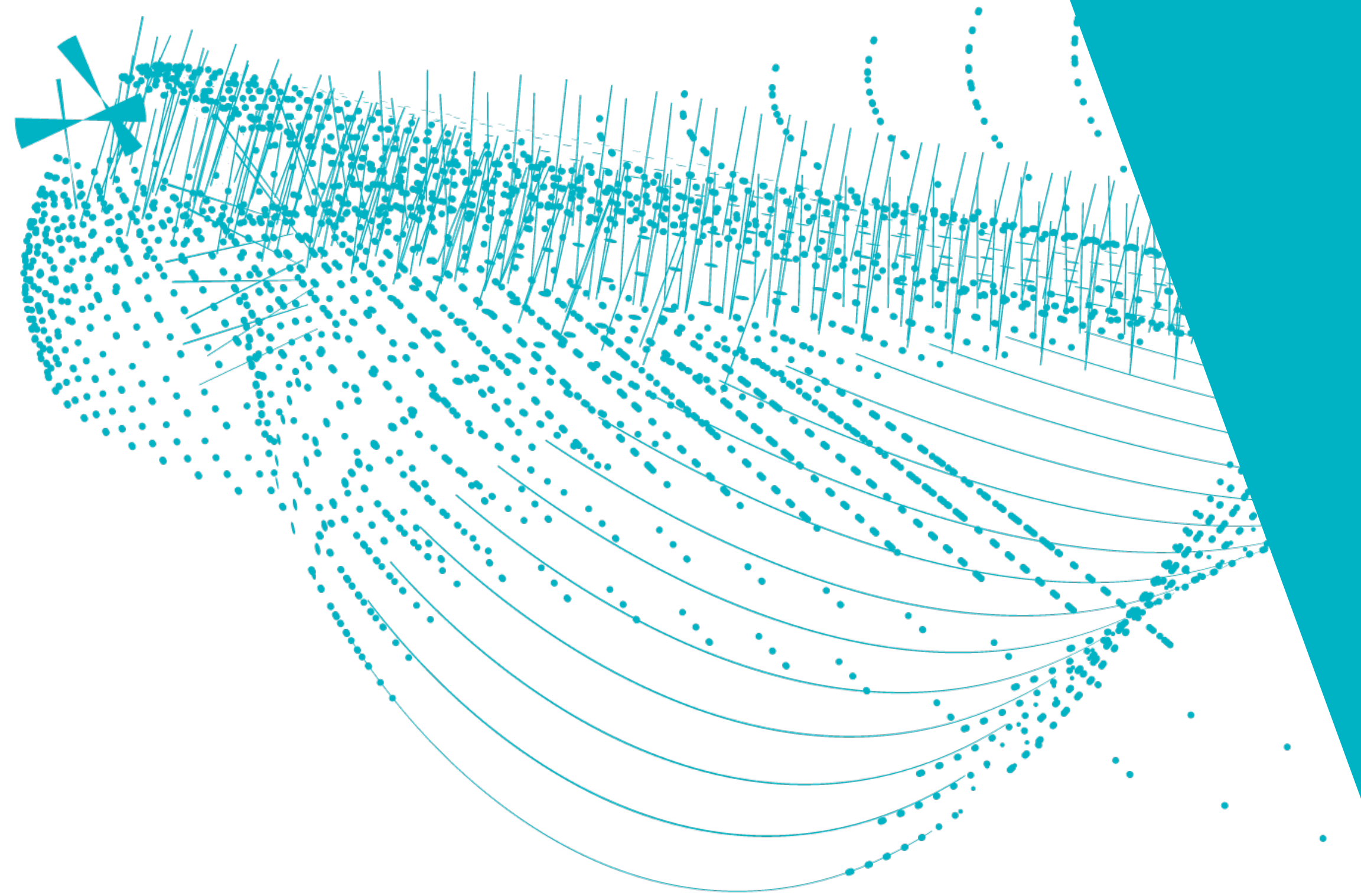




NIKHEF JAMBOREE, AMSTERDAM, 15-16 MAY 2023

# THEORY GROUP INTRODUCTION

Robert Fleischer



# DUTCH THEORETICAL PARTICLE PHYSICS

- Amsterdam: Nikhef, VU, UvA
- Nijmegen: Radboud Universiteit
- Groningen: Rijksuniversiteit
- Utrecht: Universiteit Utrecht
- Leiden: Universiteit Leiden
- Maastricht: Maastricht University

## Nikhef Theory Groups

- *Large community:*
  - O(45) staff members
  - O(60) postdocs
  - O(100) PhD students

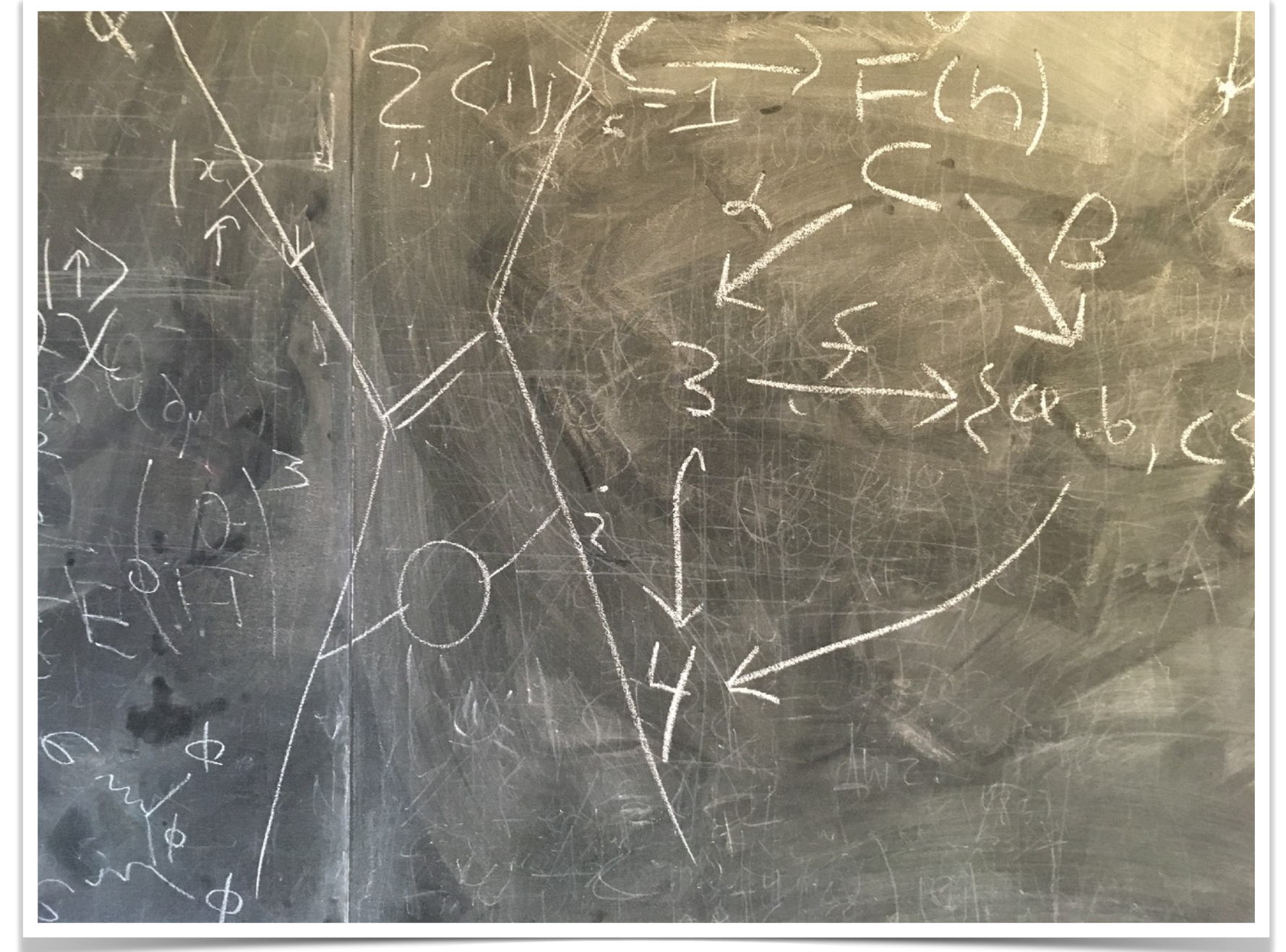


[No theoretical particle physics at Technical Universities]



# NIKHEF THEORY GROUP AMSTERDAM

- Broad spectrum of research topics:
  - QCD and collider physics
  - Flavour physics: quarks & leptons
  - Dark matter
  - Cosmology
- Serves as a national centre for particle physics phenomenology.
- Exploit environment at Nikhef through close interactions with the experimental groups.





# THEORY GROUP WEBSITE:



← PEOPLE RESEARCH SOFTWARE ACTIVITIES EVENTS FOR STUDENTS OUTREACH VACANCIES CONTACT

ZOEKEN



- O(10) Staff Members
- 4 postdocs
- 16 PhDs
- 12 MSc students
- 5 Emeriti
- Visitors...

Theoretical physics at Nikhef

About Nikhef's Theory group

Welcome to the website of the **Theory Group** of Nikhef! Here you will find information about [who we are](#), what are our [research interests](#), how to [contact us](#), as well as related information which would be useful for bachelor and master students looking for a [project/internship](#) within our group and for prospective applicants to open PhD, postdoc, and staff [positions](#). For more general information about the Nikhef institute and partnership please go [here](#).

[Instagram](#)



[Twitter](#)





# NEW ADDITION: GRAVITATIONAL WAVES

## •Béatrice Bonga: *Nijmegen*

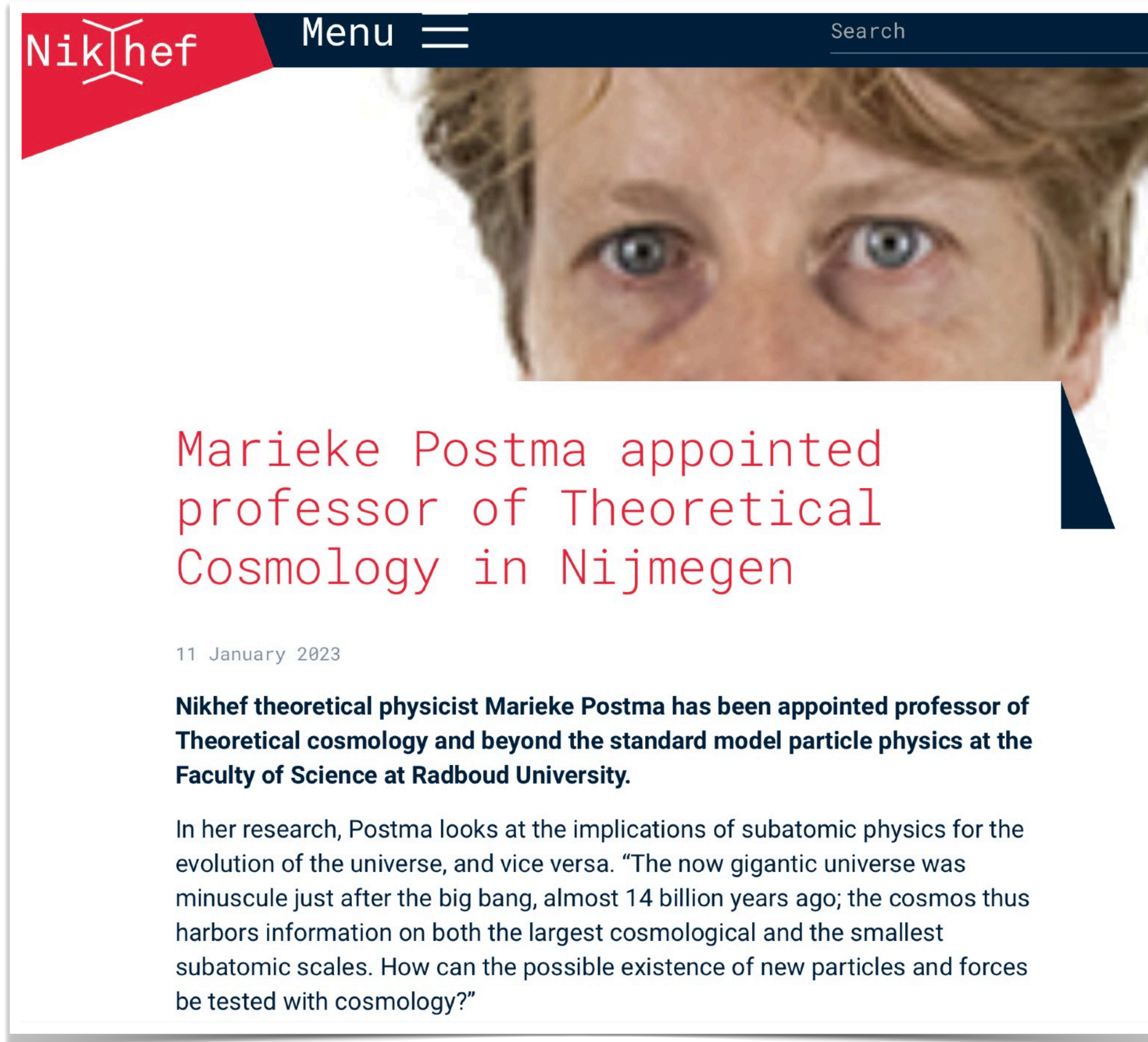
- Gravitational waves
- Black holes
- Resonances
- Cosmological constant
- QFT on curved spacetime

Complements Gideon Koekoek (Maastricht University) and Jan-Willem van Holten (Nikhef + Leiden “retired”).

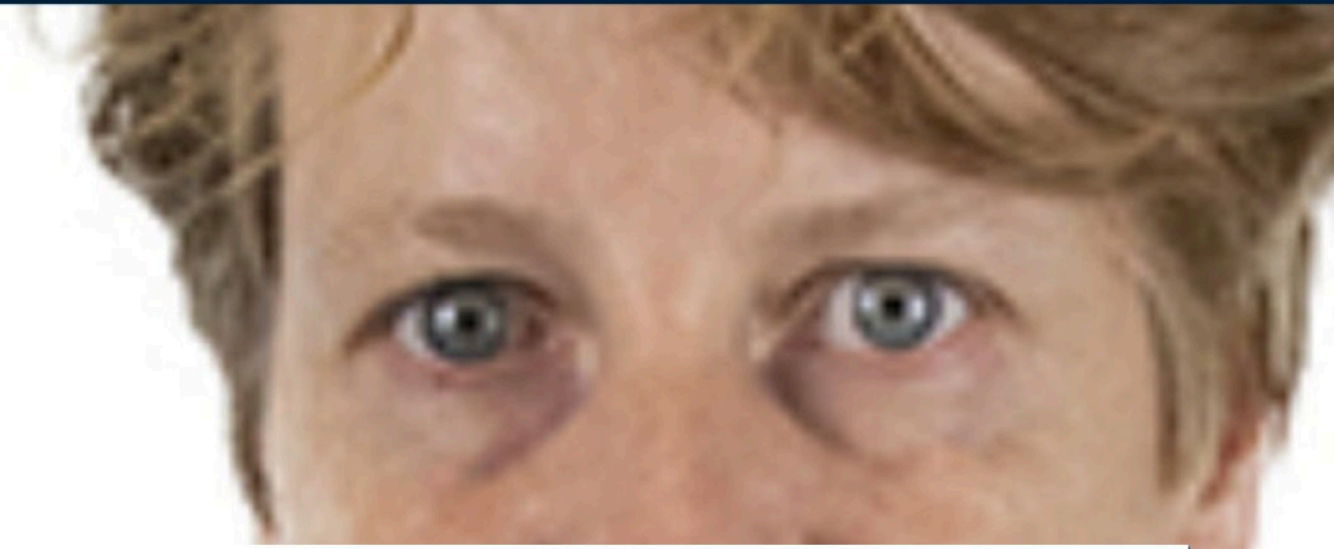




# PROFESSORSHIPS



**Nikhef** Menu



## Marieke Postma appointed professor of Theoretical Cosmology in Nijmegen

11 January 2023

**Nikhef theoretical physicist Marieke Postma has been appointed professor of Theoretical cosmology and beyond the standard model particle physics at the Faculty of Science at Radboud University.**

In her research, Postma looks at the implications of subatomic physics for the evolution of the universe, and vice versa. "The now gigantic universe was minuscule just after the big bang, almost 14 billion years ago; the cosmos thus harbors information on both the largest cosmological and the smallest subatomic scales. How can the possible existence of new particles and forces be tested with cosmology?"



## Nikhef-theoretician Juan Rojo appointed full professor at Vrije Universiteit

22 September 2022

**As of 1 September, Nikhef-physicist Juan Rojo has been appointed Professor of Theoretical Physics at the Vrije Universiteit Amsterdam. His chair is embedded in the Physics and Astronomy department.**



Rojo is an expert in the phenomenology of elementary particle interactions, in particular concerning the quark and gluon internal substructure of the proton. He is also well-known by pioneering the application of artificial intelligence (AI) for particle physics.

Rojo studied Physics at the University of Barcelona in Spain, where he obtained his doctorate in 2006. Subsequently he worked as

### Related Programme

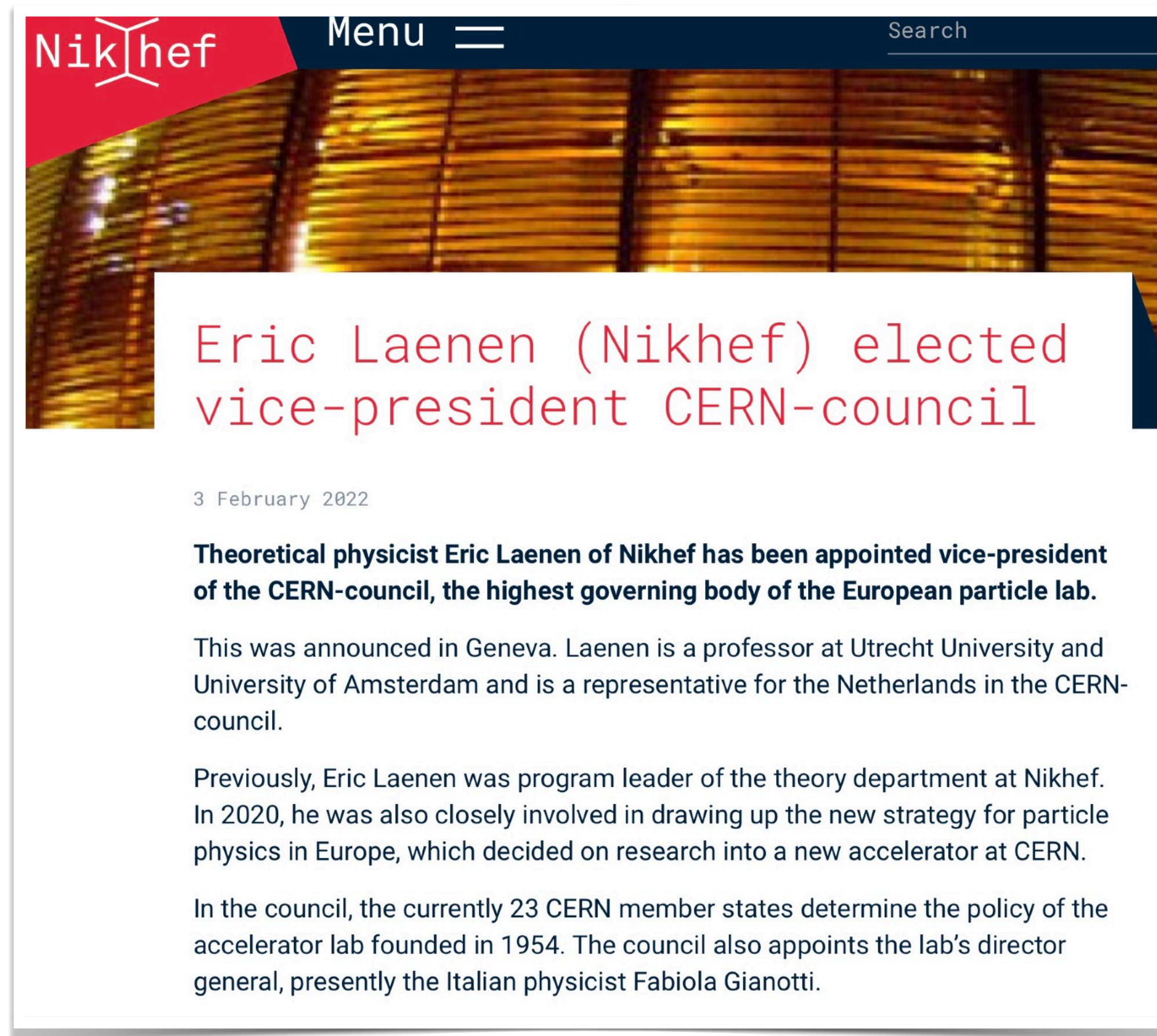


**Theoretical physics**  
Nikhef's Theoretical Physics group performs theoretical research on a wide range of

*Many congratulations!*



# NEW APPOINTMENTS ERIC LAENEN



**Eric Laenen (Nikhef) elected vice-president CERN-council**

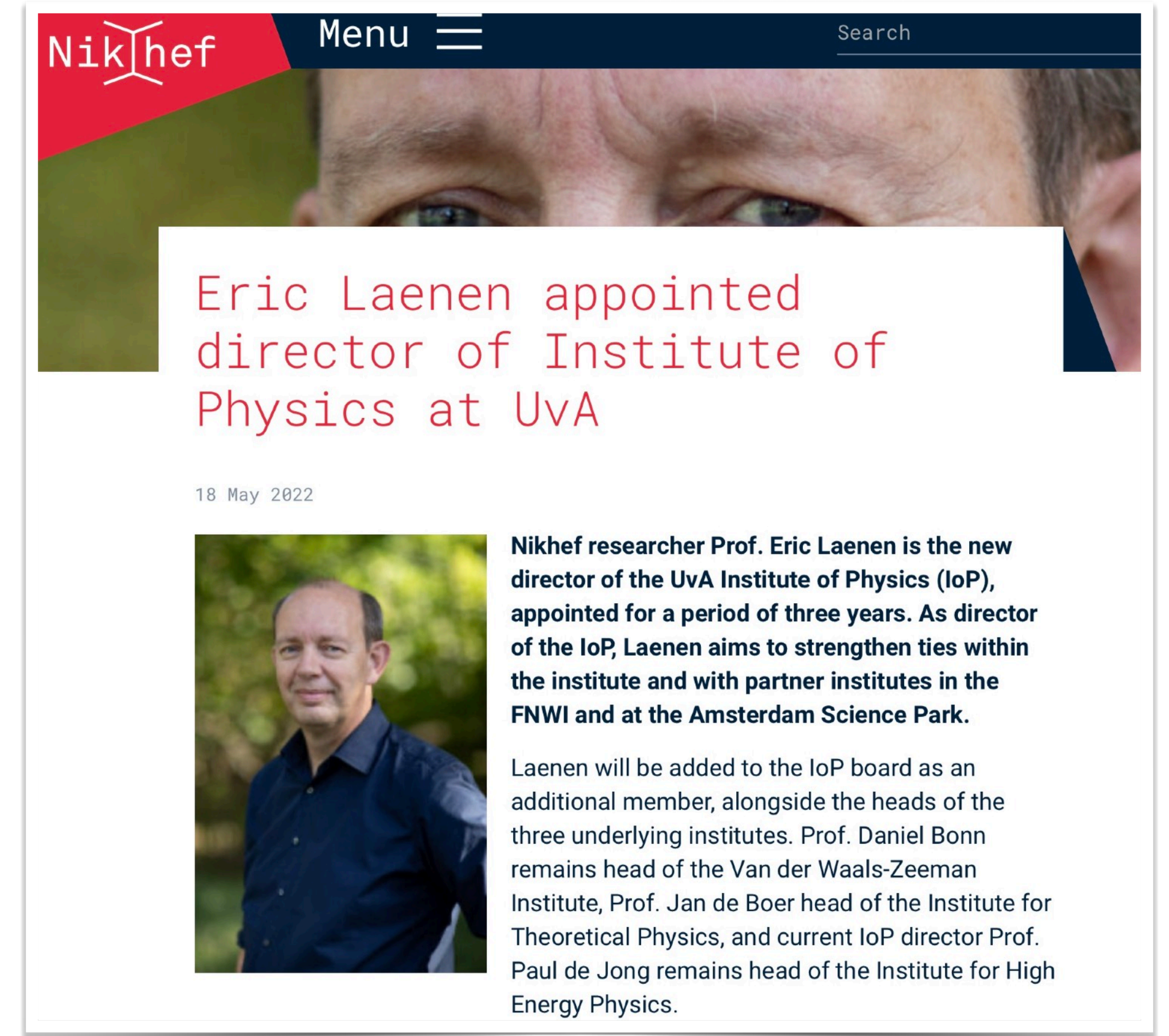
3 February 2022

**Theoretical physicist Eric Laenen of Nikhef has been appointed vice-president of the CERN-council, the highest governing body of the European particle lab.**

This was announced in Geneva. Laenen is a professor at Utrecht University and University of Amsterdam and is a representative for the Netherlands in the CERN-council.


Previously, Eric Laenen was program leader of the theory department at Nikhef. In 2020, he was also closely involved in drawing up the new strategy for particle physics in Europe, which decided on research into a new accelerator at CERN.

In the council, the currently 23 CERN member states determine the policy of the accelerator lab founded in 1954. The council also appoints the lab's director general, presently the Italian physicist Fabiola Gianotti.



**Eric Laenen appointed director of Institute of Physics at UvA**

18 May 2022



**Nikhef researcher Prof. Eric Laenen is the new director of the UvA Institute of Physics (IoP), appointed for a period of three years. As director of the IoP, Laenen aims to strengthen ties within the institute and with partner institutes in the FNWI and at the Amsterdam Science Park.**

Laenen will be added to the IoP board as an additional member, alongside the heads of the three underlying institutes. Prof. Daniel Bonn remains head of the Van der Waals-Zeeman Institute, Prof. Jan de Boer head of the Institute for Theoretical Physics, and current IoP director Prof. Paul de Jong remains head of the Institute for High Energy Physics.

*Many congratulations!*



# FORM



Nikhef Menu ☰ Search 🔍 [→ Datacenter](#) [→ Contact](#)  
[→ Intranet](#) [→ Dutch](#)

## Quanta Magazine features computing pioneer Jos Vermaseren and his FORM

HOME FOCUSBLO... → QUANTA MAGAZINE FE...

8 December 2022

**The American science magazine Quanta is running a major article this month on FORM, a computer algebra program widely used in theoretical particle physics.**

The program is the brainchild of Nikhef theorist emeritus Jos Vermaseren. It is also in danger of falling out of use due to lack of support, despite all its advantages, Quanta warns.

**Crucial Computer Program for Particle Physics at Risk of Obsolescence**

28 | 📄 *Maintenance of the software that's used for the hardest physics calculations rests almost entirely with a retiree. The situation reveals the problematic incentive structure of academia.*

$$A^{[j]}(s, t) = \sum_{i=1}^8 F_i^{[j]} T$$



# RECENT PHD THESES





# STAFF MEMBERS INVOLVED IN TEACHING...

- The theory group is very popular for MSc (BSc) students to conduct their projects [O(10)].
- Great addition to the group!
- Important part of the activities...



The screenshot shows a webblog post on the Nikhef website. The header includes the Nikhef logo, a menu icon, a search bar, and navigation links for 'Datacenter', 'Intranet', 'Contact', and 'Dutch'. The main heading of the post is 'Weekly weblog Theory master student Heleen Mulder from Seattle (week 1, 2 & 3)'. The date is '2 May 2023'. The text describes Heleen Mulder, a Master's student in theoretical physics at UvA and Nikhef, who is currently in Seattle at the Institute for Nuclear Theory. It mentions a grant from the Volkert van Willigen Fund and states that she will keep a weblog about her work and experiences. Below the text, there are two images of waterfalls and a caption for 'Week 3 in Seattle: beta decays, sterile neutrinos and a weekend in Portland'. The caption begins with 'At the start of my last week in Seattle (sadly), let me tell you about the interesting talks I've attended in the past week! The first week of the month-long conference on 'New Physics Searches at



# VARIOUS REGULAR SCIENTIFIC ACTIVITIES

- Journal Clubs
- Theoretical Physics Seminars, ...
- Activities within the PhD graduate school (DRSTP):
  - National Seminar Theoretical High-Energy Physics (2-times/year)
  - Trends in Theory (every other year)
- Involvement in Nikhef activities:
  - Colloquium
  - Theory Meets Experiment, ...

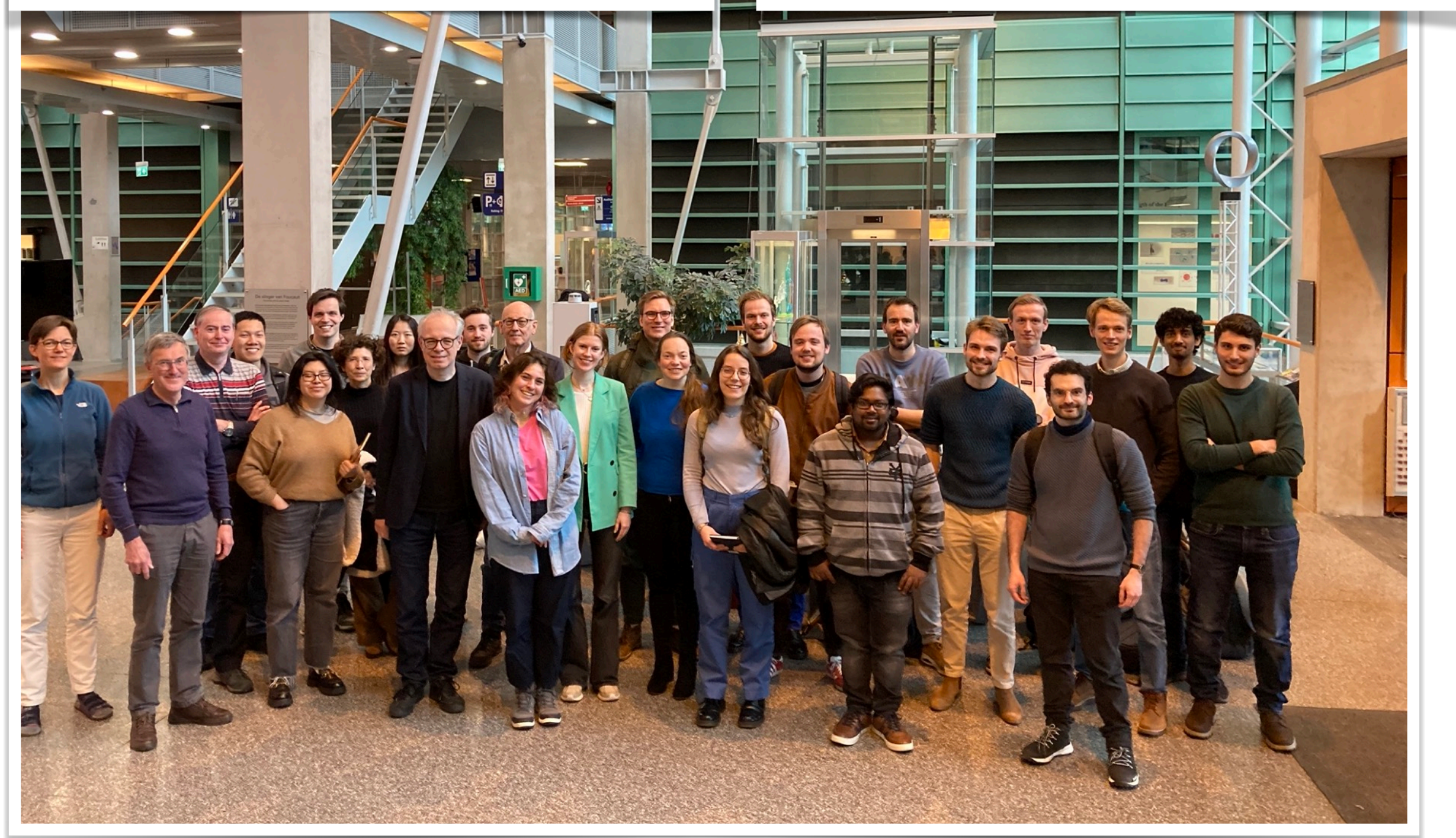
The screenshot shows the website for the Dutch Research School of Theoretical Physics (DRSTP). The header includes the TP logo, the text 'DUTCH RESEARCH SCHOOL OF THEORETICAL PHYSICS', and a navigation menu with buttons for 'CONTACT', 'SEARCH...', 'DRSTP', 'EDUCATION', 'EVENTS', 'ARCHIVE', 'MEET OUR STAFF', 'MEET OUR PhDs', and 'PHD THESES'. The main content area features a red box with the date 'THURSDAY 19 05 2022 WAGENINGEN' and a yellow box with 'CONFERENCES SYMPOSIUM TRENDS IN THEORY'. Below this is a large image of a globe with the TP logo and the word 'ARCHIVE'. To the right of the image is the event title 'DRSTP Event Symposium Trends in Theory 2022' and a short description: '14th biennial symposium of the Dutch Research School of Theoretical Physics. The symposium is organized to give an overview of research activities in theoretical physics in the Netherlands. We look forward to welcoming all members of the DRSTP on this occasion.' At the bottom, a green bar contains the text 'DATE: Thursday 19 + Friday 20 May 2022'.



# “THEORY DAY” MEETINGS

- *Mini Workshops* to connect the Dutch theo/pheno community.
- Include a student session without staff members being present.
- Successfully revived “in-person” and restructured after the pandemic.
- Recent meeting in Nijmegen.

[Jordy de Vries, Anders Rehult & Coenraad Marinissen +Susanne Westhoff (RU), Keri Vos (UM), ...]





# "THEORY MEETS EXPERIMENT"

**Mini Nikhef Workshop: Theory Meets Experiment - Sterile neutrinos: neutrinoless double beta decay, direct searches, and cosmology**

Friday 9 Jun 2023, 11:00 → 18:00 Europe/Amsterdam

**Description** Theory Meets Experiment on sterile neutrinos: neutrinoless double beta decay, direct searches, and cosmology

Location: CWI (Z011/Z009)

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<b>11:00</b>	→ 12:00	<b>Sterile neutrinos and neutrinoless double beta decay</b>	🕒 1h
		Speaker: Jordy de Vries (UvA & Nikhef)	
<b>14:00</b>	→ 14:05	<b>Opening of Afternoon Session</b>	🕒 5m
		Speakers: Marcel Merk, Robert Fleischer, Tristan du Pree	
<b>14:05</b>	→ 14:30	<b>Neutrinoless double beta decay (KamLAND-Zen and future detectors)</b>	🕒 25m
		Speaker: Kelly Weerman	
<b>14:30</b>	→ 15:00	<b>Sterile Neutrinos and Leptogenesis</b>	🕒 30m
		Speaker: Marieke Postma	
<b>15:00</b>	→ 15:30	<b>Coffee Break</b>	🕒 30m
<b>15:30</b>	→ 16:00	<b>Long-lived particle searches at the LHC and FPF</b>	🕒 30m
		Speaker: Flavia de Almeida Dias	
<b>16:00</b>	→ 16:30	<b>Discussion</b>	🕒 30m
<b>16:30</b>	→ 18:00	<b>Borrel</b>	🕒 1h 30m

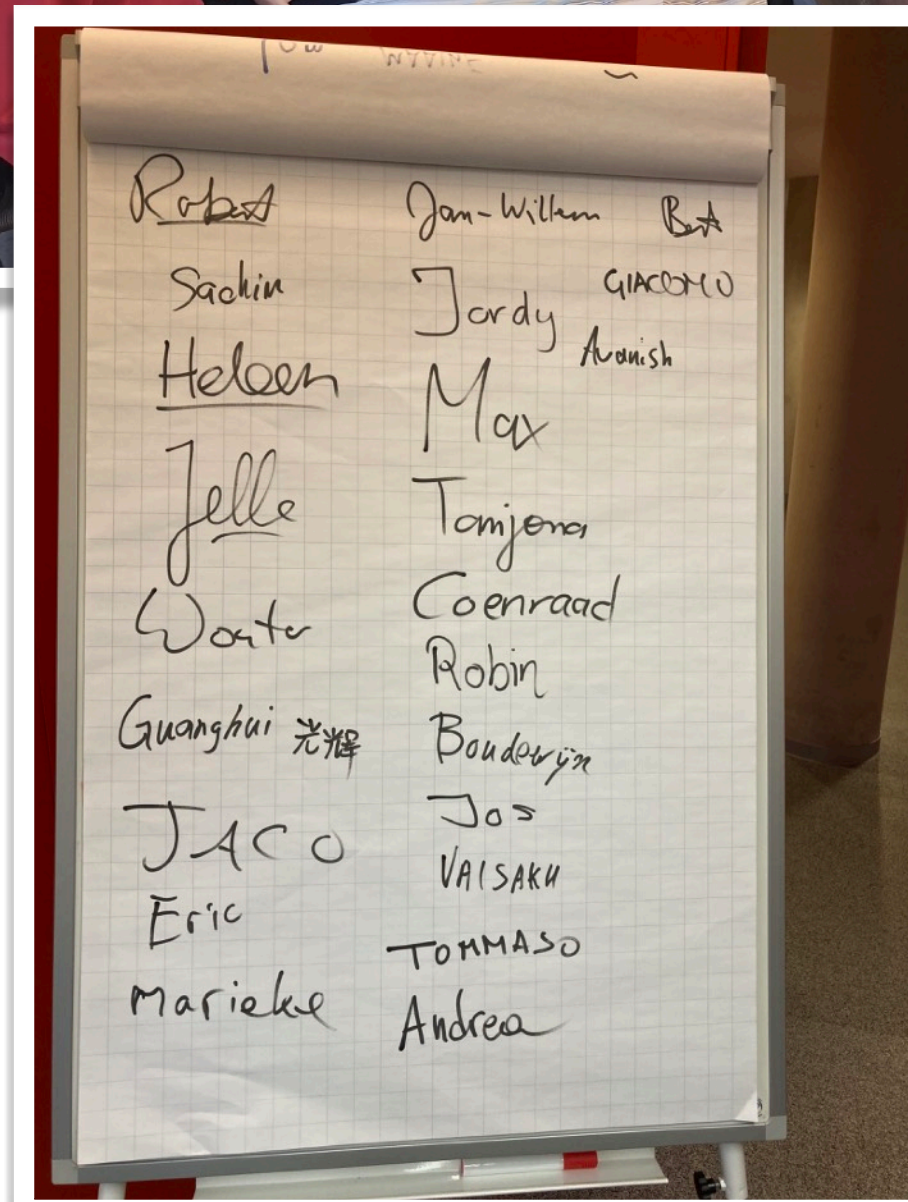
Next meeting:  
Friday, June 9th

*Please join!*

Suggestions of topics  
are very welcome!



# SOCIAL "THEORY" EVENTS...





# “SNAPSHOTS” OF RESEARCH (I)

**nature**

Explore content ▾ About the journal ▾ Publish with us ▾

[nature](#) > [articles](#) > [article](#)

Article | [Open Access](#) | [Published: 17 August 2022](#)

## Evidence for intrinsic charm quarks in the proton

[The NNPDF Collaboration](#)

[Nature](#) **608**, 483–487 (2022) | [Cite this article](#)

43k Accesses | 7 Citations | 373 Altmetric | [Metrics](#)

## Power counting energy flow polynomials

Pedro Cal,<sup>a,b,c</sup> Jesse Thaler<sup>d,e</sup> and Wouter J. Waalewijn<sup>b,c</sup>

## First extraction of inclusive $V_{cb}$ from $q^2$ moments

Florian Bernlochner,<sup>a</sup> Matteo Fael,<sup>b</sup> Kevin Olschewsky,<sup>c</sup> Eric Persson,<sup>a</sup>  
Raynette van Tonder,<sup>d</sup> K. Keri Vos<sup>e,f</sup> and Maximilian Welsch<sup>a</sup>

## Flow-oriented perturbation theory

Michael Borinsky,<sup>a</sup> Zeno Capatti,<sup>b</sup> Eric Laenen<sup>c,d,e</sup> and Alexandre Salas-Bernárdez<sup>f</sup>





# “SNAPSHOTS” OF RESEARCH (II)

PHYSICAL REVIEW LETTERS **129**, 121801 (2022)

## Pion-Induced Radiative Corrections to Neutron $\beta$ Decay

Vincenzo Cirigliano<sup>1,2,\*</sup> Jordy de Vries<sup>3,4,†</sup> Leendert Hayen<sup>5,6,‡</sup>  
Emanuele Mereghetti<sup>1,§</sup> and André Walker-Loud<sup>7,||</sup>

Jan 2023

## New Perspectives for Testing Electron-Muon Universality

Robert Fleischer<sup>a,b</sup>, Eleftheria Malami<sup>a,c</sup>, Anders Rehult<sup>a</sup>, and K. Keri Vos<sup>a,d</sup>

<sup>a</sup>Nikhef, Science Park 105, NL-1098 XG Amsterdam, Netherlands

<sup>b</sup>Department of Physics and Astronomy, Vrije Universiteit Amsterdam,  
NL-1081 HV Amsterdam, Netherlands

## Resolving the flavor structure in the MFV-SMEFT

Sebastian Bruggisser<sup>a,b</sup> Danny van Dyk<sup>c,d,e</sup> and Susanne Westhoff<sup>a,f,g</sup>

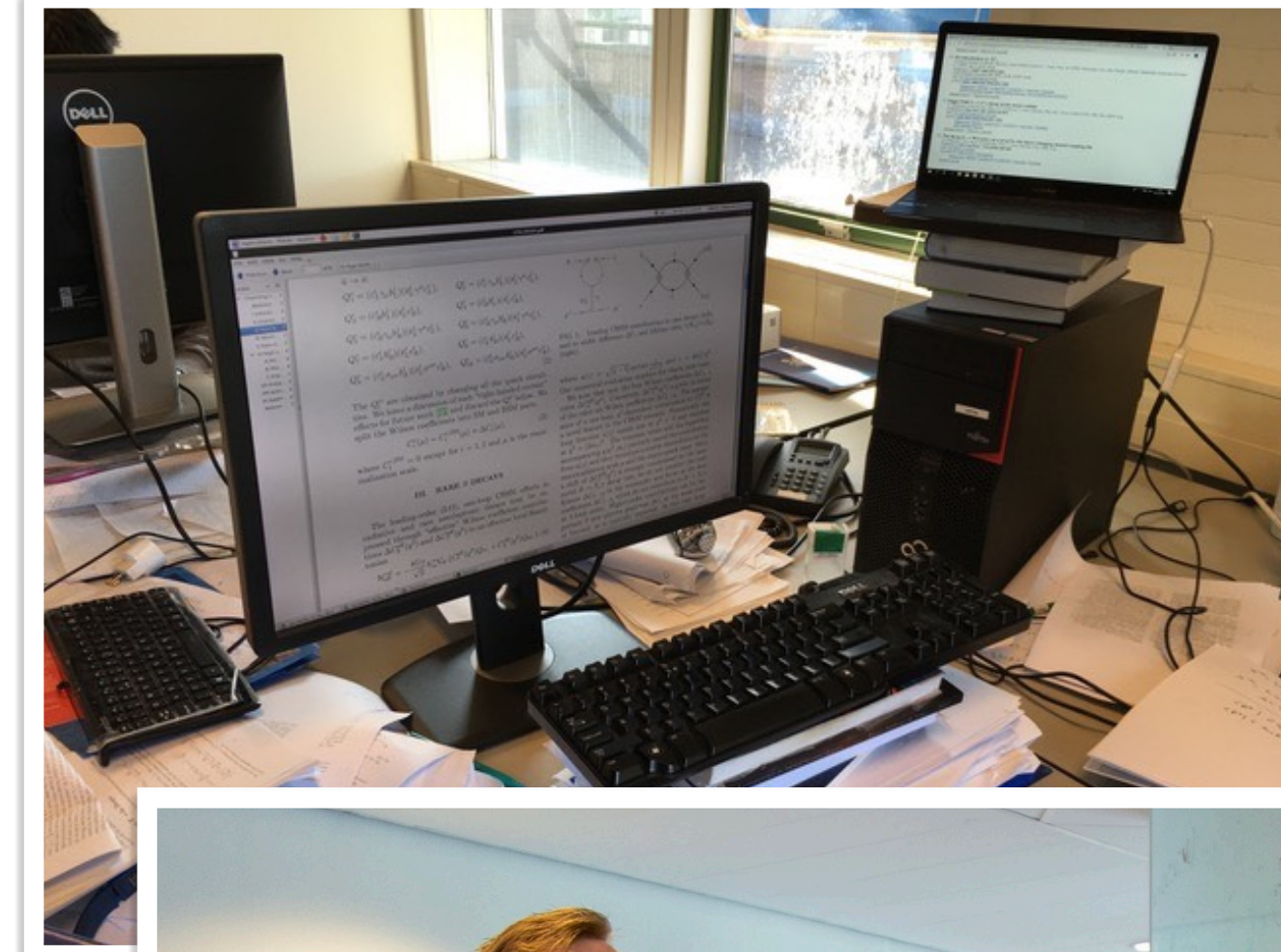
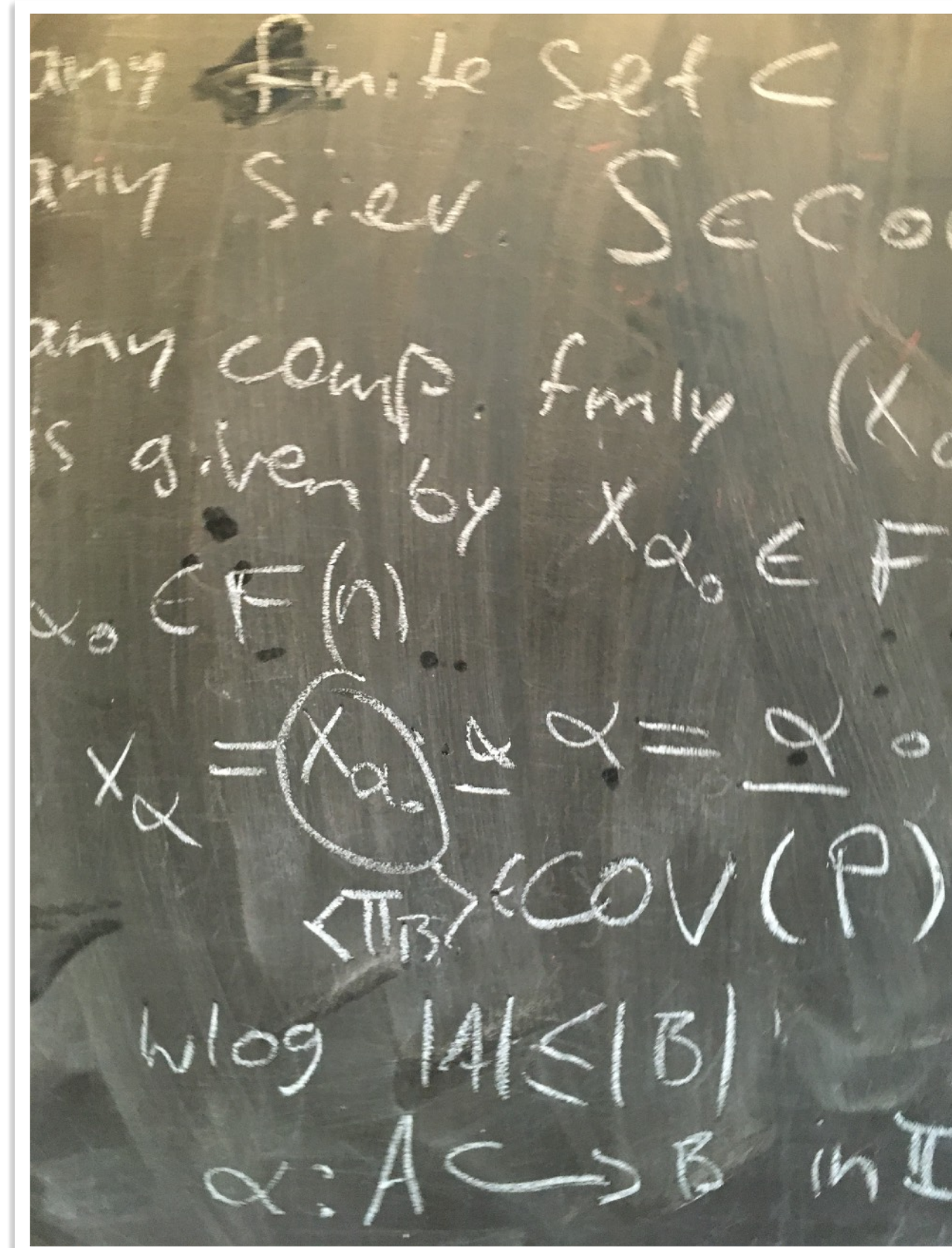
## SIMPLY add a dark photon

Pieter Braat<sup>a,b</sup> and Marieke Postma<sup>a,c</sup>

*+ many more papers and results ...*



# THEORETICAL PHYSICS “INSTRUMENTATION”



*Biggest resource/investment: talent!*



# SCIENTIFIC PROGRAMME OF THIS SESSION:

*Impressions of the broad research in the theory group:*

- Giacomo Magni:

*Unraveling the structure of the proton with QCD and machine learning*

- Coenraad Marinissen:

*Taming infinities, a theorist job*