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Development and commissioning of HIBISCUS: A new ion beam Radio Frequency Quadrupole Cooler Buncher for high-precision experiments with exotic radioactive ions at NUSTAR/FAIR

NUSTAR (Nuclear Structure, Astrophysics and Reactions) experiment at FAIR will explore exotic nuclei far from stability. The mass measurements and laser spectrocospy will be performed with the MATS and LaSpec experiments. In order to fully utilise the unique production capabilities at FAIR, the radioactive beams have to be slowed down and bunched for the experiments. For this purpose, a new ion beam cooler-buncher has been built in the JYFL accelerator laboratory of the University of Jyväskylä, Finland, where the device is being commissioned and characterized before transportation to its final location in the low-energy branch of FAIR [1]. The cooler-buncher — a Finnish in-kind contribution named HIBISCUS — is a central device as it will transform the beam of ions from the upstream cryogenic stopping cell behind the Super FRS [2] to be suitable for downstream experiments at MATS and LaSpec experimental halls [3]. The device features an enclosed quadrupolar electrode configuration for application of a radio frequency electric field for ion confinement and is filled with helium gas for ion cooling. The axial field is realized with progressively shorter wedge-shaped electrodes placed in-between the radiofrequency electrodes. Ions can be extracted as a continuous beam or collected into a pair of potential wells in subsequent enclosures on the exit side of HIBISCUS, for beam bunching. In this mode, HIBISCUS can be set to deliver bunches either with low energy spread or low temporal spread. Upon extraction, the ions are accelerated back to 6keV of energy to be then sent to downstream setups and experiments.

[1] P. Spiller et al., NIM A 561 (2) (2006) 305—309
[2] M. Winkler et al., NIM B 266 (19-20) (2008) 4183—4187
[3] D. Rodriguez et al., EPJ ST 183 (2010) 1—123

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