



High Energy Physics & Cosmology at Nordita



HEP/Cosmo group

ronnie.rodgers@su.se



Konstantin
Zarembo

Paolo di
Vecchia

Watse
Sybesma

Evita
Verheijden

Ronnie
Rodgers

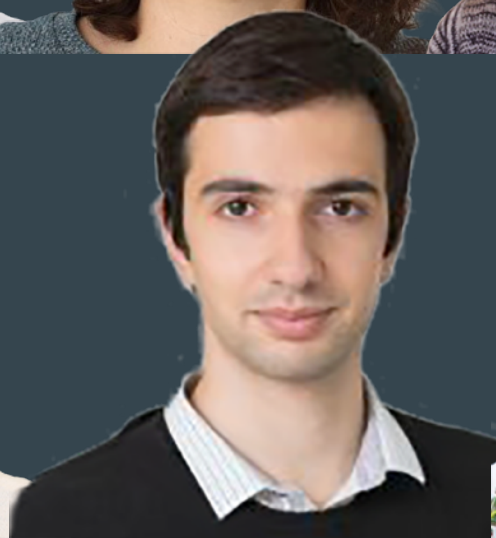
Victor
Mishnyakov



Florian
Niedermann



Oksana
Iarygina



Aleksandr
Chatrchyan



Judit
Prat Martí

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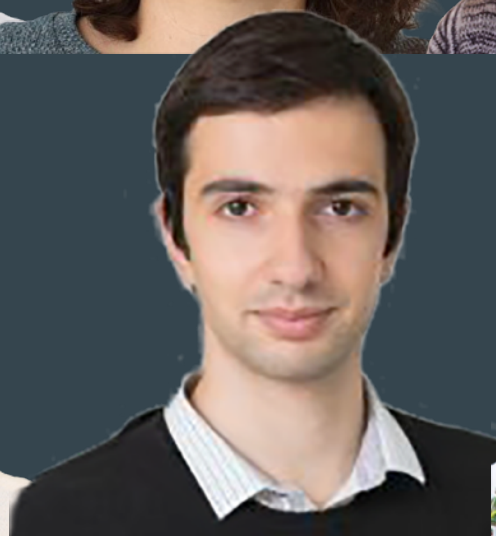
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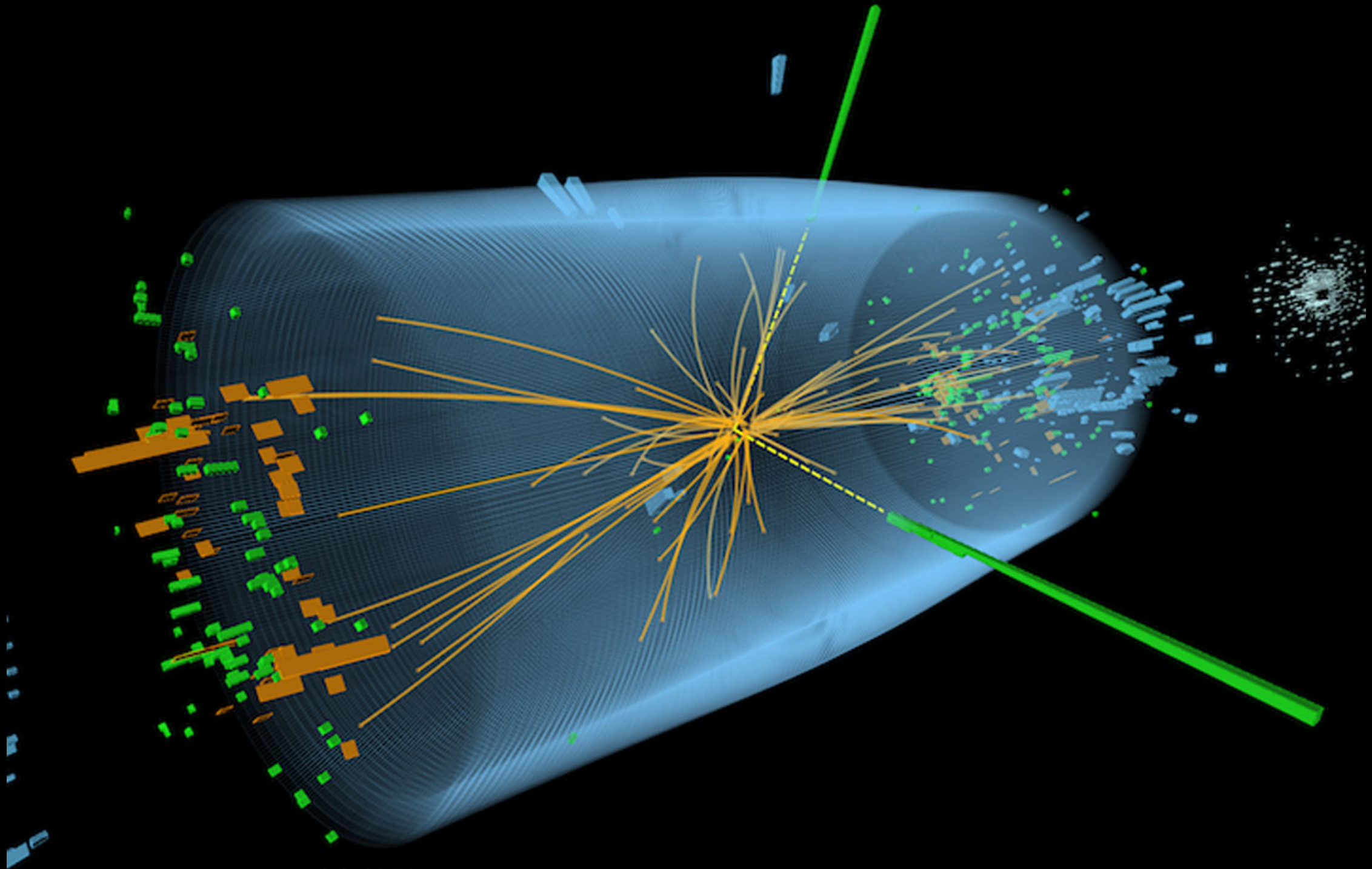


Aleksandr
Chatrchyan



Judit
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High Energy Physics

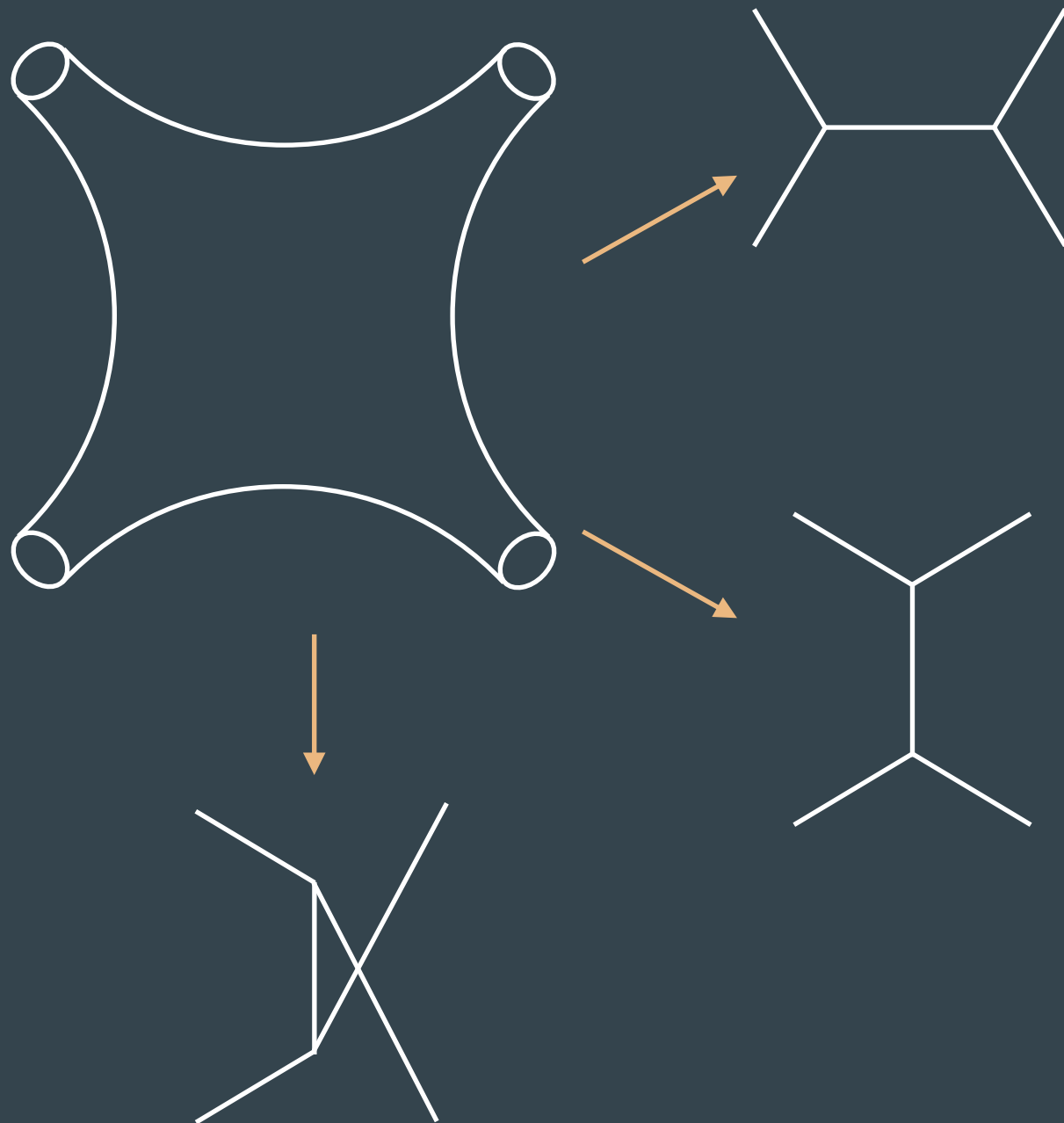


Scattering amplitudes



Paolo di Vecchia

From string theory:



+ Uppsala



Henrik
Johansson

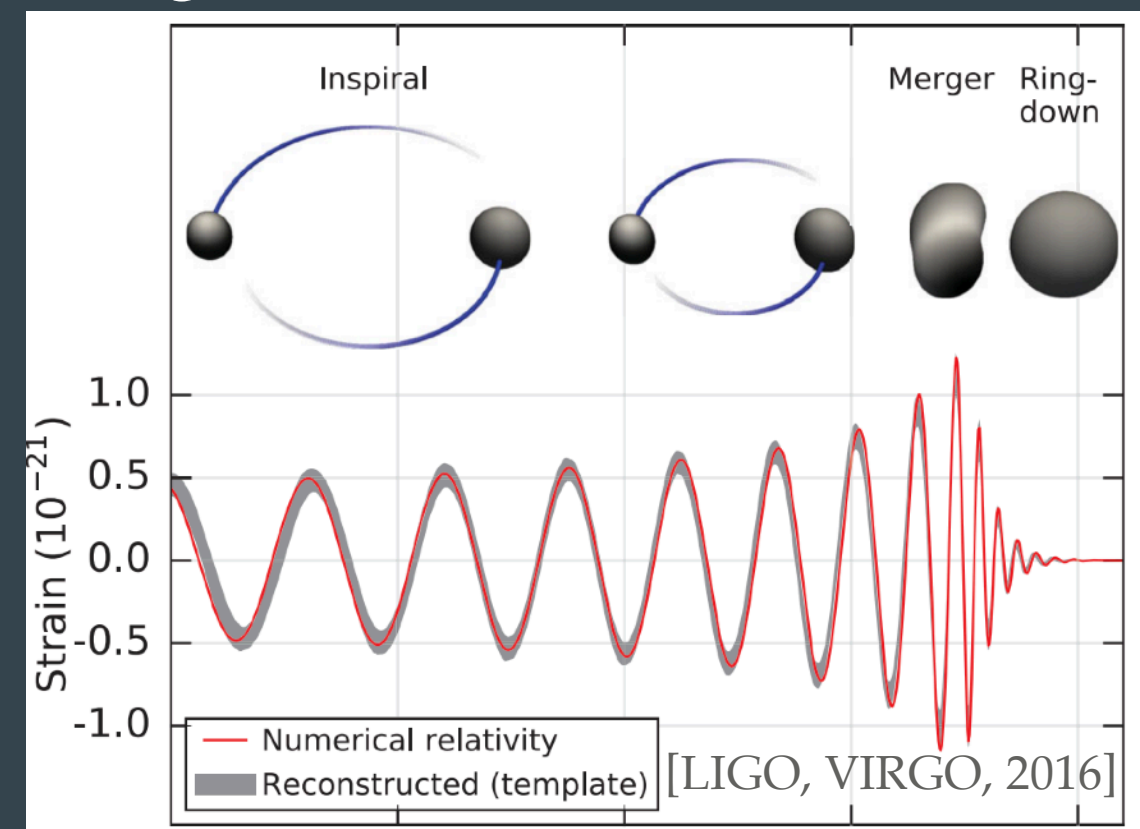


Ingrid
Vazquez-Holm



Michele
Santagata

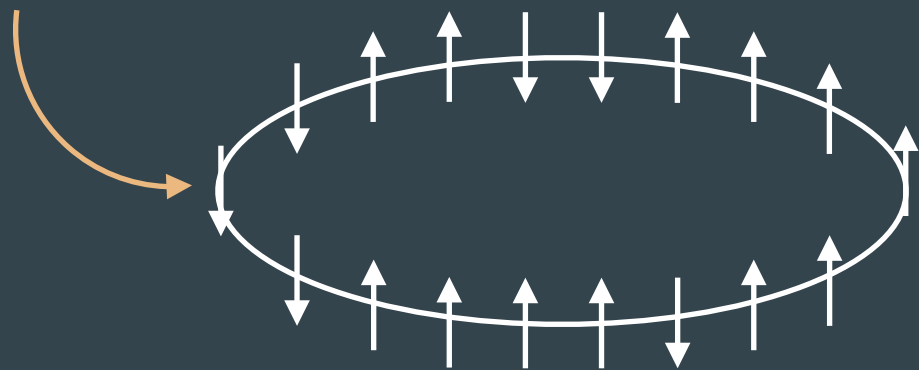
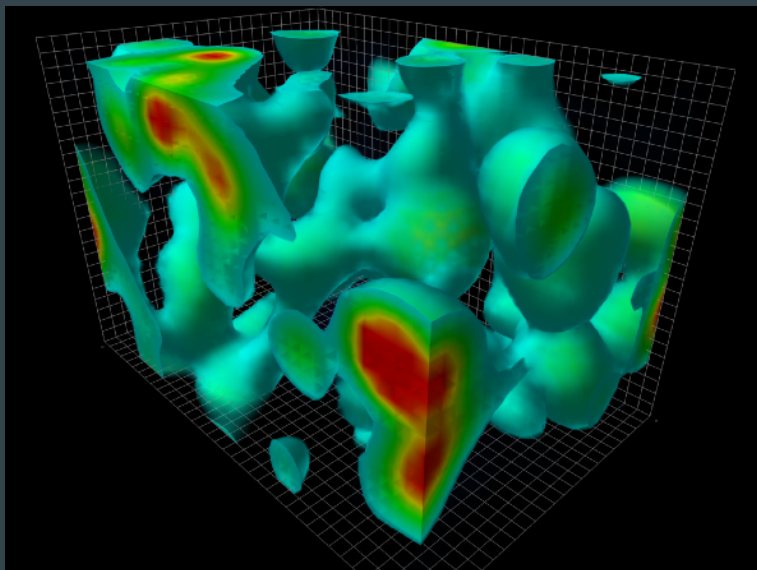
For gravitational waves:



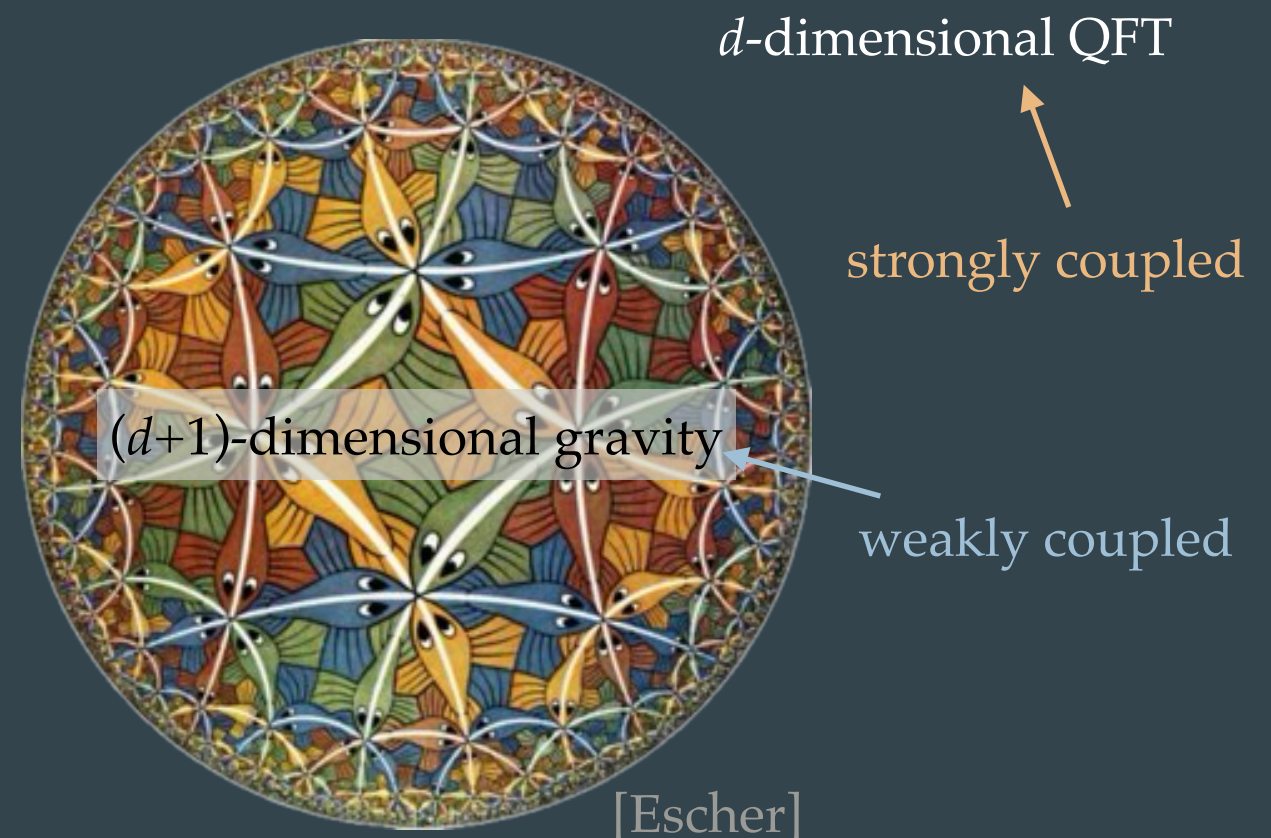
QFT beyond perturbation theory

Integrability

[Leinweber / CSSM Adelaide]



Holography (AdS / CFT)



Konstantin Zarembo



Ronnie Rodgers



Konstantin Zarembo

1. Matrix models and Quantum Field Theory

Explore non-perturbative Quantum Field theory and holographic duality using matrix models that arise from localization of the path integral.

2. Quantum Field Theory, AdS/CFT correspondence and integrable spin chains

Use integrability methods to study AdS/CFT duality and string theory.

3. False vacuum decay

Study false vacuum decay in one-dimensional models, e.g. transverse-field Ising model.



Ronnie Rodgers

1. Holographic entanglement entropy for defects

Developing and applying methods for computing entanglement entropy for quantum field theories with defects, using holography.

Nordita master's project list:



Quantum horizons



Evita Verheijden Watse Sybesma

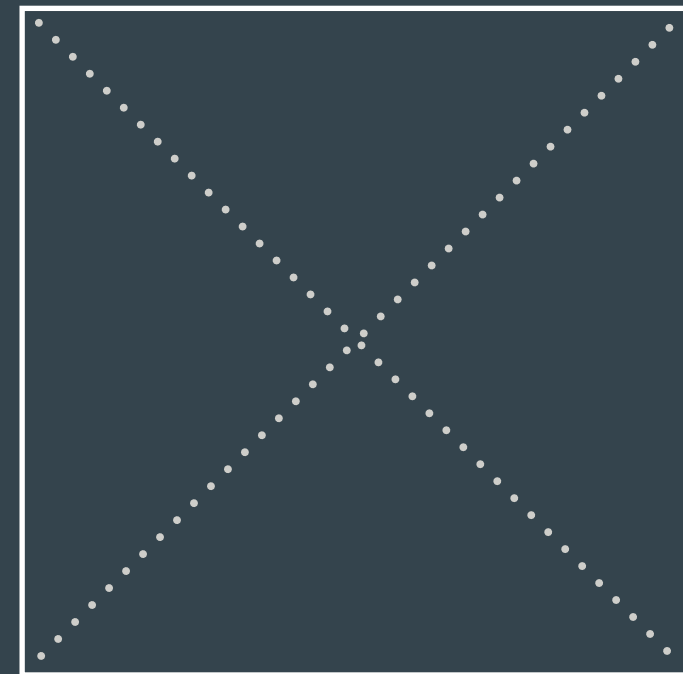
Of black holes:



Quantum information

Hawking radiation

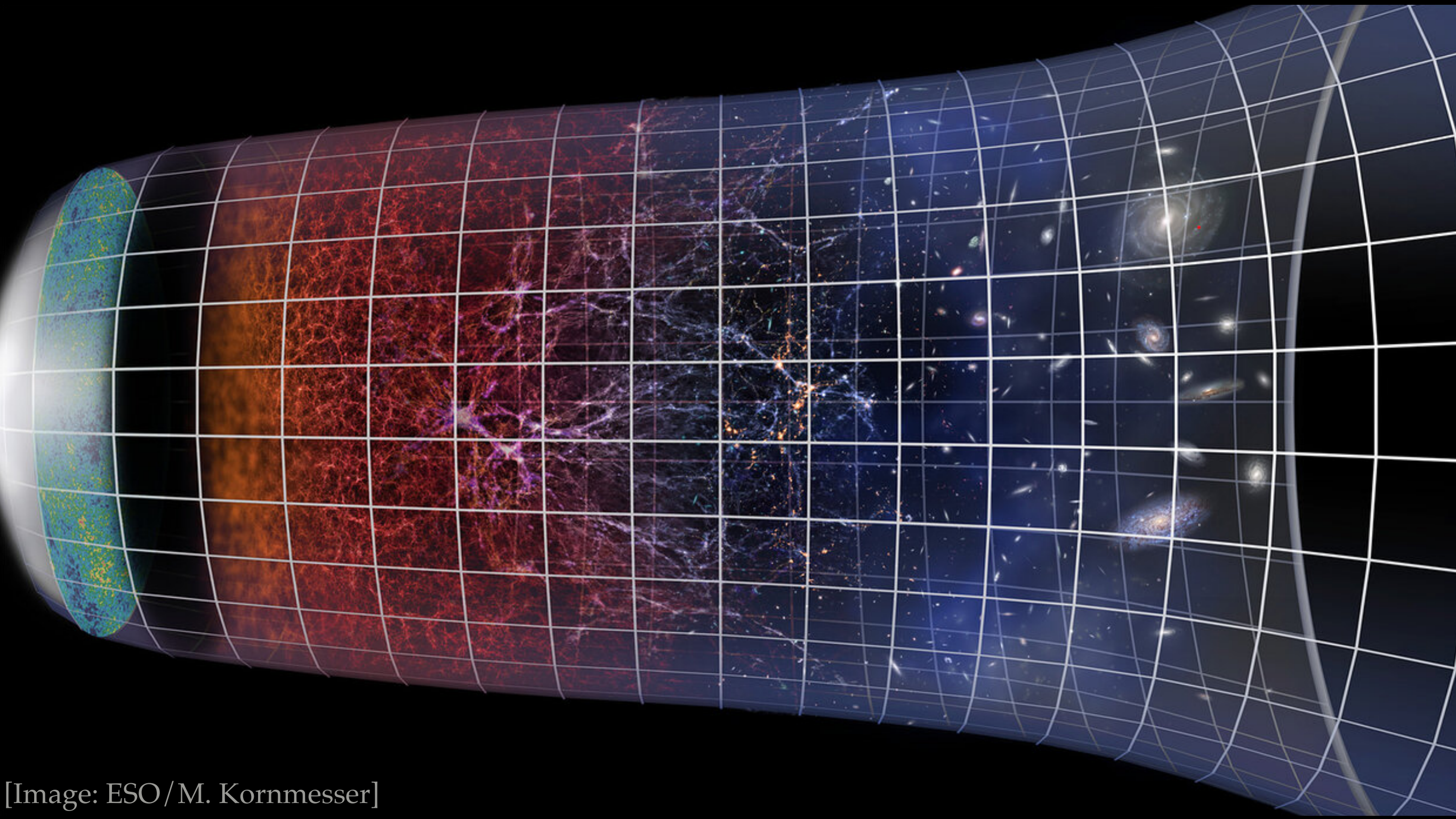
In de Sitter:



Two-dimensional gravity

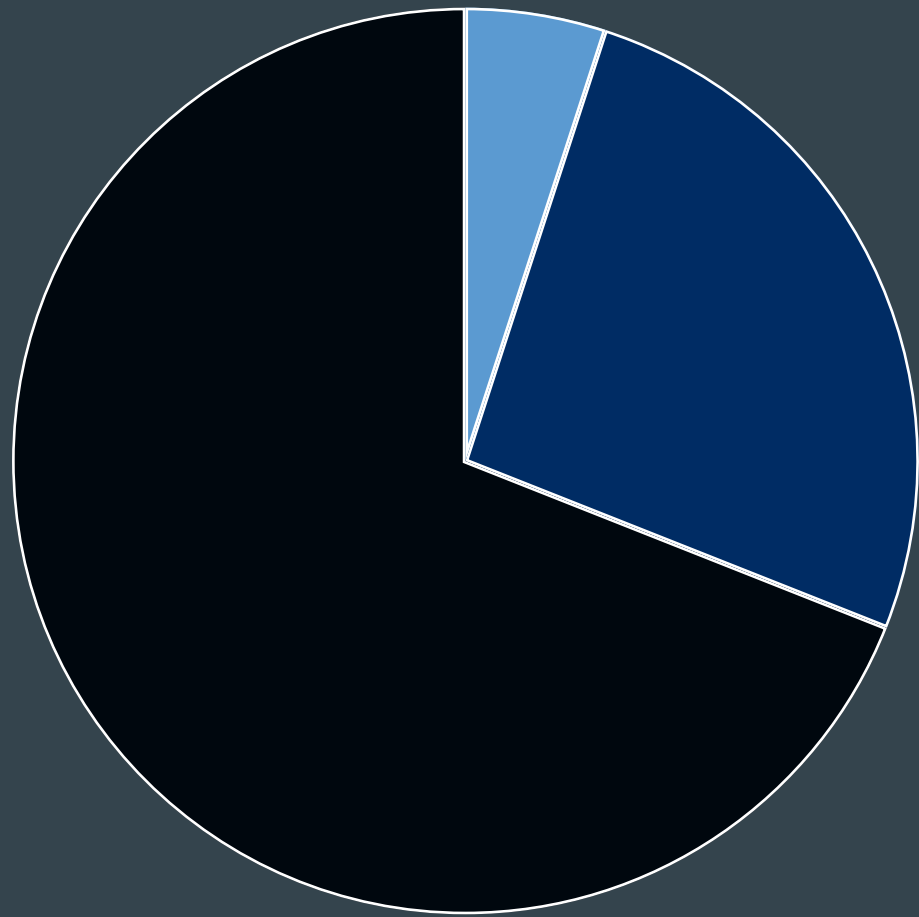
Holography

Cosmology



[Image: ESO/M. Kornmesser]

Dark energy



Cosmological constant?

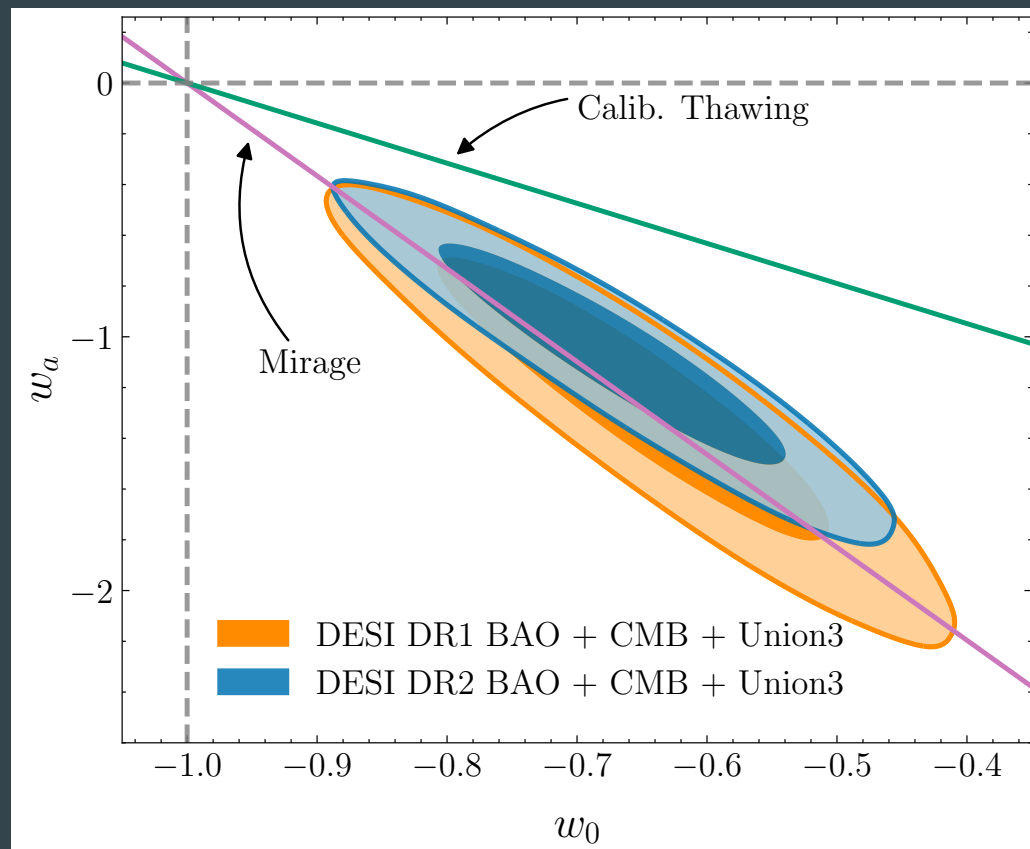
$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R + \Lambda g_{\mu\nu} = 8\pi GT_{\mu\nu}$$

$$\approx 4 \times 10^{-123} \ell_P^{-2}$$

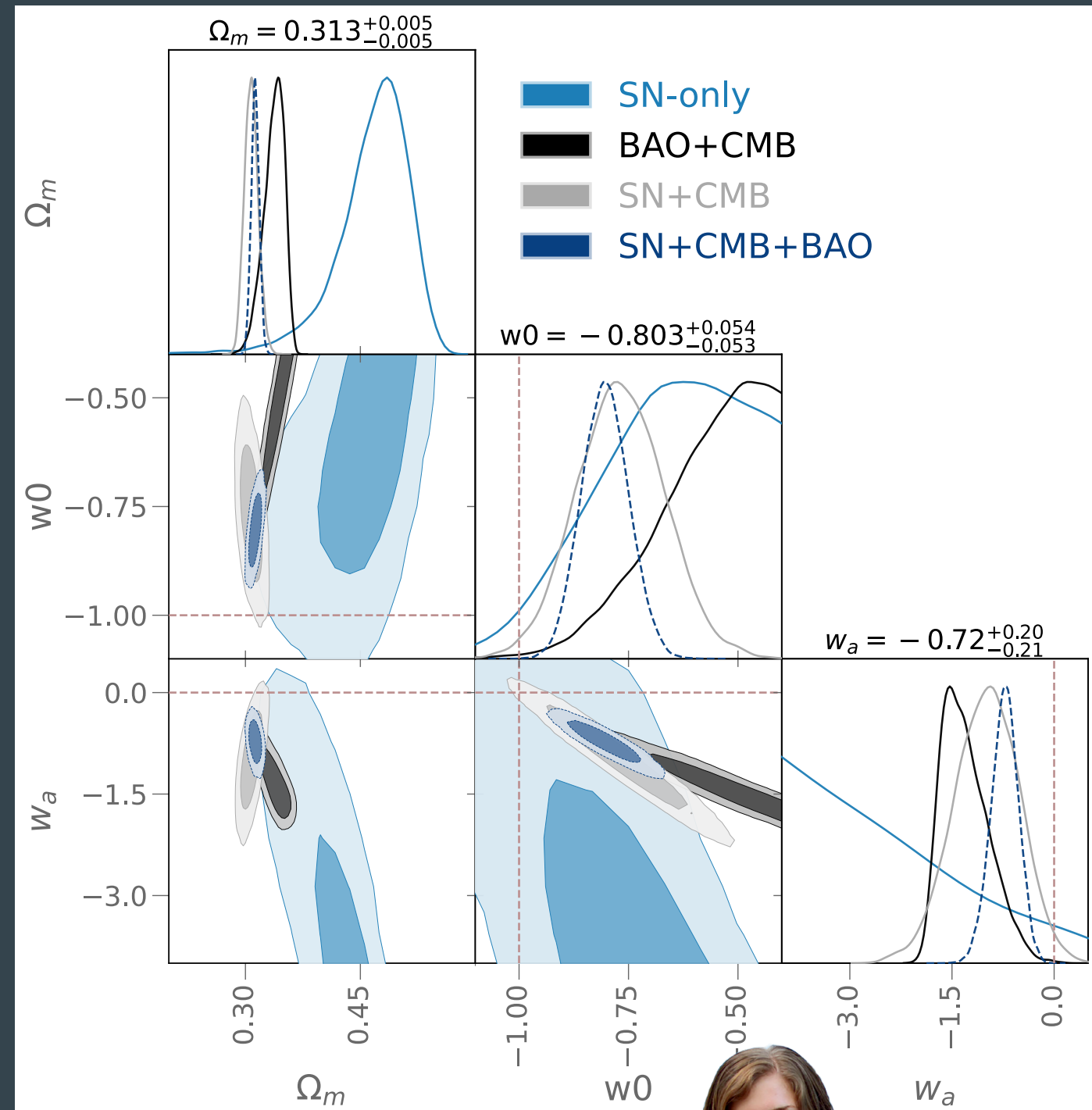
Dark energy

$$p = w\rho$$

$$w = w_0 + w_a(1 - a)$$



Dark Energy Spectroscopic Instrument
[Lodha et al, 2025]

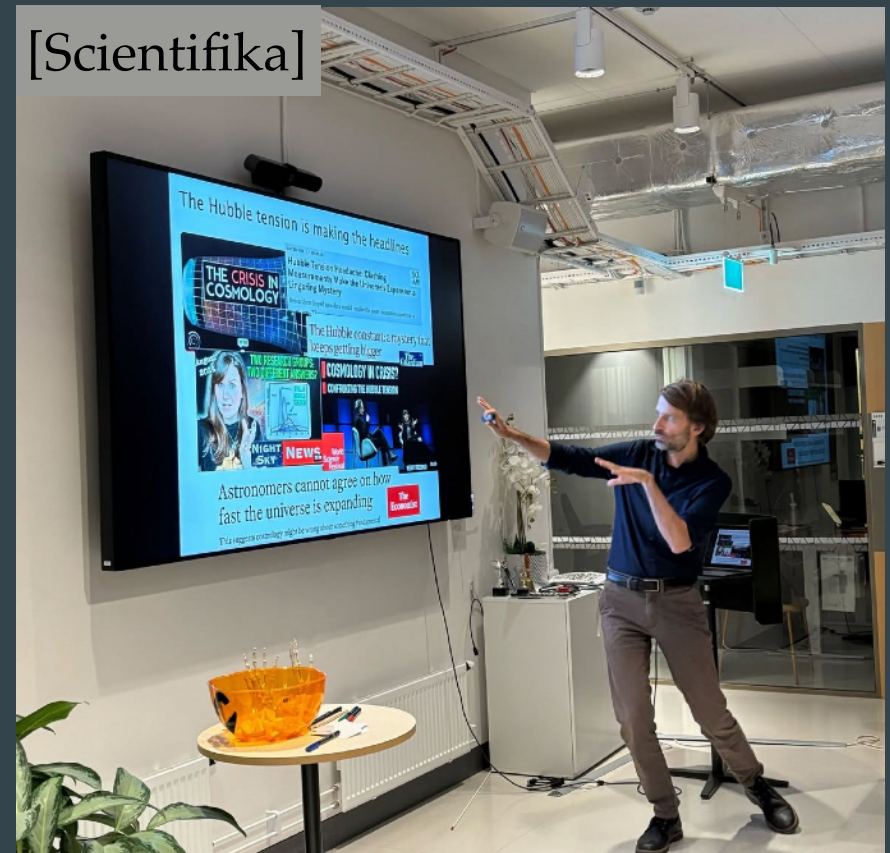
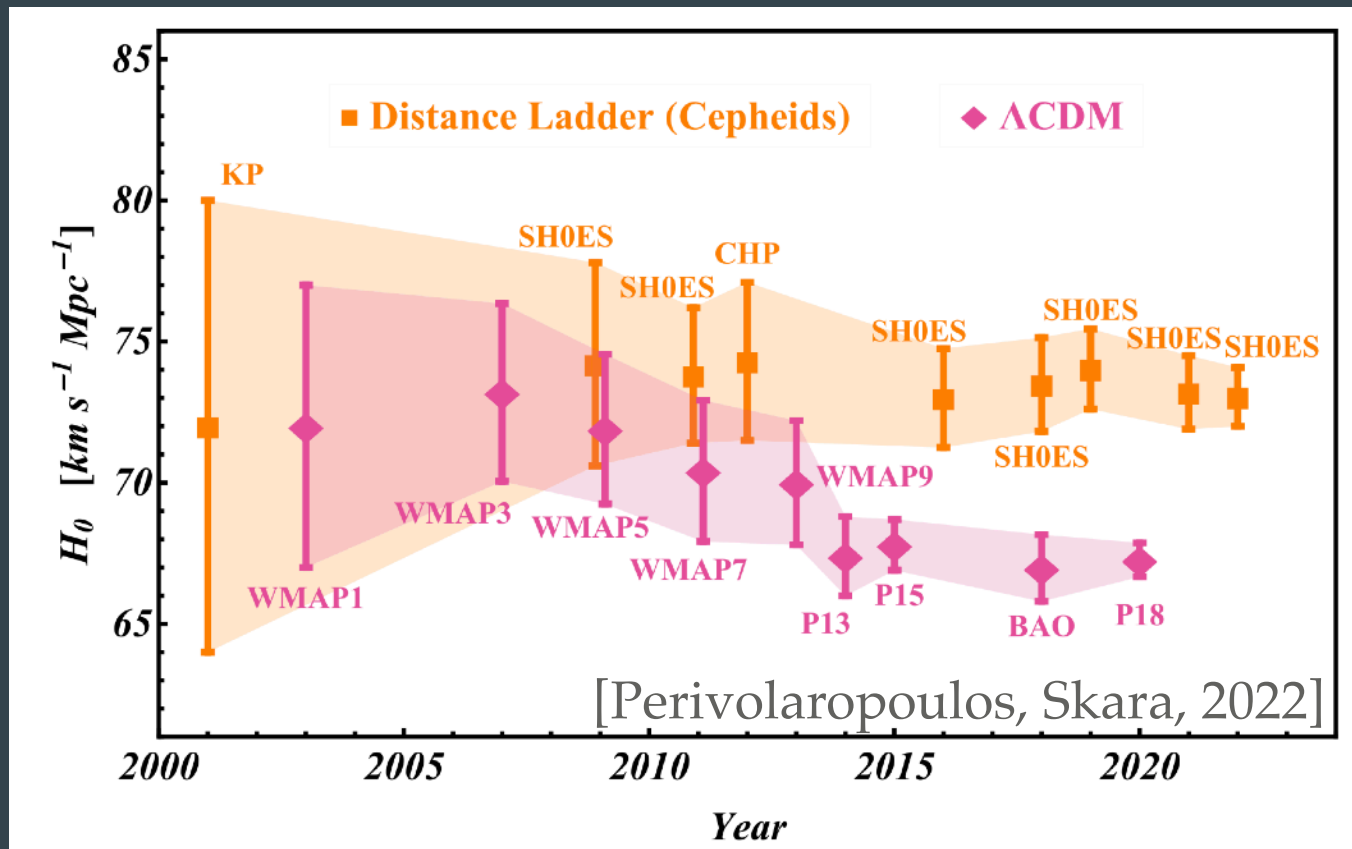


Dark Energy Survey (DES)
[Popovic et al, 2025]



Judit Prat Martí

DE + Hubble tension



Florian
Niedermann

2. Simulating Novel Cosmologies with an Early Dark Energy Component

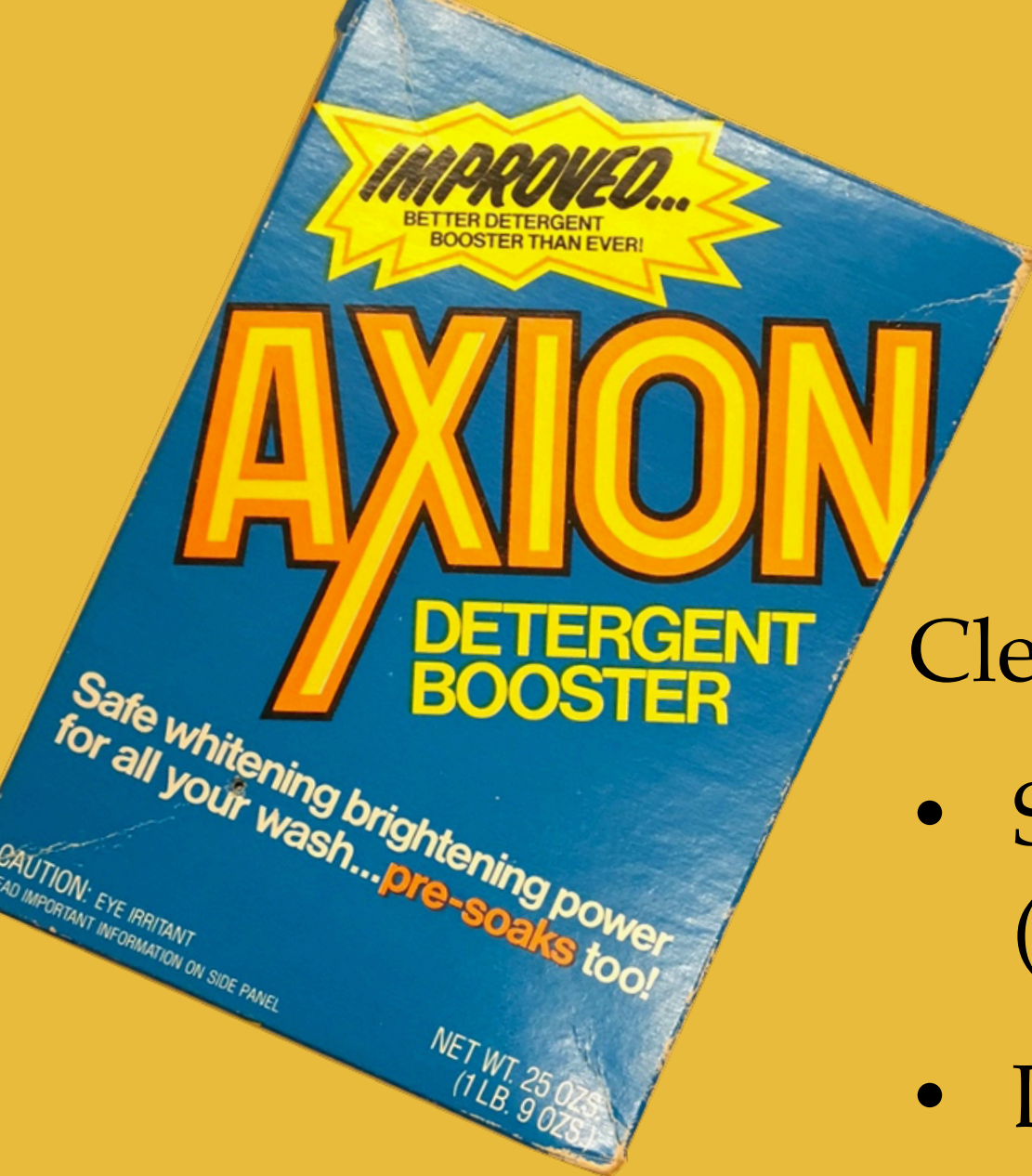
This is a data analysis and coding project focused on testing a cosmological model describing the triggered decay of an early dark energy component. The first part of the project involves testing and improving a new implementation of the code TriggerCLASS. In the second part, the model will be tested against the latest CMB and LSS datasets. Depending on progress, the third part could explore devising and testing new scenarios.

3. Dynamical Relaxation of the Cosmological Constant

Recently, in [arXiv:2204.1312](#), the idea was put forward that the value of the cosmological constant can be dynamically relaxed through numerous membrane nucleation events. This theory project aims to explore in detail how this proposal overcomes the challenges faced by previous mechanisms, such as Abbott's construction in [InspireHEP:15763](#).



Frank Wilczek



Cleans up problems:

- Strong CP problem (Peccei-Quinn mechanism)
- Dark matter
- Inflation

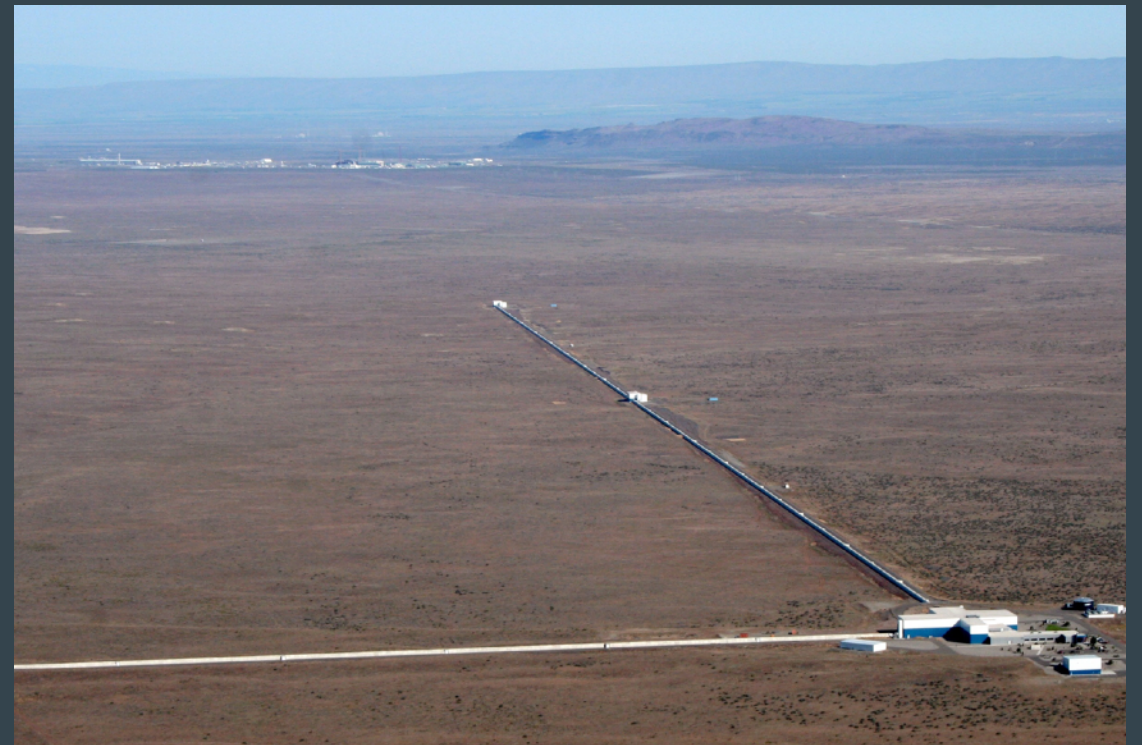
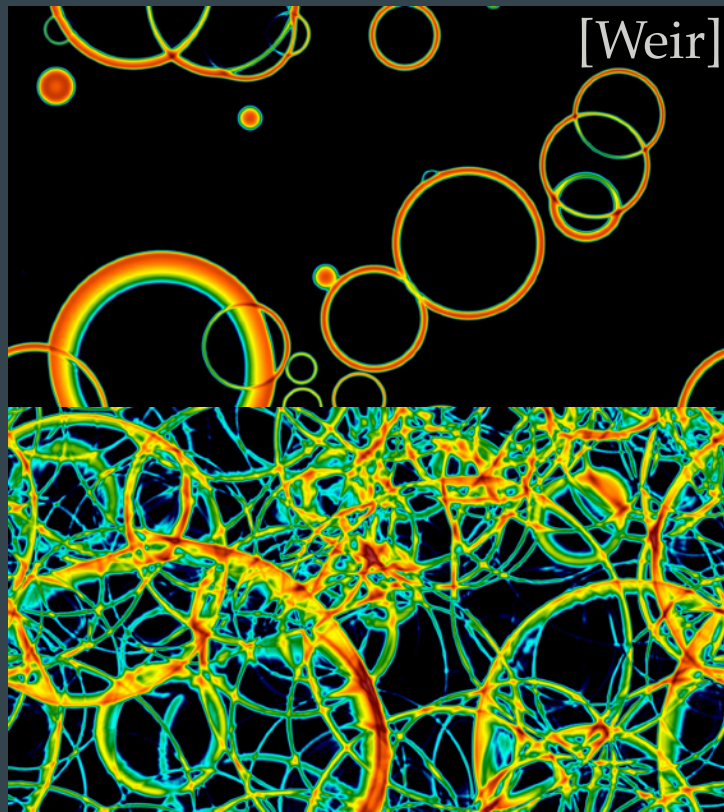


Oksana Iarygina

1. Axion Inflation

This Master's project explores axion inflation, focusing on the amplification of gauge fields during inflation caused by interaction with an axion and the resulting production of gravitational waves.

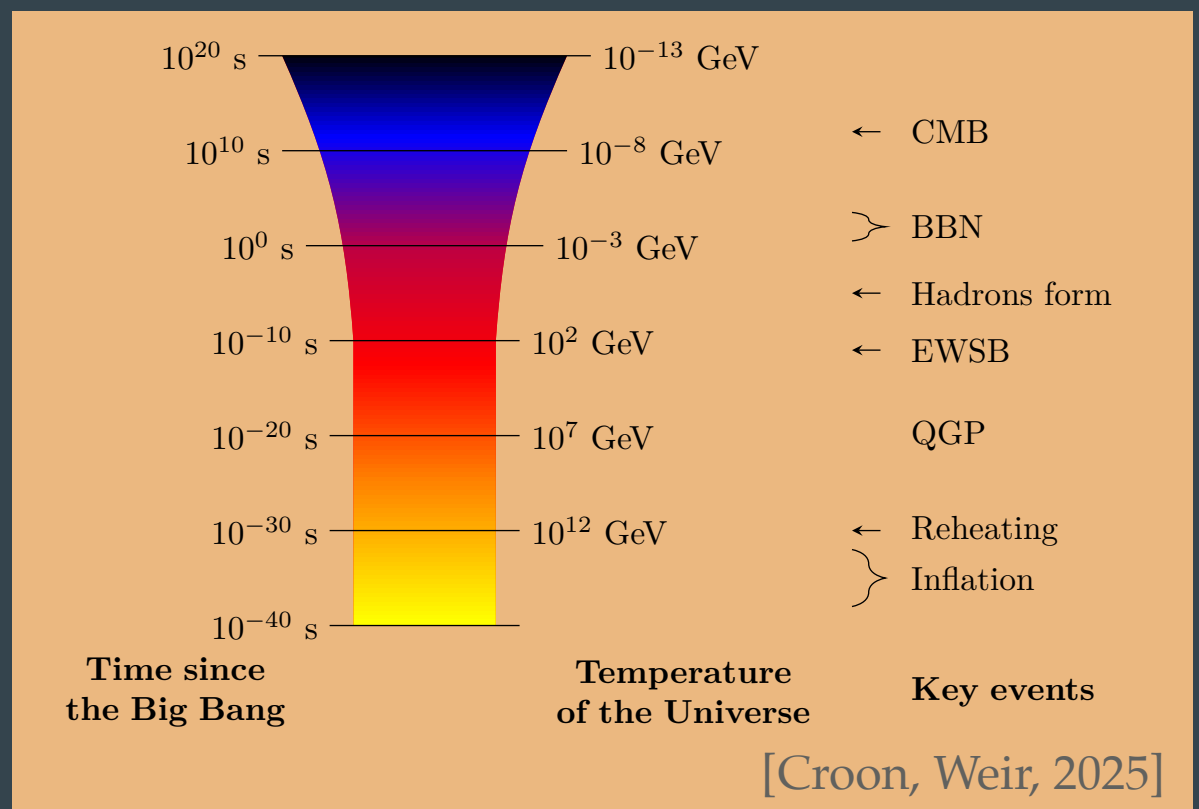
Phase transitions in the early universe



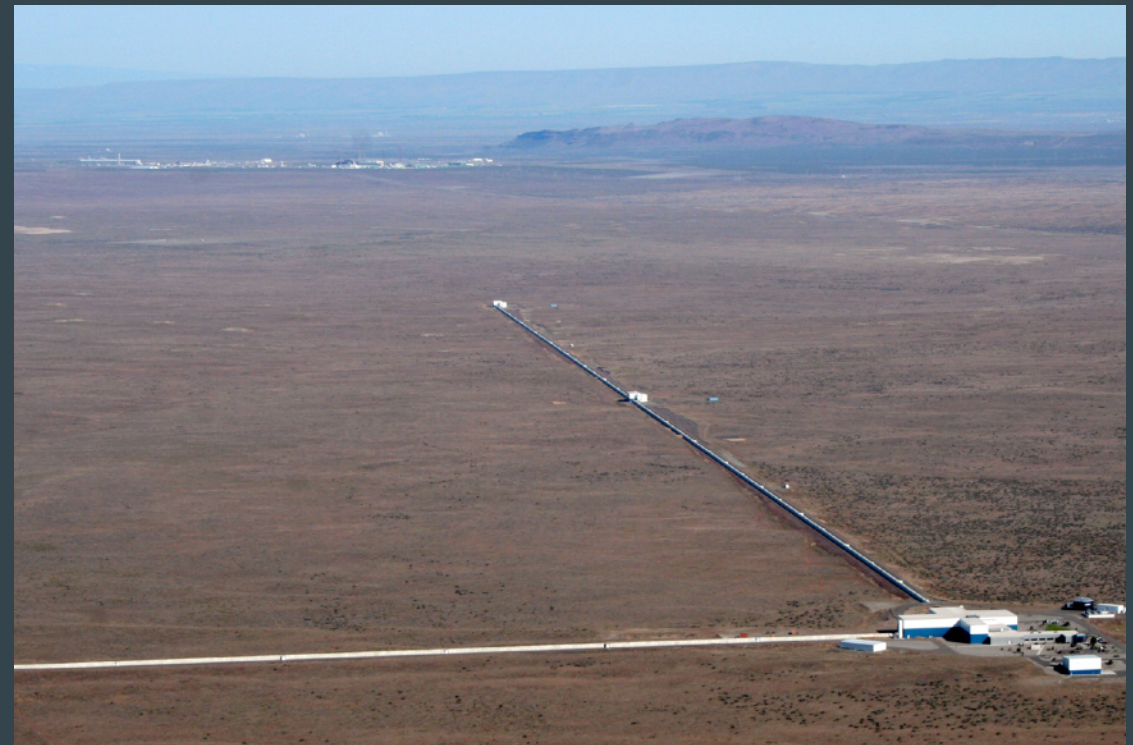
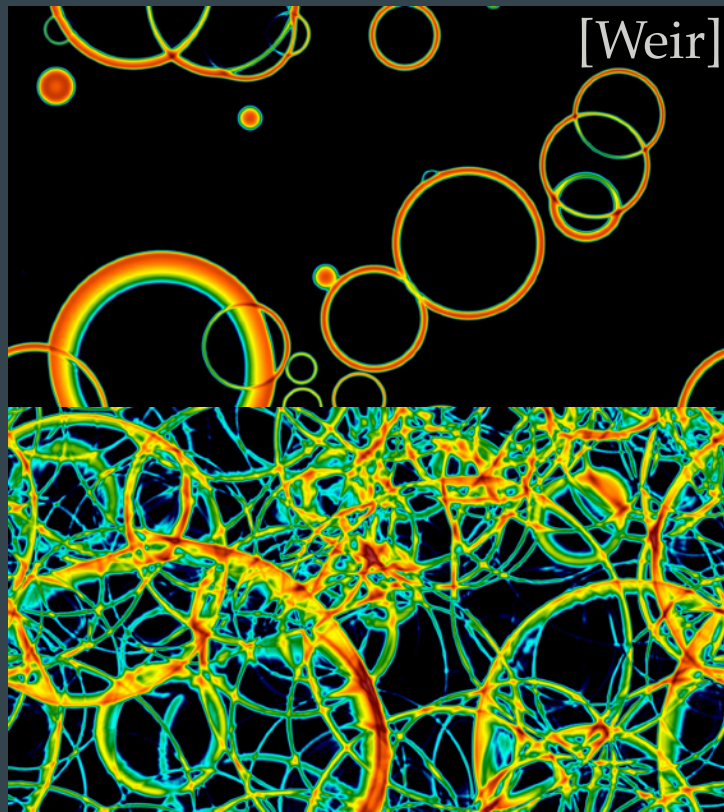
Florian
Niedermann



Aleksandr
Chatrchyan



Phase transitions in the early universe



Florian
Niedermann

1. Probing scalar and tensor modes from a first-order phase transition with the cosmic microwave background

In this project, we will investigate the conditions under which scalar and tensor perturbations produced during a first-order phase transition in the dark sector can be probed through the cosmic microwave background and large-scale structure. Depending on the student's interests, the project can be extended in either a more theoretical or phenomenological direction.

How to find out more

- Contact details on Nordita people page
- Research papers: search “inspire <name>”
- Attend events:
 - Scientifika
 - Seminars / group meetings



A screenshot of the INSPIRE HEP website. The top navigation bar includes 'authors', 'Literature', 'Authors', 'Jobs', 'Seminars', 'Conferences', 'Data', 'BETA', and 'More...'. The main content area displays the profile of Konstantin Zarembo (Nordita and Moscow, ITEP). It includes his author identifier (K.Zarembo.1), INSPIRE ID (INSPIRE-00346227), and advisor (Andrei A. Slavnov). A timeline shows his positions: 2010-present as SENIOR at Nordita, 1996-present as JUNIOR at Moscow, ITEP, and 2008-2010 as SENIOR at Ecole Normale Supérieure. Below the profile, there are tabs for 'Literature (138)', 'Cited By', and 'Seminars'. A 'Date of paper' histogram shows a distribution from 1992 to 2025. On the left, filters for 'Number of authors' (Single author: 89, 10 authors or less: 137) and 'Exclude RPP' (Exclude Review of Particle Physics: 138) are shown. The 'Document Type' section lists article (121), published (118), conference paper (16), and review (8). The right side shows a list of 138 results, with the first four papers displayed: 'String integrability on the Coulomb branch', 'Coulomb branch and integrability', 't Hooft loops in N=4 super-Yang-Mills', and 'Kosterlitz-Thouless transition in two-dimensional superfluid'.