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Simultaneous 3D measurement of the translation and rotation of finite size particles and the flow field in a fully developed turbulent water flow[1] MATHIEU GIBERT, SIMON KLEIN, EBERHARD BODENSCHATZ, MPI-DS — We report a novel experimental technique that measures simultaneously in three dimensions the trajectories, the translation, and the rotation of finite size inertial particles together with the turbulent flow. The flow field is analyzed by tracking the temporal evolution of small fluorescent tracer particles. The inertial particles consist of a super-absorbent polymer that renders them index and density matched with water and thus invisible. The particles are marked by inserting at various locations tracer particles into the polymer. Translation and rotation, as well as the flow field around the particle are recovered dynamically from the analysis of the marker and tracer particle trajectories. We apply this technique to study the dynamics of inertial particles much larger in size ($Rp/\eta \approx 100$) than the Kolmogorov length scale η in a von Kármán swirling water flow ($R_\lambda \approx 400$). We show, using the mixed (particle/fluid) Eulerian second order velocity structure function, that the interaction zone between the particle and the flow develops in a spherical shell of width 2Rp around the particle of radius Rp. This we interpret as an indication of a wake induced by the particle. (http://arxiv.org/abs/1205.2181)

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