Within GSAM the plateau-like behavior of the hadronic ratios obtained by the realistic version of the hardon resonance gas model (HRGM) [1] allows us to reveal, at chemical freeze-out (CFO), remarkable irregularities such as an abrupt change of the effective number of degrees of freedom and plateaus in the collision-energy dependence of the entropy per baryon, total pion number per baryon, and thermal pion number per baryon at lab energies 6.9-11.6 GeV [2]. Using the shock adiabat model we show that these plateaus give evidence for thermodynamic anomalous properties of the mixed phase at its boundary with the quark-gluon plasma (QGP). This result is supported by an independent meta-analysis [3]; we compare the quality description of model spectra and multiplicities of strange hadrons for 10 different models and find that at $\sqrt{s_{NN}} \approx 5 - 10$ GeV and above 13.5 GeV the models with QQM existence perform notably better, while at 4.3-4.87 GeV and 10-13.5 GeV the QGM models perform as good as purely hadronic ones.

**Generalized shock adiabat model (GSAM) of central nuclear collisions**

- Evolution of system along the Rankine-Hugoniot-Taub abitut [3]: $(p+\rho_0)X^2 - (p+\rho_0)(X+X_0) = 0$, $X_0 = (p_0 + \rho_0)/\rho_0^2$ (index 0 corresponds to initial state).
- Collision energy per nucleon mass
  $$E_{lab}^{CM} = \frac{(p_0 + \rho_0)(p_0 + \rho_0)}{(p_0 + \rho_0) + (p_0 + \rho_0 + \rho_0)} = 1$$
- Equation of State: MIT Bag model for QGP, HRGM with smummed spectrum for hadronic matter [1, 2].
- One phase regions $\Rightarrow$ thermodynamically normal properties $(\frac{\rho}{\rho_M} > 0)$. Two phase regions $\Rightarrow$ thermodynamically anomalous properties $(\frac{\rho}{\rho_M} < 0)$.

The anomalous properties of mixed phase (A_nA_2B) lead to instabilities of shock transitions into the region A_2B (see fig. p.X). In this case a single shock to the region A_2B should be replace by the shock from D to A_2 (Chapman-Jouguet point) and by a compressional simple wave starting at point A_2 (see collision sketch). For such a solution the entropy is conserved, i.e., the ratio $s/n_B$ = const, because the whole entropy production is generated by a shock OA_2 at the A_2 point. This means that by increasing $E_{lab}$ one generates more compressed states which have the same value of $s/n_B$. Thus, one gets the plateau in $E_{lab}$ dependence of $s/n_B$. The important physical consequence of such an instability is an appearance of quasi-plateau in the collision-energy dependence of the total number of pions per baryon, i.e., $p_{\pi^\pm}/p_B$ $\approx$ const [3], provided by the entropy conservation during the subsequent expansion of the hydrodynamic flow formed by the GSA.

**Determination of plateaus**

Mixed phase anomalous properties $\Rightarrow$ plateaus in $s/n_B$, $p_{\pi^\pm}/p_B$, $p_{\pi^\pm}/p_B$ energy dependence [3]. CFO data show them:

- The plateaus heights $R_A$, for $A \in [s/p_B, p_{\pi^\pm}/p_B, \rho_0^2]$.
- The plateaus are generated by the same physical cause $\Rightarrow$ they have the same width $\Delta M > 1$, $\delta A$ denotes its beginning.
- The plateaus are correlated to each other if $\chi^2/\delta A < 1$.

It is necessary to find the set of wisdest correlated plateaus.

**Minimization of $\chi^2$**

$$\chi^2 = \frac{1}{3M - 3\sum_i k_i} \sum_{i,k_i} \frac{(R_i - A_i)^2}{\delta A_i}$$

**Meta-analysis of data**

- Quality of Data description (QDD):
  $$\chi^2 = \frac{1}{3M - 3\sum_i k_i} \sum_{i,k_i} \frac{(R_i - A_i)^2}{\delta A_i}$$

**Conclusions**

- On the basis of high quality experimental data it is found that narrow range of collision energy $E_{lab} = 6.9 - 11.6$ GeV contains remarkable irregularities in various thermodynamic quantities.
- With GSAM the plateau-like behavior of $s/n_B$ is explained as a signal of mixed phase formation.
- The most promising regions of c.m. collision energy to probe at FAIR and NICA are 3.8-4.9 GeV and 10-13.5 GeV.

**References**