Solve classical equation of motion on the lattice via inverse particle cascade.

Isotropic distribution at soft momenta for large occupancies leads to

Sampling with quantum initial conditions accurately describes quantum field theory for large occupation.

Abelian plasmas, relevant for heavy-ion collisions in the limit of high energy and weak coupling, approach a nonthermal fixed point. \[1,2\]

Initial conditions

- Fluctuation dominated
- Condensate driven

Thermal-like distribution

Hard momenta: Stationary integrated distribution

Universal scaling

- Self-similar evolution
  \[ f(\tau, p_1, p_2) = \tau^\alpha f_s(\tau^\beta p_1, \tau^\gamma p_2) \]
  with transverse and longitudinal momenta \( p_1 \) and \( p_2 \), dynamical scaling exponents \( \alpha, \beta, \gamma \) and scaling function \( f_s \).

Universal scaling function \( f_s \)

At characteristic hard momenta \( (p_1 = p_2^* \text{ for scalars}) \), gauge and scalar theories share the same scaling function for different initial conditions.

Isotropic distribution & Bose condensate

Similar properties of longitudinally expanding and non-expanding backgrounds share the same universal properties at characteristic (hard) momenta. These are insensitive to initial conditions.

Conclusion & Outlook

Scalar and non-Abelian gauge theories in longitudinally expanding systems share the same universal properties at characteristic momenta, independent of initial conditions.

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