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Development of data acquisition and control system for quasi-2D turbulent electrolyte flow experiment

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A new experimental device has been designed, manufactured and tested for quasi-2 dimensional turbulence studies in magnetized electrolyte system. This experiment can provide significant information about the interaction of large scale shear flows (zonal flows) and smaller scale turbulent vortices. This physics problem has a relevance in different scientific areas such as the turbulent transport reduction via shear flows in magnetically confined fusion plasmas.

14x14 pieces of N52 10x10x10 mm neodymium magnets have been placed below a plastic container in different geometrical configurations in order to create a large variety of turbulent drives together with a few amps DC electrical current which has been driven through the electrolyte (NaCl). Beside the small vortices induced by the permanent magnets, a large (system-size) seed flow has been also generated by a solenoid placed below the flow. Using this set-up, the interaction of large sheared flows with small scale vortices can be experimentally studied.

This paper describes the whole system: the hardware and the software developed for the turbulent flow experiment described above. In order to evaluate the velocity field of the flow observed by a high resolution camera, PIV (Particle Image Velocimetry) techniques have been used. Matlab, Simulink, sensors and actuators with microcontroller for data acquisition and process control have been implemented. We also developed our own Matlab routines for automated evaluation of the measurements, enabling remote (overnight) data processing.

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