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Optimizing charge breeding techniques for ISOL facilities in Europe: conclusions from the EMILIE project

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Since the pioneering work of Tamburella et al. for the PIAFE project[1], the charge breeding technique in ECRIS and EBIS sources has nicely evolved. The development of the PHOENIX ECR charge breeder at LPSC, and REX-EBIS at ISOLDE by the REX-ISOLDE collaboration, paved the way for many facilities which are now using or developing one or the other technique[2]. On the roadmap to EURISOL, SPES and GANIL/SPIRAL 1 plan to use a PHOENIX ECR charge breeder, while ISOLDE has upgrade plans for REX-EBIS. The EMILIE project[3] gathers 8 European laboratories to tackle present issues of both charge breeding techniques for future facilities, for example:

- The low duty cycle of the EBIS beam, by the development of an EBIS beam debuncher
- The beam purity limitations of ECR charge breeders by using appropriate materials, vacuum and separation techniques
- The relatively low capture of light ions in ECR charge breeders, by optimizing the 1+ ion beam optics

During the EMILIE project, a number of experimental results have been obtained. These concern for example the study of the 1+ beam capture under different conditions using the Phoenix ECR charge breeder at LPSC[4,5,6], the capture of light ions using the ANL ECR charge breeder[7,8], and the charge breeding of carbon beams at LPSC[9]. A prototype of hot 1+ ECR source was also developed[5]. The SPIRAL 1 charge breeder has been upgraded to make use of UHV and pure Al components, optimized gas injection and improved 1+ beam ion optics[8], and is now being tested at LPSC[10]. The ECR charge breeder for SPES, recently tested at LPSC, has shown very good performances for charge breeding of Rb and Cs ions[11] . The EBIS beam debuncher is being commissioned at LPC Caen and is about to produce first results. As a first milestone, the first trapping tests show that the Paul trap, on which the debuncher is based, can confine ions over periods longer than 100 ms.

This contribution intends to summarize the experimental results obtained in the frame of EMILIE, drawing conclusions on the studies undertaken so far, and discussing a possible optimized charge breeding scheme for future large scale radioactive ion beam facilities like EURISOL.

References

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