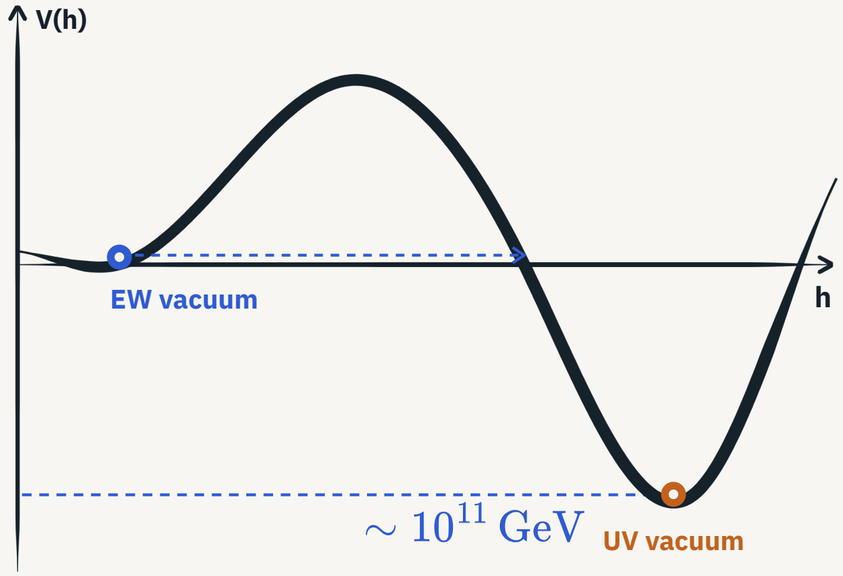
PARTICLE PHYSICS · JGU MAINZ

My path in particle physics

Victor Enguita-Vileta

Humboldt Postdoctoral Fellow



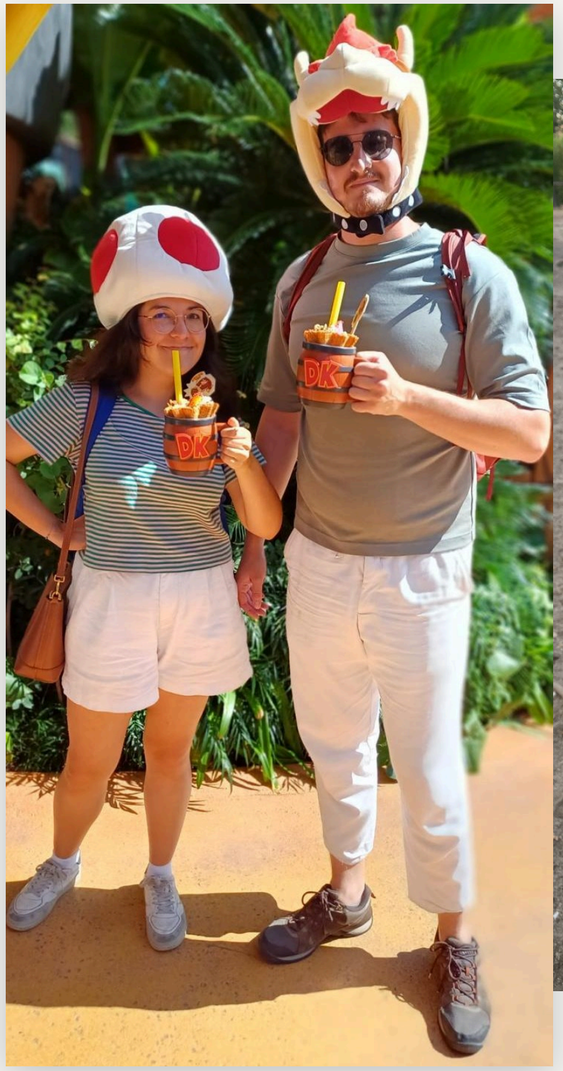
Our Future in Research: Physics, Collaboration and Careers Across Europe

Kraków · 30 October 2026

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

JG|U

Alexander von HUMBOLDT STIFTUNG





ABOUT ME

Beyond the physics

Currently living in Mainz with my wife Alba and our dog Philip

From	Zaragoza, Spain



Hobbies	Tons of reading, particularly classics Photographing Outdoorsy: hiking, rural tourism Sport: practice Aikido and jap. fencing

THE JOURNEY

My academic journey

Bachelor’s

2015–2019

Universidad de Zaragoza

+ 1 year at University of Gothenburg





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Bachelor’s

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Onsala Space Observatory, Sweden



Northern lights above Tromsö, Norway

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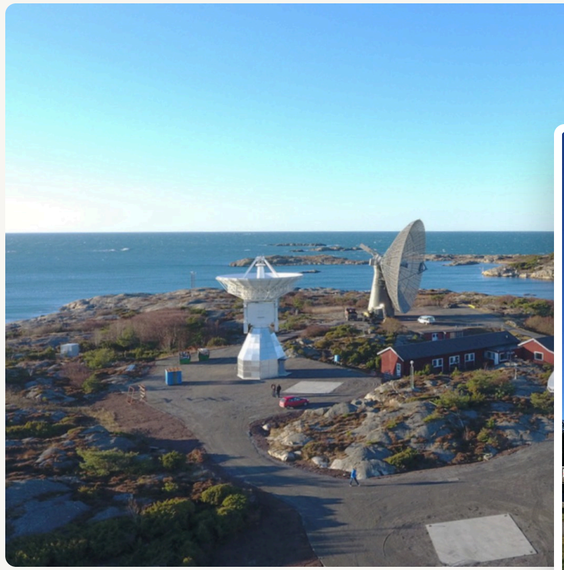

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MSc in Theoretical Particle Physics and Phenomenology

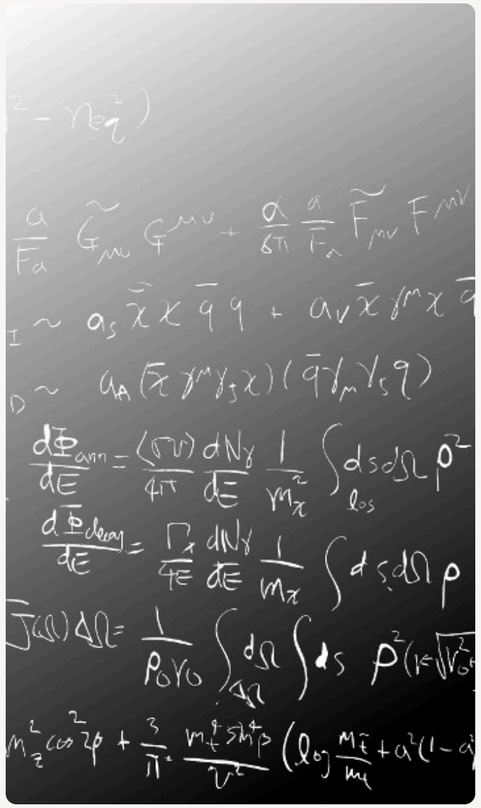








Instituto de Física Teórica (IFT) in Madrid



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Pre-doc

2020–2021

IFIC, Valencia

COVID motivated pause with short pre-doctoral contract





Instituto de Física Corpuscular (IFIC) in Valencia



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PhD

2021–2025

IFT, Madrid

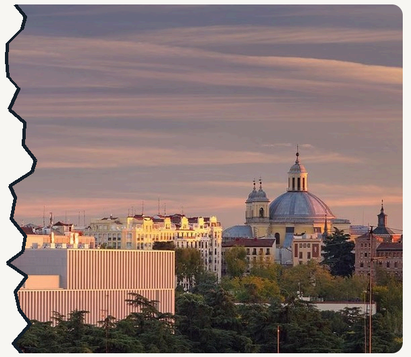
FPI Severo Ochoa Fellow











PHD · IFT MADRID · 2021–2025

During my PhD

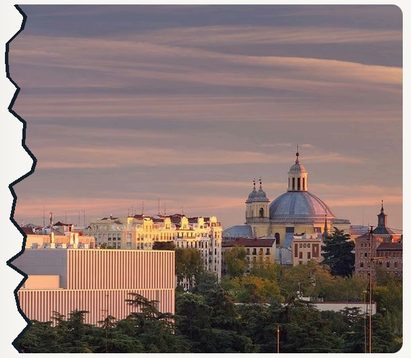
- First year of PhD also impeded by COVID

PhD

2021–2025

IFT, Madrid

FPI Severo Ochoa Fellow



JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Alexander von HUMBOLDT STIFTUNG

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- Difficulties in obtaining first results

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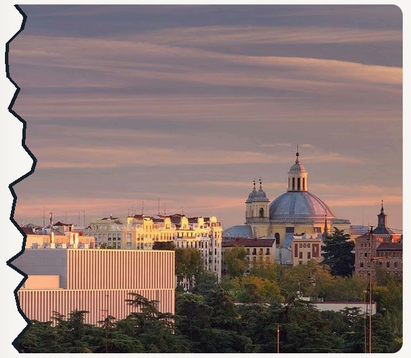

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During my PhD

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- Difficulties in obtaining first results
- Improved after supervisor and peer counseling

IMPORTANT REMARK

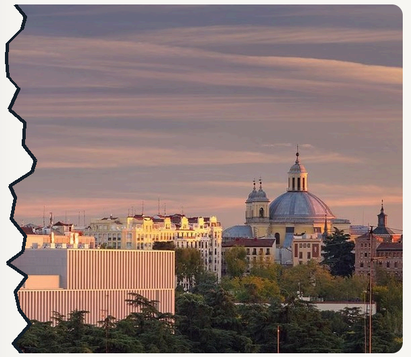
If you don't feel great for these reasons,
seek a friendly hand.

PhD

2021–2025

IFT, Madrid

FPI Severo Ochoa Fellow



JOHANNES GUTENBERG UNIVERSITÄT MAINZ JG|U

Alexander von HUMBOLDT STIFTUNG

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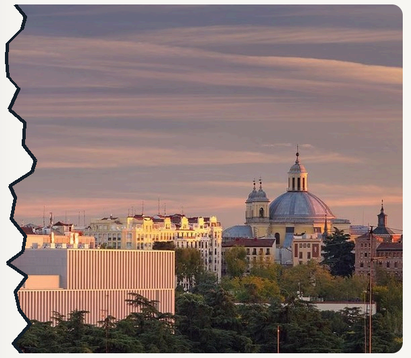

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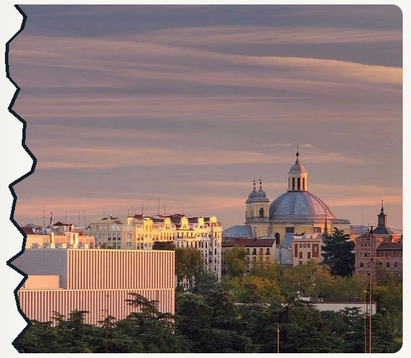

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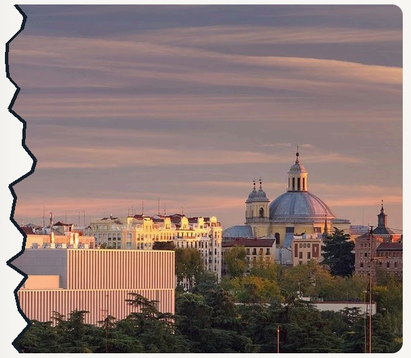

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MIT · Cambridge, MA, USA	2023 · 2024
IPMU · Tokyo, Japan	2025

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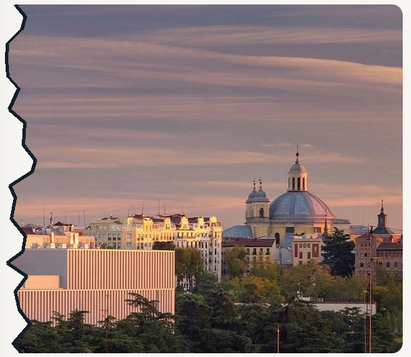

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SCIENTIFIC STAYS

UCSD · San Diego, USA — 2023

MIT · Cambridge, MA, USA — 2023 · 2024

IPMU · Tokyo, Japan — 2025

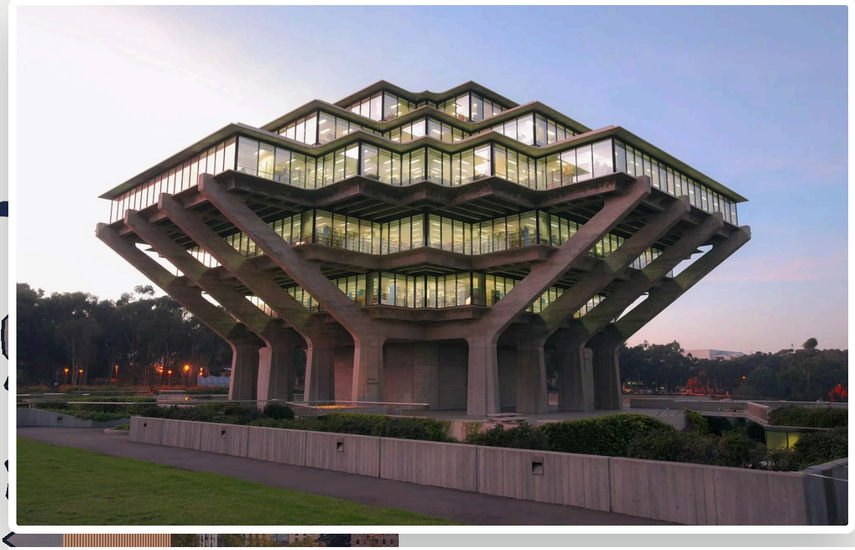
- Published on axions and ALPs with UCSD collaborators

PhD

2021–2025

IFT, Madrid

FPI Severo Ochoa Fellow



Geisel Library, UC San Diego

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

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SCIENTIFIC STAYS

UCSD · San Diego, USA	2023
MIT · Cambridge, MA, USA	2023 · 2024
IPMU · Tokyo, Japan	2025

- Met a key collaborator with a moving idea

PhD

2021–2025

IFT, Madrid

FPI Severo Ochoa Fellow



The Great Dome, MIT, Cambridge (MA)

JOHANNES GUTENBERG UNIVERSITÄT MAINZ JG|U

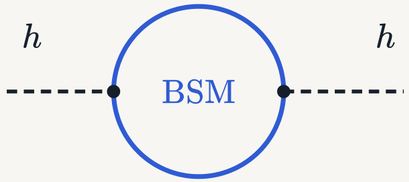
Alexander von HUMBOLDT STIFTUNG

The metastability of the Higgs

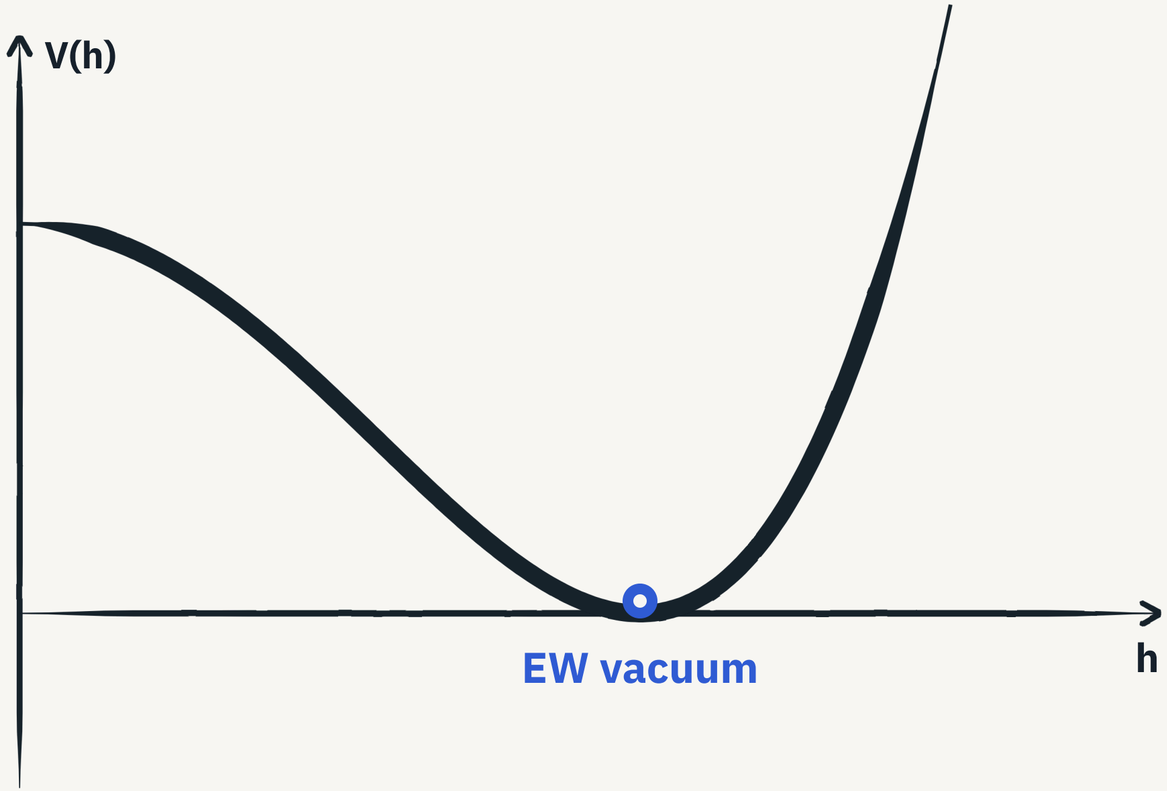
THE ELECTROWEAK HIERARCHY PROBLEM

Why is the Higgs ($125\ \mathrm{GeV}$) so light compared to new-physics scales (up to $10^{19}\ \mathrm{GeV}$)?

$$\delta m_h^2 \sim (\text{loop factor}) \times \Lambda_{\mathrm{BSM}}^2$$



The EW hierarchy problem can be well understood within the framework of **Higgs metastability**.



MY RESEARCH

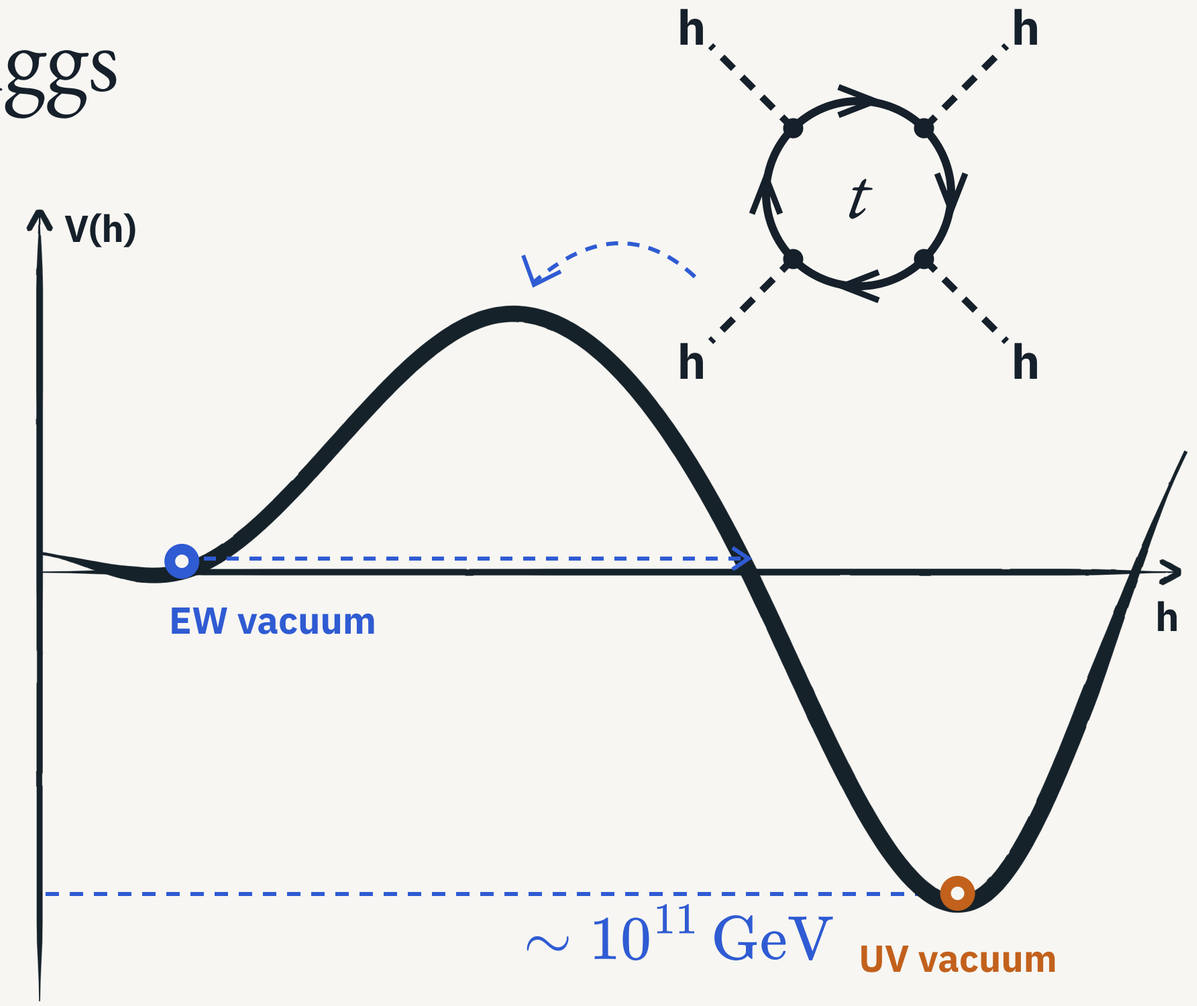
The metastability of the Higgs

EW HIERARCHY PROBLEM

Why is $m_H \ll 10^{19}\,\mathrm{GeV}$?

At high field values $V(h)$ can drop into a deeper **UV vacuum**: in the SM it is metastable.

The hill and the drop come from **radiative corrections**, dominated by the **top quark**.



The metastability of the Higgs

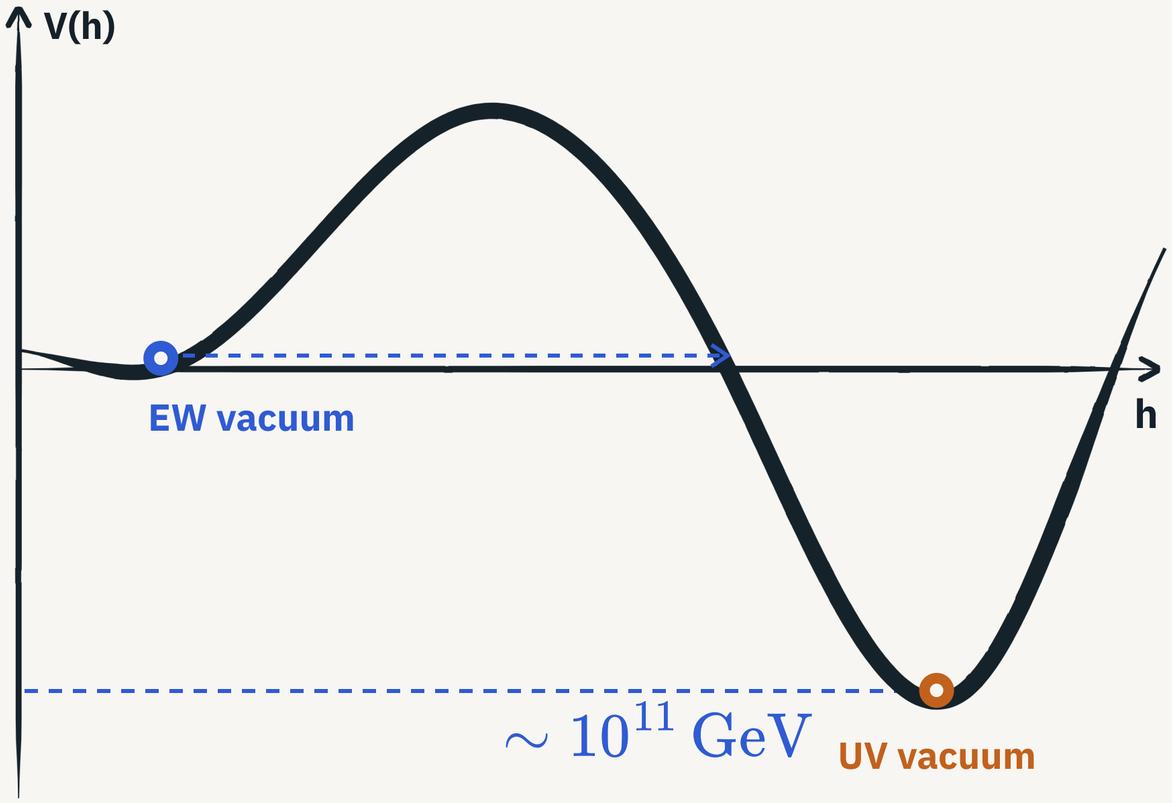
EW HIERARCHY PROBLEM

Why is $m_H \ll 10^{19}\,\mathrm{GeV}$?

At high field values $V(h)$ can drop into a deeper **UV vacuum**: in the SM it is metastable.

Decay by tunnelling is very slow:

$$\tau \simeq 10^{129}\,\mathit{years}$$



MY RESEARCH

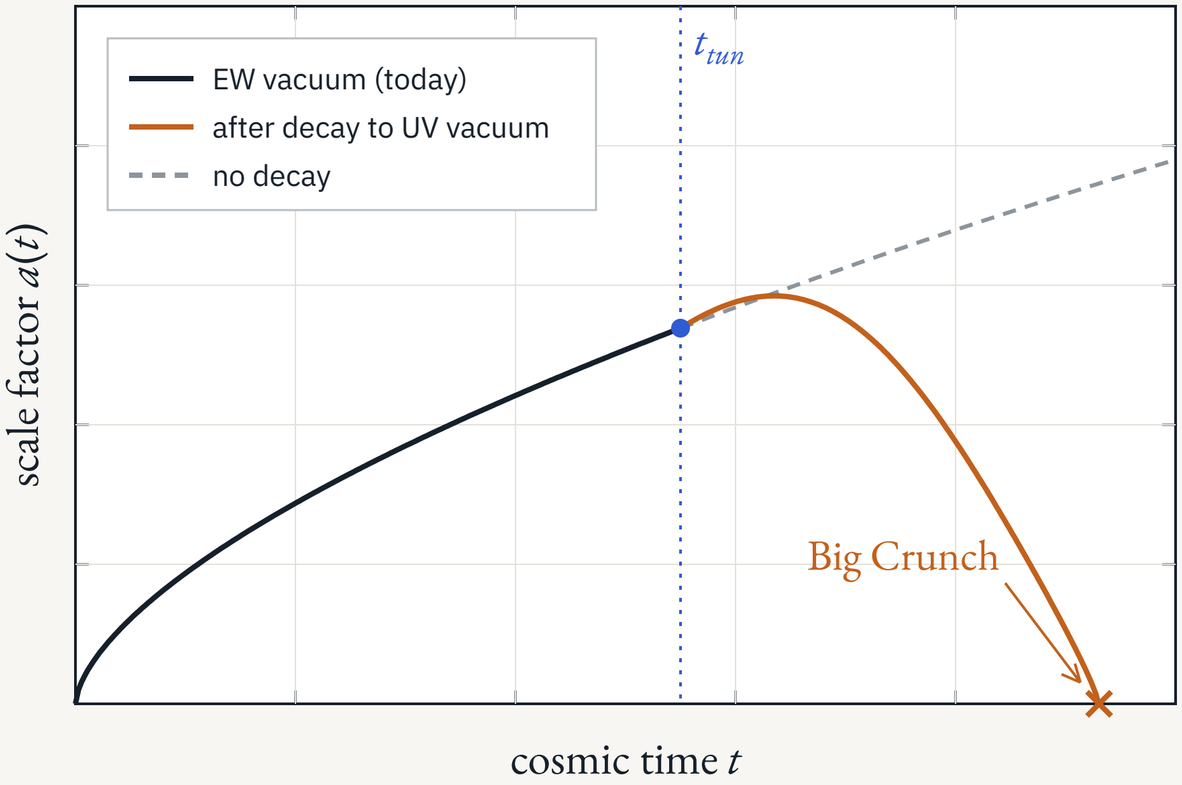
The metastability of the Higgs

EW HIERARCHY PROBLEM

Why is $m_H \ll 10^{19}\,\mathrm{GeV}$?

Tunnelling at $\tau \simeq 10^{129}\,years$ would nucleate a bubble of **UV vacuum** expanding at nearly the speed of light.

Its large negative energy **overcloses the Universe**: expansion stops and everything collapses in a **Big Crunch**.



MY RESEARCH

The metastability of the Higgs

EW HIERARCHY PROBLEM

Why is $m_H \ll 10^{19}\,\mathrm{GeV}$?

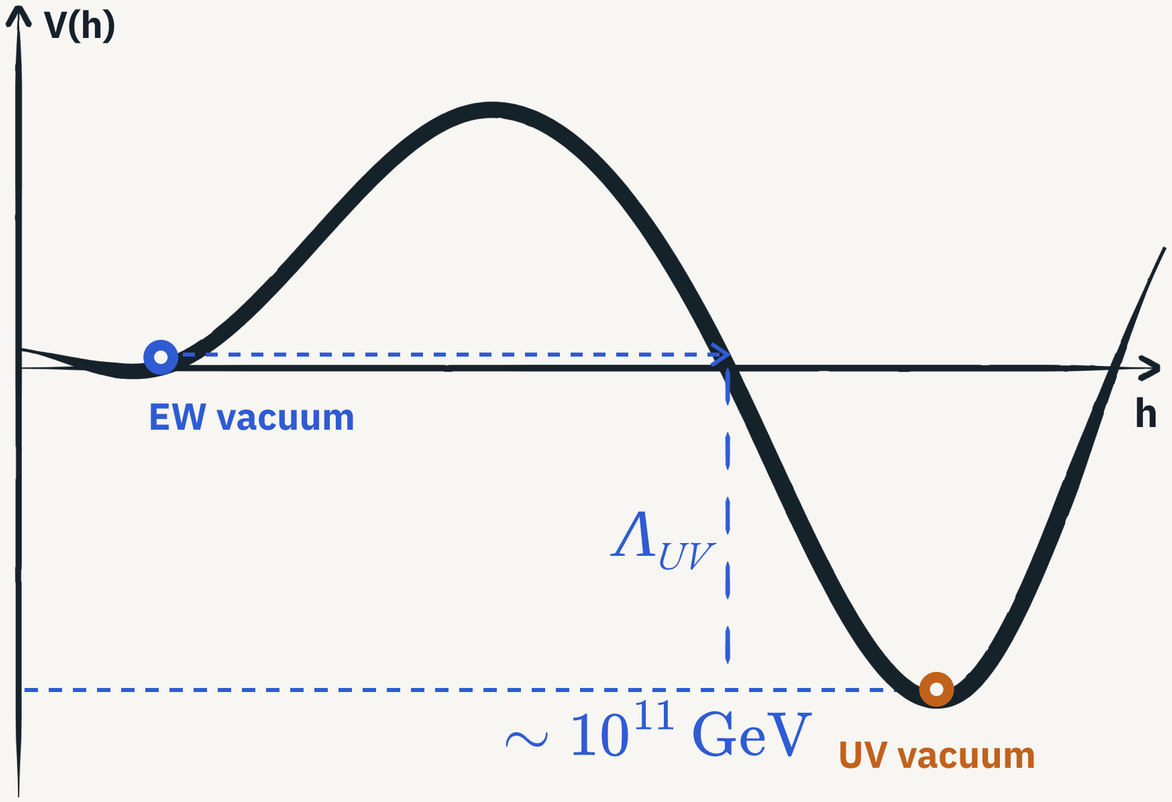
HIGGS METASTABILITY BOUND

The EW hierarchy problem can be solved using the analytical result that

$$m_H^2 \lesssim \Lambda_{\mathrm{UV}}^2$$

if there is to be an **EW vacuum**.

In the presence of BSM, the bound can change dramatically.



MY RESEARCH

The metastability of the Higgs

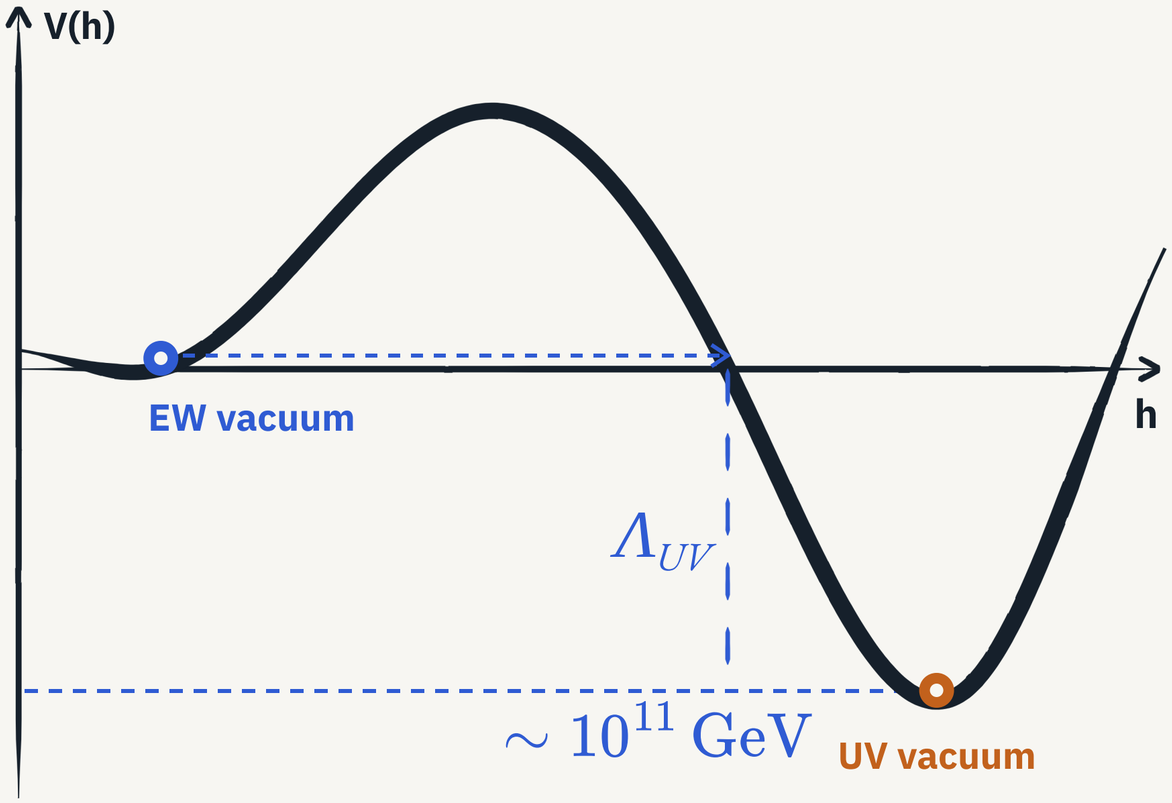
HIGGS METASTABILITY BOUND

$$m_H^2 \lesssim \Lambda_{\rm UV}^2$$

In the presence of BSM, the bound can change dramatically.

We are interested in:

- understanding Higgs metastability in generic BSM scenarios (e.g. already the **Type-I Seesaw**)
- the extent to which the bound can help solve the **EW hierarchy problem**



PHD · IFT MADRID · 2021–2025

During my PhD

4 **Publications**

15 **Conferences + schools**

4 **Scientific stays**

SCIENTIFIC STAYS

UCSD · San Diego, USA	2023
MIT · Cambridge, MA, USA	2023 · 2024
IPMU · Tokyo, Japan	2025

MAIN TOPICS LEARNED

- **Extended scalar sectors: ALPs and axions**
- **The Higgs and its near criticality**

SUBSIDIARY TOPICS

- **Effective Field Theories**
- **CP violation**
- **Phenomenology at LHC and the FCC**
- **Bubble nucleation**

PhD

2021–2025

IFT, Madrid

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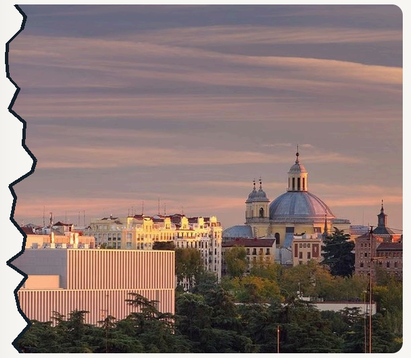

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+ 1 year at University of Gothenburg





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2019–2020

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Pre-doc

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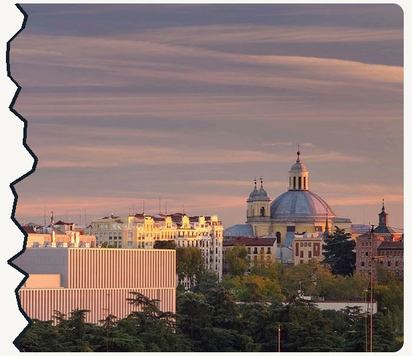

1st Postdoc

2026–today

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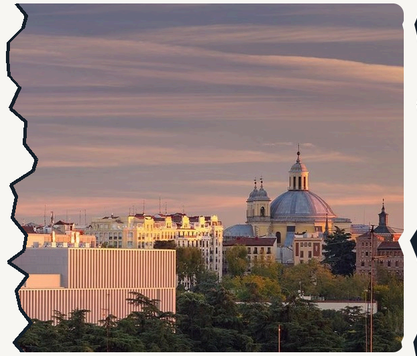

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JG|U

Alexander von HUMBOLDT STIFTUNG

POSTDOC SEARCH · 2025

What did go wrong?

Things I could not control

- Exceptional **geopolitical turmoil**
- Extremely **competitive job market**
- Internal **department politics**

Things I could control

- Lack of **precision** in applications
- Lack of **confidence**, especially after the first rejections
- Lack of **stamina**

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2021–2025

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Industry

2025–2026

Madrid

Lecturer and researcher in biomedical engineering at a private institution



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PhD

2021–2025

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INDUSTRY

2025–2026

Madrid

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2026–today

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POSTDOC SEARCH · 2025

What did I do right?

- Did a few **tailored** and **well-directed** applications
- Took the **initiative** to prepare **my own grant**

European Research Council
Established by the European Commission

MSCA-PF
Funding for
International
Postdocs

EPC
European
Project Center

Alexander von
HUMBOLDT
STIFTUNG

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Humboldt
Postdoctoral Fellow



JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Alexander von HUMBOLDT STIFTUNG

1st lesson learned

Things do not always go your way. That does not mean they won't go well

1st lesson learned

Things do not always go your way. That does not mean they won't go well

2nd lesson learned

Keep going, and always keep your morale high

1st lesson learned

Things do not always go your way. That does not mean they won't go well

2nd lesson learned

Keep going, and always keep your morale high

3rd lesson learned

Let your scientific interests drive you

Thank you

JOHANNES GUTENBERG UNIVERSITÄT MAINZ
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Alexander von HUMBOLDT STIFTUNG