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Investigation of charge stripping scheme for uranium ions at 1-20 MeV/nucleon

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Charge stripping is one of the essential topics in heavy ion acceleration. For efficient acceleration of heavy ions such as uranium (U), which has a large amount of electrons, the charge states after passing through a stripping material are crucial for the facility design, in terms of acceleration voltages and magnet specifications. Charge stripping sections for U acceleration are commonly installed where the stripping energies become 1-20 MeV/nucleon, because the mean charge state becomes almost doubled in this energy range if the incident charge state is around 30-35 [1].

Also, charge distributions after the stripping material are very important since the fraction of the desired charge state determines the beam intensity downstream and spoiled beam amount at the same time.
This issue should be treated carefully in high-intensity beam facility because it can lead to unfavorable beam loss and radioactivation.

Recently, a simulation for new U beam acceleration at J-PARC has been in progress [2],
which is planning to achieve world highest intensity by a new booster synchrotron using multi-charge acceleration [3]. To realize this acceleration scheme, the charge distribution after the stripping section, which is located at the booster injection, is expected to have a distribution width as narrow as possible. Besides that, thickness of the stripping material should be thinner because the energy loss
in the stripping material would be compensated by an auxiliary accelerating cavity.

In this study, the optimized energy and stripping materials are searched in the cases of foils and gases, using the computed electron loss and capture cross sections as written in ref. [4]. The results and further potential using some auxiliary method such as laser excitation/stripping, plasma, etc. would be presented.

[1] H. Kuboki et al., Phys. Rev. Accel. Beams 14, 053502 (2011).

[2] P.K. Saha, H. Harada, M. Kinsho, M. Yamamoto, and H. Sako, Proceedings of HIAT'15 (2015).

[3] H. Harada et al., to be published.

[4] H. Kuboki et al., Phys. Rev. Accel. Beams 17, 123501 (2014).

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