Nonequilibrium scalar fields in the early universe

Aleksandr Chatrchyan

Email: aleksandr.chatrchyan@desy.de

CLUSTER OF EXCELLENCE
QUANTUM UNIVERSE

About Me

Background, past activities

2014: Bachelor’s in physics, Yerevan State University, Armenia.

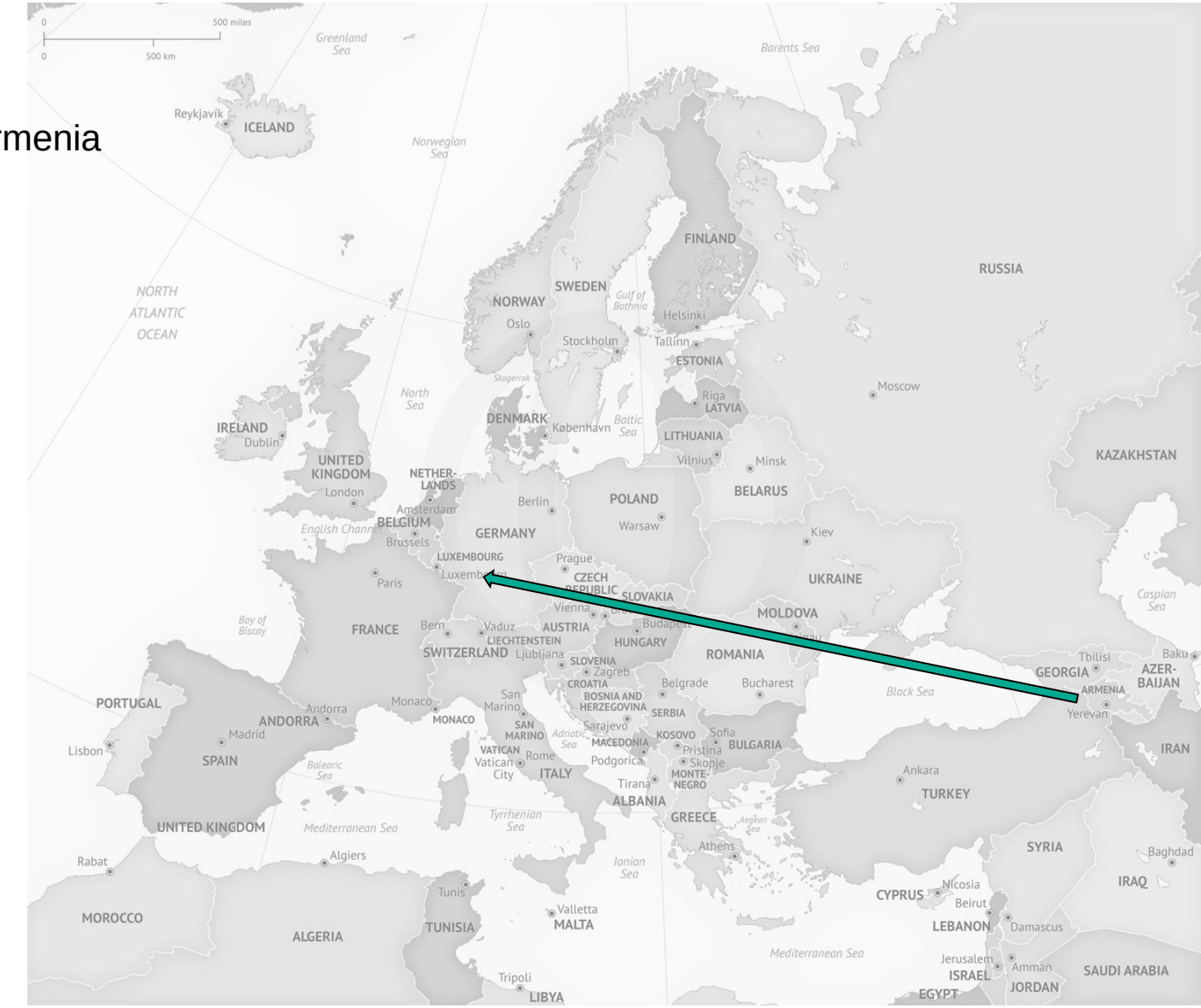
About Me

Background, past activities

2014: Bachelor’s in physics, Yerevan State University, Armenia

2020: Ph.D. in Heidelberg University

- Thesis: link, supervisors: J. Berges, J. Jaeckel



About Me

Background, past activities

2014: Bachelor's in physics, Yerevan State University, Armenia

2020: Ph.D. in Heidelberg University

- Thesis: link, supervisors: J. Berges, J. Jaeckel

Main area of research: **nonequilibrium quantum field theory**

- Description in real-time
- Matrix elements for $|\mathrm{in}\rangle$ and $|\mathrm{out}\rangle$ states not so useful
- Applications: Heavy-ion collisions, ultracold atom, early universe physics

Approximate descriptions

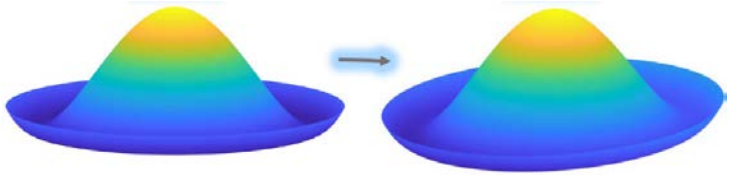
- Semiclassical (lattice) simulations, kinetic description, 2PI effective action framework, etc.

My Research

Activities and challenges

Why scalars?

- Higgs, QCD axion, string theory compactifications.



Significance for cosmology

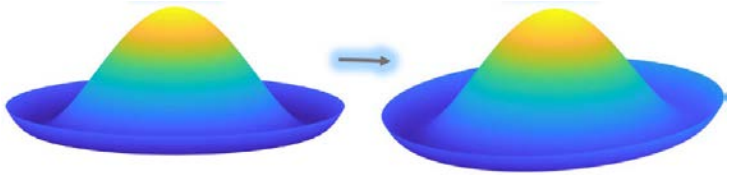
- Inflation & reheating, nonthermal scalar dark matter

My Research

Activities and challenges

Why scalars?

- Higgs, QCD axion, string theory compactifications.



Significance for cosmology

- Inflation & reheating, nonthermal scalar dark matter

Can have very rich dynamics

- Large occupation numbers: coherent field behavior (BEC)

- Axion-like particle dark matter *1903.03116* , *2004.07844*

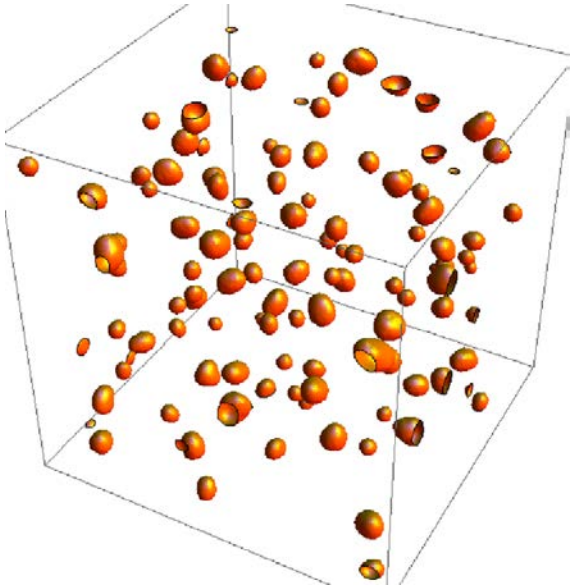
- Attractors and universal dynamics *1707.07696* , *2008.02290*

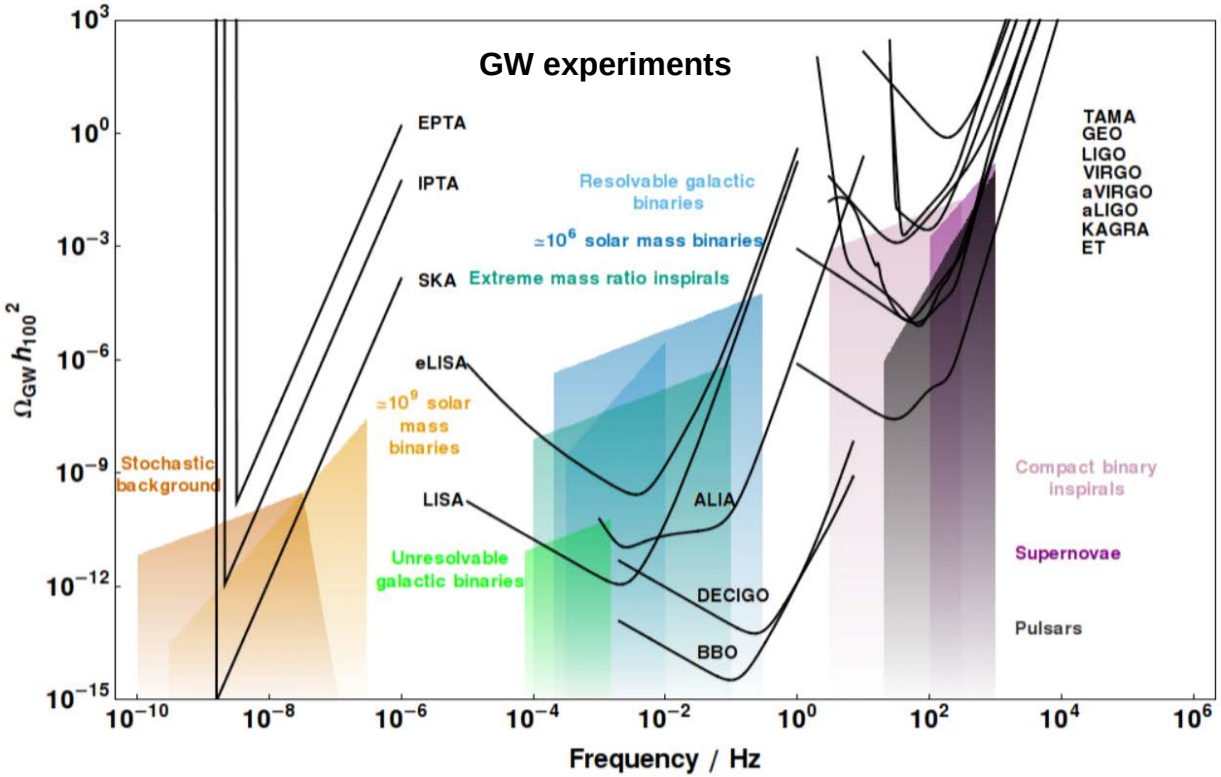
My Research

Activities and challenges

- Gravitational waves signatures of scalar field dynamics in the early universe

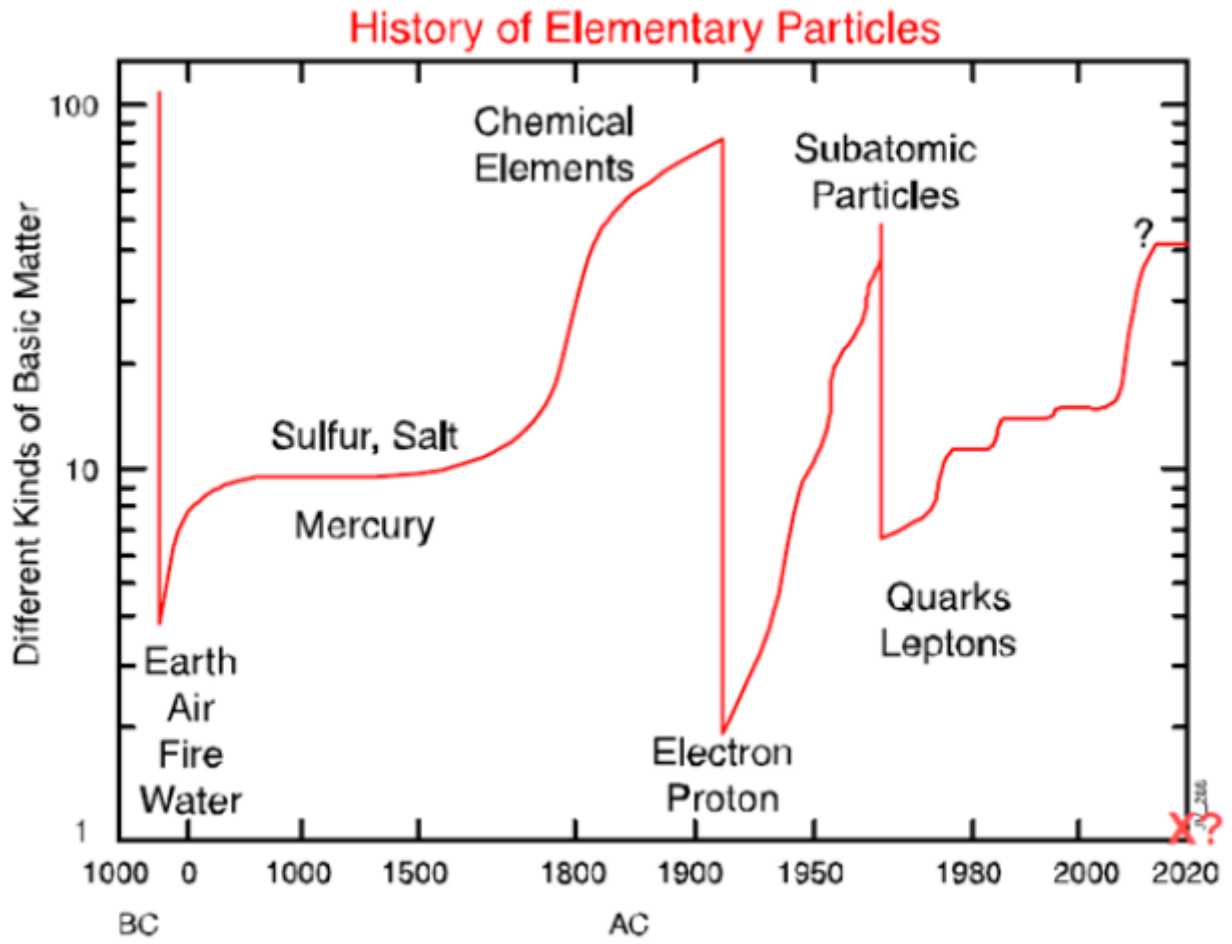
- The role of oscillons (scalar field clumps), power spectrum and implications for structure formation





My Favorite Plot

Or the one question you always wanted to ask!



Taken from *1311.1769*

Thanks for your attention!