Coupled Fokker-Planck and transport simulations of runaway electrons in COMPASS

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An extensive study of discharges with the runaway electrons (RE) generation [J. Mlynar et al. invited, EPS 2018] was performed within several dedicated campaigns at the COMPASS tokamak [Panek et al. PPCF 2016]. The formation of the RE population and its dynamics are strongly sensitive to the background plasma parameters (density, magnetic field, electric field, impurity content etc.). Signals from RE related diagnostics at COMPASS such as HXR or neutron detectors correspond to high energy RE losses. The low energy part of the RE population and its losses are given by the ECE radiometer and the Cherenkov detector respectively. The lack of direct measurement of the RE momentum distribution function motivates us to use sophisticated numerical models as a complementary tool to obtain more comprehensive information and insight. Presented RE simulations are based on coupling of the fast transport code METIS [Artaud et al. NF 2010] and the 1D + 2V relativistic bounce-averaged kinetic Fokker-Planck solver LUKE [Decker and Peysson, EUR-CEA-FC 2004]. The LUKE code includes avalanche source of RE, radiation losses, fast particles radial transport with phase-space dependence and trapping effect. The METIS-LUKE coupling allows us to calculate time and space resolved electron distribution function and an improved evolution of plasma profiles. Plasma parameters vary slowly in COMPASS quiescent and flat-top RE discharges. This makes them good candidates for METIS-LUKE simulations which can give a better understanding of the RE related physics. We demonstrate how METIS-LUKE simulations can reconstruct RE formation based on available, indirect diagnostics, such as plasma current, loop voltage or electron temperature.