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Adaptation of the THERMINATOR model for BES program

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One of the most important goals of heavy-ion physics at lower collision energies is to scan phase diagram. In order to understand properties of the system created at such collisions theoretical description of models are needed. One of such implementations is **THERMal heavy IoN generATOR**.

THERMINATOR [1, 2] is a Monte Carlo event generator designed for studying of particle production in relativistic heavy-ion collisions performed at such experimental facilities as the SPS, RHIC, or LHC. The program implements thermal models of particle production with single freeze-out.
Current implementation uses BlastWave model [3]

[1] A. Kisiel,T. Tałuć, W. Broniowski, W. Florkowski, Comput.Phys.Commun. 174 (2006) 669-687;
[2] M. Chojnacki, A. Kisiel, W. Florkowski, W. Broniowski, arXiv:1102.0273 [nucl-th]
[3] F. Retiere, M. Lisa, Phys.Rev. C70 (2004) 044907

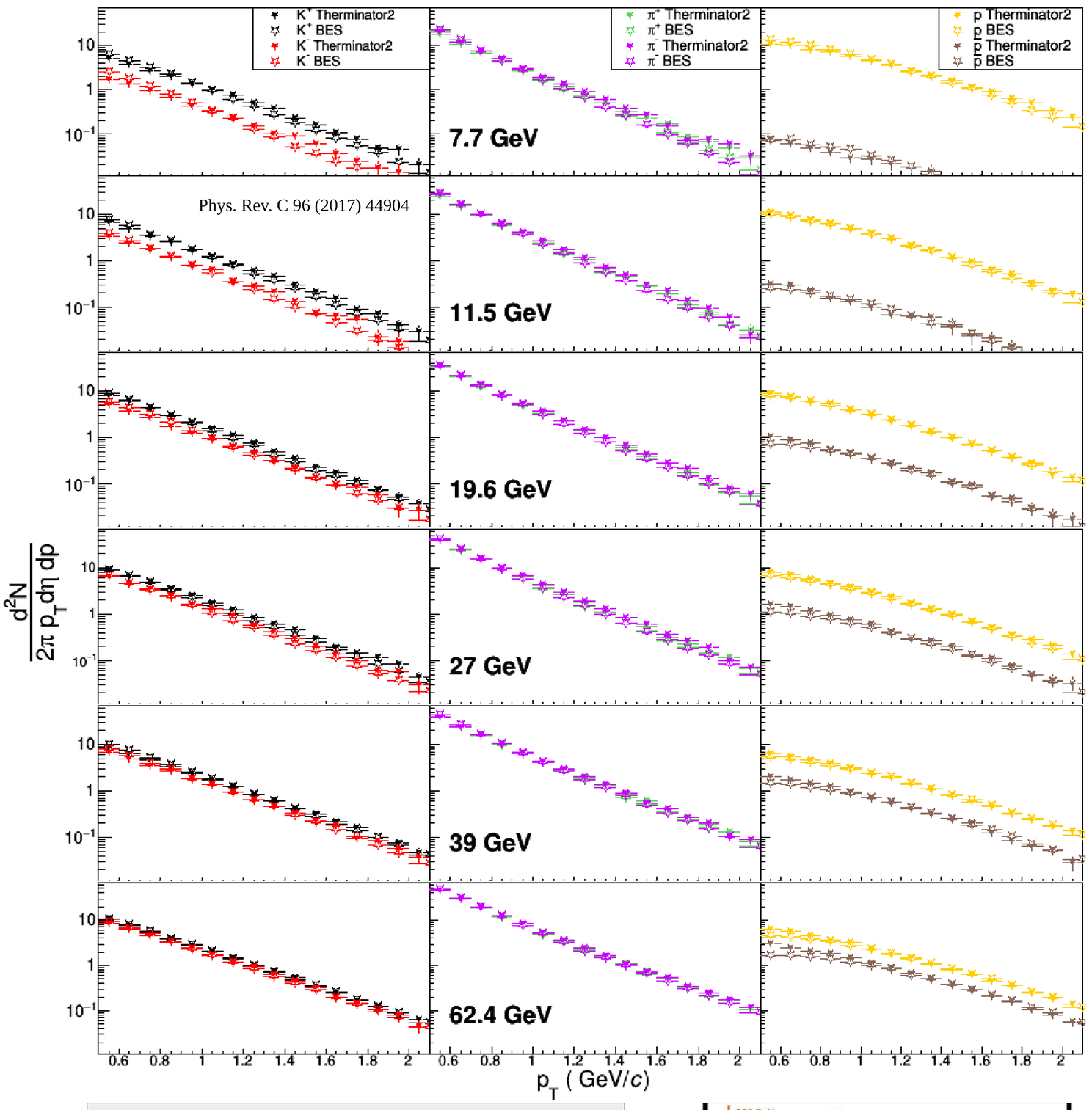
THERMINATORS' parameters:
- *thermodynamical*: temperature (**T**) and chemical potentials: barion (μ_B), strangeness (μ_S), third component of isospin (μ_{I3})
- *geometrical*: mean lifetime (τ), source size at freeze-out (ρ_{max})
- *dynamical*: Velocity (V_t)

$$\rho_{max}^2 \cdot \tau \sim V$$

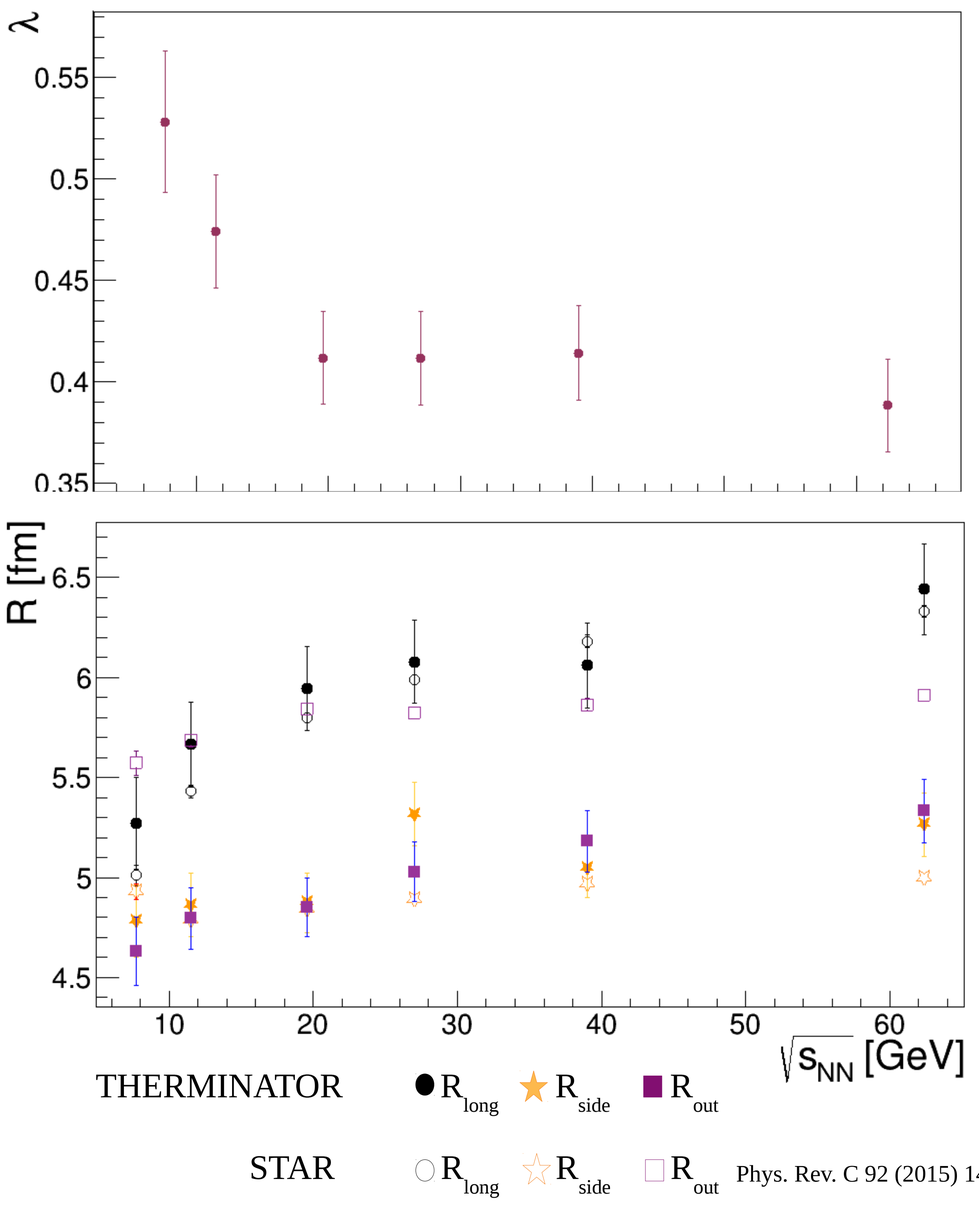
$\sqrt{s_{NN}}$ [GeV]	T [MeV]	μ_B [MeV]	μ_{I_3} [MeV]	μ_S [MeV]
7.7	139.0	406.4	-10.5677	93.4685
11.5	150.1	303.2	-7.9697	69.9562
19.6	156.2	196.8	-5.2882	45.6875
27	157.6	149.0	-4.0845	34.7938
39	158.4	106.9	-3.0241	25.1974
62.4	158.8	68.9	-2.0676	16.5409

"Therminator generator adaptation to the conditions of RHIC and FAIR experimantal complexes", Engineer's Thesis, Monika Seniut

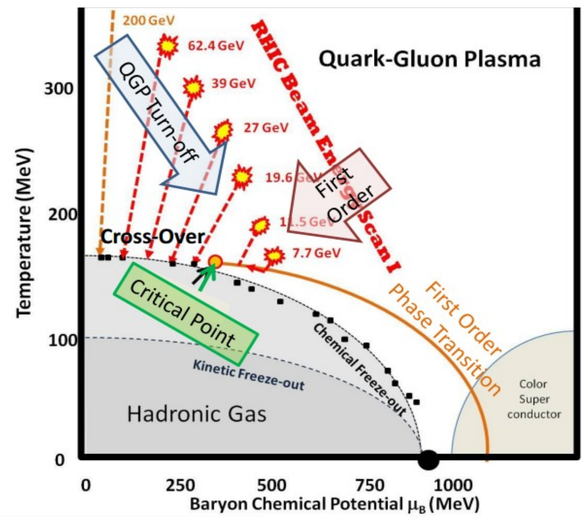
$\sqrt{s_{NN}}$ [GeV]	7.7	11.5	19.6	27	39	62.4
ρ_{max}	8	8	8.2	8.85	8.7	9
τ	8.3	8.35	8.75	8.75	8.6	9.4
V_t	0.65	0.8	0.85	0.8	0.75	0.75

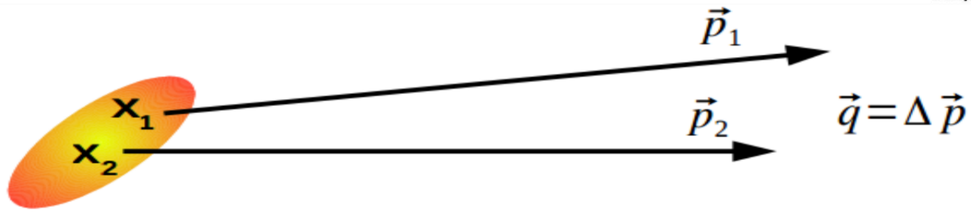


Femtoscopy of two particles investigates the properties of matter produced in heavy-ion collisions. Two-particle correlations use **Quantum Statistics** and the Final State Interactions which allow one to examinate the space-time characteristics of the medium.



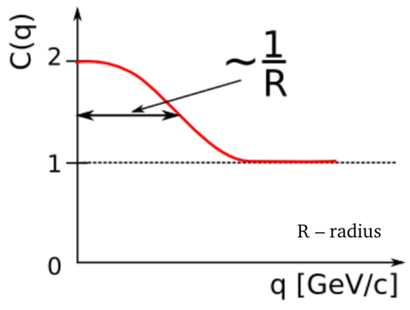
Goal of the RHIC
Beam Energy Scan Program:
- Search for turn-off of QGP signatures
- Search for the QCD critical point
- Search for the signals of phase transition





- analize many pairs of particles $(\vec{p_1}, \vec{x_1})$ and $(\vec{p_2}, \vec{x_2})$ with relative momentum $\vec{q} = \vec{p_1} - \vec{p_2}$
- calculate correlation function (CF) of pairs:

$$CF(\vec{p_1}, \vec{p_2}) = \frac{P_2(\vec{p_1}, \vec{p_2})}{P_1(\vec{p_1}) P_1(\vec{p_2})}$$



- **Hydrodynamical evolution of the source is not implemented**
- **Transverse momentum distributions of single particles agree well**
- **Femtoscopic parameters:**
  - **R_{long} and R_{side} are mostly overestimated (still within error-bars)**
  - **R_{out} are underestimated**
- **Another freeze-out hypersurface should be used for BES program**