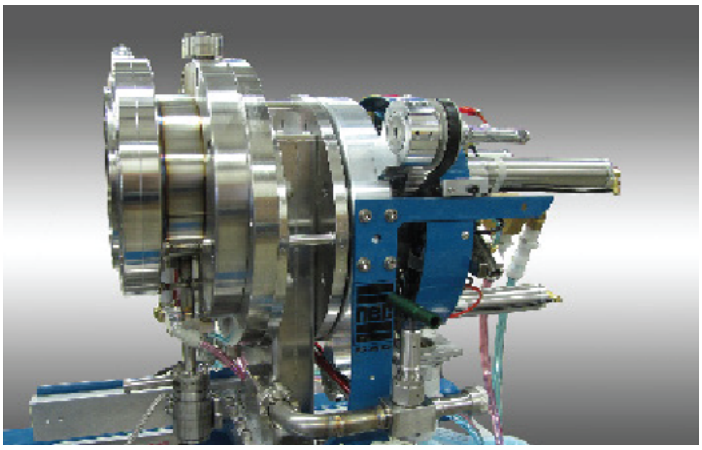
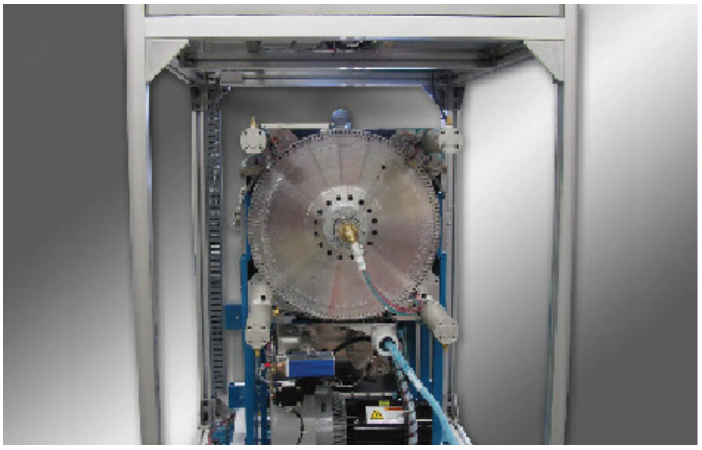
NEGATIVE ION SOURCES
National Electrostatics Corp.

Multi - Cathode Source of Negative Ions by Cesium Sputtering (MC-SNICS)



40 Sample MC-SNICS



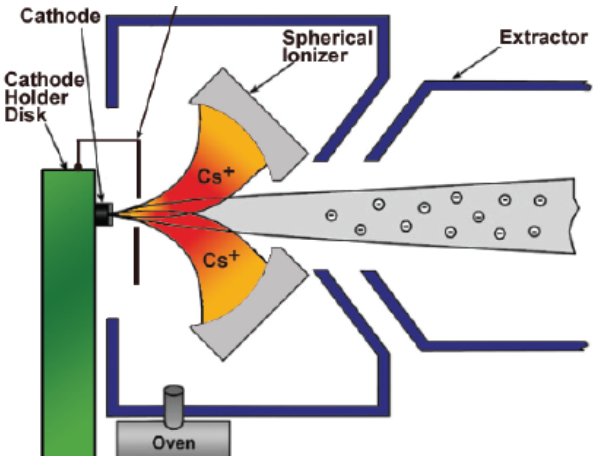
134 Sample MC-SNICS

APPLICATIONS

NEC developed the Multi-Cathode SNICS (MC-SNICS) source, as a reliable sputter cathode ion source for all applications requiring rapid cathode change and precise, repeatable positioning without cathode exposure to air. This has proven to be especially beneficial in the field of Accelerator Mass Spectrometry (AMS) where the ability to return to the precise location on a particular cathode is critical. Among its many applications, the MC-SNICS is used for a variety of AMS applications including the production of beams such as Be, I, Cu, Cl, and the actinides. There are two standard sizes available, the 40 sample and the 134 sample source.

Principle of Operation: Cesium vapor flows from the cesium oven into an enclosed area between the cooled cathode and the heated spherical ionizing surface. Most of the cesium is ionized by the hot surface, while some of the cesium condenses on the front of the cathode.

The ionized cesium sputters particles from the cathode through a condensed cesium layer on the cathode face. Negative ions are propelled near the cathode surface and then accelerated back toward the ionizer.



DESIGN

The MC-SNICS uses the basic elements from the NEC SNICS II ion source with the addition of cathode indexing system that allows the change of cathodes without breaking vacuum. The MC-SNICS has an all-metal/ceramic extraction/ lens assembly. The rotating seal for the cathode wheel is Ferrofluidic. The entire indexing mechanism is pneumatically driven with bidirectional indexing.

As with the standard SNICS source, the cathode wheel can be retracted through a valve that isolates the cesiated area from the multiple position cathode wheel. The time to change the cathode wheel is approximately one hour from beam on target to beam on target.

The reliability of these sources has been proven in many laboratories throughout the world. Other than cathode wheel changes, the time between maintenance is on the order of 1000 hours.

PERFORMANCE

Beam tests were conducted with the 40 MC-SNICS on a standard NEC injector with beam measurements after the 90° injection magnet. Using POCO graphite as the cathode material, typical beam currents for $^{12}C^-$ were 80 to 125 µA within a few seconds of cathode change after initial burn in. Although beam currents of 100 µA are typical, beam currents above 200 µA have been observed for $^{12}C^-$. For aluminum, tests were conducted using aluminum oxide standards made available by the Center for AMS at Lawrence Livermore National Laboratory. Beam currents for Al- after the 90° magnet were typically 1.0 to 1.2 µA with beam currents as high as 2 µA observed.

The beam emittance is on the order of 5 πmm mR $(MeV)^{1/2}$ for optimum transmission through a tandem electrostatic accelerator with proper optics.

The simple cathode indexing system has proven to be highly reliable while reproducing the cathode position to within 0.002" of its original position.

Both a tandem Pelletron based AMS system and the NEC Single Stage AMS system equipped with the 134 MC-SNICS have demonstrated radiocarbon ratio measurements for 2000 modern carbon samples to within 2% precision within 5 days. Typically, 40 samples are measured in 24 hours to 0.2% precision.

OPTIONS

There are two models of the MC-SNICS:

40 MC-SNICS

- Includes an indexing system that is compatible with cathodes that can hold approximately 1 mg of sample (typical sample size for AMS). CO_2 sample sizes are around 500 micrograms.
- The standard cathode wheel can hold up to 40 cathodes at a time.
- A 20-sample cathode wheel is also available. This wheel is compatible with cathodes that can hold larger samples that can be useful for implantation or other long runs.
- The source efficiency is better than 1%.

134 MC-SNICS

- Similar to the 40 MC-SNICS, except the standard 1 mg sample cathode wheel can hold up to 134 samples at a time.
- The larger sample cathode wheel can hold up to 67 cathodes at a time.

Though the MC-SNICS source is primarily designed for the use of solid samples, NEC offers a gas option that allows the input of carbon dioxide behind a hollow titanium cathode assembly. This is available for both the 40 MC-SNICS and 134 MC-SNICS models.

CONFIGURATIONS

A typical MC-SNICS system includes:

- The source
- Extractor/einzel lens
- A cooling system
- Power supplies

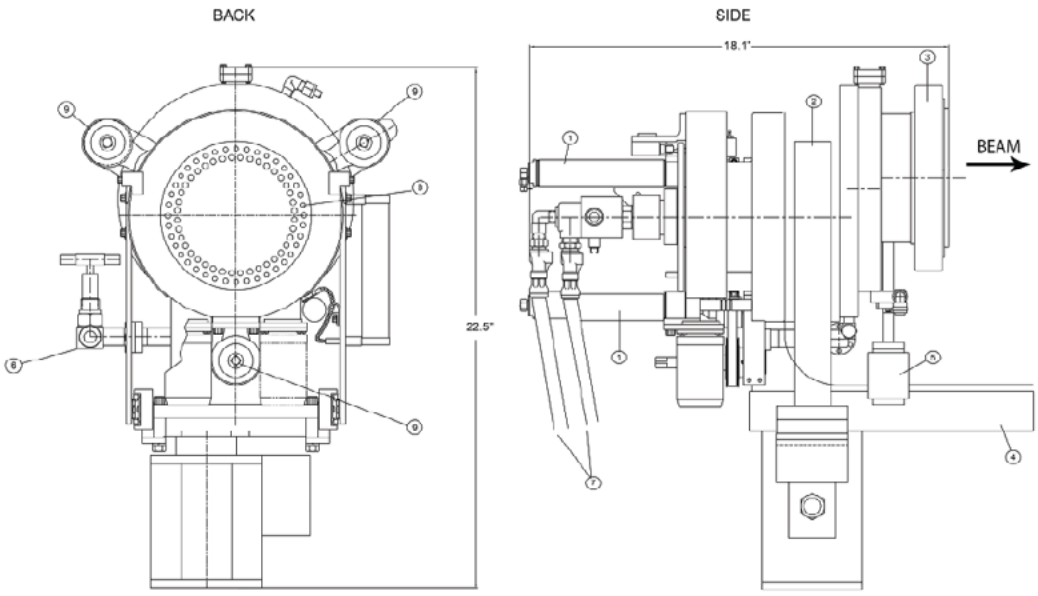
NEC can provide just the source, a complete injector system, or anything in-between. Contact NEC for more information on MC-SNICS injector systems.

ACCESSORIES

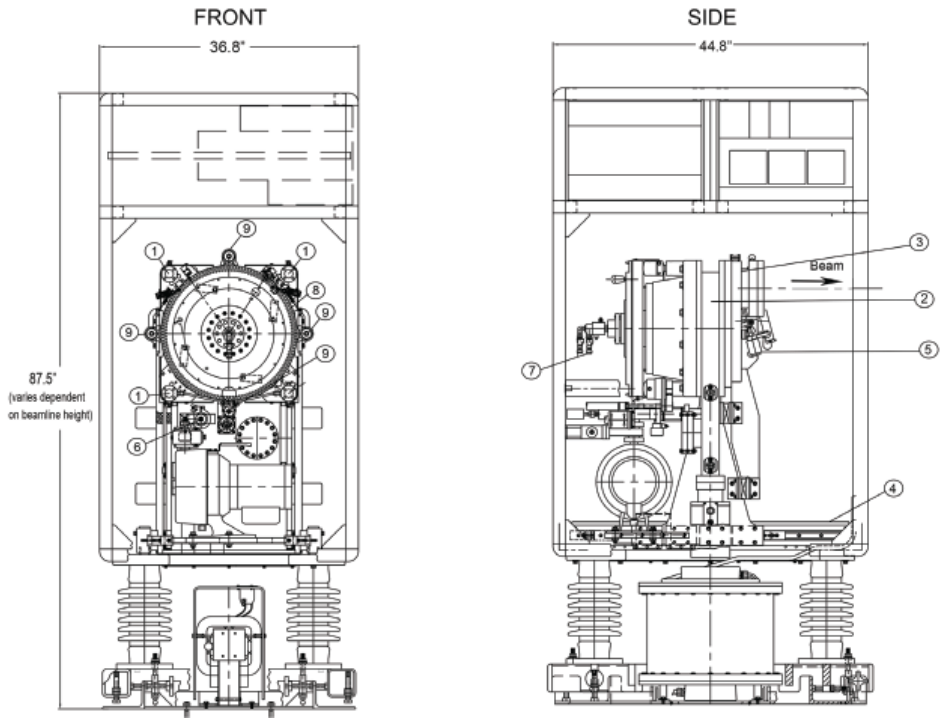
NEC also offers manual and electric cathode presses to pack powdered elemental samples into cathodes suitable to generate negative ion beams.

Contact NEC for more information.

40 MC-SNICS

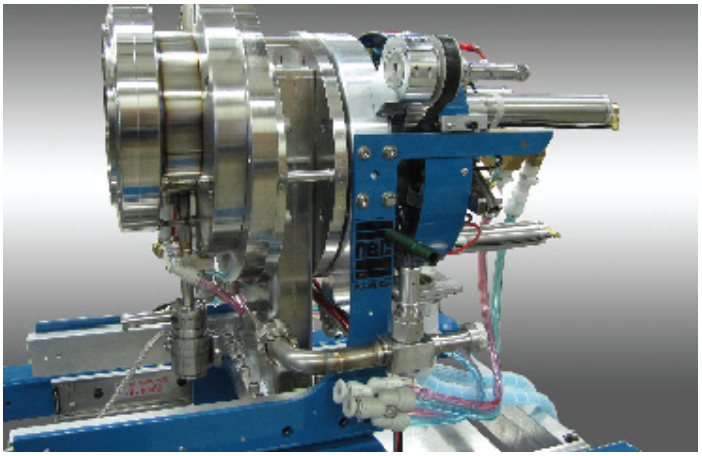


134 MC-SNICS

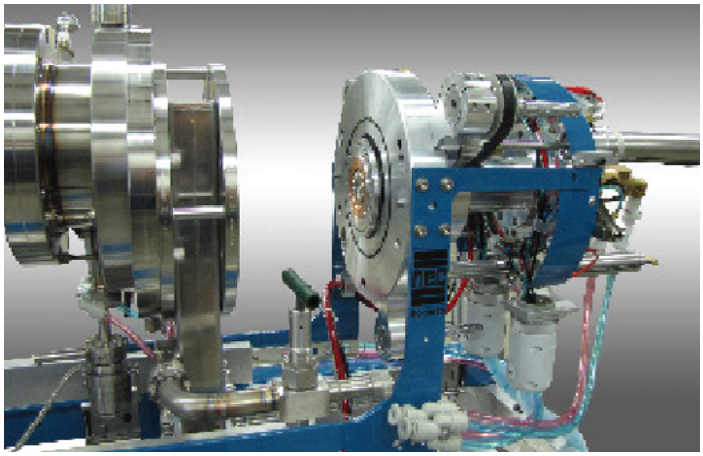


Component Key

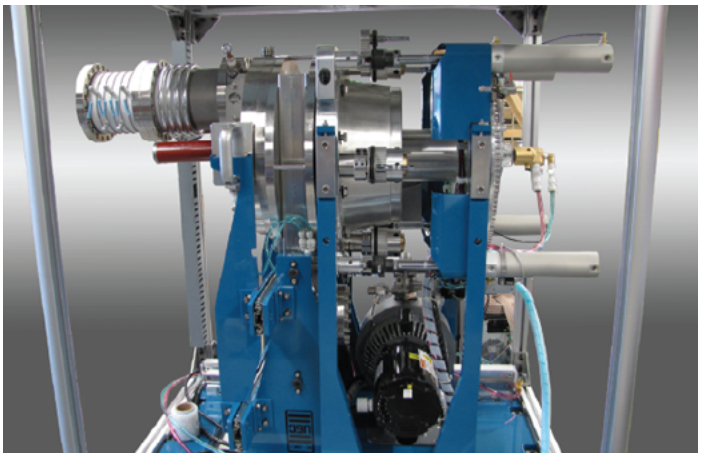
1. Pneumatic cylinders for cathode retraction
2. Valve
3. Ionizer housing
4. Slide rail
5. Cesium oven
6. Pumpout
7. Cathode cooling
8. Cathode indexing system



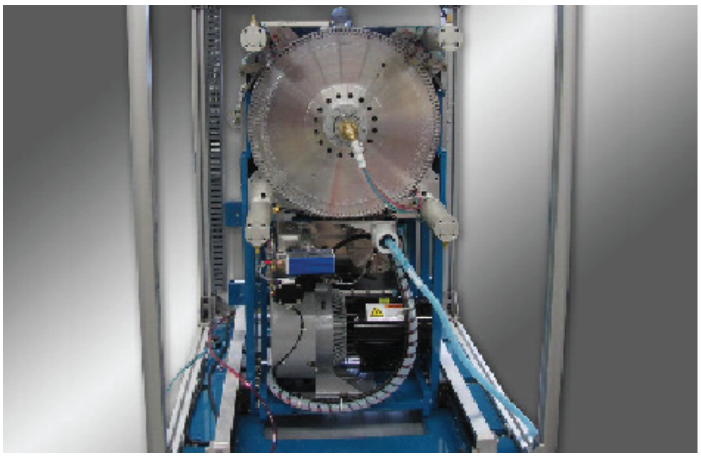
The negative ion beam exits to the left (40 MC-SNICS shown). Pneumatic cylinders for cathode removal and cathode cooling fittings are to the right. The 4" valve separating the cathode removal system from the source is located in the center. The cesium oven is located below the source to the left of the valve.



In this view, the 4" valve has been closed and the entire cathode assembly has been moved back on the rail system. The aluminum cathode wheel is now visible and can be changed. In this position, the main body of the ion source is still under vacuum. (40 MC-SNICS)



The MC-SNICS with the pneumatic system activated and the cathode wheel pulled out of the main source volume. The cathode wheel is now positioned to the right of the 12" valve out of the cesiated volume of the source. (134 MC-SNICS)



This view shows the cathode indexing system (134 MCSNICS shown). The entire system is pneumatic. To move a cathode, a locking pin is pulled back out of the indexing wheel. A pneumatic cylinder pushes on a cathode positioning rod. When the proper position is sensed, the locking pin is reinserted at the new cathode position. The four large pneumatic cylinders in the foreground are used to pull the cathode wheel out of the ion source body. The brass fittings in the center are for liquid cooling of the cathode wheel.

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