Strangeness production in Carbon-nucleus interactions and the upgrade program of the BM@N experiment

QM-2019, Wuhan, China, 4-9 November 2019

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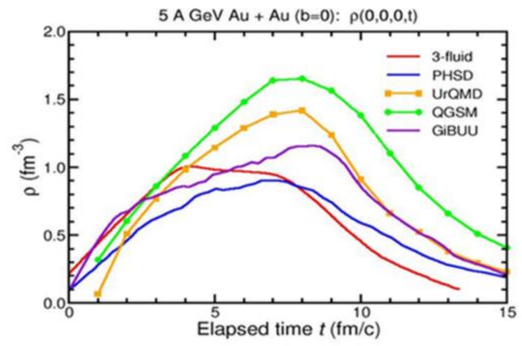
BM@N detector and physics

Nuclotron at JINR:

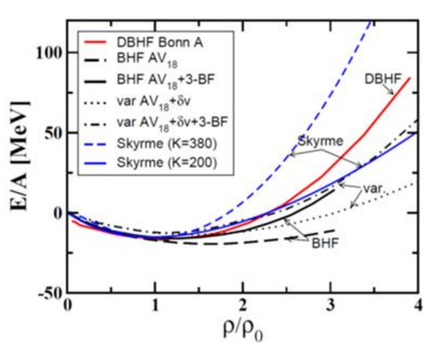
- Gold beams with kinetic energies from 2-4.5 AGeV
- Densities from 3-5 ρ_0



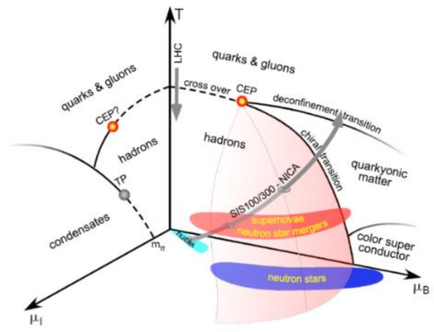
I.C. Arsene et al., Phys.Rev.C75, (2007) 034902

Physics case and observables:

- High density equation-of-state, new phases of QCD matter
- Collectivity, fluctuations, correlations, multi-strange hyperons
- *ΛN, ΛNN, ΛΛN* interactions: (multi-) Lambda hypernuclei

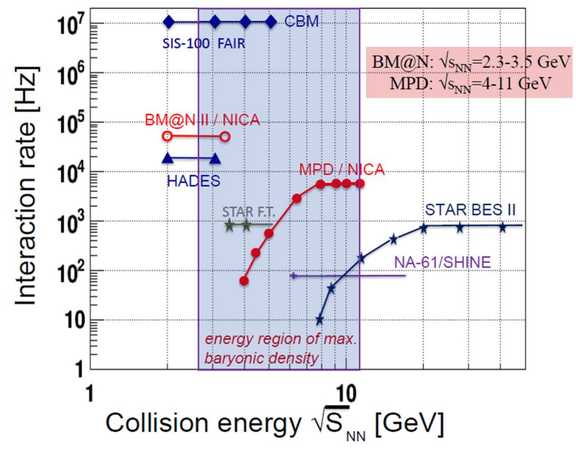


Ch. Fuchs, Prog.Part.Nucl.Phys. 56 (2006) 1



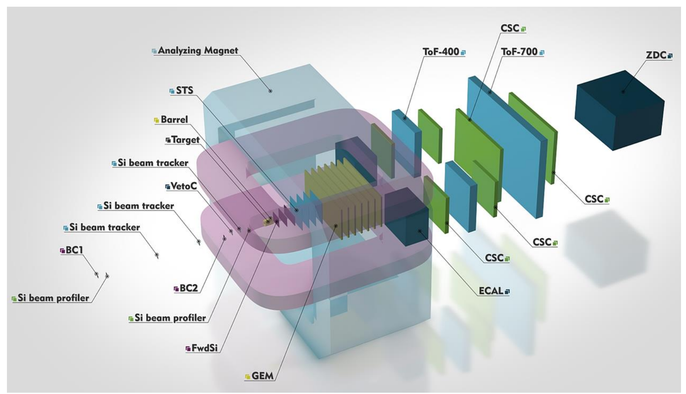
NUPECC Long Range Plan 2017

Rate capabilities of heavy-ion experiments:



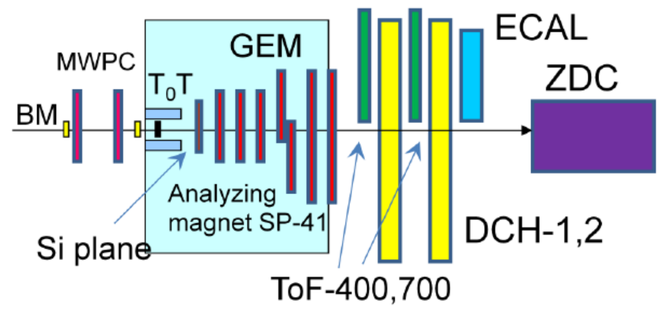
BM@N detector:

- Central tracker (GEM+Fwd Si+STS) inside analyzing magnet for track reconstruction; 7x2 big GEM detectors of 163x45 cm^2 with strip pitch of 0.8 mm, strip inclination angles of 0, 15°
- Outer tracker (DCH/CPC) behind magnet to link central tracks to ToF detectors
- ToF system based on mRPC and T0 detectors to identify hadrons and light nuclei
- ZDC calorimeter to measure centrality of *AA* collisions and form trigger
- Detectors to form T0, Level 1 trigger and beam monitor

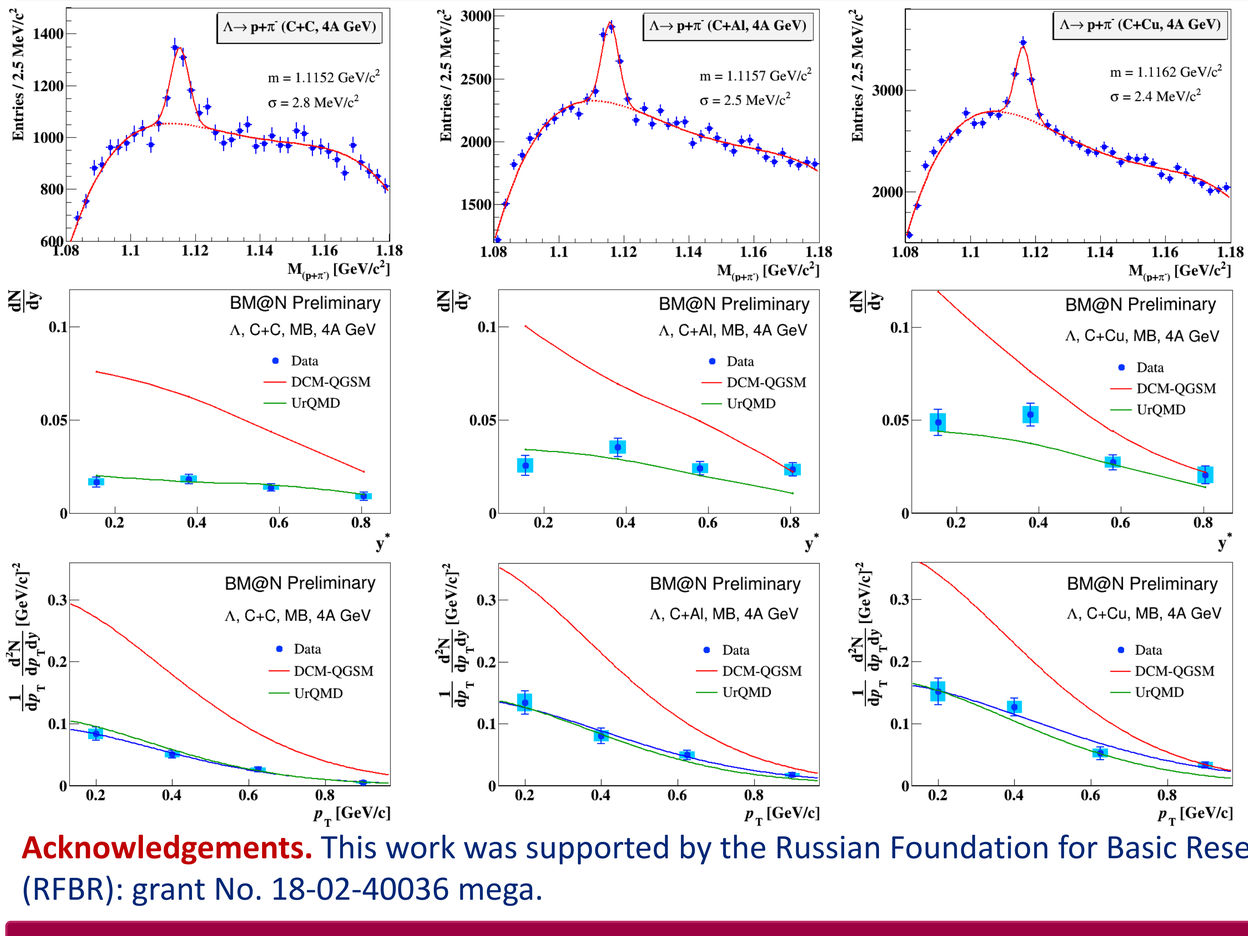


BM@N set-up in the March 2017 run:

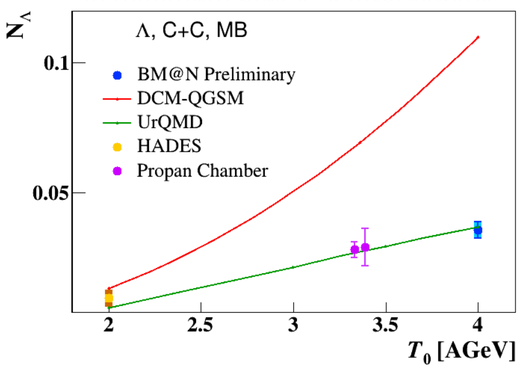
***C + C, Al, Cu, Pb* with a *C* beam of 3.5 - 4.5 AGeV**



Λ hyperon production in Carbon-nucleus interactions



Energy dependence of Λ hyperon yields in minimum bias *C+C* interactions



Next plans→ add results for 3.5 and 4.5 AGeV Carbon-nucleus interactions

Inverse slope *T* of invariant p_T spectra

$1/p_T \cdot d^2N/dp_T dy = A \cdot \exp(-(m_T - m_\Lambda)/T)$, $m_T = \sqrt{(m_\Lambda^2 + p_T^2)}$

	T [MeV] *C+C*	*T* [MeV] *C+Al*	*T* [MeV] *C+Cu*
BM@N Preliminary	**113±14±11**	**146±19±15**	**170±24±20**
DCM-QGSM	124±4	123±4	130±4
UrQMD	105±4	123±4	133±4

Λ hyperon yields and cross sections in 4 AGeV *C+A*

	C+C	*C+Al*	*C+Cu*
Acceptance, efficiency in the measured kinematic range / Extrapolation factor to the full kinematic range	0.028 2.76	0.023 3.08	0.021 4.26
Λ yield in the measured kinematic range $0.1<p_T<1.05$ GeV/c, $0.03<y^*<0.93$	0.0129 ±0.0011 ±0.0012	0.0241 ±0.0020 ±0.0019	0.0333 ±0.0026 ±0.0024
Λ yield in the full kinematic range, N_Λ	0.0355 ±0.0031 ±0.0033	0.0744 ±0.0062 ±0.0058	0.142 ±0.011 ±0.012
Λ min bias cross section σ_Λ [mb] $\sigma_\Lambda = N_\Lambda \cdot \sigma_{inel}$	29.5 ±2.6 ±2.1	93.8 ±7.8 ±6.3	254 ±20 ±20

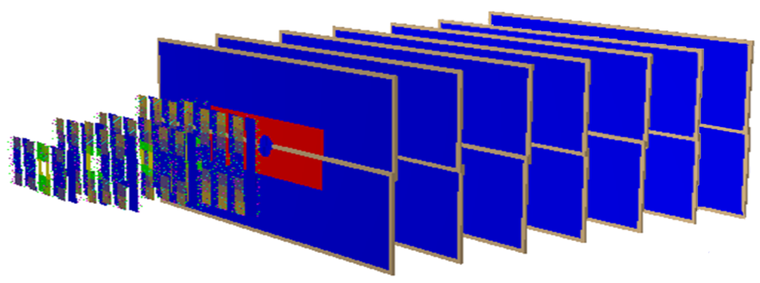
Acknowledgements. This work was supported by the Russian Foundation for Basic Research (RFBR): grant No. 18-02-40036 mega.

Upgrading the BM@N experiment at NICA for studies of dense nuclear matter

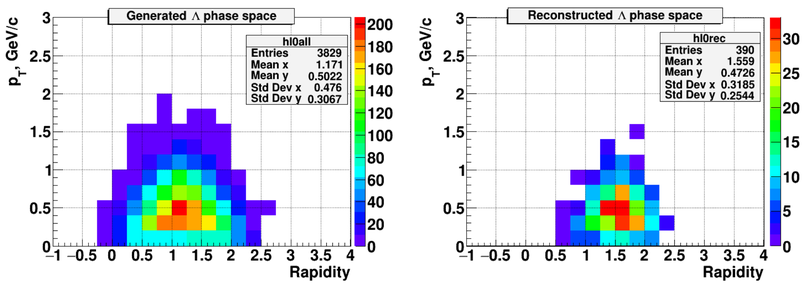
The new BM@N hybrid tracker: 4 layers silicon sensors and 7 GEM stations

Simulations of central *Au+Au* collisions at 4 AGeV with the QGSM event generator based on the BM@N hybrid tracker

Model of the Silicon and GEM stations in the simulations

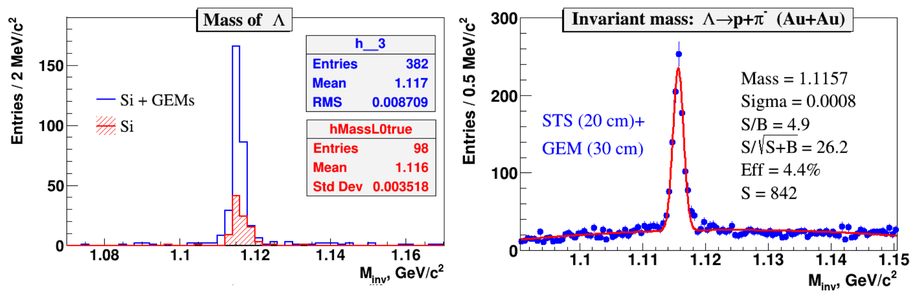


Phase space of Λ

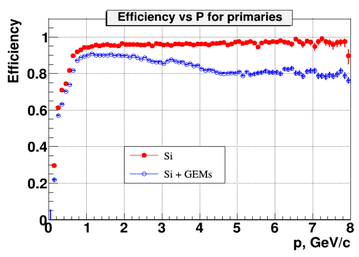


Generated Reconstructed

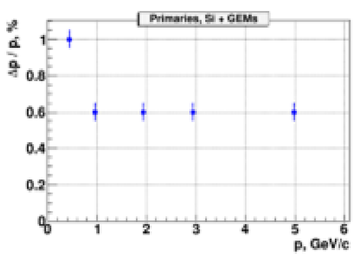
STS + GEM: $\varepsilon(\Lambda)$ =10% without PID for *p* and π



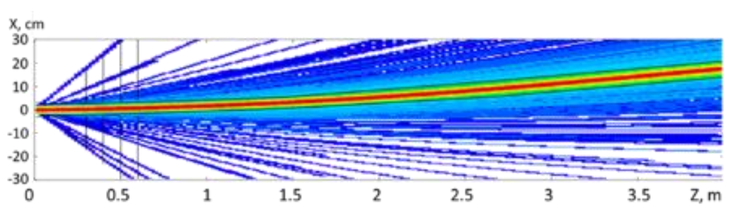
Tracking efficiency



Momentum resolution



Fluka calculations: *Au*-beam 4.5 AGeV with beam pipe



Work in progress:

- Construction of the Silicon tracker (see poster by D. Dementiev)
- Construction of the missing GEM stations
- Construction of the beam pipe from the Nuclotron to and through the BM@N set-up
- Next BM@N physics run in 2021
- Full hybrid tracker set-up in 2022