Spin polarizations in a covariant angular momentum conserved chiral transport model

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Based on the side-jump formalism for the scattering of chiral fermions, we have constructed a transport model that conserves the total angular momentum of the quark matter created in relativistic heavy-ion collisions [1]. Via the introduction of a covariant angular momentum tensor, the spin polarization of massless quarks then has both spin and orbital contributions. In the case of an expanding

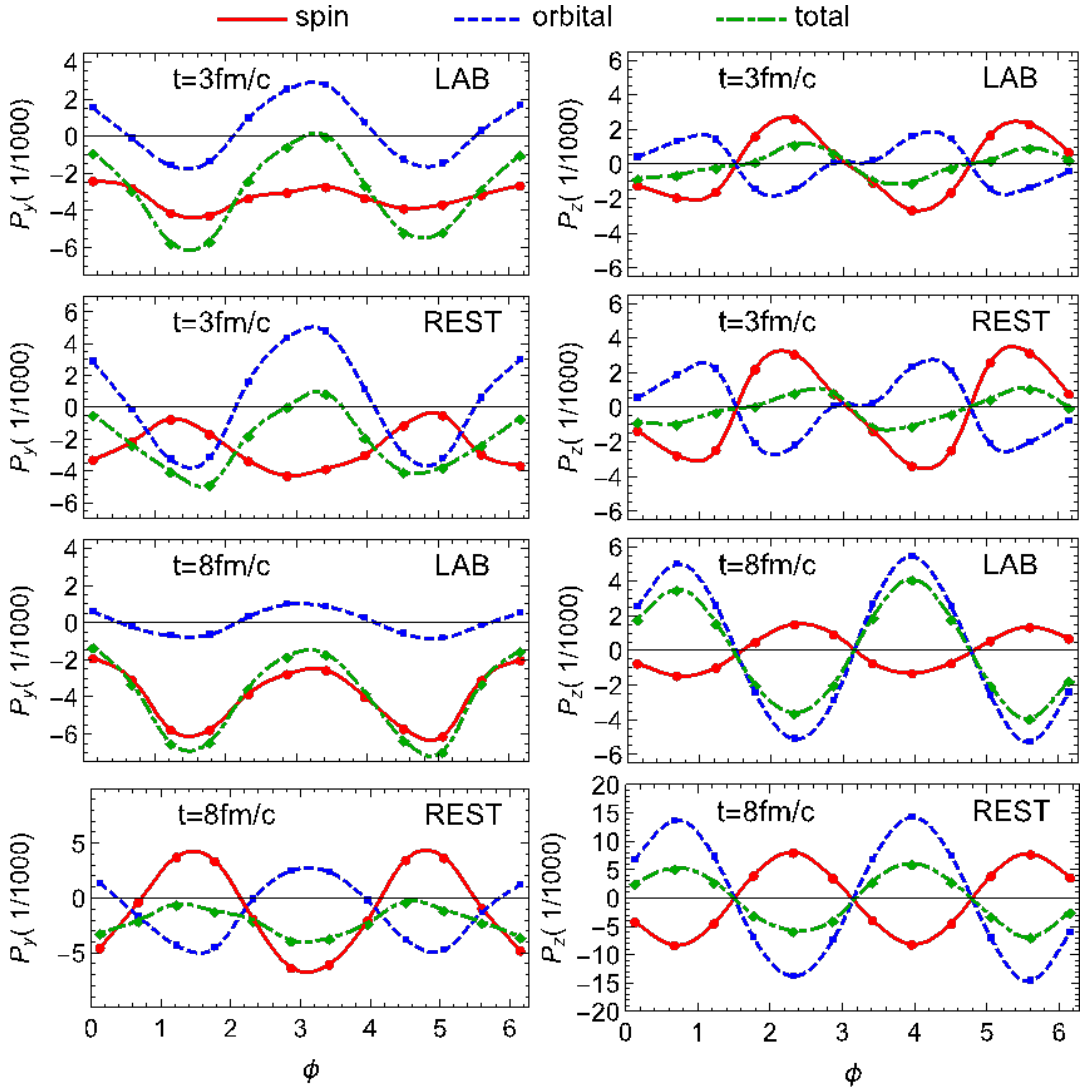

Fig. 1. Azimuthal angle φ dependence of spin polarizations P_y along the y-direction and P_z along the z-direction in the LAB and medium rest (REST) frame at times t = 3 and 8 fm/c.

box with a given vorticity field, we have found that the final quark spin polarization is consistent with that expected from the thermal model. For the case of a heavy ion collision using initial conditions from the realistic AMPT model [2], the chiral vortical effect is found to lead to a redistribution of the axial charges in the produced quark matter, resulting in the appearance of dipole and quadrupole structures in the transverse plane of heavy ion collisions. As shown in Fig. 1, including both the spin and orbital contributions of these redistributed quarks to the quark local spin polarizations, we have found that their azimuthal angle dependence along the transverse (P_y) and longitudinal (P_z) directions in the medium rest frame are similar to those obtained from a chiral kinetic theory [3] and also of Lambda hyperons observed in experiments [4].

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