

Heavy-ion collisions main goal

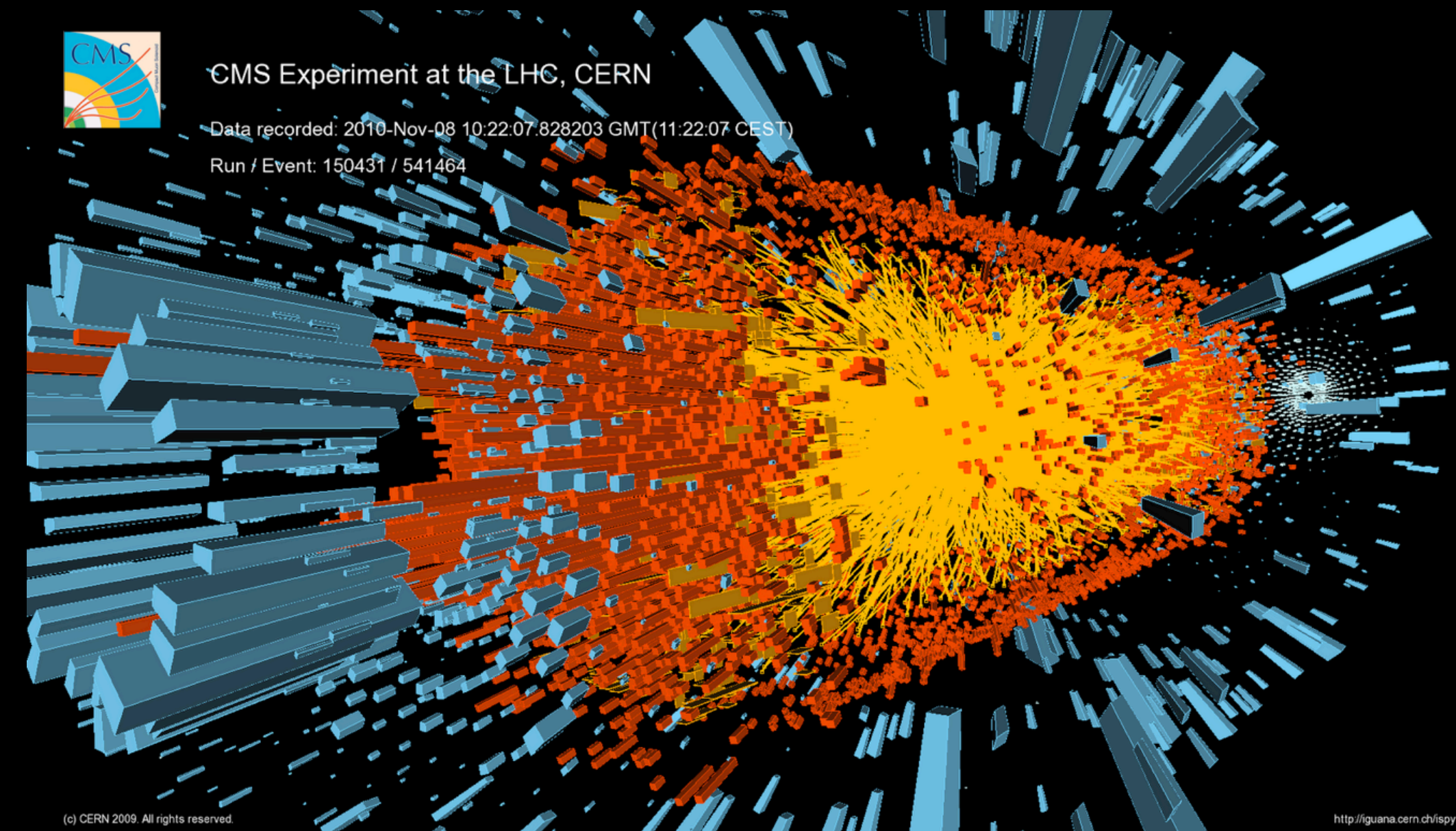
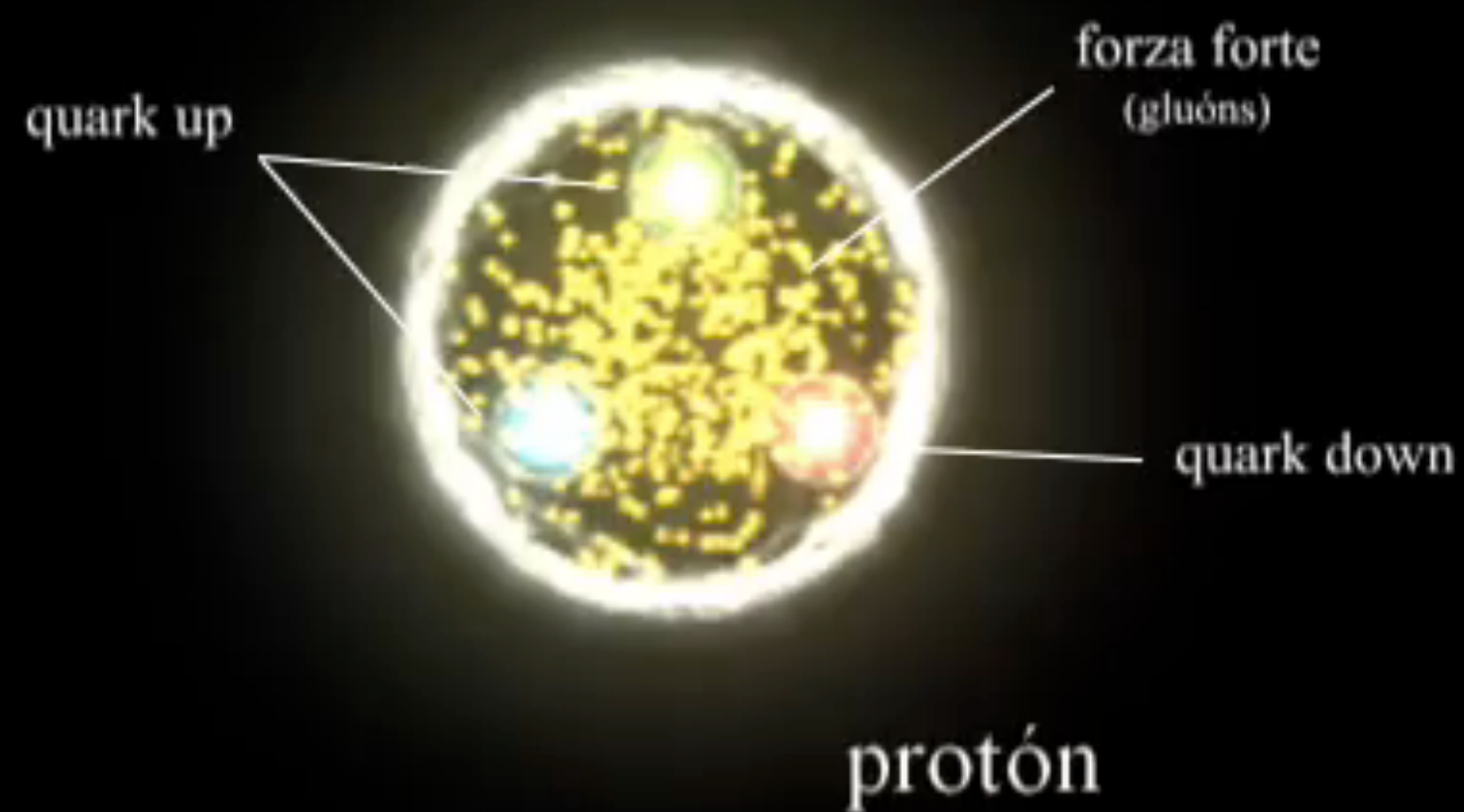
Study QCD under extreme conditions

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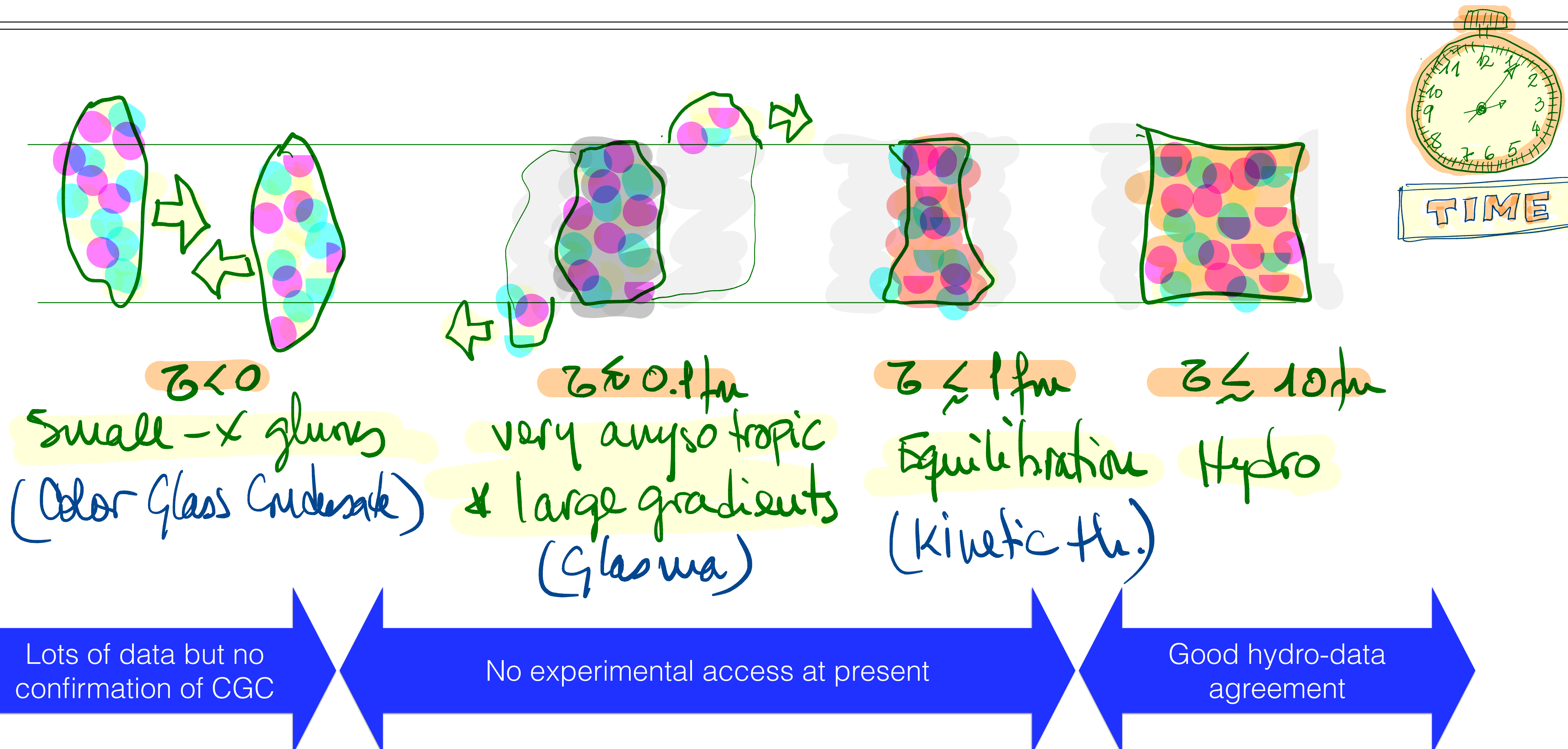
High density

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High temperature

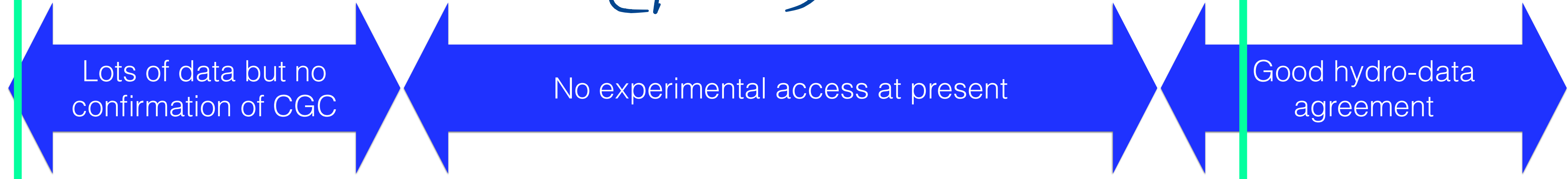
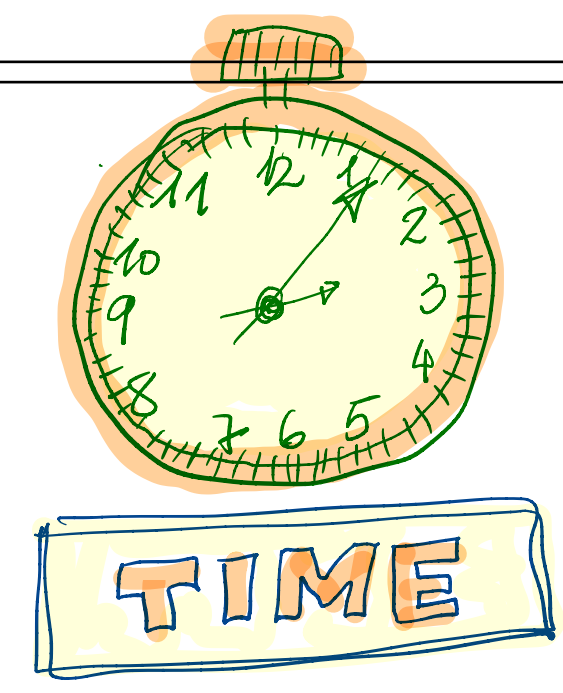
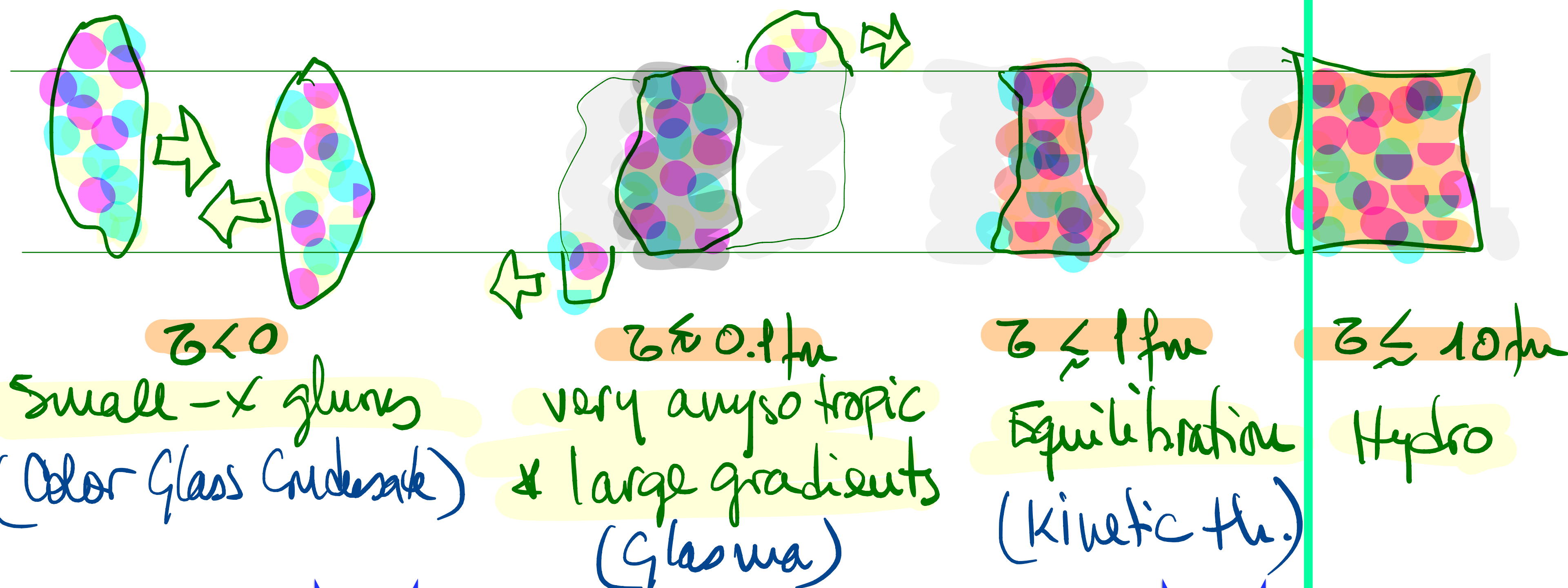


Instead of conclusions



In my opinion this is perhaps the most interesting regime of QCD to be explored in the medium-long term

Start fixing now the strategy to measure in the 30's (LHC Runs 4 and 5)



Executive summary

The goal of the ALICE physics programme is to determine the properties of strongly interacting matter and to discern how they arise from the underlying interactions as described by quantum chromodynamics, i.e. to understand the condensed matter of QCD. Collisions of heavy nuclei at the LHC provide unique experimental access to the hottest and longest-lived quark–gluon plasma available in the laboratory with abundant production of heavy flavour probes.

A rich programme of theoretical and experimental studies targets key questions in this area:

- What is the nature of interactions between high-energy quarks and gluons and the quark–gluon plasma? How do transport properties arise from first-principle quantum chromodynamics?
- Which mechanisms drive strongly-interacting matter towards equilibrium? To what extent do quarks of different mass reach thermal equilibrium within the plasma? How do they behave close to the diffusion regime?
- How do partons transition to hadrons as the quark–gluon plasma cools down? How does this process differ from hadron formation in elementary collisions?
- What are the mechanisms for the restoration of chiral symmetry in the quark–gluon plasma?

Despite the progress expected in the current decade, it will not be possible to fully answer these questions with the present or currently planned detectors. A number of key measurements will still be missing after Runs 3 and 4, among which:

- accurate measurements of charm and beauty hadrons, including their correlation over a wide rapidity range, to determine the interactions of heavy quarks of different mass in the quark–gluon plasma down to the thermal scale.
- systematic measurements of multiply heavy-flavoured hadrons for which the production from the quark–gluon plasma is expected to be enhanced by orders of magnitude, providing sensitivity to how quarks combine into hadrons depending on their degree of thermalisation.
- comprehensive data on the production and behaviour of the charmed exotic states in the quark–gluon plasma and their structure, for example by determining the strong interaction potential between hadrons from measurements of their momentum correlations.
- high-precision, multi-differential measurements of electromagnetic radiation from the quark–gluon plasma to probe its early evolution and the restoration of chiral symmetry through the coupling of vector and axial-vector mesons.
- measurements of net-quantum number fluctuations over a wide rapidity range to constrain the susceptibilities of the quark–gluon plasma and to test the realisation of a cross-over phase transition as predicted by lattice QCD.

To pursue this physics programme, we propose a novel detector with high readout rate, superb pointing resolution and excellent tracking and particle identification over a large acceptance, us-