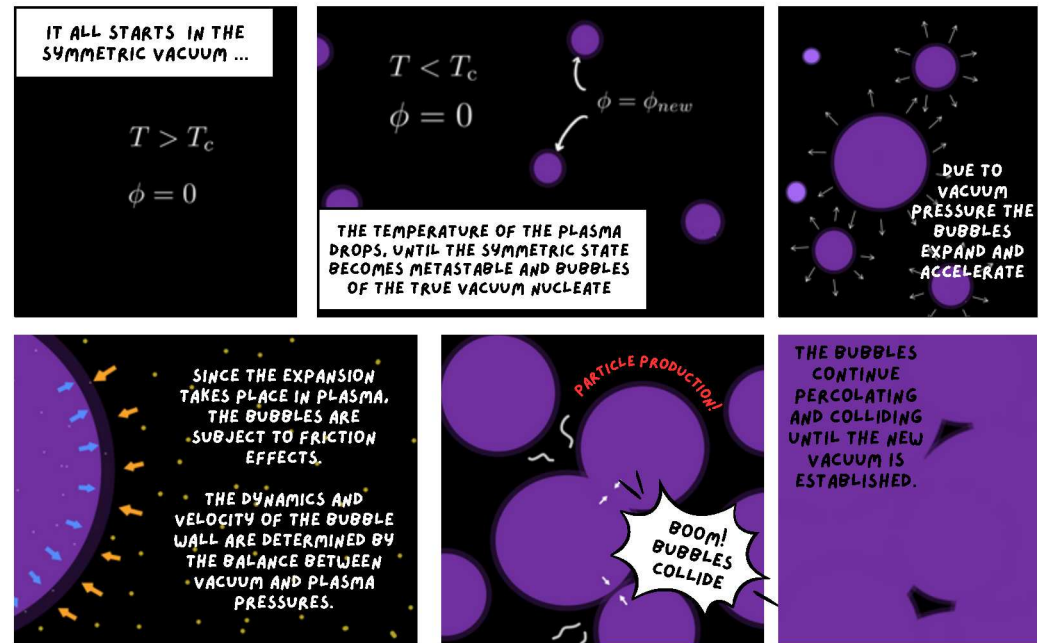


PhD start in June 2023  
with Felix Kahlhöfer.

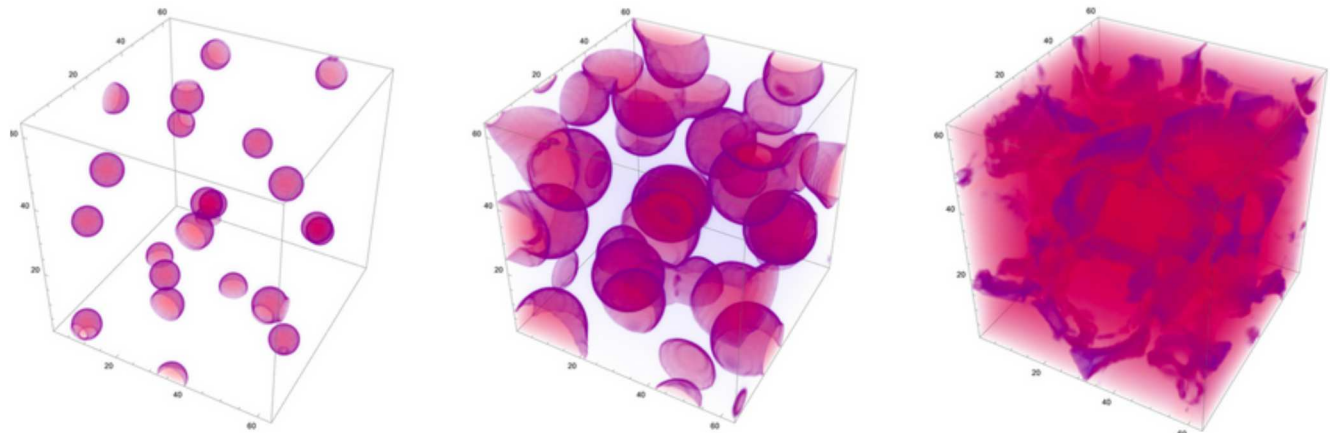
Current projects:

*Dark Matter production  
during FOPT?*

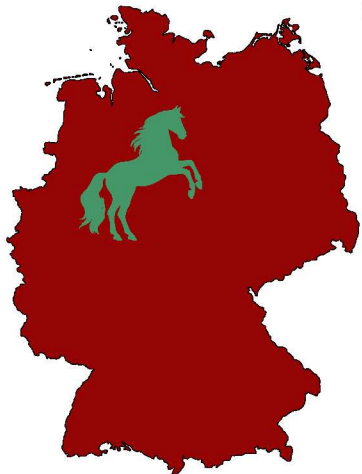
*Equation of state of the  
universe during/after a  
FOPT?*



Results from 3D lattice simulation:



- Yes, we always talk about food
- No, I will not judge you if you put ananas on pizza
- (maybe)



- Stopped drinking beer
- Started smacking my legs saying "so" to leave a social situation

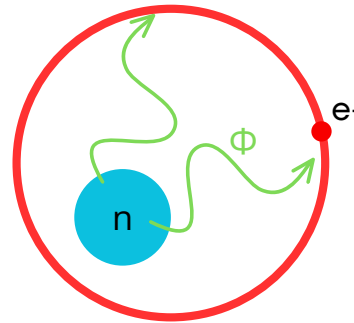


Leibniz  
Universität  
Hannover



Professional editing: Althea Cappelli

Use isotope shift spectroscopy  
measurements to search for New Physics

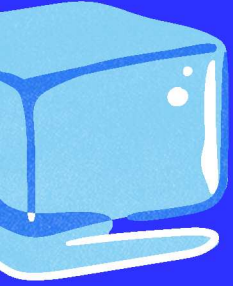


A NP coupling would  
change the  
transition energies  
=> bounds on  
coupling strength

Why are you in a cosmology school?

- Interested in cosmology
- Particularly GWs and early universe
- But ultimately...

*to learn!*



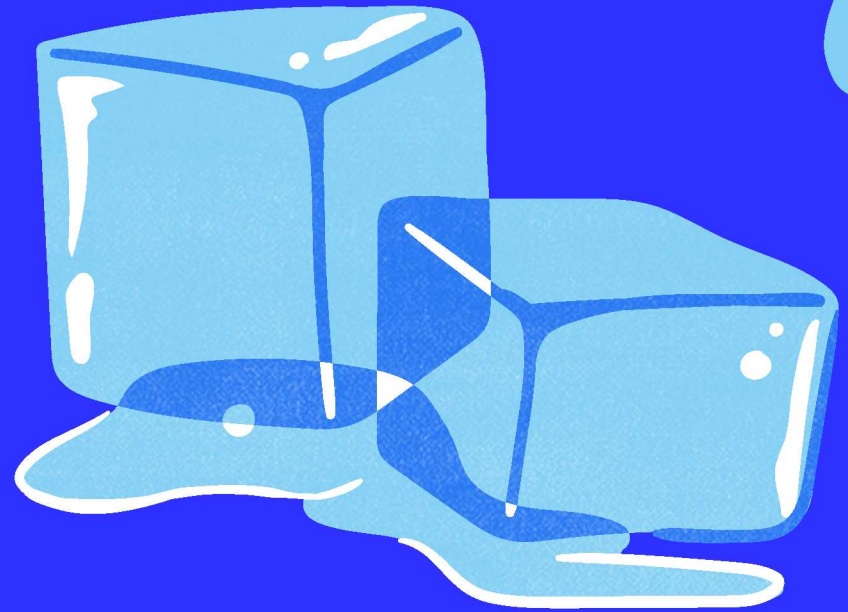
# Breaking the Ice



Luca, Italy

## Hobbies

- Tennis and Basketball
- I play drums
- I like reading and hiking





# Research Interests



I did my Master's thesis on testing an  $SO(10)$  model with gravitational waves from cosmic strings and I got interested in gravitational waves, topological defects, and early universe cosmology. I kept working on these topics at the IPPP in Durham and now I am working on high-frequency gravitational waves detection and dark matter models.

Currently, I am a Ph.D student at the IFIC in Valencia!





# Jonas Matuszak



\* From: Lake Konstanz



† Studied in: Freiburg



Hobbies:

- Guitar
- Kite Surfing
- Swimming



† Now in: Karlsruhe



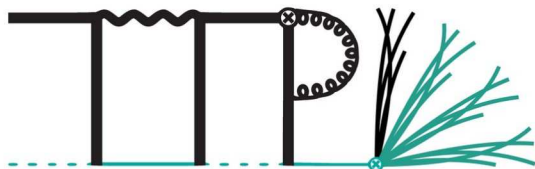
# Research Interests

- Cosmological first order phase transitions
- Gravitational wave signals from dark sectors

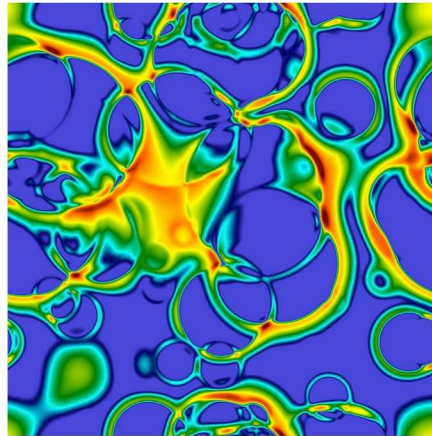
Institute:



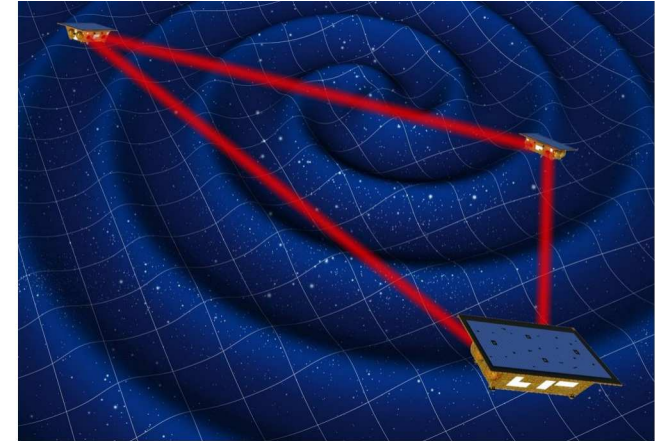
Karlsruhe Institute of Technology



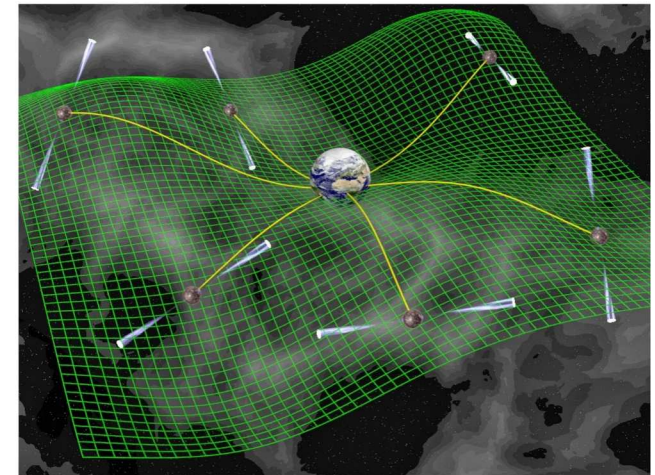
Institute for Theoretical Particle Physics



Bubble wall dynamics in the early universe plasma



Observability of first order phase transition with future GW detectors (LISA, ET)



Pulsar timing array data: BSM origin?

# Halvor Melkild

## Hobbies

- Football
- Skiing
- Bouldering

## Other relevant interests

- German beer
- Arguing about physics



# Halvor Melkild

PhD student

University of Oslo, Norway

Supervisor: Torsten Bringmann

Background:

- MSc from LMU Munich
- BSc from NTNU, Norway

Research topic:

Dark Matter

- Strongly Interacting Dark Matter
- Primordial Black Holes

# Who am I? (personal version)

- My name is Liyang MIAO, from People's Republic of China (PRC)
- My hobbies include playing badminton and swimming.
- I am now very interested in photography and economy but do not have much time for that.

# Who am I? (professional version)

- Currently a PhD student for the first year at the Hong Kong University of Science and Technology (HKUST) in HKSAR.
- I am now working on using Machine Learning techniques to find anomalies within Gravitational Waveforms. Unlike match-filtering, we want to pick out unmodeled events within. These events can be later studied phenomenologically to enhance our knowledge of GW.



Hi / こんにちは!

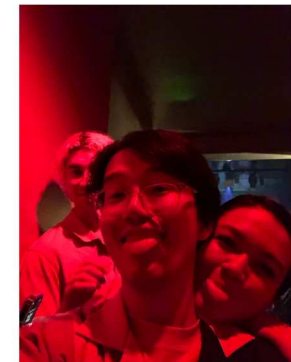
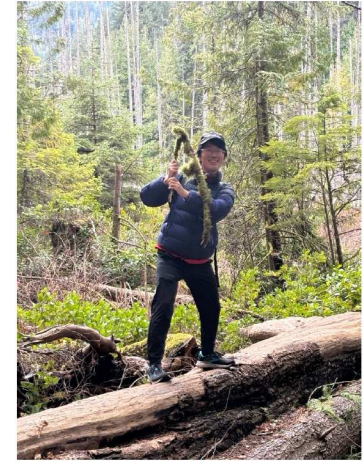
Riku Mizuta  
(he/him)

Born and raised in Kobe, Japan

Undergraduate: U. Toronto, Canada

Graduate: U. British Columbia / TRIUMF  
(Vancouver, Canada)

2024-07-14



Discovery,  
accelerated

2406.18635

## Dark Matter from Dark Glueball Dominance

David McKeen,<sup>1,\*</sup> Riku Mizuta,<sup>1,2,†</sup> David E. Morrissey,<sup>1,‡</sup> and Michael Shamma<sup>1,§</sup>

<sup>1</sup>TRIUMF, 4004 Wesbrook Mall, Vancouver, BC V6T 2A3, Canada

<sup>2</sup>Department of Physics and Astronomy, University of British Columbia,  
6224 Agricultural Road, Vancouver, B.C. V6T 1Z1, Canada

# Academic Background

Institution: TRIUMF / UBC

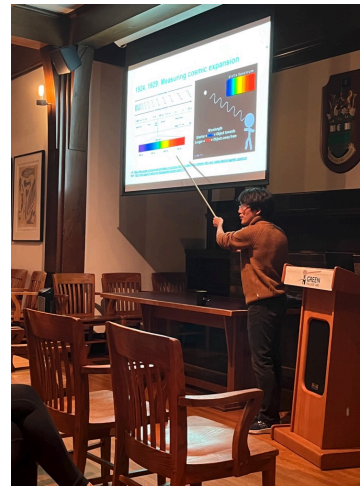
Research topics: dark matter

- dark sector models
- light dark matter

Outreach:

- public presentation
- TRIUMF tour guide

Equity and inclusion





# Charalampos Nikolis

MSc student, LMU Munich

## The nightmare of pronouncing my name

Name on the Identity: Charalampos



The way it is pronounced: Haralabos (or Haris)



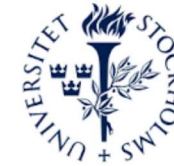


HELLENIC REPUBLIC  
**National and Kapodistrian**  
**University of Athens**  
 EST. 1837

BSc



MSc



**Stockholm**  
**University**

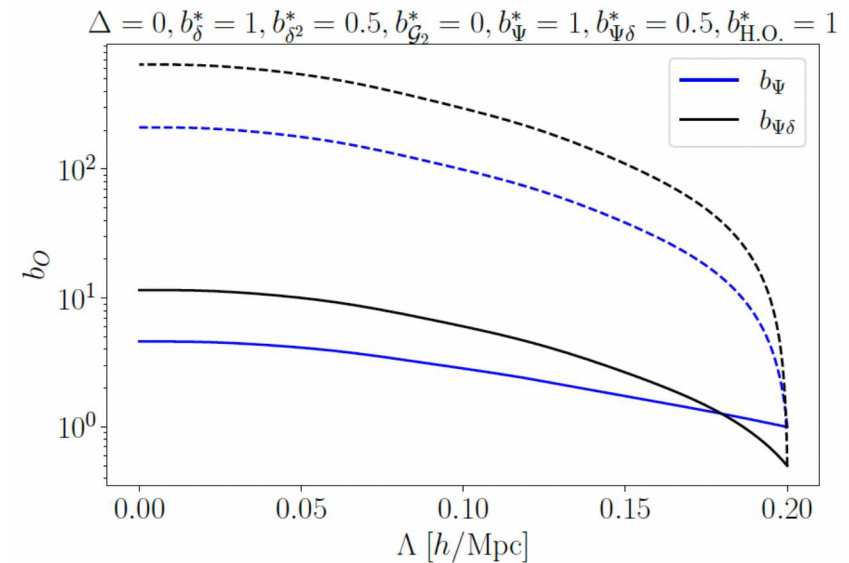
PhD (starting on 1st of  
 September): Early  
 Universe Phase  
 Transitions

MSc Thesis: Large Scale Structure Renormalization Group with Primordial Non Gaussianity

2405.21002 (CN, Rubira, Schmidt)

$$\delta_g[\delta^{(1)}] = \sum_O b_O^\Lambda(\tau) O[\delta^{(1)}]$$

Cut-off



# Shreya Pandit

Home:

- Jalgaon, Maharashtra, India

Education:

- Ph.D. student at University of Southampton, UK
- Integrated BS-MS from Indian Institute of Science Education and Research Bhopal, India

**Work : Music : Sports**

Hobbies & Interests:

- Physical activities and Sports
- Listening to music
- Volunteer work
- Nature walks
- Mythological/Fictional reading
- Learning new languages



# Shreya Pandit

- First year Ph.D. student in Southampton High Energy Physics Theory group at the University of Southampton.
- Looking forward to expand my research about early universe physics with focus on Neutrino physics and Particle cosmology.

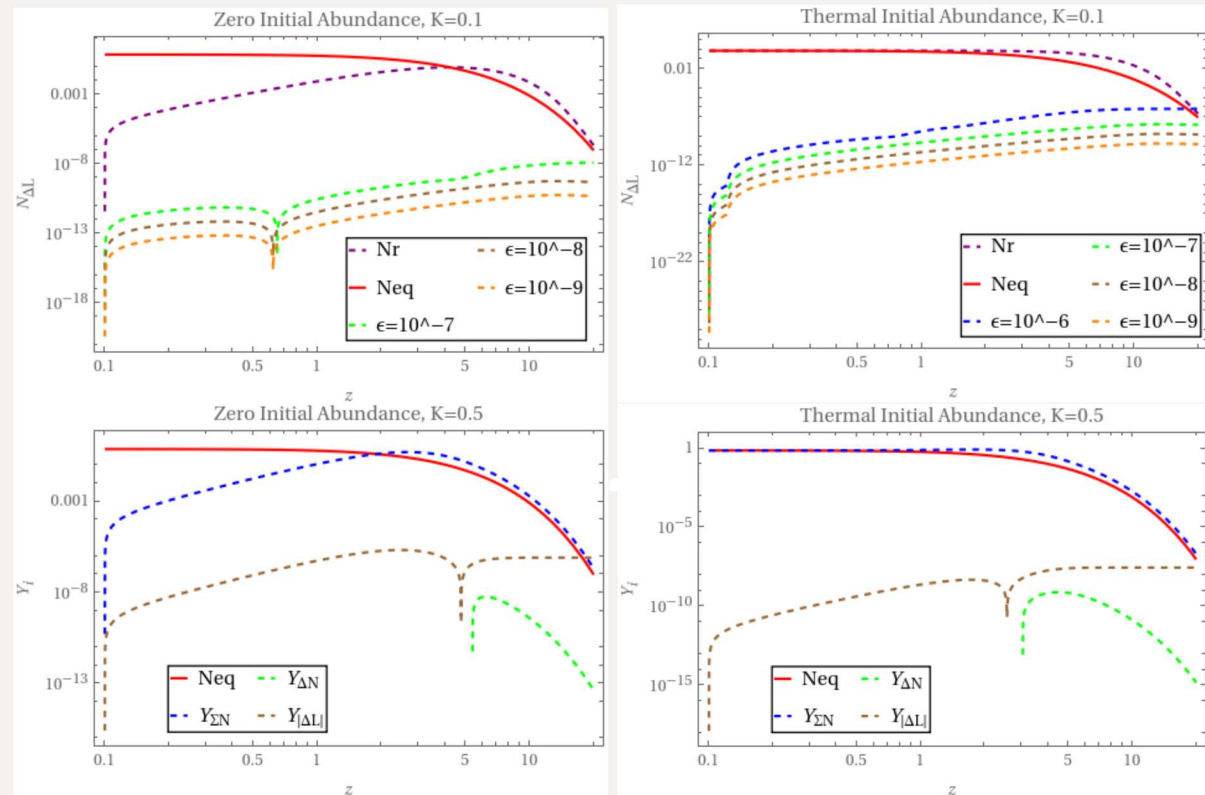
Current work:

- Density matrix calculation of the dark matter abundance in the Higgs induced right-handed neutrino mixing model



## Matter-Antimatter Asymmetry using Leptogenesis

- We use the breaking pattern of global  $U(1)_{B-L}$  to investigate the difference between Majorana and Dirac Leptogenesis using Type I Seesaw and Dirac Scotogenic model.



# About me

- Name: Nick Proff
- Age: 24
- Hobbies/Interests: Bicycling, hiking and enjoying the nature near the Alps, chess

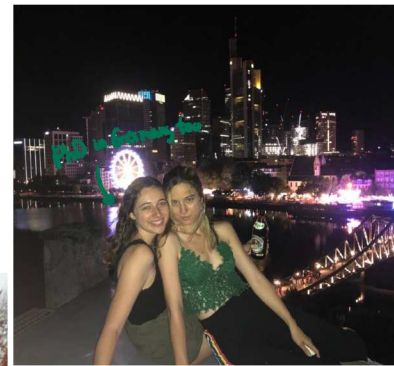
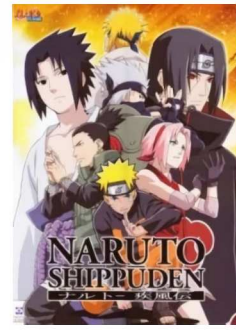
# About my research

- Master student at TUM currently working on my thesis
- Group: T30d (Prof. Alejandro Ibarra)
- Research topics at T30d
  - BSM
  - Neutrino Physics
  - Astroparticle Physics and cosmology
- My research interests: cosmology, early universe
- Current project: Matter-antimatter asymmetry and neutrino masses from asymmetric DM



Hi!  
I'm Cristina Puchades  
Ibáñez

- ◆ 26 years old
- ◆ From València, Spain.
- ◆ Hobbies: Books, Switch Games, Anime, Violoncello, Techno...
- ◆ Best anime: Naruto
- ◆ Favourite author: Haruki Murakami



## Professional Introduction.

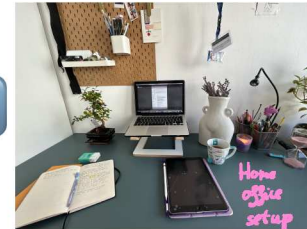
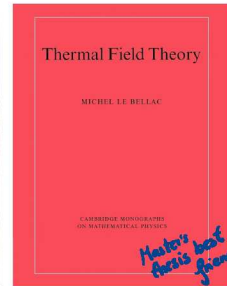


Erasmus  
at JGU



- ◆ Bachelor at Universitat de València

VALÈNCIA



- ◆ Master degree at the JGU
- ◆ Scientist Assistant at the tSPECT group in UCN (JGU)
- ◆ Master thesis on:  
“Distribution of the axion in the Early Universe using TFT”  
at the group of Pedro Schwaller
- ◆ Soon a paper in thermal axion production 🍌

- ◆ 2nd year PhD student of Pedro Schwaller

New journey!

MAINZ

- ◆ Interests: Physics beyond standard Model, Dark Matter, Early Universe, Gravitational Waves...
- ➡ Love-Hate: Thermal Field Theory



**Name: Andrija Rasovic**



**Interests: Sports (wrestling and weightlifting) and Music (currently Varsity Athlete)**



**Name: Podgorica, Montenegro**



**Undergrad:** Cornell University  
**Currently:** PhD student at **University of Toronto**  
**Advisor:** David Curtin

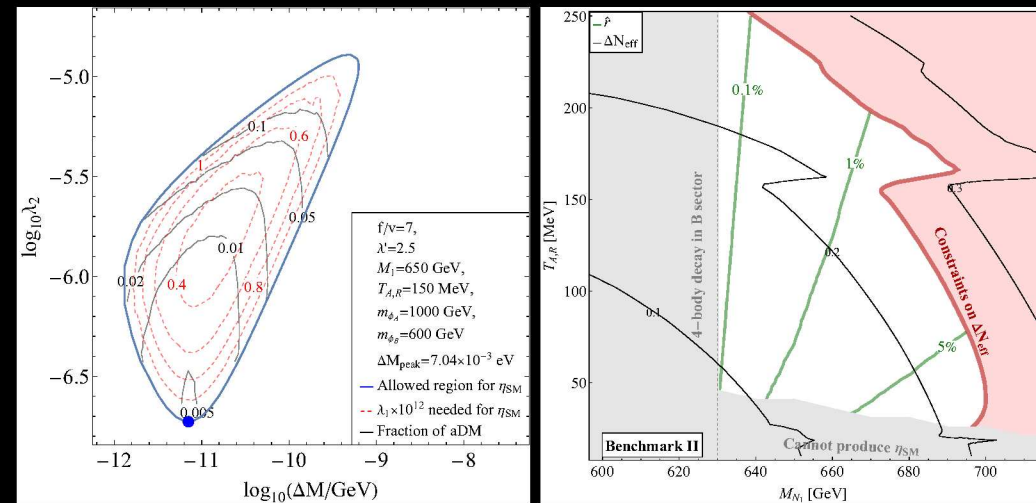


**Research Interests:** Baryogenesis, Dark Matter Model Building, Cosmological Phase Transitions, Finite Temperature Field Theory



**Projects:**  
 Baryogenesis through Asymmetric Reheating in Mirror Twin Higgs (arX: 2311.06341) with Linda Yuan, Gonzalo Alonso Alvarez, David Curtin

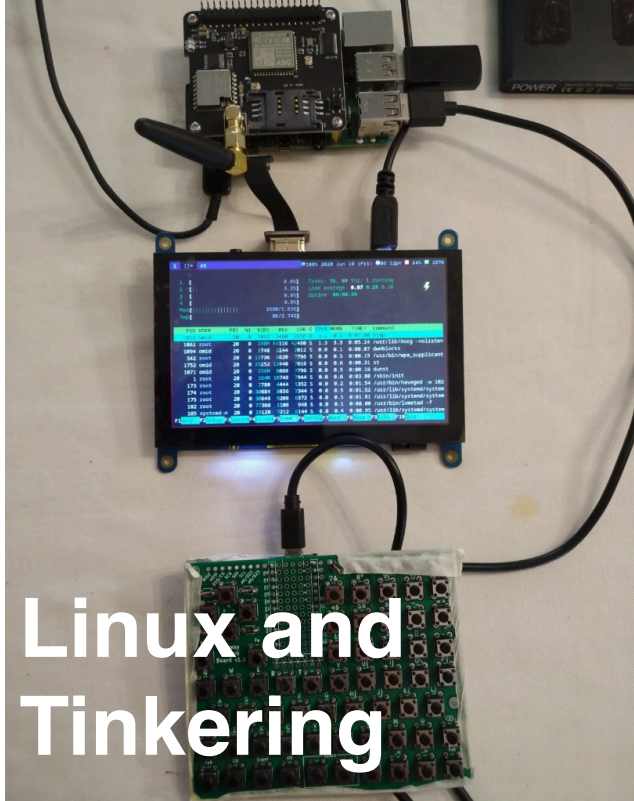
RG Improvement in Finite Temperature in the Optimized Partial Dressing Formalism (in preperation) with Jyotrimoy Roy, Michael Luke, David Curtin



**(Sayyed) Farbod Rassouli** I am Persian and Italian.

Instruments: Violin, Ney and Setar.

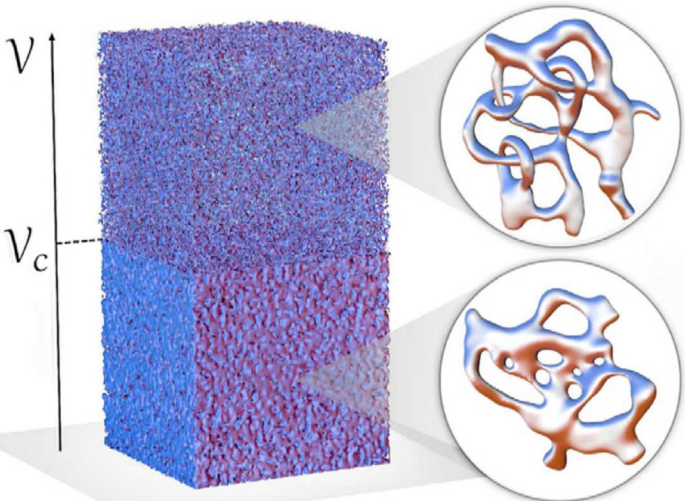
Favourite camera: Rolleiflex 3.5f Planar with 800 iso BW.



## Research Projects:

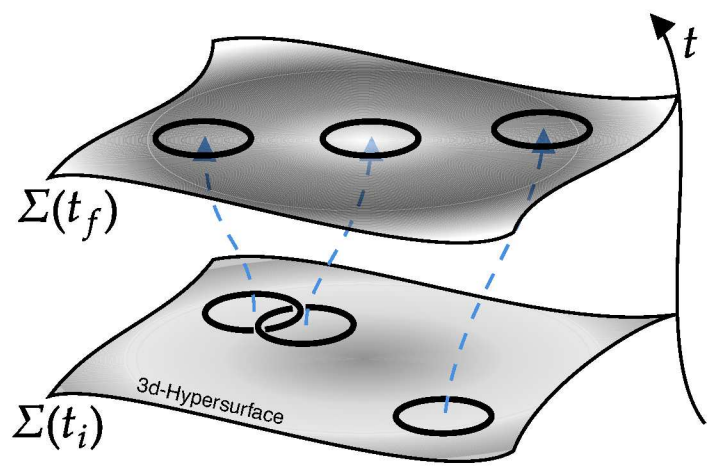
- How TQFT enters in Thermal Field Theory and what role it plays to understand Phase transition.
- Towards topological evolution of invariants

## In phase transition



Matteo Gori et al 2022

## In Gravity



arXiv:2311.11160

## Other Collaborators:

- |           |                  |
|-----------|------------------|
| ICL       | João Magueijo    |
| METU      | Byram Tekin      |
| METU      | Burak Oğuz       |
| ICL       | Paolo Bassani    |
| UC Irvine | Anubhav Nanavaty |
| UC Irvine | Misa Toman       |
| NU        | Yang Liu         |
| Soton     | Felix Haehl      |
| Soton     | Altay Etkin      |

Hello!



I'm Francesco Rescigno and I'm 28.

I like books and Nature.

# Research Interests

- ▶ I graduated at "Sapienza" University of Rome in Theoretical Particle Physics and now I'm a PhD student at "Tor Vergata" University of Rome
- ▶ My interests are particle physics and cosmology
- ▶ I studied composite dark matter models during my master thesis project (supervisor: Prof. Roberto Contino)
- ▶ I published my research about composite dark matter models in this paper: [arXiv:2403.07759v2 \[hep-ph\]](https://arxiv.org/abs/2403.07759v2), S. Palmisano, F. Rescigno, F. Troni
- ▶ My PhD project is about phase transition in quantum field theory and cosmology, in particular I'm currently focusing on PBH formation during 1OPT (supervisor: Prof. Alberto Salvio).



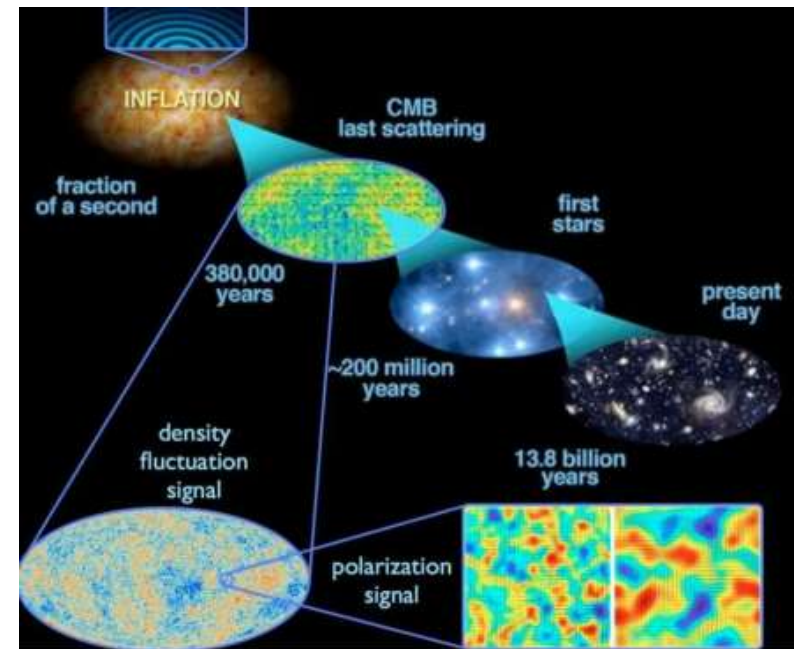
Alica Rogelj, Mainz Summer School, July 2024

# Personal

- Climbing (outdoor activities)
- Painting
- Petting animals
- Board games
- Being with friends

# Professional

- PhD at University of Bern (AEC, ITP, supervisor: Mikko Laine)
  - Scalar perturbations
  - Warm inflation
- MSc at University of Amsterdam (Emergent gravity: Spacetime thermodynamics from gravitational path integral)
- BSc at Maastricht University (projects on analytical black hole motion and flavour physics)





# Giona Sala



## Background

### Nationality:

Swiss

### Languages:

Italian

English

French

(German)



## Hobbies

Photography

### Sports:

Ice hockey

Football, Skiing, Hiking, ...



## Interests

Physics (of course)

Space missions and exploration

Travel & nature

# Giona Sala



## Studies

**Bachelor:**

ETH Zurich

(University of Toronto)

**Master:**

EPFL Lausanne

Université de Genève



## Research

**Institute:**

RWTH Aachen

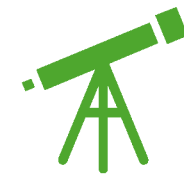
**Supervisors:**

Julien Lesgourgues

Philipp Mertsch

**Main topic:**

Gravitational waves



## Projects

White Dwarf Binaries with atom-  
interferometer



Dark Sirens as probes of  
Cosmology

(PBH cluster and merger rates)

# Character: Sai Charan Sekar

Level: 26

## Attributes:

Strength	4
 Dexterity	15
Intelligence	10
 Adaptability	8
Faith	10



## Strength skills

Weight lifting

Martial arts

## Dexterity skills

Painting

Sketching

## Adaptability skills

Travel luck

Pilgrim points

Debuffs: Videogames

Scholar academy: Oklahoma State University

Apprentice of: Prof. Dr. K. S Babu, Dr. Vedran Brdar

Sorceries under study:

1. Axion and Flavor puzzle
2. GUT Leptogenesis
3. Astrophysical axion and sterile neutrino detection
4. Axion DM Stellar structures

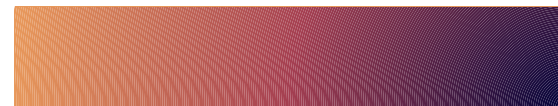
Incantations performed at the Academy of LMU:

Phenomenology of SUSY SU(5)



# PERSONAL INTRODUCTION

- GUSTAVO SADAO SOARES SAKODA
- BRAZIL
- HOBBIES AND INTERESTS:
  - SPORTS (IN GENERAL):  
FOOTBALL, RUN, HIKINGS, ETC...



# PROFESSIONAL INTRODUCTION

- PhD student from Universidade de São Paulo, Brazil --- with Professor Josif Frenkel.

Working with:

- IR divergences of QCD at Finite Temperature.

- PhD internship/exchange in Universität Bern, Switzerland --- with Professor Mikko Laine.

Working with:

- Thermal Particle Production:

Keywords:

- ✓ Thermal Field Theories;
- ✓ Landau-Pomeranchuk-Migdal (LPM) effect;
- ✓ Majorana Neutrinos;
- ✓ Photon and Dilepton Production from QGP;
- ✓ Etc...

Thank you !



Melbourne (Naarm), Australia



Alexei Sopov



When I'm not thinking about physics I enjoy ...

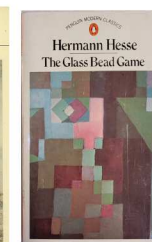
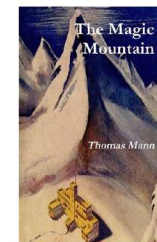
Running



Playing futsal (and watching football)



Reading phil. / lit.



# University of Melbourne

Masters (2020-2021)  
PhD (2022 - ...)

Supervisor:  
Raymond Volkas



## Research Interests

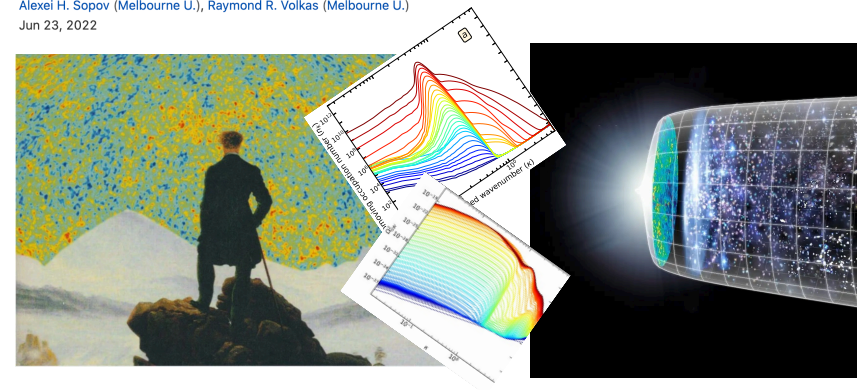
- Axions/majorons as dark matter
- Reheating/inflation
- Primordial GWs
- Naturalness in model-building
- ....



VISH $\nu$ : solving five Standard Model shortcomings with a Poincaré-protected electroweak scale

2206.11598

Alexei H. Sopov (Melbourne U.), Raymond R. Volkas (Melbourne U.)  
Jun 23, 2022

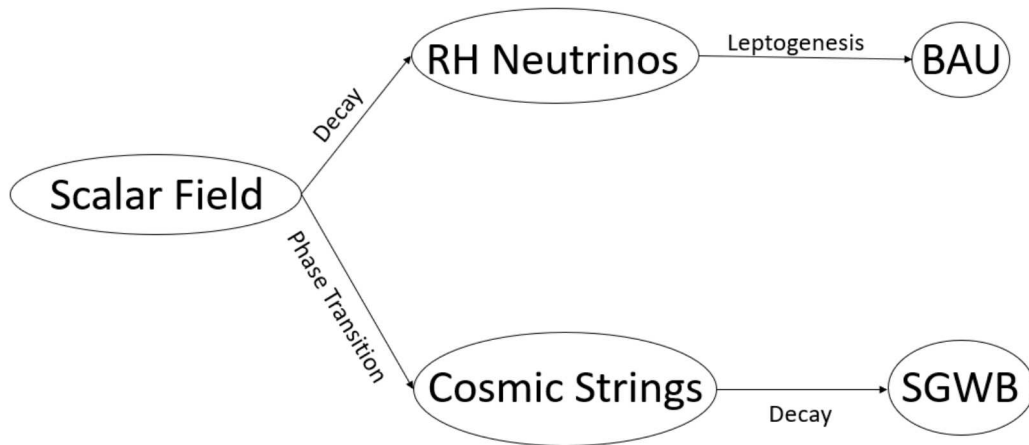




# Me and Hobbies:



# Research Project:



- This is a BSM project where we add a scalar field and two RH neutrinos to the standard model.
- Scalar field decays into RH neutrinos giving rise to BAU from non-thermal leptogenesis.
- Simultaneously, scalar field undergoes a phase transition giving rise to a cosmic string network.
- This cosmic string network decays giving rise to a SGWB
- Goal is to find the parameter space where we have correct leptogenesis and a GW background.

## Personal introduction

My name is Aidan Symons.

I grew up in Melbourne, Australia.

I moved to Amherst, Massachusetts last year  
for my PhD.

I've become an avid rock climber in recent  
years.

I enjoy reading and good coffee *(let me know  
your recommendations for cafés nearby!)*

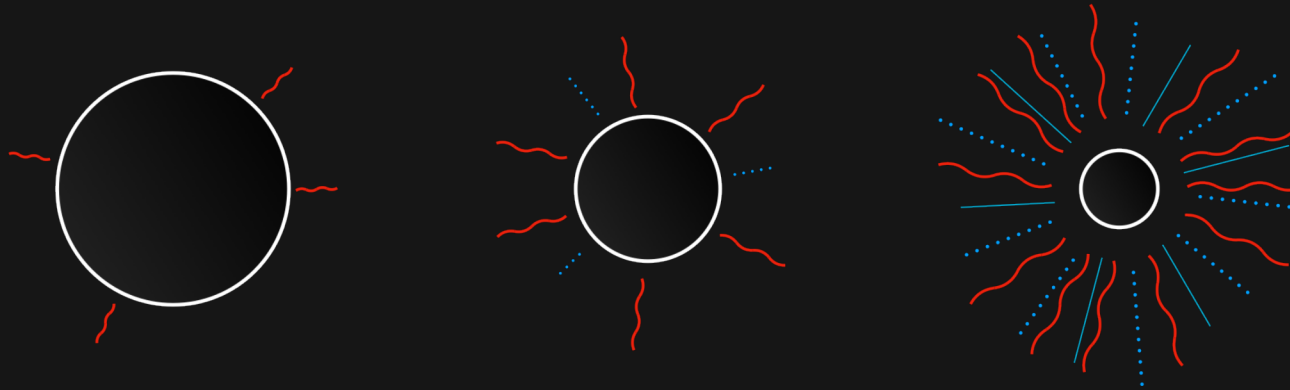


## Professional introduction

I completed my Masters at the University of Melbourne in 2022 under the supervision of Andrea Thamm and Michael Baker.

Following my advisors, I transferred to the University of Massachusetts, Amherst in September 2023.

I work with Michael, Andrea, and Joaquim Iguaz Juan on black hole evaporation in the presence of BSM degrees of freedom, with an emphasis on connections with experiment.



# Icebreaker

Jasmine Thomson-Cooke (it/its, she/her)  
Dr. Venus Keus (they/them)

# DIAS

Institiúid Ard-Léinn | Dublin Institute for  
Bhaile Átha Cliath | Advanced Studies



**IRISH RESEARCH COUNCIL**  
An Chomhairle um Thaighde in Éirinn

15.07.2024

- Places visited:
  - England - Leeds
  - Finland - Helsinki
  - Germany - Mainz
  - Japan - Osaka
- Hobbies/interests:
  - Tattoos
  - Heavy metal music
  - Cooking
  - Learning Mandarin



- Model: Standard Model + two Higgs doublets
- Application: Electroweak baryogenesis
- Progress so far:
  - Compute effective potential at two loop using DRalgo
  - Minimise potential with CP conserving background fields
  - Compute the critical temperature of the phase transition
  - Scan around 2 million points in parameter space at 1 loop





Piotr Toczek  
from Poland

hobbies: football, playing guitar,  
music, gaming, hiking



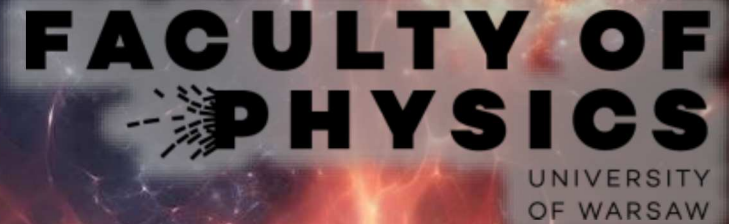
Affiliation: University of Warsaw

Research interest:

phase transitions +

primordial black holes +

gravitational waves



# Personal Introduction



Sascha Weber



# Professional Introduction

Early Universe  
Cosmology

- Institute: JGU Mainz
- Group: Julia Harz
- PhD Student: 2<sup>nd</sup> year

- Baryogenesis (and ...):
  - Low-Scale Leptogenesis (ARS)
  - Neutrinoless Double Beta Decay
  - Non-Standard Interactions

- Cogenesis of Dark Matter and Baryon Asymmetry
  - Inflaton Decay

# MITP Summer School 2024

## Introduction :

- Name: Fazlul Yasin
- Hometown: Guwahati, Assam, India

## Interests :

- Travel and History
- Music
- Football

## Hobbies :

- Reading Comics
- Playing Acoustic, Bass Guitar

# MITP Summer School 2024

## Affiliation :

- Carleton University, Ottawa, Canada
- Ph.D. Student in Theoretical Particle Physics Group

## Research Project :

‘Non-Thermal Production Mechanisms of Fermionic Dark Matter’

# Zhihan (Linda) Yuan

## Hobbies and Interests:

- Singing and piano
- Brazilian Jiu-jitsu
- I have two pet frogs



# Research

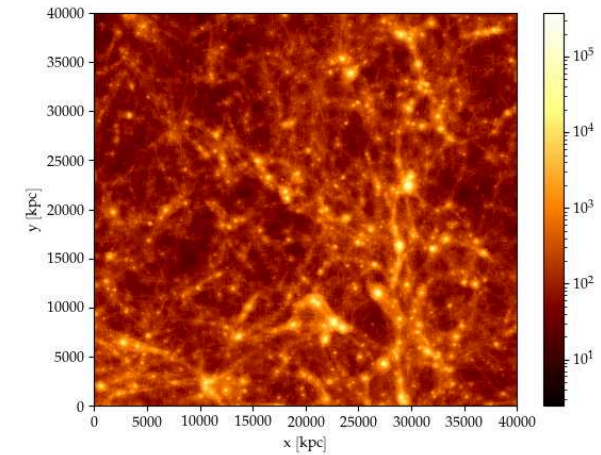
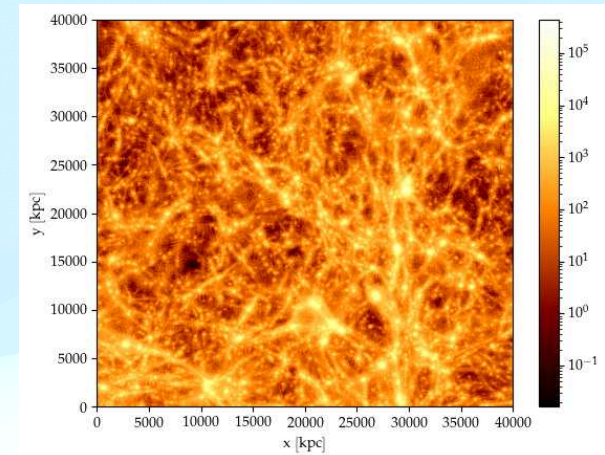
## University of Toronto

- General interest: BSM physics, cosmology, astrophysics
- Baryogenesis through Asymmetric Reheating in the Mirror Twin Higgs

(arXiv: 2311.06341)

- Lyman-alpha constraints on atomic dark matter from N body simulations

(on-going)



# About me

- Name: Robert Zimmermann
- Age: 22
- Hobbies: Guitar, Volleyball
- Interests: Cooking, language learning (spanish, japanese)



# My research

- Master student at TUM in group of Prof. Alejandro Ibarra
- Thesis topic: clustering and boosting of neutrinos around supermassive black holes
- Research interests: neutrinos