A characterisation of Alfvénic instabilities at ASDEX Upgrade and its use in the reconstruction of current density profiles.

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In a tokamak plasma, knowledge of the toroidal plasma current profile is essential for the calculation of plasma equilibrium and plasma stability against MHD phenomena. To this end, the study of the behavior and effects of MHD instabilities can reveal considerable information about the current profile within the plasma. In a magnetised plasma, Alfvén Eigenmodes with a characteristic velocity primarily dependant on the safety factor q and density profiles, can be excited through Inverse Landau Damping of resonant fast particles accelerated by Ion Cyclotron range of frequencies (ICRF). Under well defined plasma conditions various types of Alfvén eigenmodes, such as the Toroidicity induced Alfvén Eigenmode (TAE), Beta induced Alfvén Eigenmode (BAE) are excited. A temporal variation of the relevant plasma parameters allows one to make a scan for these types of resonance. In addition, recent experiments have demonstrated the ability of ICRF beat waves specifically, to drive the very same TAE as excited with fast particles. This knowledge, and the new ability to sweep the beat wave frequency make it possible to scan the q-profile during stationary plasma conditions. This technique involves the repeated sweeping of the beat wave frequency in a predetermined pattern through a frequency range that completely covers all TAE gaps. The time resolution provided by this technique is determined by the sweep time of the beat wave frequency. Multiple MHD diagnostics such as reflectometry, Soft-XRay and ECE are then used to localise these driven modes, which in turn provides points to constrain the q-profile reconstruction in addition to those already supplied by other MHD instabilities, such as Sawteeth, Fishbones and when present, Neoclassical Tearing modes. In the future, this may provide a passive diagnosis of the current density profile independent of other such diagnostics at regular time intervals for each discharge that uses ICRF power.