Contribution ID: **77** Type: **Invited Oral**

Review of ion sources for charged particle radiotherapy - status, challenges and future trends

Tuesday, 9 September 2025 08:40 (30 minutes)

In order to treat a deep-seated tumor in a body by radiations, it is important to decrease the damage to normal organs surrounding the tumor. The high energy ion beam gives the good localized dose distribution on such tumors. This advantage was proposed by R. Wilson in 1946. First, proton beams have been utilized since 1954, after that, heavier ion beams have been utilized since 1970s at LBNL. Several institutes followed LBNL as pioneers in the dawn of the charged particle radiotherapy from 1950s to 1990s. Almost of them converted accelerators from physics research to medicine. Their ion sources were various due to their primary purposes and ages. The medical specified facilities have been constructed in 1990 at Loma Linda Univ. for proton and in 1994 at QST for heavy ion. The follower was only one hospital in the 20th century, however the commercial based facilities has become widespread now. This review summarizes the status of their ion sources.

The performances of an ion source are classified into some categories, such as power, efficiency, reliability and cost effectiveness. The optimizing of parameters frequently shows a conflict between them. For example, in the case of the production of carbon ions, the carbon deposition affects the condition of the surface of the chamber wall. This phenomenon causes the decreasing of the intensity and the short-term stability together. The lower microwave power improves the short-term stability, however decreases the intensity simultaneously. The two-frequency heating technique improves both the short-term stability and the intensity, though it is expensive. The technology becomes established during over 30 years of experiences.

The optimizing for the existing facilities has been continued. In addition, new ideas have been proposed for a future facility. It seems there is still room for further developments to improve an ion source. This review also introduces past, present and future challenges and its trends.

Primary author: KITAGAWA, Atsushi (National Institutes for Quantum Science and Technology (QST))

Presenter: KITAGAWA, Atsushi (National Institutes for Quantum Science and Technology (QST))

Session Classification: Oral Session

Track Classification: Applications of ion sources