

1 Probing the spin dynamics of QCD medium and initial strong
2 magnetic field in heavy-ion collisions via global spin alignment
3 of vector mesons at RHIC

4 Subhash Singha and Gavin Wilks (for the STAR collaboration)

Institute of Modern Physics Chinese Academy of Sciences, Lanzhou
University of Illinois at Chicago, Chicago IL, USA

5 **Abstract**

6 In non-central heavy-ion collisions (HIC), the large initial angular momentum can induce
7 a non-vanishing polarization for hadrons with non-zero spin. The global spin alignment
8 of vector mesons, quantified by the 00^{th} element of spin density matrix (ρ_{00}), can offer
9 information on the spin-orbital interactions of the QCD medium. Surprisingly large signal
10 of vector meson ρ_{00} compared to hyperon spin polarization poses challenges to the con-
11 ventional theoretical understanding of polarization in HIC. Preliminary observations from
12 Beam Energy Scan (BES-I) of large deviations of ρ_{00} from 1/3 for ϕ mesons can only be
13 explained by introducing the vector meson strong force fields.

14 In this talk, we will present transverse momentum and collision centrality dependence of
15 ϕ , K^{*0} , \overline{K}^{*0} , K^{*+} , and K^{*-} vector mesons using recent high statistics Beam Energy Scan
16 (BES-II) data of Au + Au collisions at $\sqrt{s_{NN}} = 7.7 - 27$ GeV, and isobar collisions (Zr+Zr
17 and Ru+Ru) at $\sqrt{s_{NN}} = 200$ GeV. The BES-II data will provide unprecedented precision
18 in ρ_{00} at these energies. Comparison of ρ_{00} between Au+Au and isobar species can provide
19 information on the system size dependence of ρ_{00} . Moreover, since the magnetic moment
20 of charged and neutral K^* differ by a factor of seven, the comparison of their ρ_{00} may serve
21 as a new probe for the initial strong magnetic field in HIC.