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Observation of charge-dependent azimuthal correlations and possible local strong parity violation in heavy ion collisions

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Parity-odd domains, corresponding to non-trivial topological solutions of the QCD vacuum, might be created during relativistic heavy ion collisions. These domains are predicted to lead to charge separation of quarks along the orbital momentum of the system created in non-central collisions. To study this effect, we investigate a three particle mixed harmonics azimuthal correlator which is a ¶ even observable, but directly sensitive to the charge separation effect. We report measurements of this observable using the STAR detector in Au+Au and Cu+Cu collisions at $\sqrt{s_{NN}}$=200 and 62 GeV. The results are presented as a function of collision centrality, particle separation in rapidity, and particle transverse momentum. A signal consistent with several of the theoretical expectations is detected in all four data sets. We compare our results to the predictions of existing event generators, and discuss in detail possible contributions from other effects that are not related to parity violation.