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Study of nonlinear dynamics among zonal flow, GAM, and turbulence on the HL-2A strongly heated L-mode plasmas[1] MIN XU, KAIJUN ZHAO, JUN CHEN, JIAQI DONG, WENYU HONG, LONGWEN YAN, QINGWEI YANG, XIANMING SONG, YUAN HUANG, LAIZHONG CAI, WULU ZHONG, ZHONGBING SHI, XUANTONG DING, XURU DUAN, YONG LIU, Southwestern Institute of Physics — Experiments to directly measure the nonlinear energy exchange among turbulence, zonal flows, and GAMs were carried out on the HL-2A tokamak at the Southwestern Institute of Physics (SWIP) in China. At various discharge conditions, 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). The turbulent Reynolds stress $\langle \tilde{v}_r \tilde{v}_{pol} \rangle$ profiles were shown consistent with the time-averaged ExB and TDE (time-delay estimation) poloidal velocity profiles. Other micro statistics, such as particle flux $\langle \tilde{n} \tilde{v}_r \rangle$ and vorticity flux $\langle \tilde{v}_r \tilde{\omega} \rangle$, together with the macro equilibrium profiles at various discharge conditions will also be presented, which form a consistent picture that turbulent vortices mediate turbulent energy and momentum and integrate them into sheared flows across the edge plasmas.

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