Quasi-continuous low frequency edge fluctuations in the W7-X stellarator

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We have observed quasi-continuous low frequency (150-400 Hz) n=0 edge oscillations via multiple diagnostics in Wendelstein 7-X for some magnetic configurations. These events appear to originate at mid-radius, losing energy outwards to the walls, while a weak cold wave propagates towards the core. They are characterized by easily observable decreases in plasma kinetic energy (via diamagnetic loops) and simultaneous large ($\Delta I/I$ = 300%) transient plasma current increases, albeit on a small net plasma current (<1kA). Core and edge responses occurs after the initial (~1-3%) global energy drop on each event. Fast cameras and segmented Rogowski diagnostics show an overall m=0 edge brightening, while electron cyclotron emission show an electron temperature fluctuation inversion point at mid-to-outer-radii. Using fiber filterscopes at multiple toroidal locations, the n=0 nature of the edge response (H-alpha, Carbon-III emission) is determined. Langmuir probes in the divertor show an edge density increase with each burst. These events are especially visible in so-called “high iota” discharges, when iota-bar is nearly 1 in the core, rising to 5/4 at the edge. Their magnitude is larger with higher input power, and their frequency is increased at higher plasma density. Their associated sawtooth-like energy loss, integrated over one energy confinement time, accounts for ~30% of the total energy loss.