Growth Rate of Knock-on Runaway Electron Generation in Tokamaks

The ability to tolerate disruptions is an important issue for high current tokamaks. To minimize the electro-mechanical stresses that can be produced during current quench in a disruption, it has been proposed to inject killer pellets to quench the plasma thermally and thus allow a rapid current decay. A serious concern is that a high electric field will develop which could produce long-lived runaway electrons. Specifically, knock-on collisions can cause an avalanche of runaways. The key quantities in such an event are the growth rates of the avalanche and the energy spectrum of the runaways. Previous works have used the approximation that the runaway distribution generating the knock-on’s have zero pitch angle when calculating the knock-on source. Here, we abandon this approximation and use the actual electron distribution to calculate the knock-on source. Using the bounce-averaged Fokker-Planck code CQL3D, the growth rates and energy spectrum of runaways are calculated and compared with previous results.

1Work supported by U.S. DOE Grant DE-FG03-95ER54309.