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Linac4負イオン源における引き出し電極電圧のH^-引き出しへの影響
Effect of Puller-electrode Voltage on the H^- Extraction in Linac4 Negative Ion Source

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CERN's 160 MeV H^- linear accelerator (Linac4) will be connected to CERN's Large Hadron Collider accelerator chain [1]. The Linac4 negative ion source is required to produce 40-50 mA of H^- ions within a transverse rms emittance of 0.25π mm·mrad [2]. In order to achieve the requirements, it is necessary to understand the H^- extraction mechanism and optimize the H^- extraction. Recently, the extraction region of the Linac4 ion source has been modeled by Particle in Cell (PIC) simulation in Ref. [3]. However, the H^- extraction mechanism has not been completely understood. In addition, the dependences of the beam current and divergence on the operation parameters (e.g. extraction voltage) in the Linac4 negative ion source have not been investigated. It is useful to analyze the effect of the operation parameters on H^- extraction by PIC simulation for the optimization of the H^- extraction and for the study of acceleration of the H^- beam.

The final goal of this study is to obtain further understanding of H^- extraction mechanism and also to clarify the effect of puller-electrode voltage on the H^- extraction by using the two dimensions in the real space and three dimensions in the velocity space (2D3V) PIC model [4-9]. We are developing to construct a reasonable 2D model of the extraction region in the Linac4 negative ion source and the basis for the parametric study of the operation parameters with the wide range of the parameter space.

We focus on the extraction of volume produced H^- ions as a first step and preliminary result of the H^- extraction in our model has been obtained. It shows that plasma meniscus formation is asymmetric to the extraction axis. This is because the plasma density in the vicinity of the extraction aperture is asymmetric by electron $\boldsymbol{E} \times \boldsymbol{B}$ drift. That leads the asymmetry of the extracted H^- beam divergence. We will show the effect of puller-electrode voltage on the H^- extraction e.g. plasma meniscus formation and H^- beam divergence.

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