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On the possible injection schemes with the ITER SPI system

The ITER Shattered Pellet Injection (SPI) system will comprise 24 injectors spread over 3 equatorial ports completed by 3 injectors in 3 upper ports. Each injector may be triggered independently to inject a pellet containing a certain mixture of H, D, Ne and Ar. In addition, in the present status of the ITER SPI system design, some freedom exists regarding the pellet size, velocity and the bending of the flight tube (which determines the shard size distribution). This leaves room for envisaging various injection schemes and for some optimization within each scheme.

The idea of using multiple synchronized SPI from equatorial ports in order to maximize the radiated fraction and minimize radiation asymmetries is an obvious example, but will be discussed mainly in other presentations during this meeting.

We will instead focus mainly on the Runaway Electron (RE) issue. Avoiding large RE beams in ITER may require increasing the electron density ne by more than one order of magnitude. The best strategy to reach this goal may be to use a 2-step injection. In a first step, pure H or D pellets would be injected. Then, after a delay leaving time for the H or D pellets to reach the plasma core, pellets containing Ne would follow. JOREK 3D non-linear MHD simulations will be presented that suggest that H or D pellets may indeed reach the core before triggering a thermal quench. The question of how much ne can be raised by superposing such pellets, as well as the impact of the pellet velocity, shard size distribution and ablation model, will be discussed based on integrated modelling with the INDEX code.

In case raising ne proves insufficient, an additional method for RE avoidance could consist in repeatedly injecting pellets during the current quench in order to deplete RE seeds before they have substantially avalanched. Estimates will be shown to support this idea and motivate further studies.

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