EMERGING FACILITIES AROUND THE WORLD FOR STRONG INTERACTION PHYSICS

- **Introduction:**
  - What is the QCD phase structure?
  - No guidance from Lattice for high $\mu_B$
  - $2 < \sqrt{s_{NN}} < 8$ GeV → Large discovery potential (1st order transition? QCD critical point? Equation of State of dense matter (relevance for NS merger)?)

- **Overview of high $\mu_B$ facilities worldwide**
  - Key parameters, anticipated start time
  - Interaction rate capabilities

- **Details on**
  - FAIR facility + HADES/CBM
  - NICA facility + BM@N and MPD
  - SPS NA60+
  - SPS NA61/SHINE+

- **Anticipated physics performance (selected cases: dileptons, e-b-e fluctuations, multi-strange, hyper nuclei)**
MATERIAL

- 93. Nuclotron-based Ion Collider Facility at JINR (NICA Complex)
- 13. Proposal from the NA61/SHINE Collaboration for the update of the European Strategy for Particle Physics
- 90. Study of hard and electromagnetic processes at CERN-SPS energies: an investigation of the high-µB region of the QCD phase diagram
- 116. IN2P3 contribution for the update of European Strategy for Particle Physics
- 80. Input of Joint Institute for Nuclear Research
- 21. Initial contribution of the INFN Hadron Physics Community
SEARCHING FOR LANDMARKS OF THE QCD MATTER PHASE DIAGRAM

- **Vanishing $\mu_B$, high T (lattice QCD)**
  - Crossover, universality
  - no CP indicated by lattice QCD at $\mu_B < 400$ MeV, $T > 140$ MeV

- **Large $\mu_B$ moderate T (IQCD inspired models)**
  - Thermal equilibrium?
  - 1st order transition?
  - QCD critical point?
  - Equation of state of dense matter?

A. Andronic et al., Nature 561 (2018) no 7723
F. Becattini et al., PLB 764 (2017) 241
HADES preliminary, Quark Matter 2018
<table>
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<th>Facility</th>
<th>SIS18</th>
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<th>Nuclotron</th>
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Program needs high precision data

- High intensity beams
- Multipurpose detectors:
  - Large acceptance, high efficiency
  - Trigger-less, free streaming read-out electronics with high bandwidth online event selection
- Substantial progress in detector technologies (mainly driven by ALICE upgrade, CBM and sPHENIX)
- High-performance / scientific computing