



# YEAR-END VILLUM SYMPOSIUM

19th December 2024  
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## Scientific Outreach Program with CERN

- What do we do at NBI? - discussion afterwards
- Teachers' programme at CERN
- Students and school classes at CERN
- Private visits
- Students at CERN as part of their/our research
- Hidden treasures

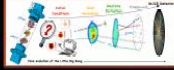


# ALICE

A LARGE ION COLLIDER EXPERIMENT

## A DROPLET OF THE EARLY UNIVERSE

What did the universe look like in the first microseconds after the Big Bang and how did it evolve from that first explosive event to the existence that we find ourselves living in today?



All matter in the early universe began in a state called the Quark-Gluon Plasma: a hot, dense soup of fundamental particles which can only exist at extreme temperatures and energy densities.

By colliding ions that have been accelerated to almost the speed of light, the extreme conditions of the early universe can be recreated on a very small scale, allowing for the production of droplets of the QGP. ALICE is designed to detect and analyze the products of these collisions in order to learn more about this exotic state of matter.

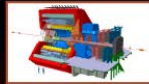
# Outreach at NBI

- School classes and individual projects
- Culture night
- Events for bachelor and masters projects
- Master classes
- Social media
- ....

I'll leave for discussion afterwards if I have missed something or we should do more (or less).

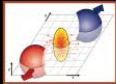
## THE ALICE DETECTOR

## FURTHER DISCOVERIES



**HEIGHT:**  
16 m  
**LENGTH:**  
26 m  
**WEIGHT:**  
10 000 tonnes

Study of the QGP has revealed that it behaves like a fluid - in fact, it is the most "perfect" fluid that has been discovered, with very low viscosity.



Though much has been learned about the QGP since its discovery, there is still much more to research. What forces do particles within the QGP experience? Could a droplet of the QGP also form in collisions of smaller particles? What state do accelerated particles exist in directly before they collide?

These are just a few of the questions being investigated at ALICE, with implications in the fields of particle, nuclear and astro physics.

Particles produced in the collisions pass through several layers of subdetectors. At each layer, information is stored about the particles - their reaction to the magnetic field, the amount of energy that they lose as they progress through the detector, and more.



# ALICE

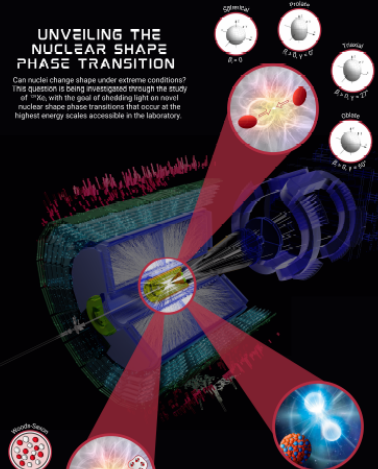
A LARGE ION COLLIDER EXPERIMENT

## IMAGINING NUCLEAR STRUCTURE VIA ULTRA-RELATIVISTIC COLLISIONS

Atomic nuclei are self-organized quantum systems bound by strong forces within femtometre-scale spaces. Traditional low-energy techniques struggle to capture their instantaneous shape due to quantum fluctuations. High-energy nuclear collisions offer a revolutionary alternative: imaging nuclear structure by analyzing debris patterns from ultrarelativistic collisions. This method provides detailed snapshots of nuclear shapes, bridging low- and high-energy observations to enhance our understanding of nuclear structure and its evolution across energy scales.

### UNVEILING THE NUCLEAR SHAPE PHASE TRANSITION

Can nuclei change shape under extreme conditions? This question is being investigated through the study of  $^{76}\text{Ge}$ , with the goal of shedding light on novel nuclear shape phase transitions that occur at the highest energy scales accessible in the laboratory.



### PRECISE DETERMINATION OF NEUTRON SKIN THICKNESS

In addition to the measurement of nuclear shape, these advanced techniques can be used to extract neutron skin properties of  $^{208}\text{Pb}$  and  $^{206}\text{Pb}$ , which will constrain the Nuclear Equation of State (EoS). This will help to enhance our understanding of the critical size and mass limits of neutron stars, linking microscopic nuclear physics to astrophysical phenomena.

### EXPLORING THE UNIQUE STRUCTURES OF LIGHT IONS

Lighter nuclei, such as  $^{12}\text{C}$ ,  $^{16}\text{O}$  and  $^{20}\text{Ne}$ , are expected to have a unique clustering structure. Examining this will help in the understanding of the nuclear force that shapes this structure, with potential implications for CO<sub>2</sub> formation processes and applications in addressing global climate challenges.





# Teachers programme at CERN

Group of 20-25 teachers at CERN for a week





# Students and school classes at CERN





## Private visits at CERN



## CERN open days





# Students at CERN as part of their/our research





# Some things are very hard to show

