Preliminary figures request: Bose-Einstein correlations in charged kaons from 200 GeV Au+Au collisions at RHIC

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Physics motivation

Bulk properties of nuclear matter can be extracted by employing femtoscopic methods to study the high-energy systems emerging form relativistic heavy-ion collisions. The space-time structure of the particle-emitting source can be examined by observing the effects of quantum-statistics and final-state-interactions on the pair correlations of particles, with data collected by the STAR experiment from the $\sqrt{s_{\mathrm{NN}}} = 200$ GeV Au+Au collisions created in the RHIC. On account of being less susceptible to resonance decays and having a smaller reaction-cross-section while interacting with hadrons, kaons provide a complementary probe of the particle-emitter as compared to pion analyses. Results from Bose-Einstein correlations between pairs of charged kaons are presented and compared to descriptions based on a Lévy-shaped source distribution.

Dataset

- Dataset: AuAu_200_production_2016, st_physics
- Year: 2016
- Production tag: P16ij
- Triggers used: VPDMB-5-p-sst (520001, 520011, 520021, 520031, 520041, 520051) & VPDMB-5-p-nosst (520002)

Bad run list

Source (analysis code located at):

/star/u/ayon1991/kaons_full_stats/StRoot/MyAnalysis/MyAnalysisMaker.cxx

17063037,17070011,17073049,17073063,17075108,17075110,17076001,17076003,
17076010,17097024,17097026,17098033,17098035,17098036,17098037,17098038,
17098039,17098040,17098043,17098045,17098046,17098047,17098048,17098050,
17103017,17103059,17103060,17103061,17104001,17104002,17104003,17104004,
17104005,17104006,17104007,17104008,17104009,17104011,17104012,17104013,
17104014,17104015,17104016,17104017,17104018,17112054,17114044,17114045,
17114046,17114047,17114049,17114050,17114051,17115001,17115002,17115003,
17115004,17115005,17115007,17115008,17115009,17115010,17115012,17115013,
17115014,17115016,17115018,17115019,17115021,17115022,17115025,17115026,
17115028,17115030,17115031,17115032,17115033,17115035,17115037,17115038,
17116006,17116047,17116048,17116049,17116050,17116052,17116053,17116054,
17116056,17116057,17116058,17116059,17116061,17116062,17116063,17116065,
17117003,17117006,17117007,17117008,17117010,17117011,17117012,17117013,
17117014,17117015,17117019,17117020,17117021,17117023,17117028,17117029,
17118051,17119001,17119002,17119003,17119004,17119005,17119006,17119007,
17119009,17119011,17119012,17119013,17119014,17119015,17119016,17119072,

17124032,17124039,17124040,17124041.

Event level cuts

- Vertex cuts:
  VPD $|v_z| < 30$ cm
  TPC $|v_z| < 25$ cm
  $|\mathrm{VPD}v_z - \mathrm{TPC}v_z| < 3$ cm
  $v_r = \sqrt{v_x^2 + v_y^2} < 2$ cm

- TOF multiplicity vs. reference multiplicity cut:
  Ref_mult $>$ 0.18 $\times$ TOF_mult - 20
  Ref_mult $<$ 0.25 $\times$ TOF_mult + 25

- Centrality cut: 0-30%

- Events before cuts: 3.06 billion.
  2.59 billion after trigger cuts,
  776 million after centrality selection,
  20% processed as of now.

Track level cuts

- PID cuts:
  $N_\sigma(K) < 1$, $N_\sigma(\pi, p) > 3$
- Nhits cut:
  $18 <$ Nhits < 50
- p_{T} cut:
  $0.2 < p_{\mathrm{T}}[\mathrm{GeV}] < 4$
- Global DCA < 3

Other selection criteria: pair cuts

- Splitting level < 0.6
- FMH < 0.001
- $\Delta z - \Delta u$ cuts

Analysis procedure

- Tracks are read in and cut, following which pair-correlations amongst particles from the same event are calculated as functions of $q_{\mathrm{LCMS}} = \sqrt{(p_{1x} - p_{2x})^2 + (p_{1y} - p_{2y})^2 + q^2_{\mathrm{long,LCMS}}}$ to obtain $A(q)$.
- Particles from the current event are stored and event-mixing is performed by randomly selecting particles from stored events.
- In the mixed event thus created, pair-correlations are calculated to obtain $B(q)$. The ratio of $A(q)$ & $B(q)$ is then calculated to obtain $C(q)$.
- $C(q)$ is fit with the Coulomb-corrected Lévy function: $\left[1 - \lambda + \lambda \cdot K(q) \cdot (1 + e^{-|Rq|^{\alpha}})\right] \cdot N \cdot (1 + \varepsilon q)$.
- The Coulomb correction, $K(q; \alpha, R)$, is calculated numerically.
- Finally, the resulting fit parameters - R, λ & α - are extracted and plotted; along with their systematic uncertainties.

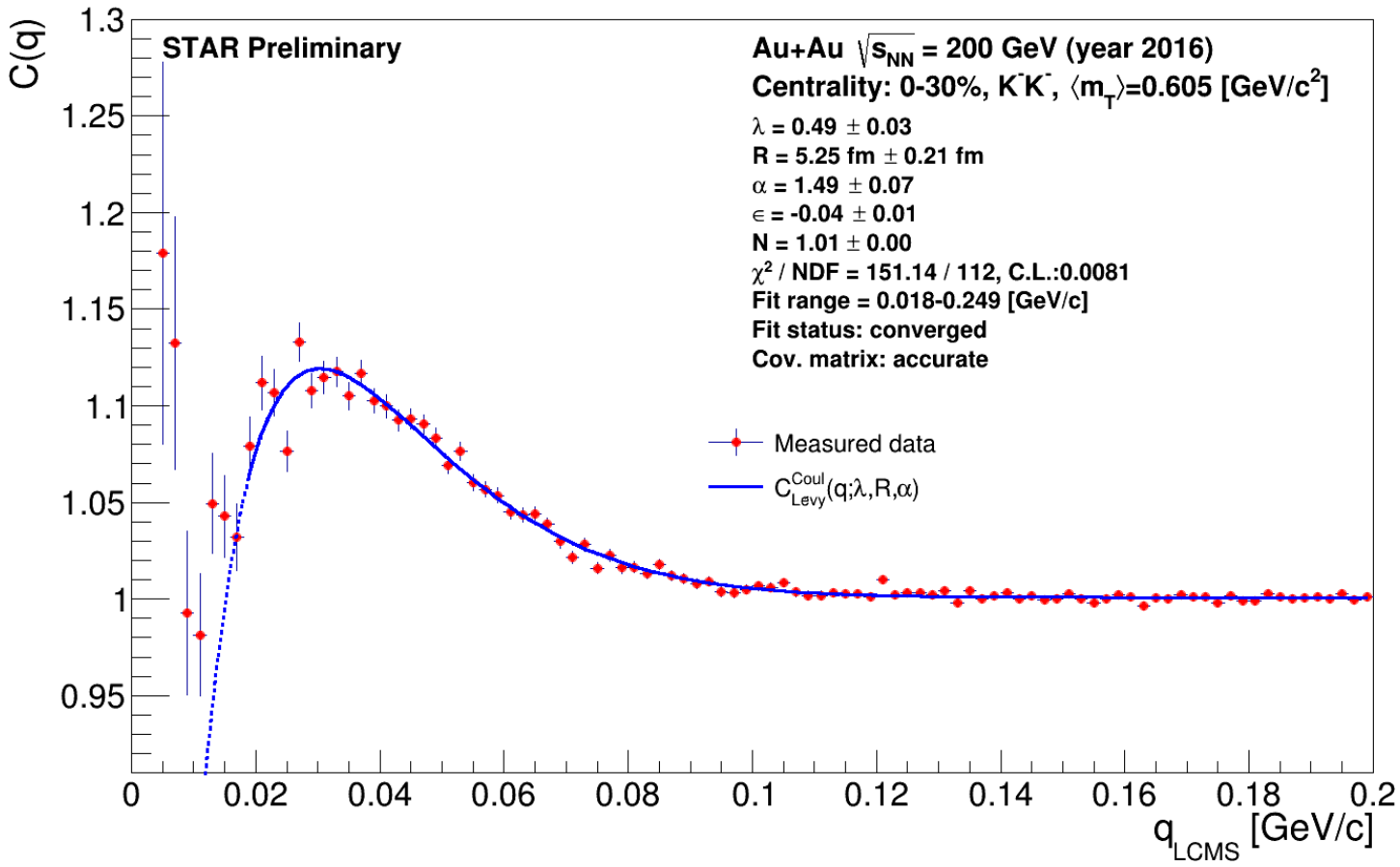
Systematic uncertainties

Qty., m_{T} [MeV/c^2]	$\Delta\mathrm{sys}_{\mathrm{high}}$	$\Delta\mathrm{sys}_{\mathrm{low}}$
R [fm], 605	0.82	0.68
R [fm], 668	1.93	2.57
R [fm], 739	0.65	1.23
λ, 605	0.14	0.12
λ, 668	0.40	0.53
λ, 739	0.17	0.30
α, 605	0.23	0.25
α, 668	0.22	0.36
α, 739	0.20	0.50

The systematic uncertainties are obtained by combining uncertainties from fit-stability calculations and from varying pair-cut settings as:
$\Delta\mathrm{sys} = \sqrt{(\Delta\mathrm{fits})^2 + (\Delta\mathrm{cuts})^2}$.

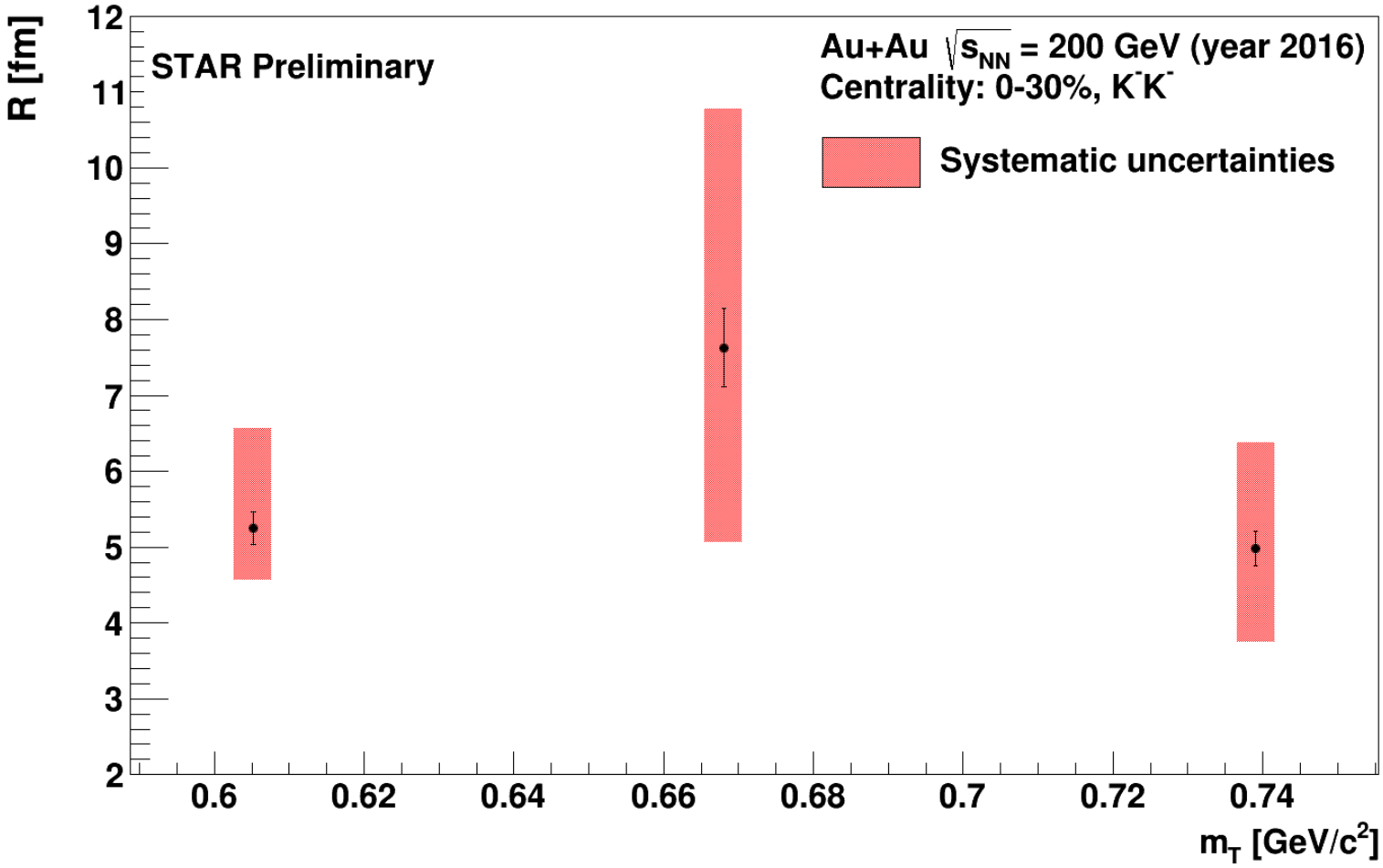
Systematic uncertainties arising from varying track-cut settings are yet to be calculated.

Fitted correlation function



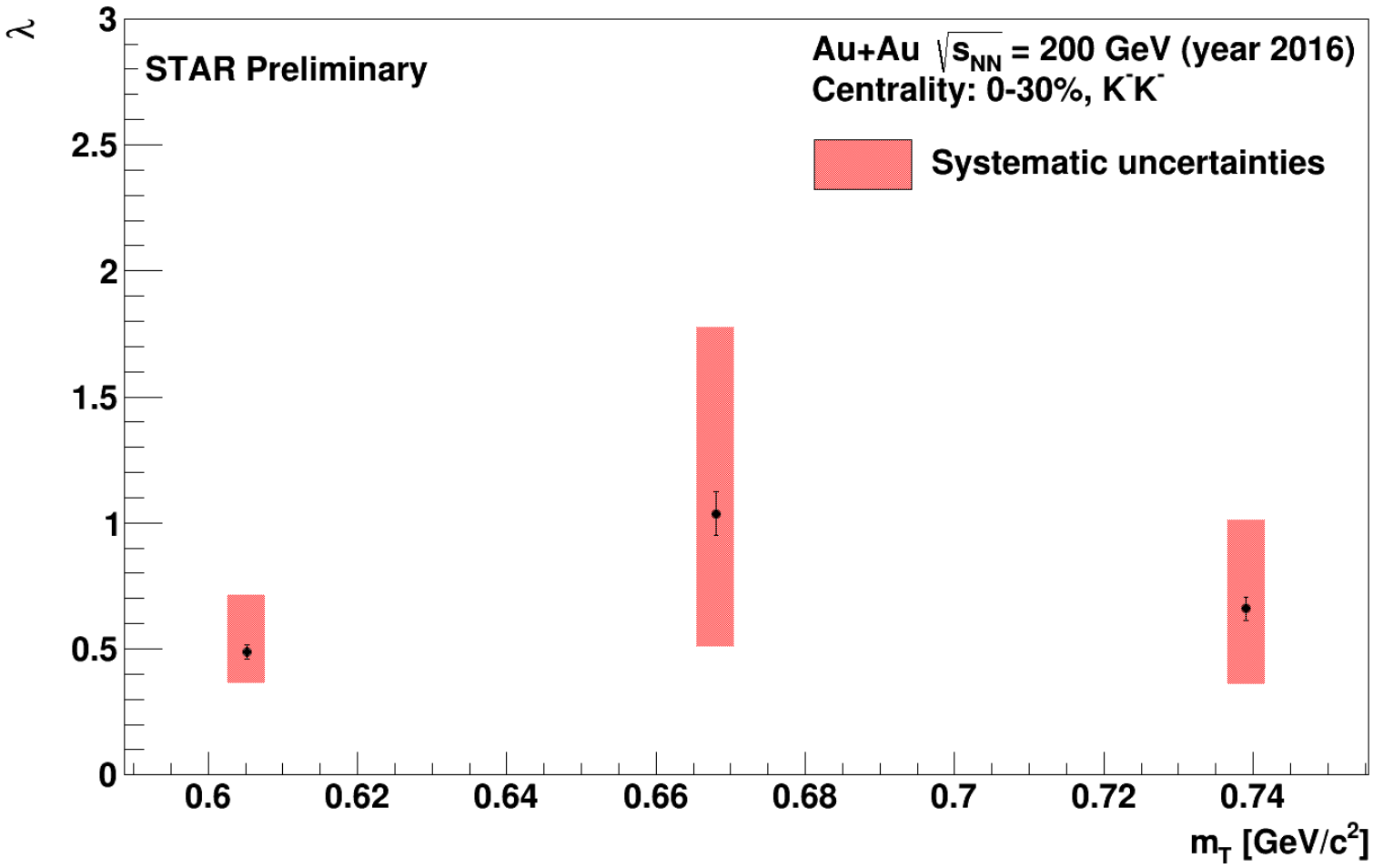
- Low-q peaking suggests unsolved problems $\rightarrow$ under investigation.
- An α value less than 2 shows the possibility of the existence of non-Gaussian sources.

Fit parameter: R



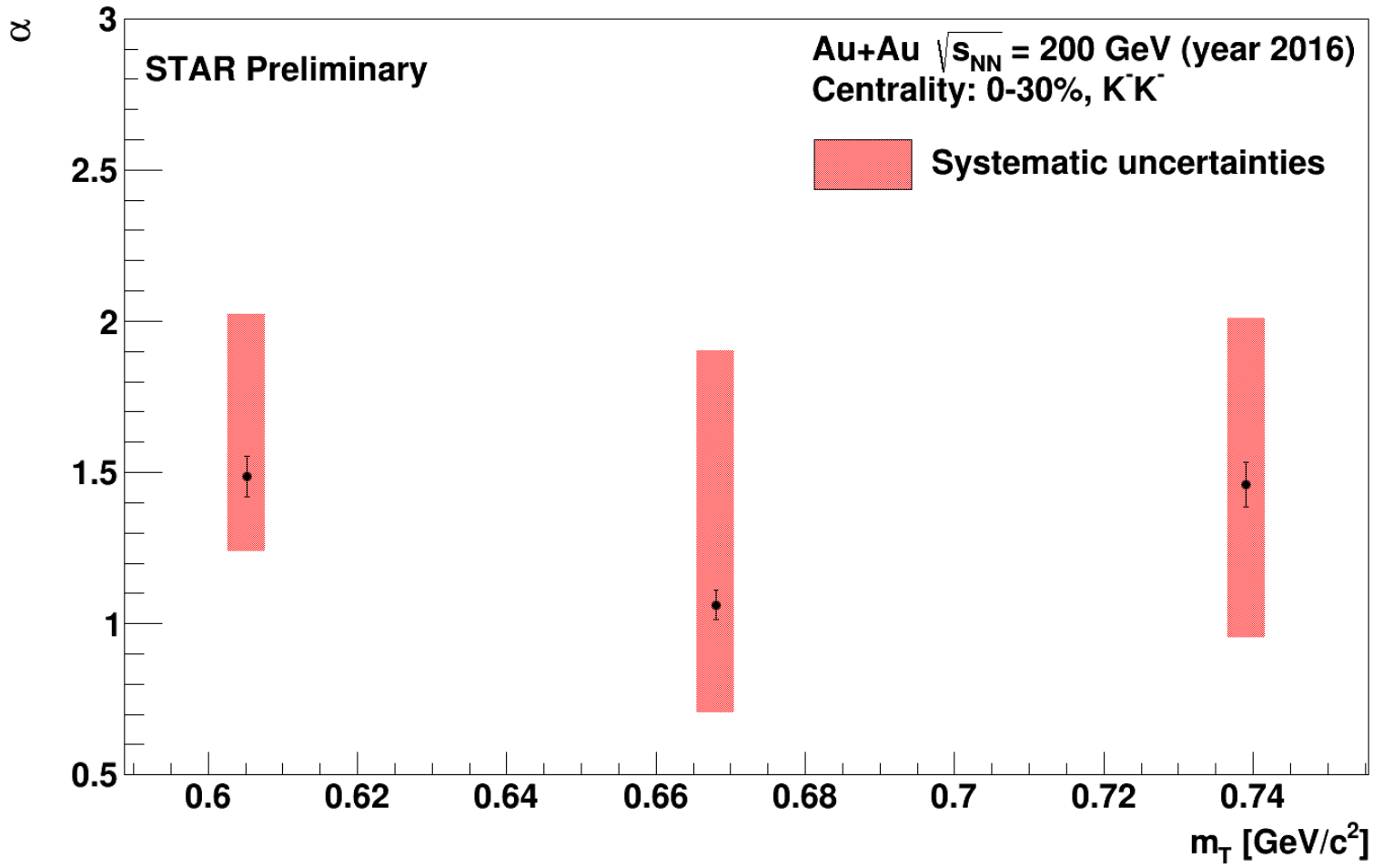
Sys. unc. high for $m_{\mathrm{T}} = 668$ MeV/c^2, suggesting low accuracy.
Systematic uncertainties arising from varying track-cut settings are yet to be calculated.

Fit parameter: λ



Sys. unc. high for $m_{\mathrm{T}} = 668$ MeV/c^2, suggesting low accuracy.
Systematic uncertainties arising from varying track-cut settings are yet to be calculated.

Fit parameter: α



Sys. unc. high for $m_{\mathrm{T}} = 668$ & 739 MeV/c^2, suggesting low accuracy.
Systematic uncertainties arising from varying track-cut settings are yet to be calculated.