On HBT parameters from high energy nuclear collisions I – the λ parameter

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Using a microscopic transport model together with a HBT after-burner, we study the behavor of the pion λ parameter in Au+Au central collisions at $\sqrt{s} = 200 AGeV$.

In summary, (i) R_{side} conststence; (ii) R_{out}, R_{long} are not consistence; (iii) in time window, the λ parameter is unity. This observation is considered as an evedence of squencial freeze-out.

It is believed that the space-time evolution informaiton of high energy nucleus-nucleus collisions can be extracted from the two particle momentum correlation functions (see Refs. [**?**,**?**] for recent good reviews on this subject.).

$$C_2(\mathbf{q},\mathbf{K}) = 1 + \lambda exp[-R_{out}^2 q_{out}^2 - R_{side}^2 q_{side}^2 - R_{long}^2 q_{long}^2] \tag{0.1}$$

These size parameters mix spatial and temporal information on the emitter in a non-trival way, and their interpretation depends on the frame in which the relative momenta q are specified. Experimental results, as well as in the model calcualtions, often show that the value of λ is much less than unity. A familiar interpretation for the effect is the resonance decays, especially the ρ and ω decays. Sometime momentum resolution is also blamed for the smallness of the λ.

space-time momentum correlation,

toy model tests

RQMD tests

pt dependence

1. The λ parameter should approach unity when the source understudy can be characterized by a single Gaussian distributions. Either sequential freeze-out, particles emitted at a different time with different size parameter, or resonance decays will reduce the value of λ.

2. It is found that the value of λ close to unity for high p_T particle pairs. This is because with the high p_T cut, particlar time slice is chosen, and hence a close to single Gaussian is selected. Of course, the resonance contributions are also reduced by the cut.

3. In general, it is believed that resonance decay will reduce the value of the λ parameter. Indeed, the

4. The cricial questions are:

   - What can we learn from the correlation measurements?
   - Do we really observe the collective behavior?

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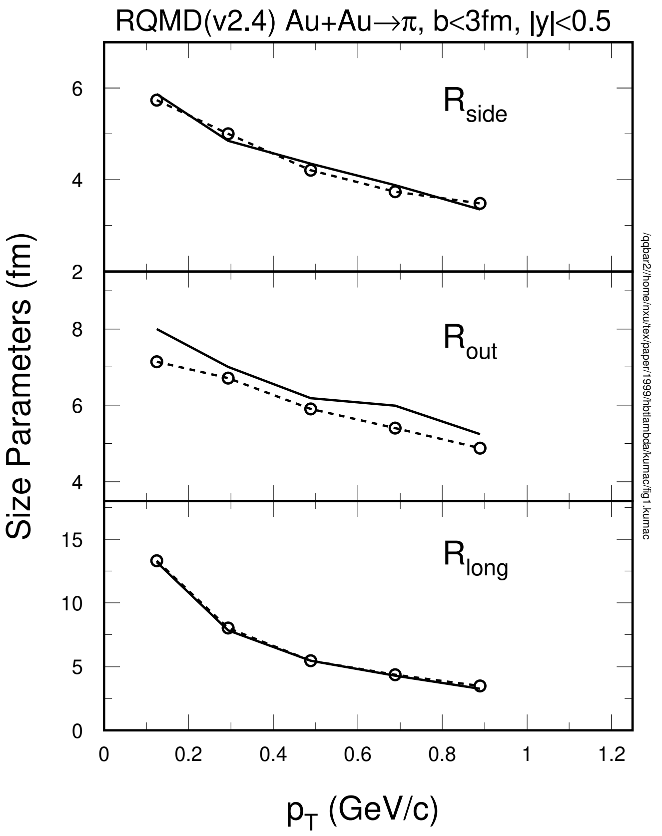

FIG. 1. The Pion source parameters as a function of transverse mass m_T. The solid and dashed lines represent the parameters extracted from Gaussian fit and correlation function, respectively.

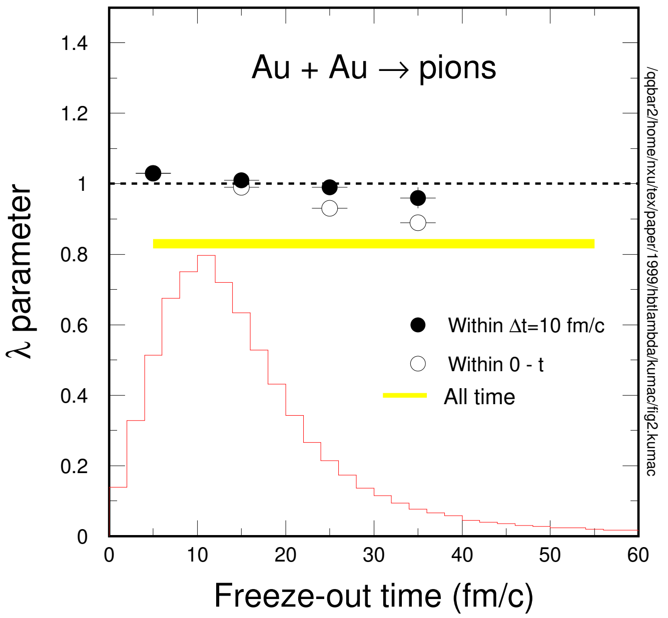

FIG. 2. The λ parameters as a function of freeze-out time. The results calculated within a fixed time window $10fm/c$ are shown as filled circles and those calculated within time interval $0 \rightarrow t_i, i = 10, 20, 30, 40$ are shown as open circles. The light histogram shows the pion time profile (arbitrarily normalized).

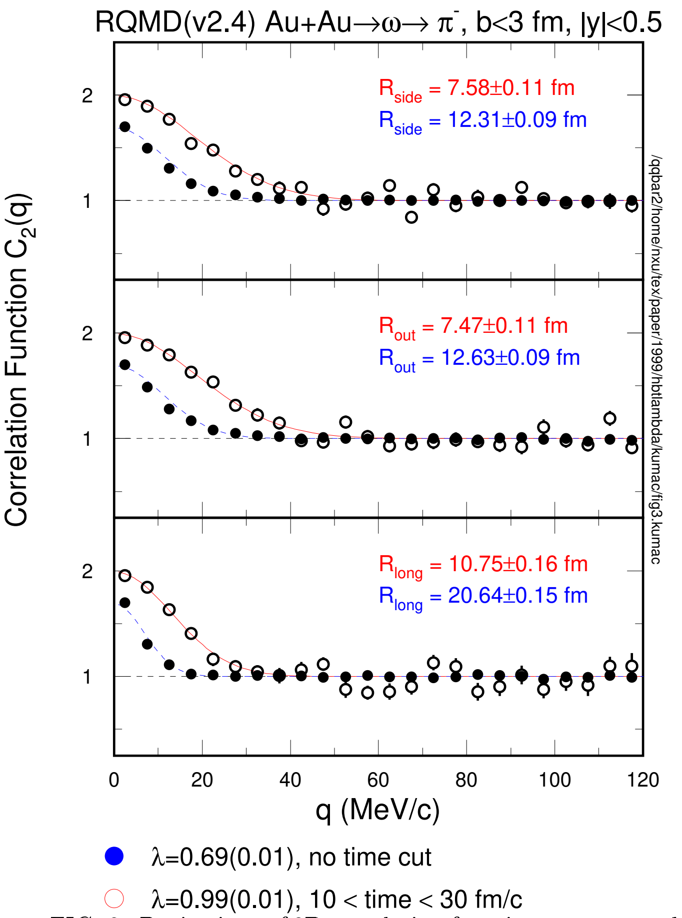

FIG. 3. Projections of 3D correlation functions constructed from those ω decayed negative pions. The λ parameter is only about 0.7 (filled symbles) when all pions are used in the calculation. An unity value is found for pions freeze-out in the time window $10 \leq t \leq 30$ fm/c, open symbles.