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Study of nonlinear dynamics among zonal flow, GAM, and turbulence on the HL-2A strongly heated L-mode plasmas MIN XU, GEORGE TYNAN, PATRICK DIAMOND, CHRISTOPHER HOLLAND, PETER MANZ, NICOLAS FEDORCZAK, SAIKAT CHAKRABORTY THAKUR, JONATHAN YU, CMTFO, CER, CASS, UCSD, CA 92093, WCI Center for Fusion Theory, NFRI, Daejeon 305-333, Korea;, KAIJUN ZHAO, JIAQI DONG, JUN CHENG, SWIP, P. O. Box 432, Chengdu, China, HL-2A TEAM — Experiments to directly measure the nonlinear energy exchange and interaction among turbulence, zonal flows, and GAMs were carried out on the HL-2A tokamak at the Southwestern Institute of Physics (SWIP) in China. The turbulent kinetic energy was clearly shown to transfer from turbulence with intermediate frequencies (20-60 kHz) to zonal flows (0-5 kHz) and GAMs ($\sim$10 kHz) and to turbulent fluctuations with high frequencies ($>$60 kHz), which also indicates that zonal flows and GAMs compete for turbulent energy as the heating power increased. The turbulent Reynolds stress $\langle \tilde{v}_r \tilde{v}_{pol} \rangle$ profiles were shown consistent with the time-averaged poloidal velocity profiles inferred by time-delay estimation. Other microphysical quantities together with the macro statistical results form a consistent picture that turbulent vortices mediate the energy, momentum, particle transport, and the formation of sheared flows in the edge of plasmas.

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