Magnetic Quasiparticles in sQGP Explain "Perfect Liquid" Observed at RHIC

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Although "dual superconductor" nature of confinement was suggested by 't Hooft and Mandelstam long ago, the importance of magnetic quasiparticles near deconfinement transition and their relation to the "perfect liquid" observed at RHIC were realized only last year. In the RHIC region $T = 1 - 2T_c$ both electric and magnetic quasiparticles are important degrees of freedom. They are about equally massive and abundant at $1.4T_c$ and below this T the magnetic ones get lighter, more weakly coupled, and become the dominant component. Evidences of this phenomenon are accumulating from lattice, including: direct measurements of monopole density and their spatial correlations; magnetic screening mass which exceeds electric one; the persistence of "flux tube" -related linear potential, seen in potential energy and entropy associated with static quarks on the lattice. The last one is quite challenging to be explained, for which we have developed a successful model.

It has been found that a plasma made of electric and magnetic quasiparticles leads to mutual trapping, similar to "magnetic bottle effect", and explains low viscosity and small diffusion observed at RHIC. Molecular Dynamics (MD) simulation has been carried out for a strongly coupled plasma consisting of totally 1000 charges of both types with variable density ratio of electric/magnetic components. The measured shear viscosity and diffusion constant are the lowest in the maximally mixed plasma (i.e. 50%-50%) which takes the most advantage of trapping effect, and their values after suitable mapping to sQGP system's parameter regions fall very close to those suggested by RHIC experiments. The importance of this effect for understanding such short mean free path as indicated by RHIC is further elucidated by studying the monopole motion in a cubic cell with alternating electric charges sitting at corners.

If this mechanism is the main one responsible for short mean free path, and since it is operative only not too far from T_c, then viscosity/diffusion will grow away from "perfect liquid" regime above $2T_c$ and LHC would show significantly different picture than RHIC.