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Exact Analytical Solutions of Continuity Equation for Electron Beams Precipitating in Ohmic and Mixed Energy Losses

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In this paper we extend the approach presented in Dobranskis & Zharkova (2014a,b) by updating the analytical solutions of continuity equation (CE) for pure Ohmic losses and developing a method for analytical solutions to account simultaneously for both collisional and Ohmic losses. The exact solutions of CE for electron density of the beams precipitating in Ohmic losses are found at different precipitation depths for precipitating and "returning") electrons. Then the iterative process was applied to calculate the differential density for mixed (Ohmic and collisional) energy losses (MEL). The differential densities obtained from the updated CE for Coulomb collisions and MEL are used to calculate the HXR intensity for relativistic cross-section and to compare the outcome with more accurate results found from the numerical Fokker-Planck (FP) solution for the same collisional and Ohmic losses. The HXR intensity distribution produced by MEL solution reveals a close resemblance to the results from the numerical FP solution, being almost identical for weaker soft electron beams. However, the MEL simulation can be run up to 30 times faster than the numerical FP. This method implemented in IDL is to be incorporated into the RHESSI software that can be used for quick estimation of the effect of Ohmic losses versus collisions from the RHESSI data.