Estimation of the runaway electron current during the flattop phase

in COMPASS

E. Macusova 1, J. Urban 1, O. Ficker 1,2, J. Mlynar 1, M. Vlaimic 3, R. Paprok 1,4, V. Weinzettel 1
J. Varju 1, J. Cerovsky 2, M. Farnik 2, P. Bilkova 1, P. Bohm 1, M. Sos 1,2, O. Bogar 1,5, J. Zajac 1
M. Vavarin 1, J. Havlicek 1, A. Havranek 1,6, R. Panek 1, M. Hron 1 and the COMPASS team
and the EUROfusion MST1 team

1 Institute of Plasma Physics of the CAS, Prague, Czech Republic
2 FNSPE, Czech Technical University in Prague, Brehova, Prague, Czech Republic
3 Department of Applied Physics, Ghent University, Gent, Belgium
4 FMP, Charles University, Prague, Czech Republic
5 Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia
6 FEE, Czech Technical University in Prague, Prague, Czech Republic
7 See the author list of ‘Overview of progress in European Medium Sized Tokamaks towards an
integrated plasma-edge/wall solution’ by H. Meyer et al., Nuclear Fusion Special issue:
Overview and Summary Reports from the 26th Fusion Energy Conference (Kyoto, Japan,
17-22 October 2016)

We report on a novel method for estimating the runaway electron current in a tokamak. On
the assumption that the plasma current consists of two distinct parts, Ohmic and runaway elec-
tron (RE), the fraction of the RE current is derived from the pre-programmed plasma current
variations. This method was tested on approximately twenty non-disruptive discharges with
different plasma parameters (elongation, density, plasma current) and a requested plasma cur-
rent variations during the plasma current flattop phase. All discharges were made during three
dedicated campaigns focused on the RE studies at the COMPASS tokamak. We have bench-
marked the method using the fast integrated METIS code, which solves the current diffusion
equation with an explicit RE current term. This demonstrates the accuracy and sensitivity of our
method. METIS outputs, including the electric field, are then used in the 3-D Fokker-Planck
solver LUKE. LUKE calculates the time evolution of the electron distribution function, includ-
ing the runaway electrons. The fast particles diffusivity, which represents the RE loss term,
can then be characterized by matching LUKE results with the experimental RE current.