

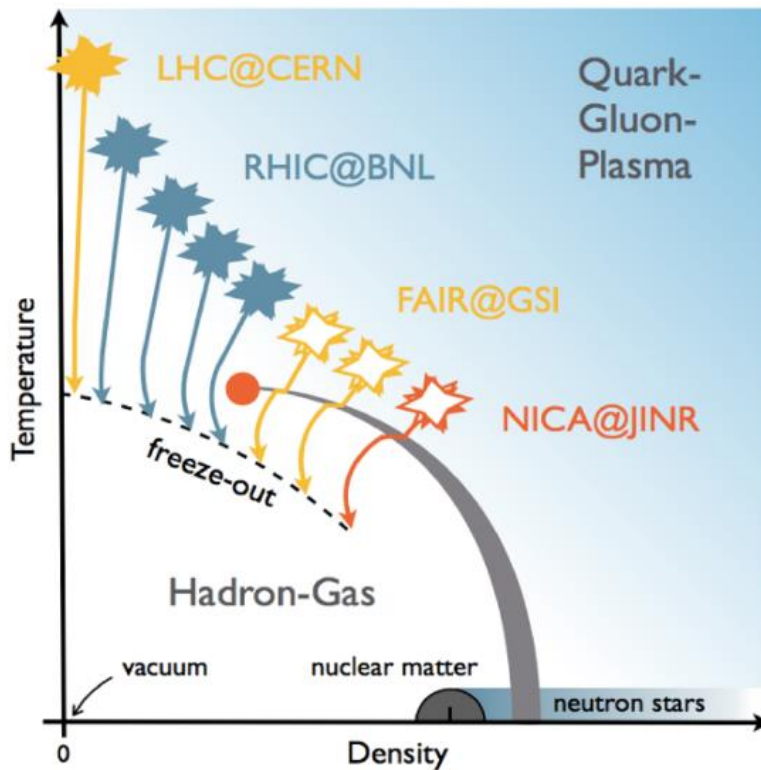


Heavy-Ion Input

- Authors:
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- Outline:
 - Status
 - Goals
 - What is needed to make progress
 - Wishlist

Rich large system program

QGP study via heavy ion collisions at the LHC: $\varepsilon_0 \sim 10-40 \text{ GeV/fm}^3$



QGP probes

- Global observables
- Light hadrons
- Strange hadrons
- Quarkonia
- Open heavy flavours
- Electromagnetic probes
- Jets and high p_T hadrons
- Hypernuclei, anti-nuclei

NuPECC Long Range Plan 2017

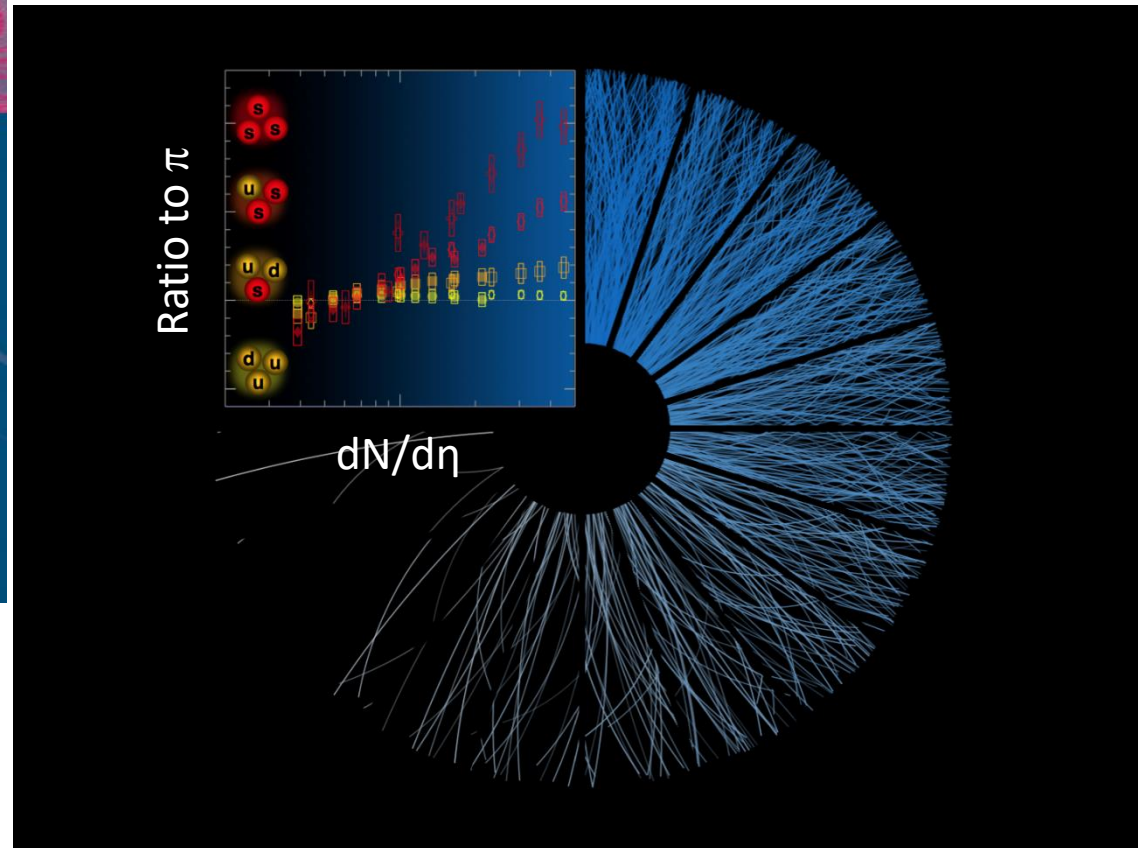
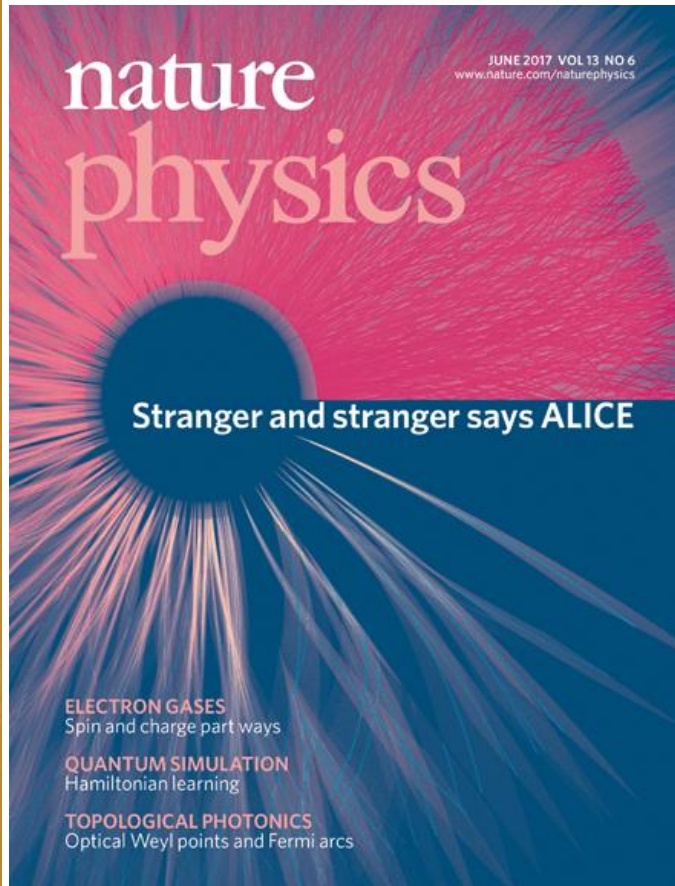
<http://www.nupecc.org/lrp2016/Documents/lrp2017.pdf>

As a function of rapidity, transverse momentum, azimuthal angle, centrality, centre of mass energy, reaction plane, fluctuations, small systems (pp and pA), correlations ...



And novel small system program

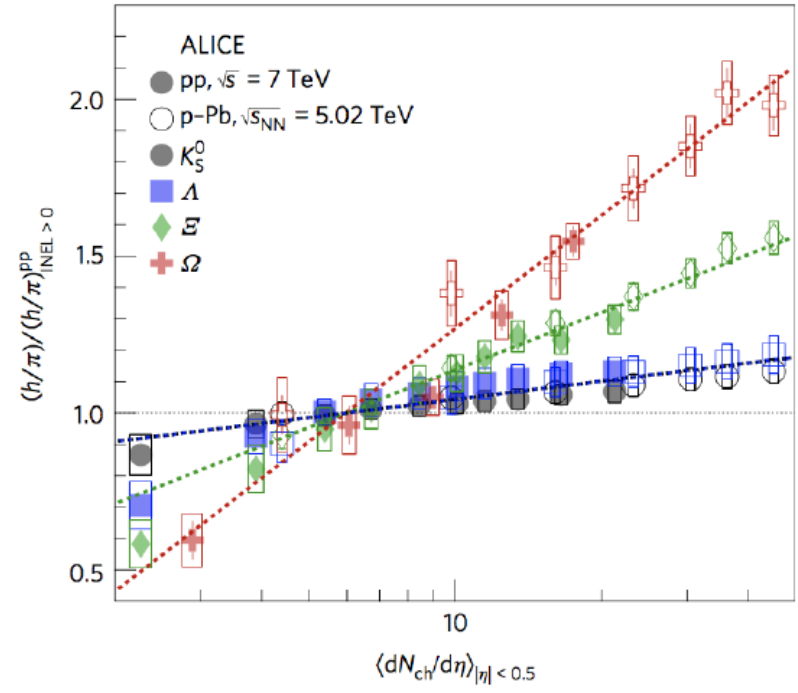
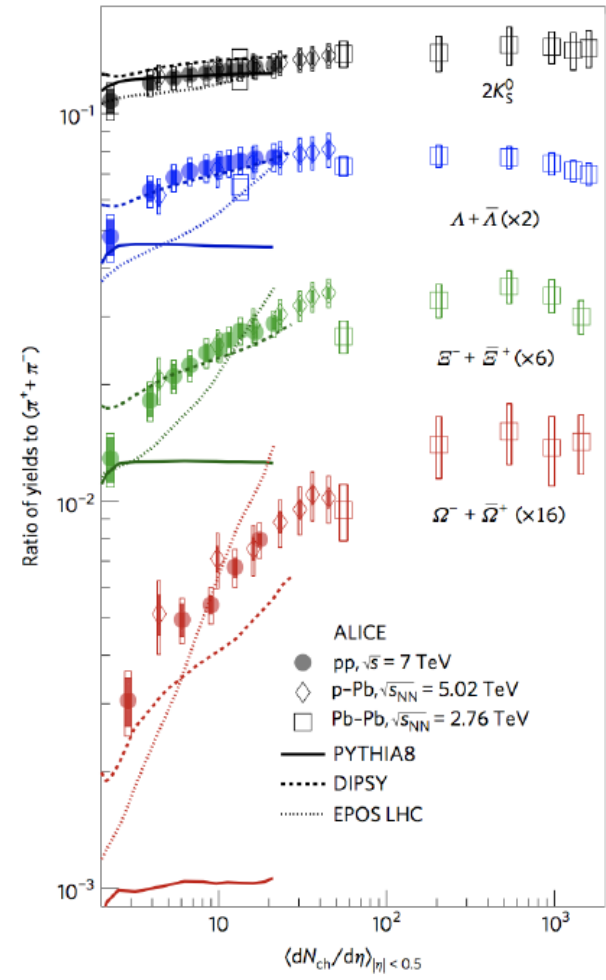
Heavy Ion (P. Christiansen, Lund)





The ALICE revelation: goodbye jet universality!

Heavy Ion (P. Christiansen, Lund)

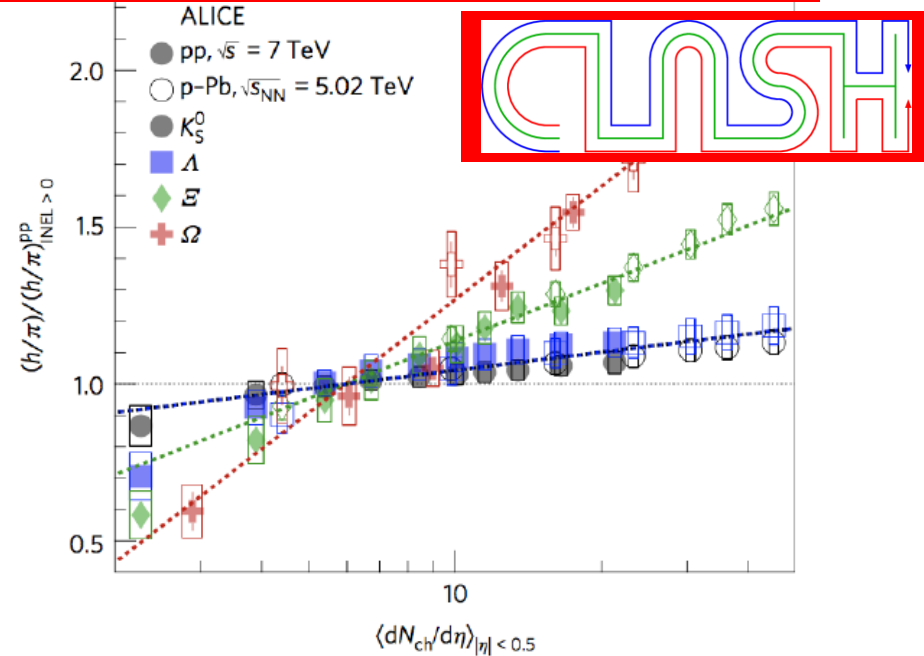
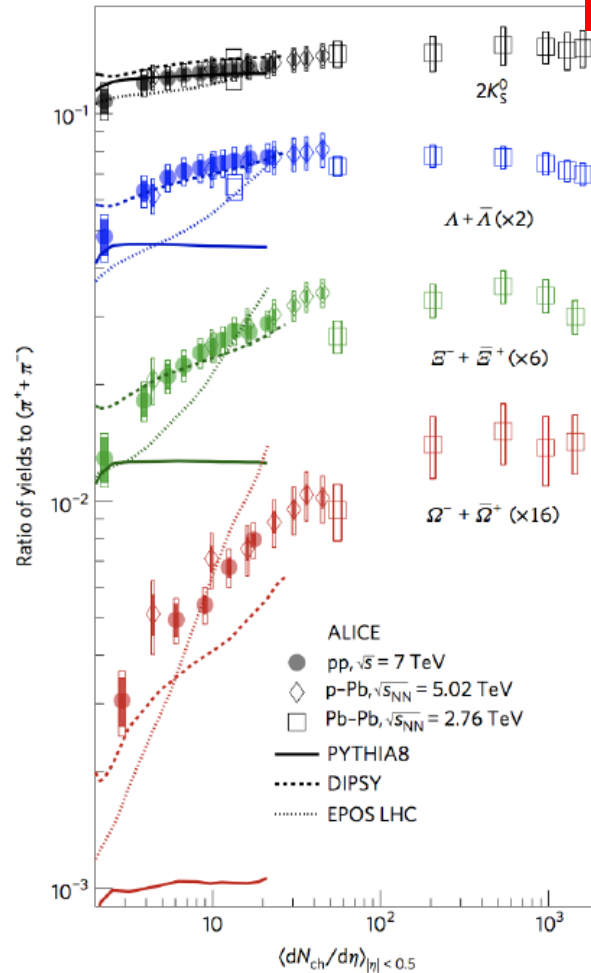


Signs of QGP in high-multiplicity pp collisions? If not, what else? A whole new game!



The ALICE revelation: goodbye jet universality!

But Hello DIPSY/ANGANTYR &



Signs of QGP in high-multiplicity pp collisions? If not, what else? A whole new game!

Heavy Ion (P. Christiansen, Lund)



Scientific goals

- In some sense the field is more vital than ever and the main open questions are:
 - What is the microscopic nature of the observed phenomena such as flow and jet quenching
 - What are the thermodynamic properties of the Quark-Gluon Plasma
 - What effects are driven by non-linear QCD evolution (gluon branching and fusion) in the initial stage
 - Do the phenomena observed in the small and large systems have the same origin

- Collectivity in small systems challenges two paradigms at once!
 - 1 How far down in systems size does the "SM of heavy ions" remain?
 - 2 Can the standard tools for min bias pp remain standard? **C. Bierlich**



Where do we go from here?

- More statistics and better detectors
 - ALICE LS2 upgrade + LHC Run 3 and 4
- New ideas
 - To achieve the goals is not only an issue of more statistics, but also of developing new measurements that are more sensitive to the underlying physics and exploring new theoretical directions in models
- Better models
 - See next slide



Model challenges

- pp models are microscopic, while PbPb models are macroscopic
- If one wants to take a PbPb model to small systems, one needs to implement microscopic physics
- Vice verse: If one wants to take a pp model to large systems, one needs to model the macroscopic physics
 - Also for pp discovery physics!
- Both cases: Highly non trivial and a lot of work -> Needs support!



What do we want

- Full support for ALICE upgrade in LS2 and running in Run 3 and 4
 - Opportunity to run in Run 5 and 6 if needed
 - To achieve the scientific goals is not only a question of luminosity but also a question of new insights/ideas
- Better support for generator builders
 - One should also explore alternative collision systems to bridge the gap from small to large systems such as proton-oxygen or even proton-deuteron
- Explore an electron-ion collider