https://aleksas.eu/

Aleksas Mazeliauskas About me Research projects Code Publications Talks Blog Contact CV

Aleksas Mazeliauskas

Theoretical Physicist

Theoretical Physics Department, CERN

CV

About me

I am a theoretical physicist working on **many-body phenomena** emerging from fundamental interactions of elementary particles.

In my research I connect models of **nuclear**, **hadronic** and **particle physics** with methods of relativistic hydrodynamics, statistical physics and out-of-equilibrium dynamics to study the **hot and dense nuclear matter** created in high-energy hadron collisions. My work has contributed to a better understanding of fundamental states of matter, thermalisation of isolated quantum systems, and how a fluid-like behaviour emerges from a relatively small number of constituents interacting via the strong force.

I work at Theoretical Physics department at **CERN**, Switzerland. Previously I was a postdoctoral researcher at **Heidelberg University**, Germany. I had a joint postdoctoral research position in the groups of Prof. Dr. Jürgen Berges and Priv.-Doz. Dr. Stefan Flörchinger at the Institute for Theoretical Physics under the collaborative research project SFB 1225 ISOQUANT. Before that I was a PhD student at Nuclear Theory Group at **Stony Brook University**, US (PhD advisor Prof. Dr. Derek Teaney).

Education

- PhD in Physics, 2012 - 2017
  Stony Brook University, Department of Physics and Astronomy, United States
- Master of Mathematics, 2011 - 2012
  Cambridge University, St. Catharine's college, United Kingdom
- BA Mathematics, 2008 - 2011
  Cambridge University, St. Catharine's college, United Kingdom

Mano kelias nuo Lietuvos iki CERN

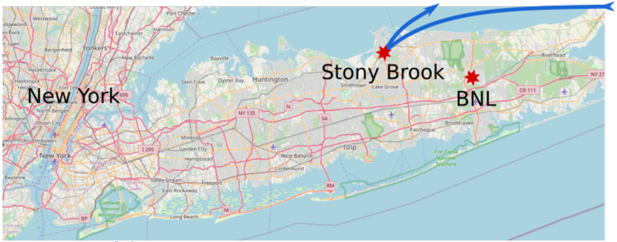
2007–2008 — Vilniaus universitetas

2008–2012 BA+MMath — UNIVERSITY OF CAMBRIDGE

2012–2017 PhD — Stony Brook University

2017–2019 postdoc — UNIVERSITÄT HEIDELBERG ZUKUNFT SEIT 1386

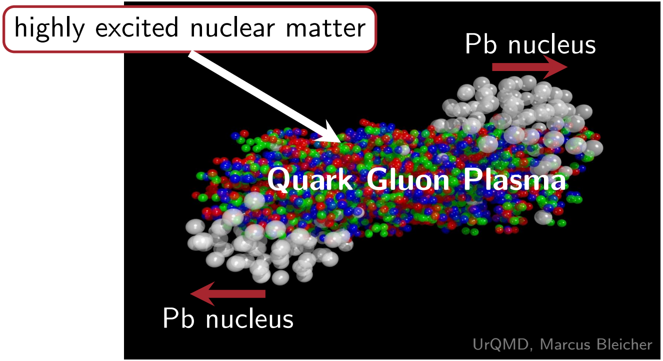
2019– fellow — CERN



Condensed QCD matter physics (heavy-ion physics)

Physics of hot and dense QCD matter

In 1974, T.D. Lee suggested studying new phenomena *"by distributing high energy or high nucleon density over a relatively large volume."*



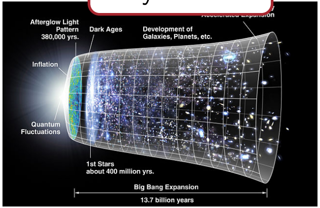
$T \sim 10^{12}$ K

$\sim 10^{-14}$ m

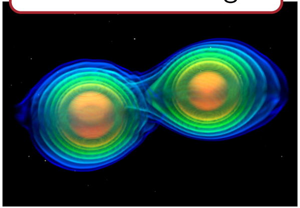
- How does the hot and dense nuclear matter equilibrate?
  My work: QCD kinetic theory, universalities out-of-equilibrium.
- What are the properties of Quark Gluon Plasma?
  My work: stochastic and viscous fluid dynamics, parton energy loss.

Quark Gluon Plasma in Nature

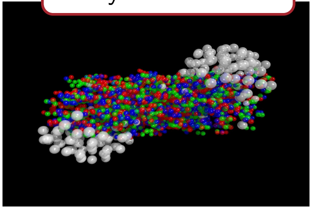
early universe



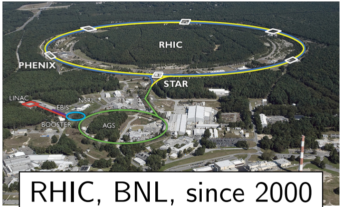
neutron star mergers



heavy-ion collisions



Relativistic Heavy Ion Collider (RHIC) and Large Hadron Collider (LHC)

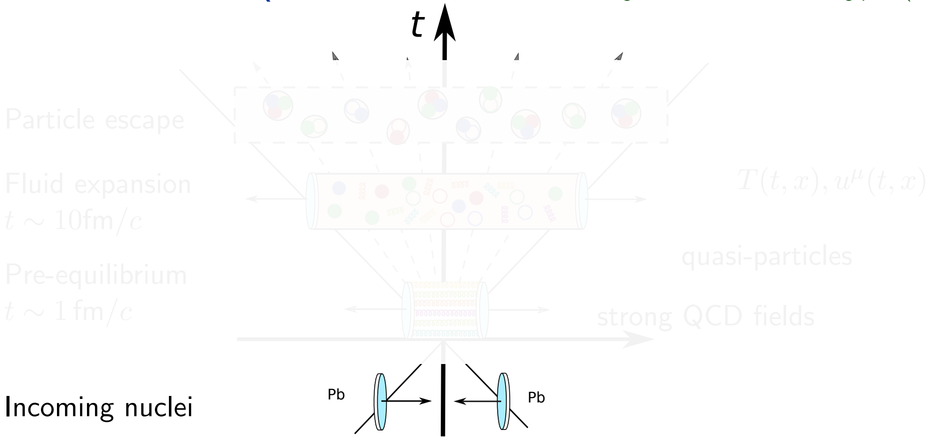


RHIC, BNL, since 2000

LHC, CERN, since 2010

Fast thermalization in QCD

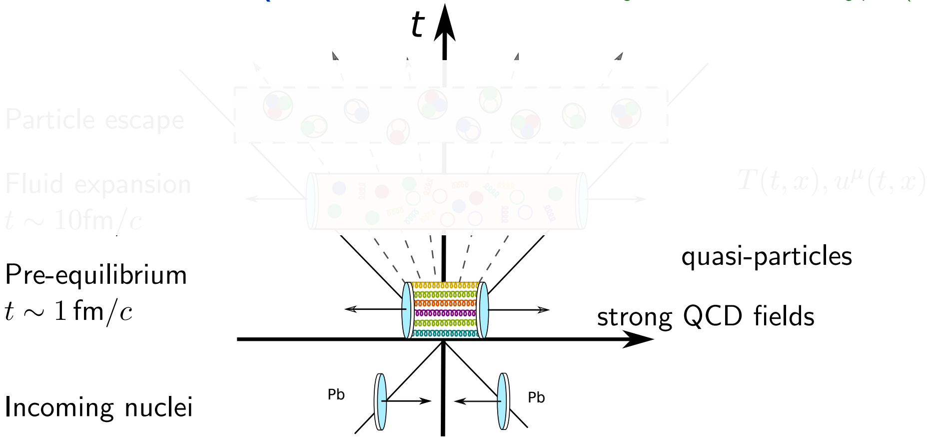
Berges, Heller, Mazeliauskas, Venugopalan (2020) [1]



- During less than 10^{-22} s QCD forms a drop of nearly perfect fluid.
- Final $\lesssim 10^4$ particles share the memory of collective behaviour (flow).
- High energy partons are stopped by the dense medium (jet quenching).

Fast thermalization in QCD

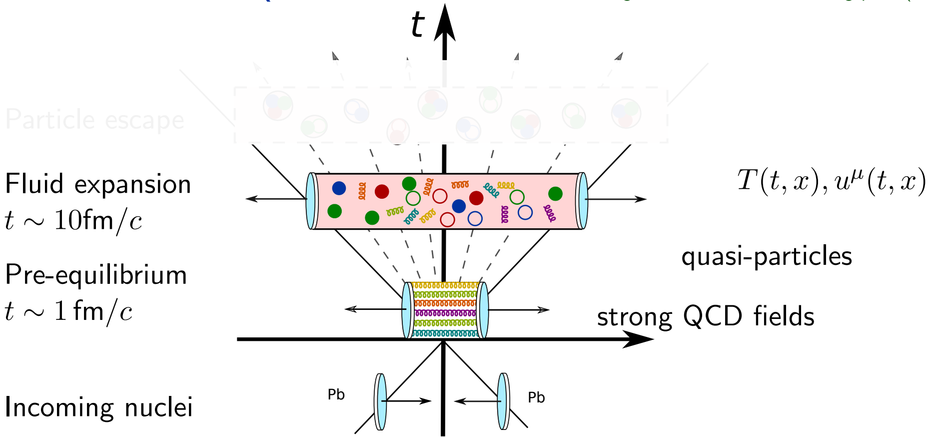
Berges, Heller, Mazeliauskas, Venugopalan (2020) [1]



- During less than 10^{-22} s QCD forms a drop of nearly perfect fluid.
- Final $\lesssim 10^4$ particles share the memory of collective behaviour (flow).
- High energy partons are stopped by the dense medium (jet quenching).

Fast thermalization in QCD

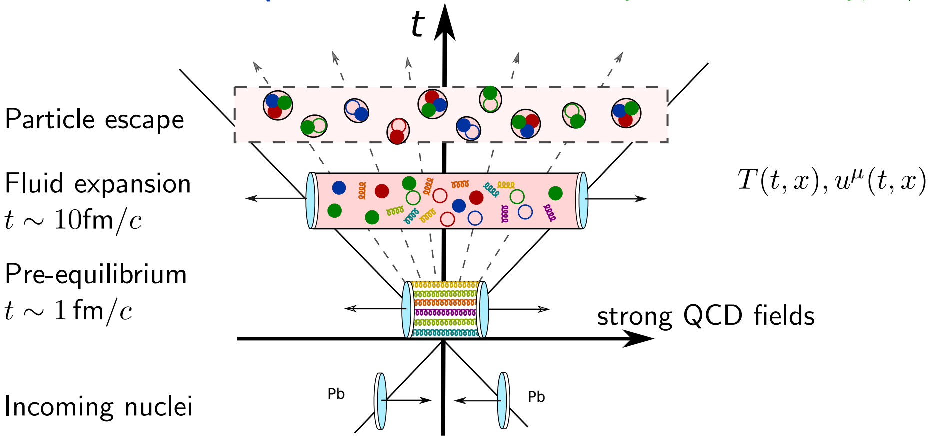
Berges, Heller, Mazeliauskas, Venugopalan (2020) [1]



- During less than 10^{-22} s QCD forms a drop of nearly perfect fluid.
- Final $\lesssim 10^4$ particles share the memory of collective behaviour (flow).
- High energy partons are stopped by the dense medium (jet quenching).

Fast thermalization in QCD

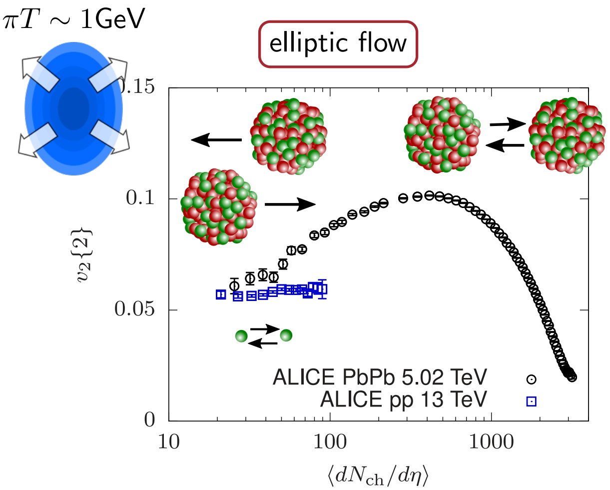
Berges, Heller, Mazeliauskas, Venugopalan (2020) [1]

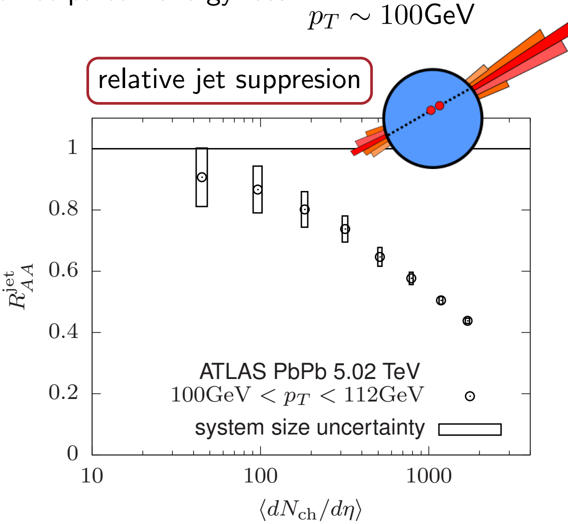


- During less than 10^{-22} s QCD forms a drop of nearly perfect fluid.
- Final $\lesssim 10^4$ particles share the memory of collective behaviour (flow).
- High energy partons are stopped by the dense medium (jet quenching).

What is the limit of collective phenomena in a few particle system?

Collective flow seen in all hadron collisions, but not parton energy loss.



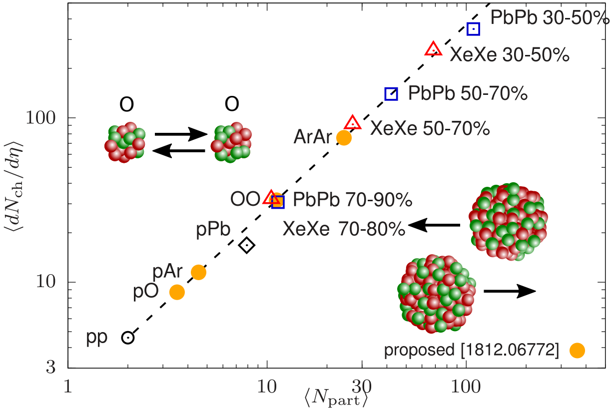


The outstanding question: is there high-p_T energy loss in small systems?

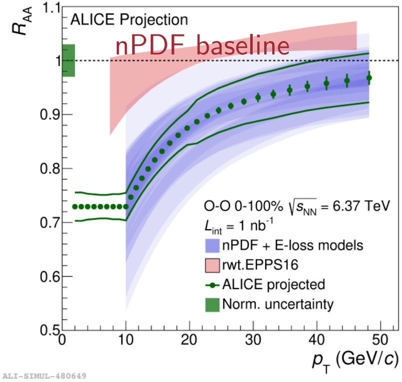
Opportunities of OO and pO collisions at LHC

OO collisions is a unique system to measure small energy loss signal.

particle multiplicity in different systems



hadron suppression in OO



Vislavicius (ALICE) [2]

Precise pQCD calculations for no-energy-loss basline opens a discovery potential!

Huss, Kurkela, Mazeliauskas, Paatelainen, van der Schee, Wiedemann (2020) [3, 4]

PHYSICAL REVIEW C **101**, 014910 (2020)

Temperature and fluid velocity on the freeze-out surface from π, K, and p spectra in pp, p-Pb, and Pb-Pb collisions

Aleksas Mazeliauskas [*]
Theoretical Physics Department, CERN, CH-1211 Genève 23, Switzerland
and Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, D-69120 Heidelberg, Germany

Vytautas Vislavicius [†]
Niels Bohr Institutet, Københavns Universitet, Blegdamsvej 17, DK-2100 Copenhagen, Denmark

(Received 12 September 2019; published 17 January 2020)

We present a new approach to take into account resonance decays in the blast-wave model fits of identified hadron spectra. Thanks to precalculated decayed particle spectra, we are able to extract, in a matter of seconds, the multiplicity dependence of the single freeze-out temperature T_{fo}, average fluid velocity $\langle\beta_{\text{T}}\rangle$, velocity exponent n, and the volume dV/dy of an expanding fireball. In contrast to blast-wave fits without resonance feed-down, our approach results in a freeze-out temperature of $T_{\text{fo}} \approx 150$ MeV, which has only weak dependence on multiplicity and collision system. Finally, we discuss separate chemical and kinetic freeze-outs separated by partial chemical equilibrium.

DOI: 10.1103/PhysRevC.101.014910

Bibliography I

[1] Jürgen Berges, Michal P. Heller, Aleksas Mazeliauskas, and Raju Venugopalan. Thermalization in QCD: theoretical approaches, phenomenological applications, and interdisciplinary connections. 5 2020, 2005.12299.

[2] Vytautas Vislavicius. ALICE goals and projections for hard probes measurements. Feb 2021.

[3] Alexander Huss, Aleksi Kurkela, Aleksas Mazeliauskas, Risto Paatelainen, Wilke van der Schee, and Urs Achim Wiedemann. Discovering partonic rescattering in light nucleus collisions. 2020, 2007.13754.

[4] Alexander Huss, Aleksi Kurkela, Aleksas Mazeliauskas, Risto Paatelainen, Wilke van der Schee, and Urs Achim Wiedemann. Predicting parton energy loss in small collision systems. 7 2020, 2007.13758.