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Beam intensity prediction using machine learning and plasma images

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Monitoring beam intensity and emittance is crucial when supplying multicharged heavy ion beams from an ECR ion source. We are developing a method to predict beam intensity using machine learning based on plasma light images taken through the beam extraction port. Our previous studies have demonstrated the effectiveness of using plasma light images for this purpose[1]. However, when an oven is used, strong light emissions are observed during heating, which may significantly affect the quality of plasma light imaging. In this study, we investigated whether such oven light emissions influence the accuracy of beam intensity predictions by machine learning, using the 28 GHz ECR ion source at RIKEN. Furthermore, in order to operate this method as a non-destructive beam intensity monitoring system over extended periods, high prediction accuracy must be maintained throughout long-term beam operation. To this end, we collected data at multiple time points during the extended operation of the ECR ion source, including after vacuum breaks due to sample refilling. In this presentation, we will discuss the role of plasma light images in maintaining prediction accuracy under oven light emission conditions, as well as the challenges and future prospects for implementing this system in long-term ECR ion source operations.

[1] K. Kamakura et al., Proceedings of the 21st PASJ Meeting, THP085 (2024).

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