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A survey of the ECE bursting phenomenon in the DIII-D tokamak*

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ECE bursting is a phenomenon in tokamaks where very intense bursts of microwave power are observed at electron cyclotron emission frequencies. The bursts have a narrow frequency width, ˜2-4 GHz, and are generally short lived pulses, ˜2 μs, but are very intense, sometimes as high as milliwatt level, which is much higher than the thermal ECE level of 100's of nanowatts. Since a general observation is that these bursts are more commonly observed in low collisionality, high electron beta plasmas, they are expected to be more prevalent in next step devices where they could strongly affect the microwave diagnostics there. Recent papers have proposed explanations of certain types of ECE bursting, in terms of electron acceleration during edge MHD instabilities [1] or parametric decay instabilities during ECH discharges [2]. A survey of the bursting types in DIII D plasmas shows some agreement with the theory predictions, particularly for the most common type of bursting, that associated with ELMs in low-density H mode discharges. However, some defy explanation, for example the very regular bursts associated with the edge harmonic oscillation (EHO) in QH-mode shots, which exhibit an unusual frequency up-shift from the ECE resonance frequency at the oscillation location. Bursts associated with ELMs, sawteeth, the EHO and other MHD instabilities are discussed and categorized. While the most virulent bursting occurs during ECH discharges, ECH injection is not a necessary condition; however, low collisionality, which is often associated with ECH, does appear to be required.

[1] E. Li, et al, Phys. Plasmas 24, 092509 (2017).
[2] S.K. Hansen, et al, Plasma Phys. Control. Fusion 59 105006 (2017).

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