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Determination of plasma parameters via optical emission spectroscopy at CERN's Linac4 H−ion source

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At the accelerator complex of CERN an upgrade of the LHC injector chain is being implemented. This upgrade includes the installation of a linear accelerator based on negative hydrogen ions, the Linac4. The ion source of Linac4 relies on inductive RF coupling with an external coil for discharge generation (RF frequency 2 MHz, maximum RF power 100 kW). In general, the H−ions can be generated via two processes: first, the volume process, where H−is created from vibrationally excited hydrogen molecules by electron impact dissociation. For the second one, the surface process, caesium is evaporated into the source in order to establish a surface with low work function. H−is produced from hydrogen ions and atoms impinging on that surface. As caesium is very reactive, the stability of the H−production rate is an issue for using the surface process. However, the H−production is generally enhanced strongly compared to the volume process and it is accompanied by a reduction of the co-extracted electron current. In order to optimize the H−yield for both processes, a detailed knowledge of the plasma parameters and the dominant control parameters is mandatory.
Insight in the plasma parameters can be obtained via optical emission spectroscopy (OES) and the evaluation of the results with collisional radiative models. These models balance the de- and excitation processes of all relevant atomic or molecular states in the discharge. Hence, modelling the measured population densities yields plasma parameters like the electron density and temperature. For the Linac4 ion source, high resolution OES measurements of the hydrogen plasma have been carried out, considering the atomic Balmer radiation and the molecular Fulcher emission (a transition, located between 590 and 650 nm). The plasma parameters obtained from the evaluation of these measurements are presented for a variation of the gas pressure and RF power.

If a proceedings is prepared,
</br> will you submit a contribution?

no

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