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First commissioning results of the MIST-2 ion source for the High-Current H2+ Cyclotron HCHC-XX

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Abstract: In the HCHC-XX cyclotron design, an H₂⁺ ion source is feeding a high-current beam through an RFQ buncher, axially embedded in the cyclotron yoke, into the central region of the cyclotron where the beam is guided onto the median plane and accelerated. The 60 MeV/amu version, the HCHC-60 will be the driver for the particle physics experiment IsoDAR, an underground search for new physics (e.g., sterile neutrinos, axion dark matter, and light X particles). Other applications of the HCHC-XX at various output energies are in fusion research, nuclear waste transmutation, and medical isotope production. For the HCHC-1.5 prototype, we initially built the MIST-1, a filament-driven, multicusp ion source tuned for H₂⁺ production. Recently, we built a new ion source, the MIST-2, incorporating lessons-learned from MIST-1. Here we report the results of a study using the MIST-1 and different permanent magnet configurations to determine the optimal magnet material for the MIST-2. Further, we show the design of the MIST-2, highlight the improvements we made, and present the first commissioning results, which, so far, approximately doubled the total beam current extracted from the MIST-1.

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