Comparison in yield of strange baryons using AMPT and UrQMD model at $\sqrt{s_{NN}}$ = 14.6 GeV

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9th November, 2022

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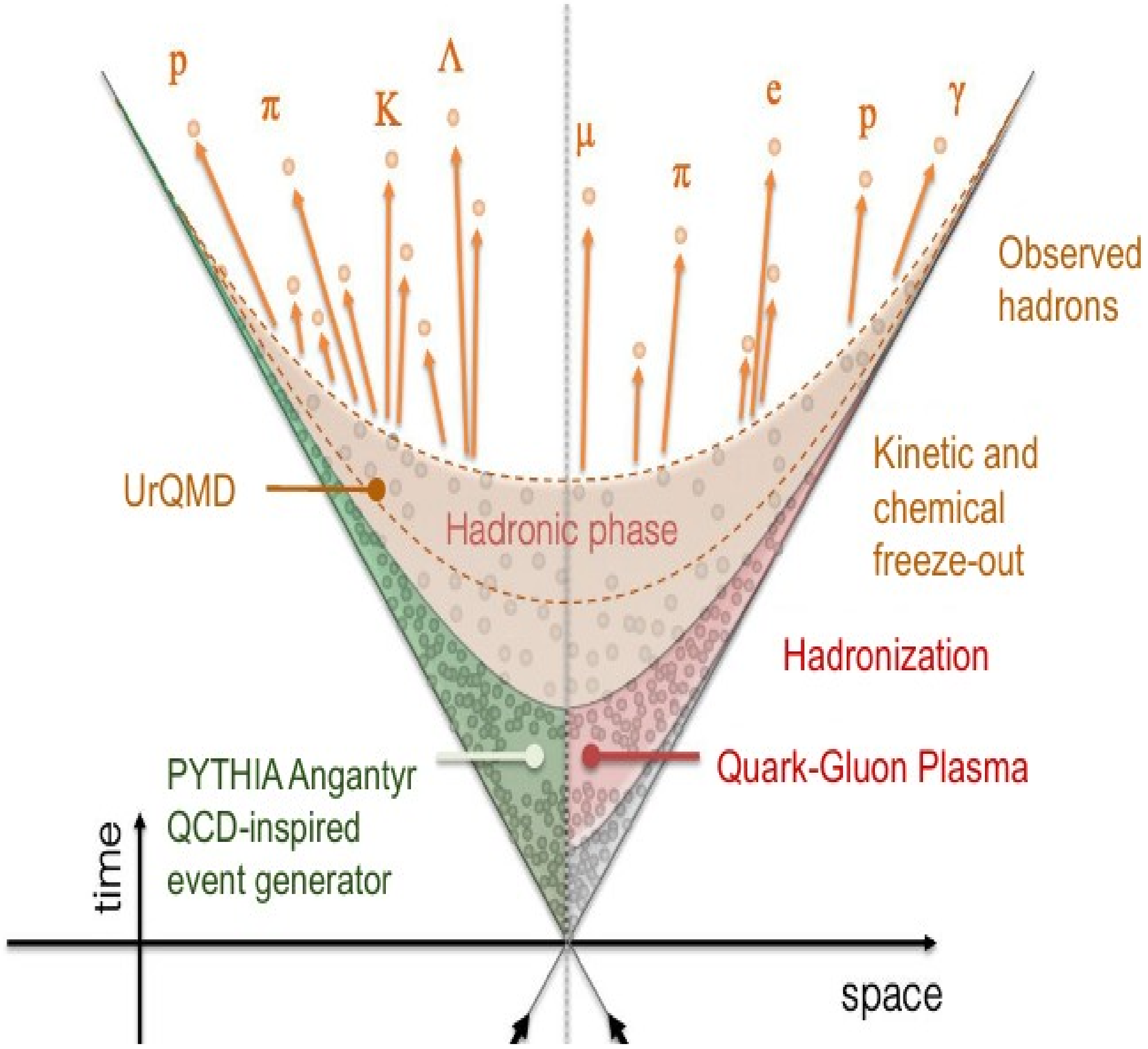
Motivation

- The goal of ultra-relativistic heavy-ion collisions is to study the properties of strongly interacting matter under extreme conditions.
- In these collisions, large energy densities are expected to be achieved and a state of matter where quarks and gluons are no longer confined in to hadrons, the quark-gluon plasma (QGP), is formed.
- The presence of such a system leads to some experimental signatures such as collective behavior and the suppression of high momentum particles that are expected and measured in the experiments at the LHC and RHIC.
- These signatures are only measured indirectly after hadronization take place and the system evolution in which inelastic and elastic interactions may still happen.
- Therefore, understanding the effects of this hadronic phase is of paramount importance to infer on the properties of the QGP.



Motivation

- Strangeness enhancement is one of the most important signatures of the phase transition between the hadronic matter “confined phase” to the quark-gluon plasma (QGP) “deconfined phase”.

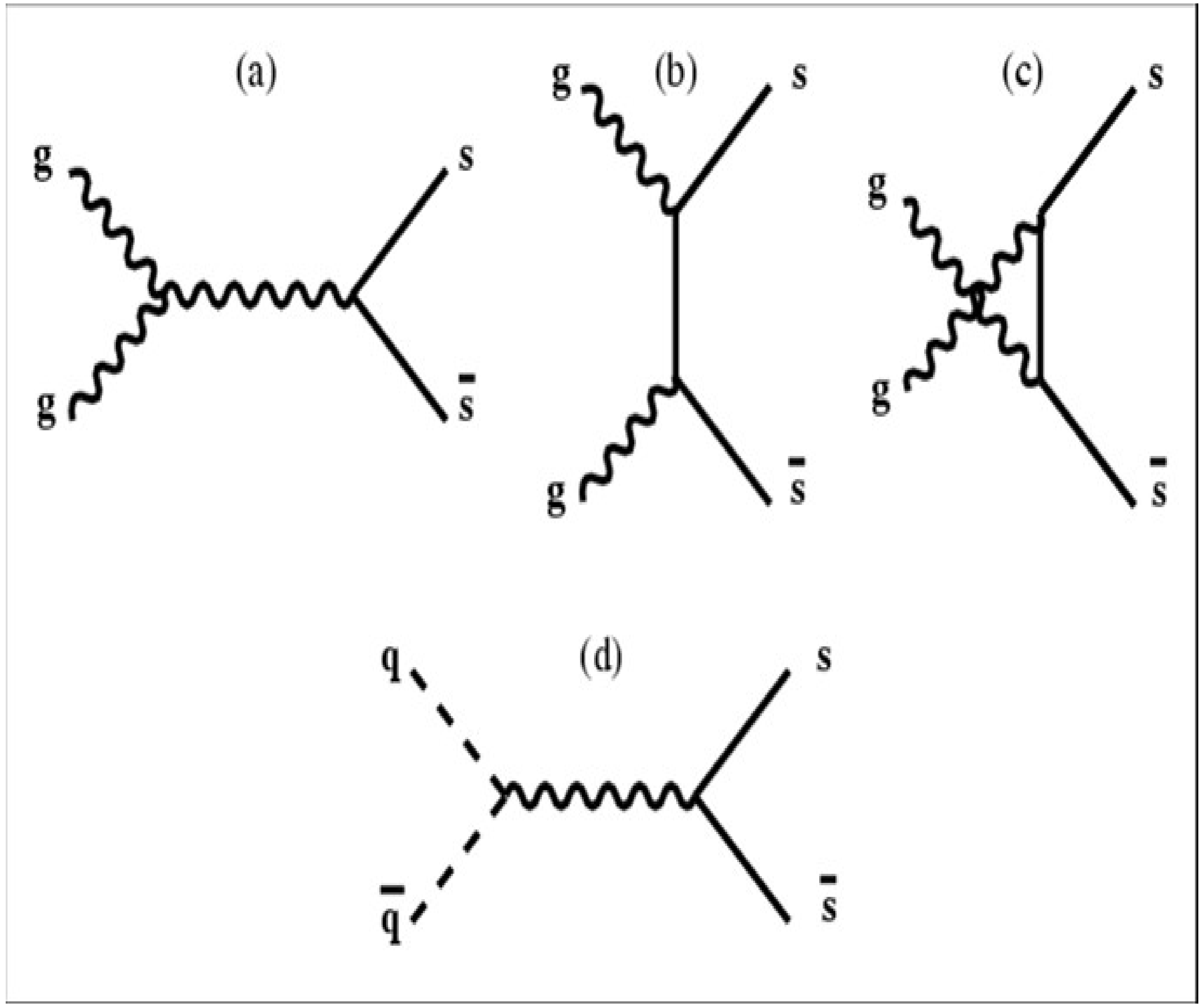
- QGP comprises an equal number of strange and anti-strange quarks.

- As the hadronization process kicks off, the density of strange quarks raises, and more multistrange hadrons are produced.

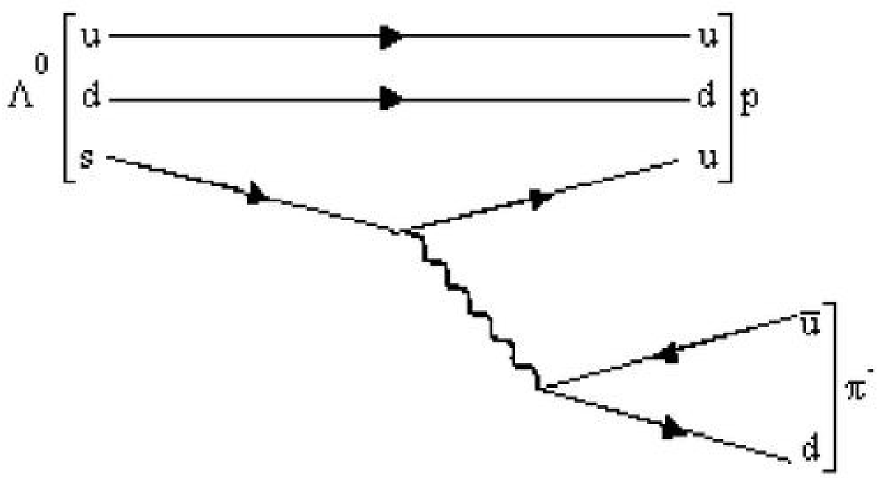
- Strange baryons are produced via strong interactions and decay through weak interactions.

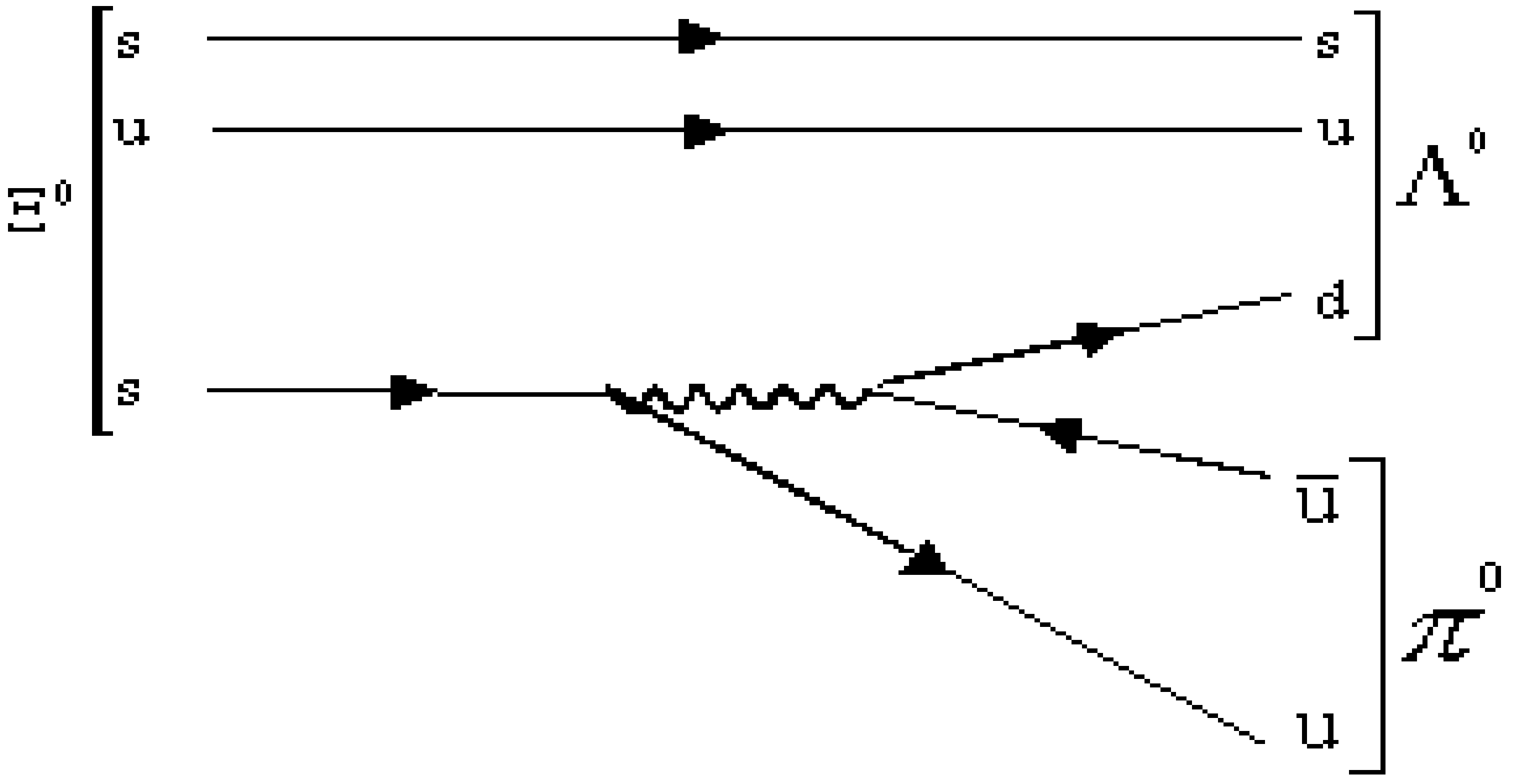
- The dominant channel for the production of strange quarks is gluon-gluon or two light quark fusion as demonstrated by Rafelski and Muller in 1982.

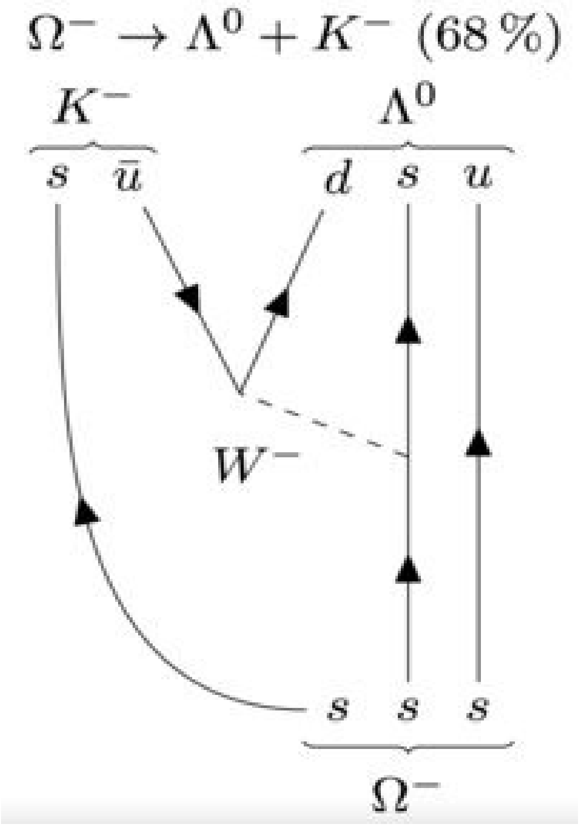
- The strangeness formation time is similar to the expected lifetime of the QGP, which basically leads to abundance of strange quark density in QGP.



Reconstruction of Strange Baryons







- $\Lambda \rightarrow p+ + \pi^-$, Branching ratio: 63.9% and cτ =7.89 cm.
- $\Xi \rightarrow \Lambda + \pi^-$, Branching ratio: 99.8% and cτ = 4.91 cm.
- $\Omega \rightarrow \Lambda + K^-$, Branching ratio: 67.8% and cτ = 3.46 cm.

UrQMD and AMPT Model

Ultra-relativistic Quantum Molecular Dynamics

UrQMD, is an effective model for simulations of nuclear collisions and scatterings.

Hadron cascade (standard mode)

- Based on the propagation of hadrons
- Rescattering among hadrons is fully included
- String excitation/decay (LUND picture/PYTHIA) at higher energies

Hybrid mode calculations

- At energies above 100 GeV the early intermediate state can not be modeled by strings and particles alone
- To take the local equilibration and the phase transition to QGP into account, a hydrodynamic phase is introduced
- Called as hybrid model (Boltzmann+hydrodynamic), hybrid models have become the standard at RHIC and LHC energies

A Multiphase Transport Model

AMPT Monte Carlo transport model for heavy ion collisions at relativistic energies

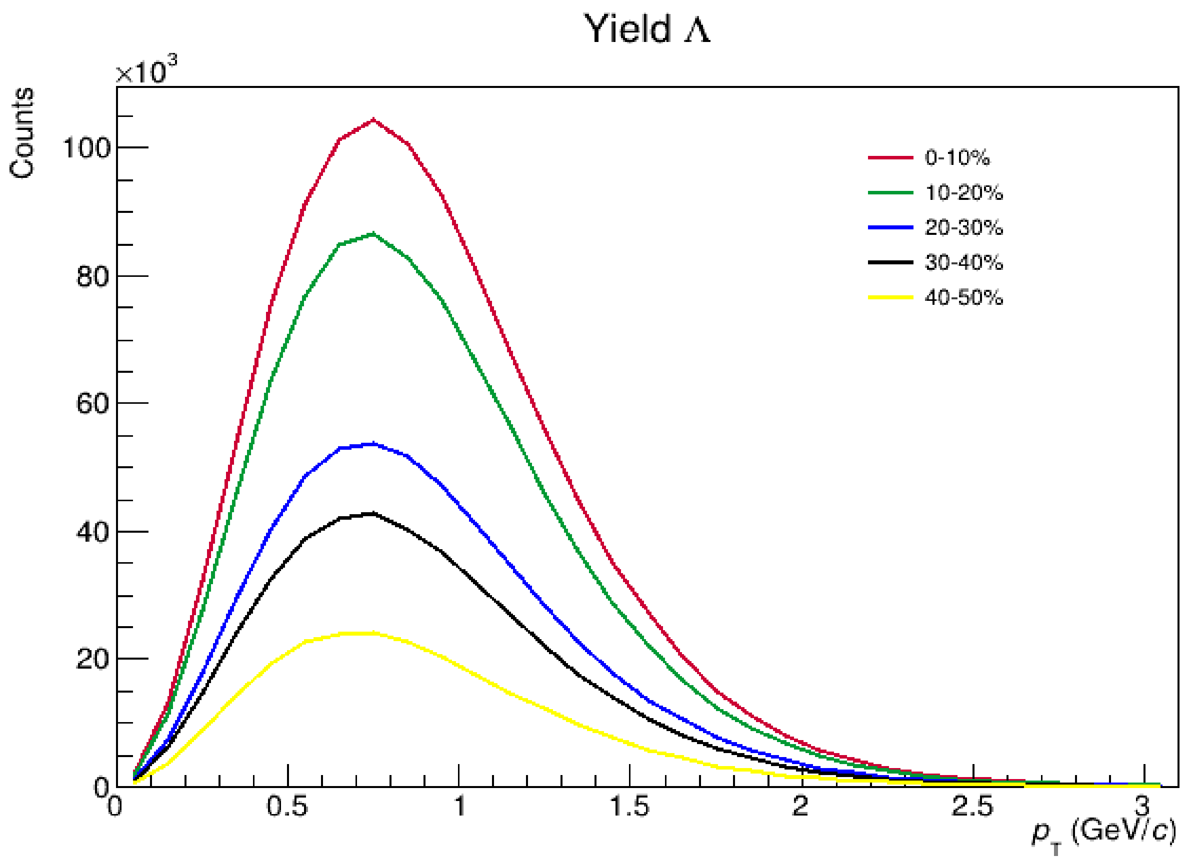
Default mode

- partons are recombined with their parent strings using the Lund string fragmentation model.

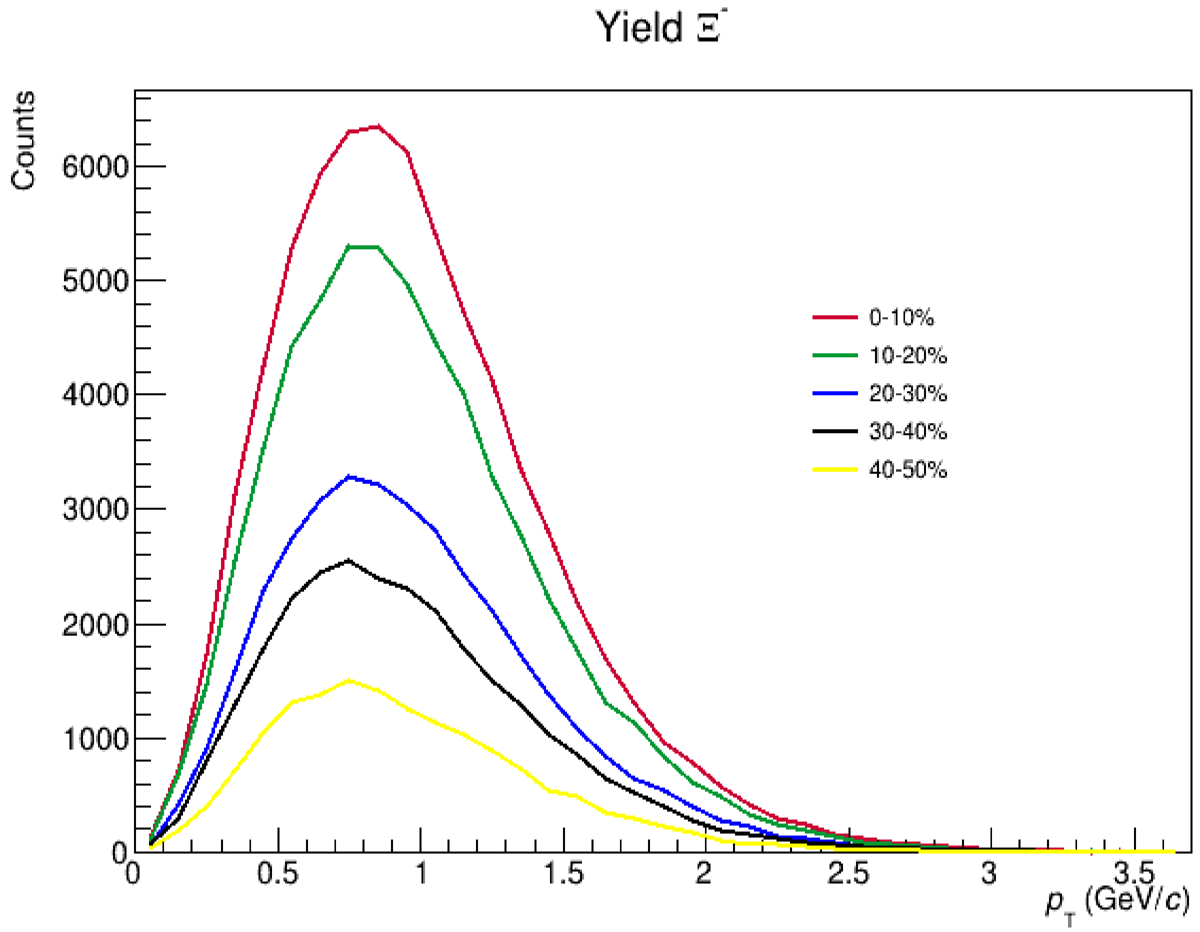
String Melting

- with string melting, a quark coalescence model is used to combine partons into hadrons.
- The default AMPT model reproduces the yield and transverse momentum spectra much better than AMPT-SM.
- Includes both initial partonic and final hadronic interactions, and the transition between these two phases of matter.
- Aims to provide a kinetic description of all essential stages of heavy ion collisions.

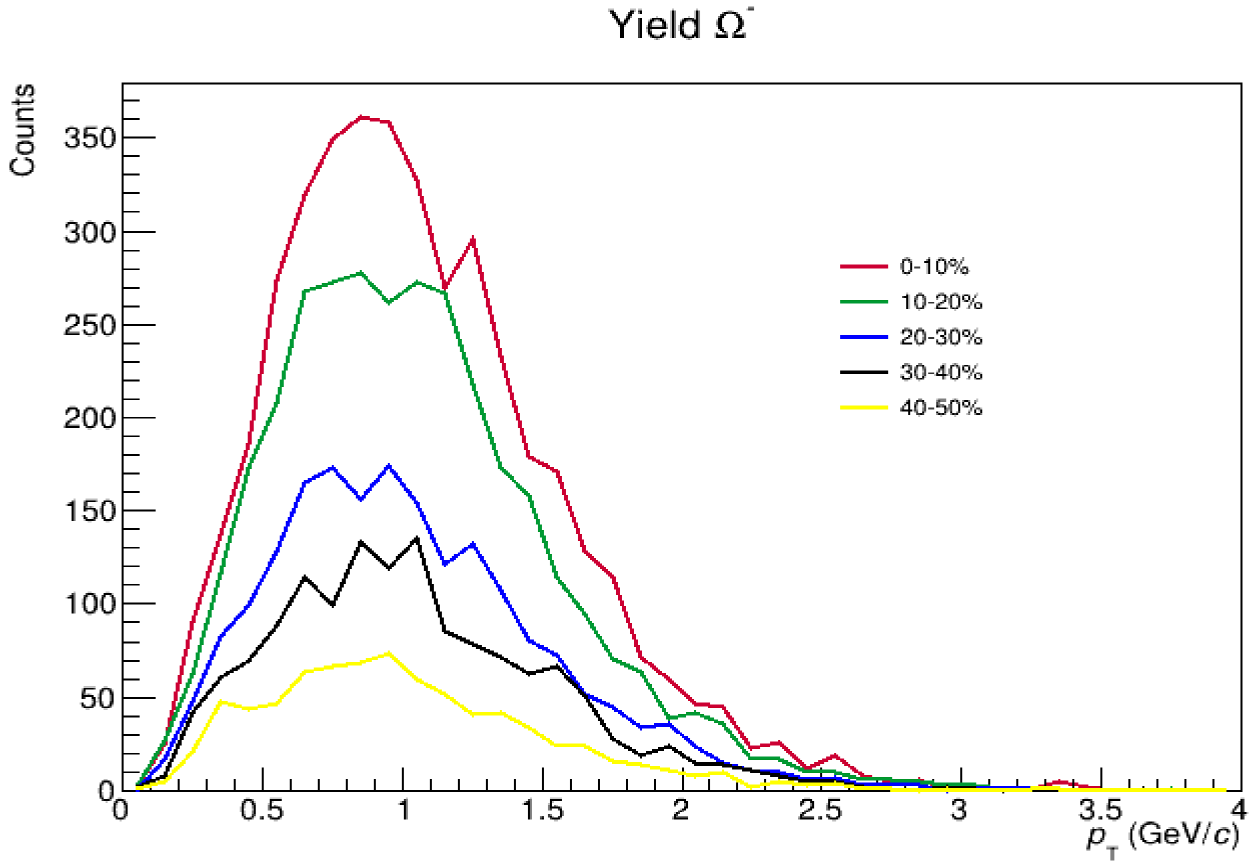
Results of AMPT model



- Approximately 1.5 million events were analyzed.

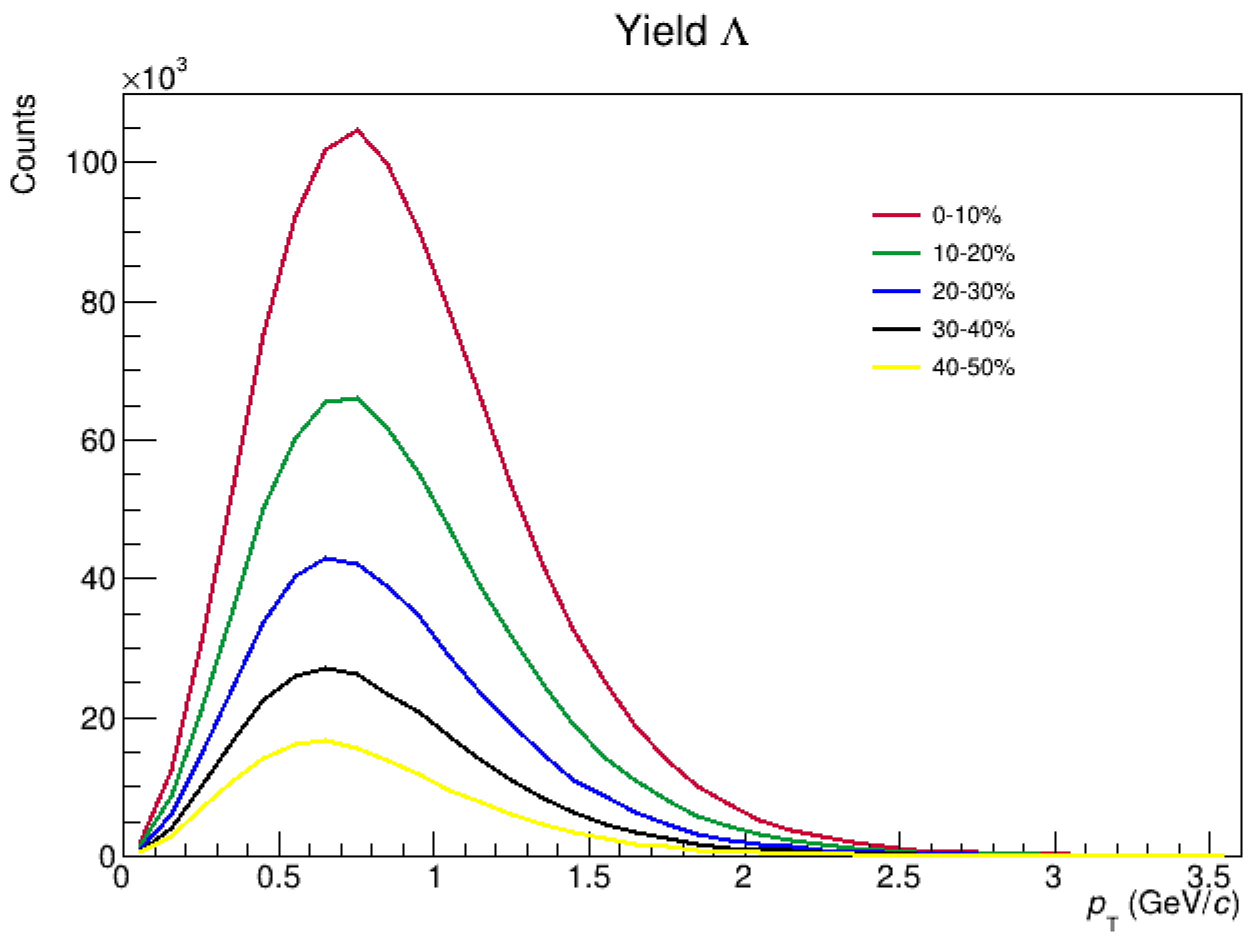


- The yield is calculated at different centralities: 0-10%, 10-20%, 20-30%, 30-40%, 40-50% .

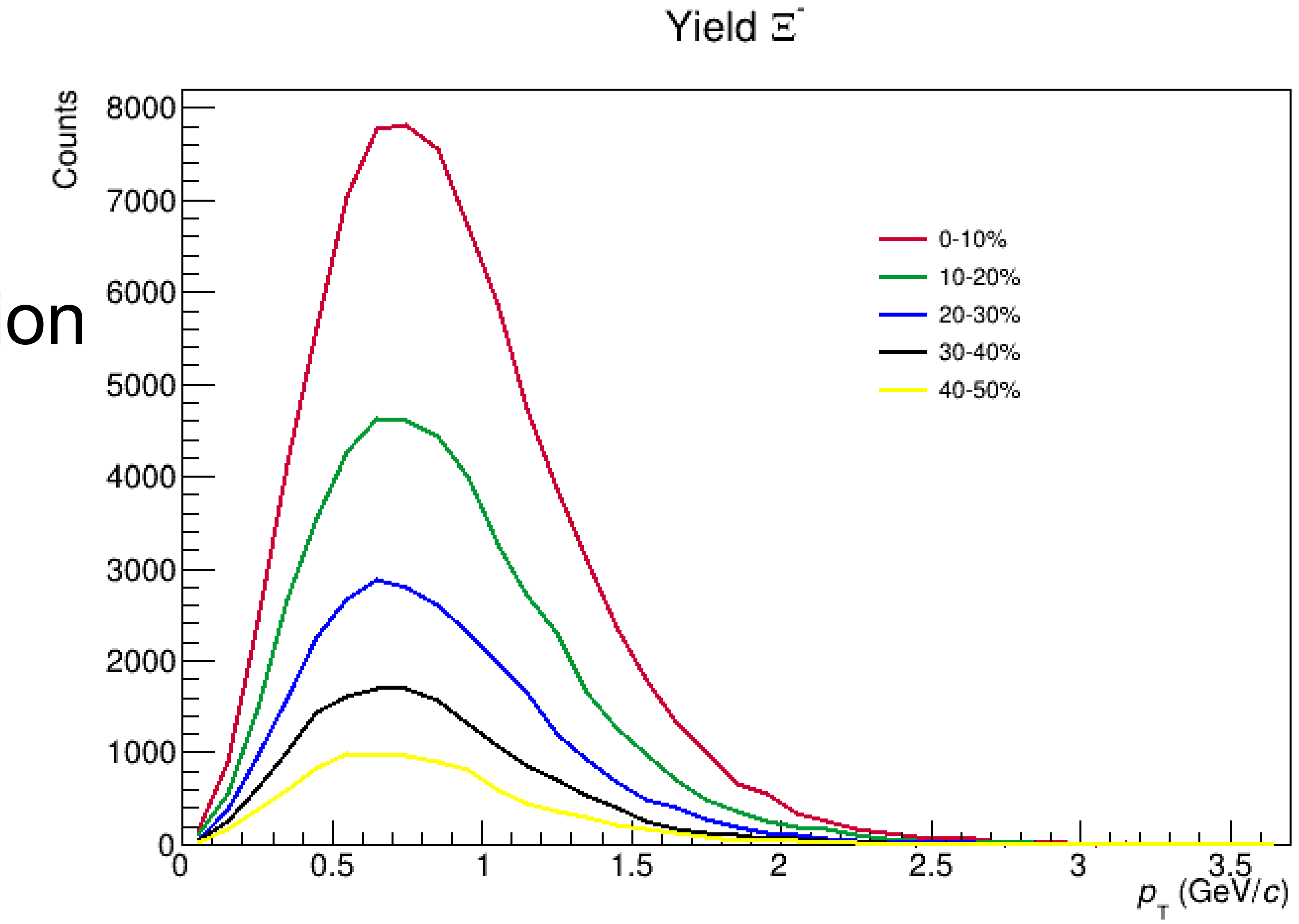


- As Omega has a sss quark content which is less stable due to which it has lesser statistics

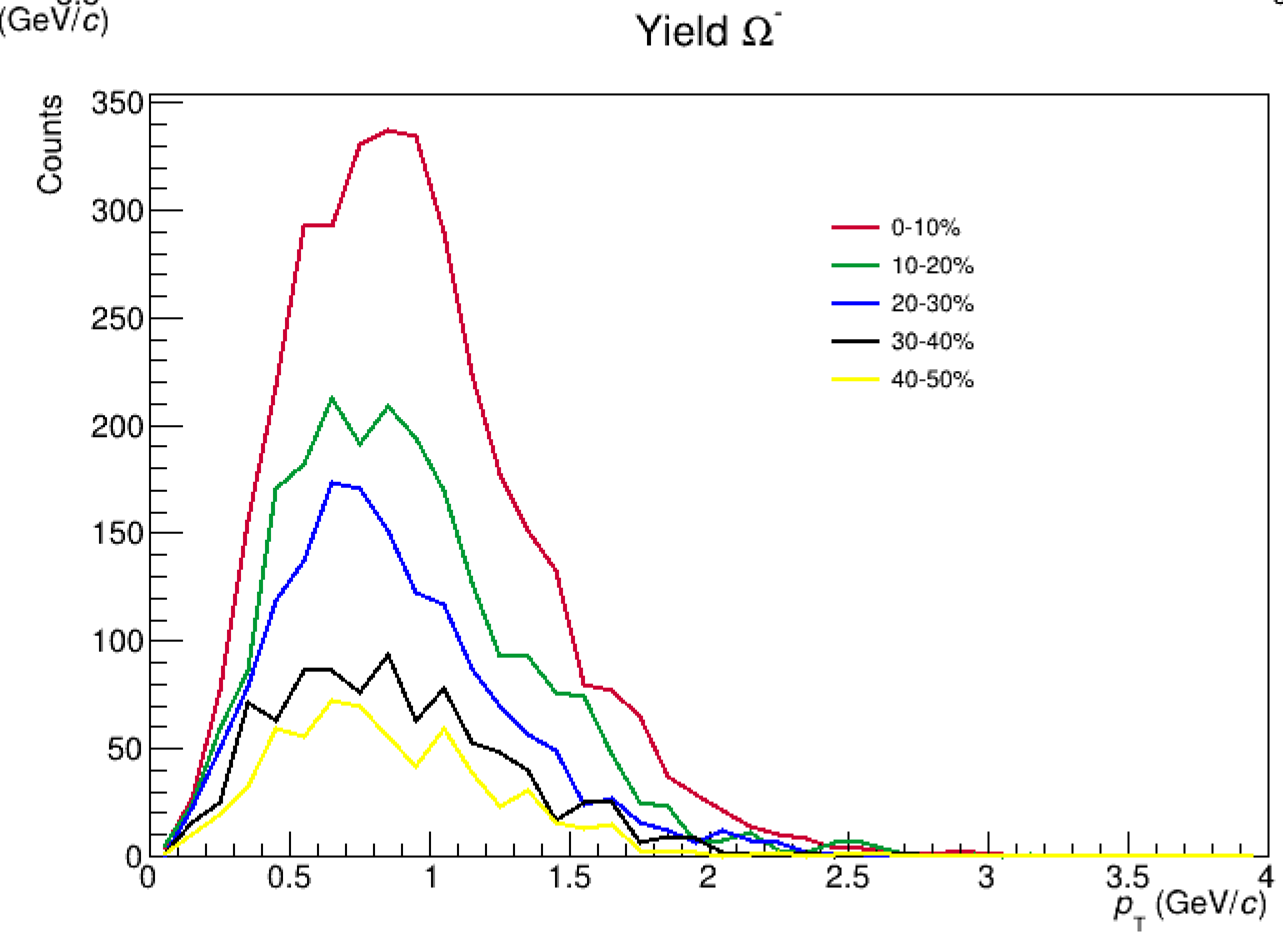
Results of UrQMD model



- Approximately 1.5 million events were analyzed



- Yield decreases from peripheral to central
- Where a clear momentum loss is seen at central collisions.
- Here the most central events are 40-50% centralities



- As Omega has a sss quark content which is less stable due to its small lifetime, hence an increase in statistics is required.

Summary and Conclusion

- The yields of strange particle are considered to be most interesting to examine the transition from hadronic matter to quark-gluon-matter (QGP).
- The yield is calculated at different centralities: 0-10%, 10-20%, 20-30%, 30-40%, 40-50% .
- Centrality is calculated using impact parameter distribution.
- The observed yields of Λ’s, Ξ’s and Ω’s are well described in the Au+Au case by the present models, but an increase in statistics is still needed especially for particles with less multiplicity.
- It will also be interesting to compare the results with the string melting mode of AMPT and hadron cascade mode of UrQMD with the experimental data for a productive outcome.
- The model used for studying the yield of strange baryons is AMPT model.

Thank you for listening