

## Phase diagram of QCD with helically imbalanced quarks

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Due to the recent STAR data on the polarization of the  $\Lambda$  hyperons produced in heavy ion collisions, it is interesting to consider the QCD phase transition in a medium exhibiting persistent polarization. Since during the chiral phase transition, the quarks acquire dynamical mass and the conservation of the axial charge current  $J_A^\mu$  is broken, the chiral chemical potential  $\mu_A$  is not suitable to thermodynamically account for the fermion polarization. Noting that the helicity current  $J_H^\mu$  remains conserved even at finite fermion mass, we propose to model the fermion polarization via the helicity chemical potential  $\mu_H$ . In the framework of the linear  $\sigma$  model with quarks, LSM<sub>q</sub>, we show that the vector and helical chemical potentials  $\mu_V$  and  $\mu_H$  form a dual pair, due to the symmetry of the free energy  $\Omega(\mu_V, \mu_H) = \Omega(\mu_H, \mu_V)$ . In this talk, we discuss on the impact of a finite  $\mu_H$  on the phase diagram associated with the chiral phase transition with a particular focus on the new critical points that emerge at sizable  $\mu_H$ .

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