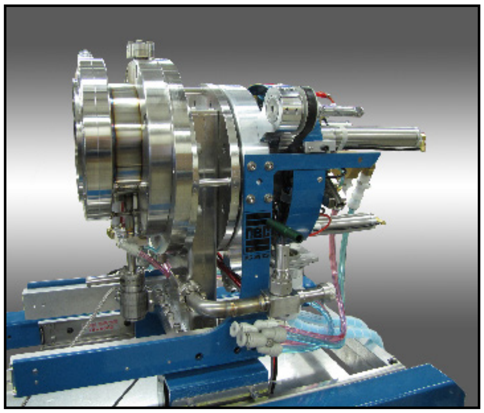
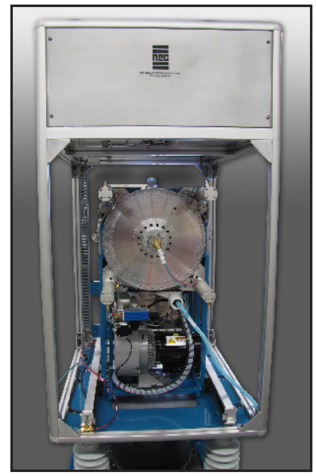
National Electrostatics Corp.
7540 Graber Rd., P.O. Box 620310, Middleton, WI 53562-0310 USA

02/17

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



40 Sample MC-SNICS (left)
134 Sample MC-SNICS (right)



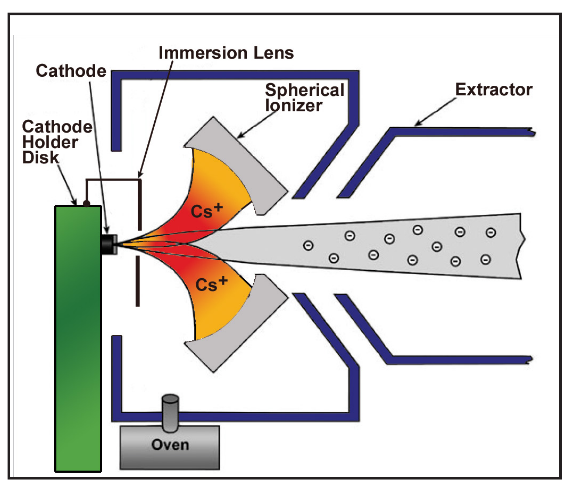
APPLICATIONS

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.

DESIGN

The MC-SNICS uses the basic elements from the NEC SNICS II ion source with the addition of the 40 or 134 position cathode disk and an immersion lens.

Principle of operation: Cesium vapor flows from the cesium oven into an enclosed area between the cooled cathode and the heated spherical ionizing surface. Some of the cesium condenses on the front of the cathode and some of the cesium is ionized by the hot ionizer surface. The ionized cesium accelerates toward the cathode and is focused to a 0.5 - 0.9 mm spot on the front face of the 1 mm diameter cathode. The ionized cesium sputters particles from the cathode through a condensed cesium layer on the cathode face. In this way, negative ions are accelerated from the cathode surface.



[MCSNICS-1]

TELEPHONE: 608-831-7600 ♦ FAX: 608-831-9591 ♦ E-MAIL: nec@pelletron.com ♦ WEB-SITE: http://www.pelletron.com

MC - SNICS

The MC-SNICS has an all-metal/ceramic extraction/lens assembly. The rotating seal for the cathode disk is Ferrofluidic. The entire indexing mechanism is pneumatically driven with bidirectional indexing.

As with the standard SNICS source, the cathode disk can be retracted through a valve that isolates the cesiated area from the multiple position cathode disk. The time to change the cathode disk 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 disk 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 125µA within a few seconds of cathode change after initial burn in. Although beam currents of 100µA are typical, beam currents above 200µA 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 1.2µA with beam currents as high as 2µA 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.

OPTIONS AND ACCESSORIES

Both solid sample cathode only and combination gas/solid cathode sample versions are available for the 40 and 134 MC-SNICS. The gas/solid sample version allows the input of carbon dioxide behind a hollow titanium cathode assembly. The cathode disk rotates to allow a fresh titanium cathode for each gas sample. A pump is needed directly on the cesiated volume.

A 20 position cathode wheel is available for the 40 MC-SNICS. This wheel accommodates larger cathode holders. The standard cathode wheels are Aluminum. However, copper 20, 40 and 134 position wheels are also available.

For cathode sample loading, NEC sells a single manual cathode press. Please contact NEC for further information.

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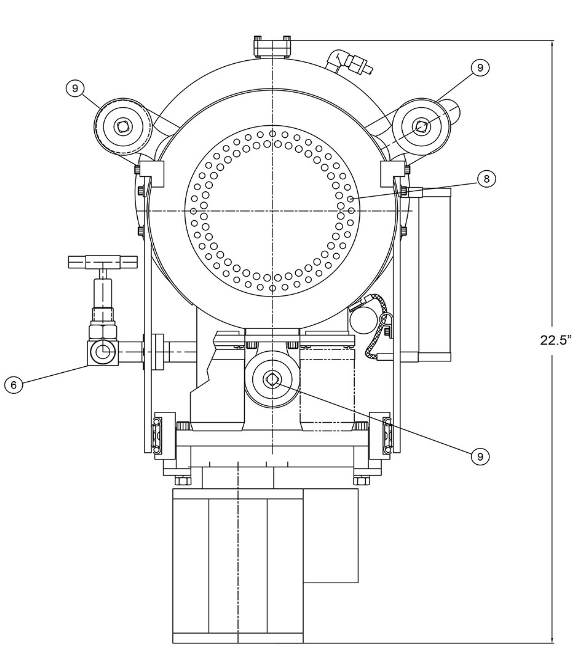
MC - SNICS

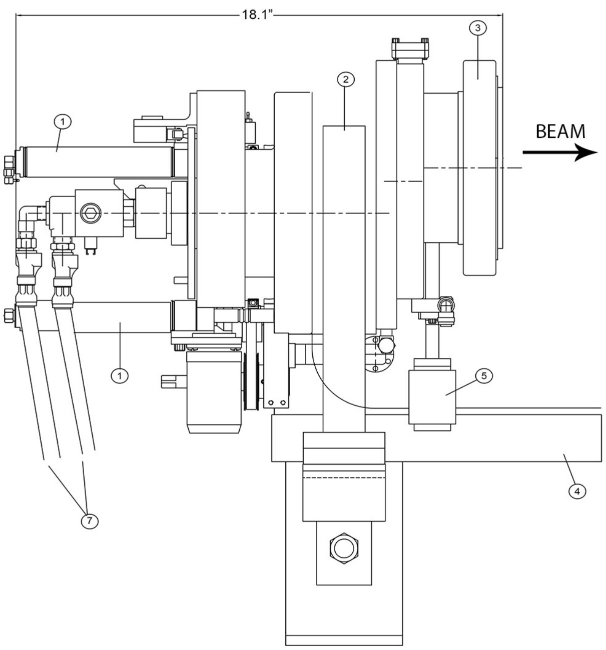
1. Pneumatic cylinders for cathode retraction
2. Valve
3. Ionizer housing
4. Slide rail
5. Cesium oven
6. Pumpout
7. Cathode cooling
8. Cathode indexing system

40 MC-SNICS

BACK

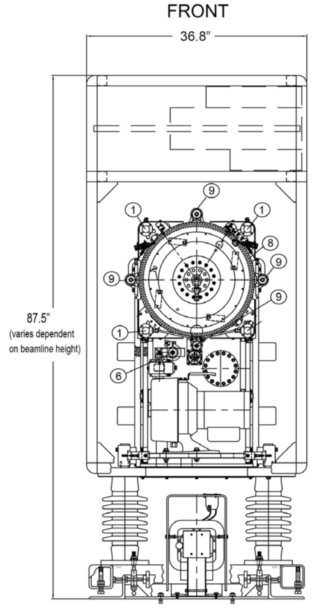


SIDE

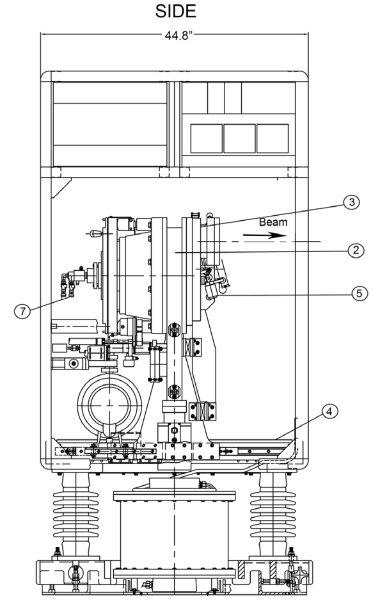


134 MC-SNICS

FRONT



SIDE



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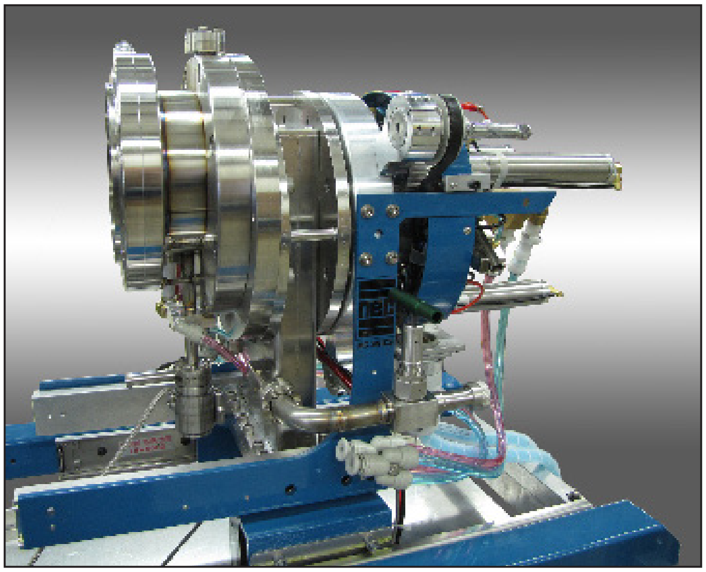
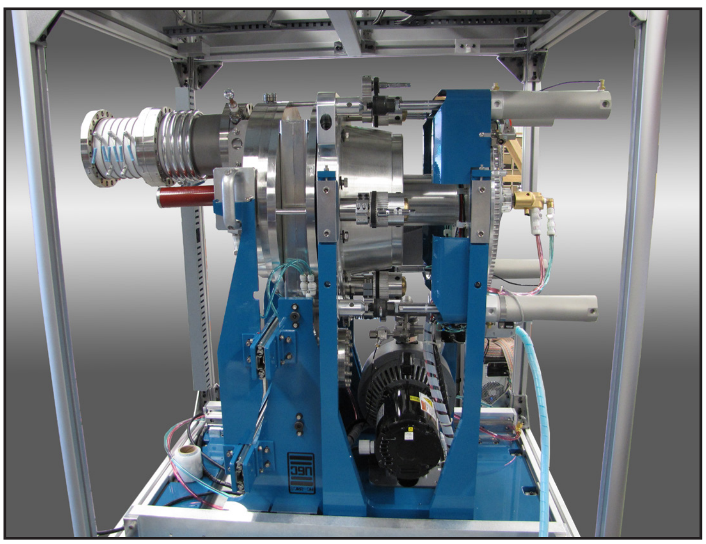
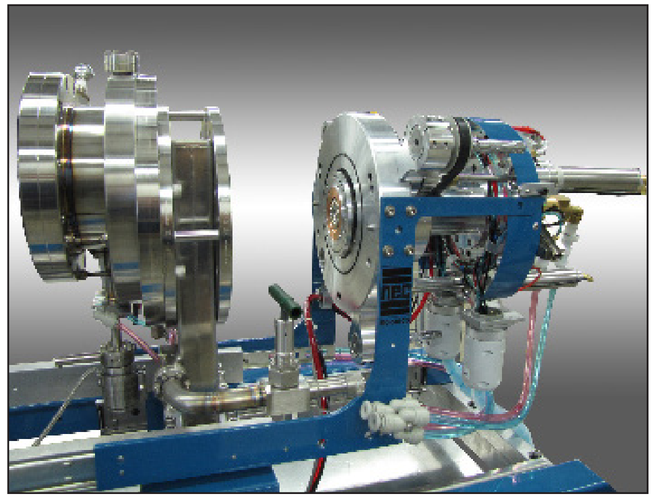
MC-SNICS - Service Positions



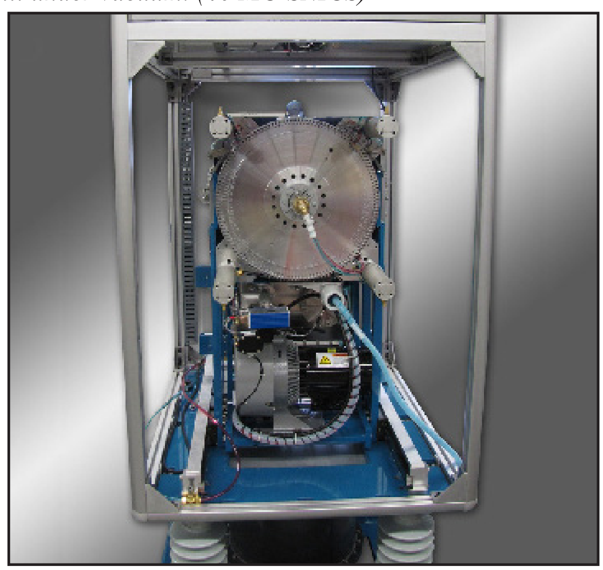
The negative ion beam exits to the left (40 MC-SNICS shown). Pneumatic cylinders for cathode removal and cathode cooling fittings are to the right. The 4" valve separating the cathode removal system from the source is located in the center. The cesium oven is located below the source to the left of the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



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



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 disk is now visible and can be changed. In this position, the main body of the ion source is still under vacuum. (40 MC-SNICS)



This view shows the cathode indexing system (134 MC-SNICS 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 disk out of the ion source body. The brass fittings in the center are for liquid cooling of the cathode disk.

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