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Restricted Euler dynamics along trajectories of small inertial particles in turbulence[1] PERRY JOHNSON, CHARLES MENEVEAU, Johns Hopkins University — The fate of small particles in turbulent flows depends strongly on the surrounding fluid's velocity gradient properties such as rotation and strain-rates. For non-inertial (fluid) particles, the Restricted Euler model provides a simple, low-dimensional dynamical system representation of Lagrangian evolution of velocity gradients in fluid turbulence, at least for short times. Here we derive a new restricted Euler dynamical system for the velocity gradient evolution of inertial particles such as solid particles in a gas or droplets and bubbles in turbulent liquid flows. The model is derived in the limit of small (sub Kolmogorov scale) particles and low Stokes number. The system exhibits interesting fixed points, stability and invariant properties. Comparisons with data from Direct Numerical Simulations show that the model predicts realistic trends such as the tendency of increased straining over rotation along heavy particle trajectories and, for light particles such as bubbles, the tendency of severely reduced self-stretching of strain-rate.

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