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## Investigation of an Internal Antenna Design for an RF ion source

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D-Pace is developing a 13.56 MHz cesium-free RF ion source capable of generating negative ion beams ( $H^-$ ,  $D^-$ ) with energies around 25 keV. The current design employs an external flat spiral antenna to couple RF energy into the plasma through a dielectric window [1]. Efforts are now underway to evaluate the performance of the RF ion source using a solenoid-type internal antenna inspired by the SNS ion source. The SNS internal antenna has demonstrated reliable operation for over four months operational period, sustaining plasma with approximately 4 kW of average RF power and achieving nearly 100% availability [2]. The implementation of an SNS-type internal antenna is expected to enhance the beam current and reliability of D-Pace's RF ion source. This article presents preliminary results of the internal antenna design and compares the performance of the internal and external antenna configurations in D-Pace's RF ion source.

[1] T Kalvas et al. "Recent negative ion source activity at JYFL". In: AIP Conference Proceedings. Vol. 1515. 1. American Institute of Physics. 2013, pp. 349–358.

[2] Robert Welton et al. "Negative hydrogen ion sources for particle accelerators: Sustainability issues and recent improvements in long-term operations". In: Journal of Physics: Conference Series. Vol. 2244. 1. IOP Publishing. 2022, p. 012045.

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