



ACCELERATOR CONTROL COMPONENTS

National Electrostatics Corp.

Carbon Accelerator Mass Spectrometry (CAMS)

Compact High Throughput

Experience

NEC began building AMS systems over 30 years ago and is one of the premier manufacturers of AMS systems in the world. Of the more than 55 AMS systems provided to customers, over half are dedicated to radiocarbon measurements in the fields of Archaeology, Geology, Groundwater analysis, Metabolite profiling, Microdosing, Atmospheric sciences, Oceanography, Nuclear waste management, Toxicology, Cosmogenic study, Astrophysics, Pharmacokinetics, and many more.

The NEC Compact Accelerator Mass Spectrometer (CAMS) is based around a 0.500 MV tandem Pelletron for beam energies around 1 MeV. The system is optimized for world-class precision, superb throughput, and low background of radioisotope samples. The NEC CAMS is a complete system with all necessary hardware and software for both on-line and off-line radiocarbon isotope measurements.

Design

Once a sample has been appropriately processed and inserted into the ion source (either as graphite or CO₂), the sample is converted to negative ions and is accelerated through the first bending magnet. This first mass spectrometer has a biased chamber to allow sequential injection of the negative ions of interest, allowing low energy ¹²C⁻ and ¹³C⁻ to be measured in offset Faraday cups. As the negative ions exit the magnet, they accelerate to higher potential energy (around 0.500 MeV) into a gas stripper that breaks up negative molecules and converts the resulting single nuclei ions to positive

ions. In this way, such ions as ¹²CH⁻, ¹²CH₂⁻, ¹³CH⁻, and others are converted to single nuclei ions, ¹²C⁺, ¹³C⁺, and ¹⁴C⁺. This eliminates interferences that might be caused by molecular ions when counting ¹⁴C⁺ ions later in the system. These positive ions are then accelerated again to ground potential to the entrance of the second mass spectrometer, resulting in an improved mass separation, allowing the abundant isotopes ¹²C⁺ and ¹³C⁺ to be measured with high precision current integrators. The rare isotope ¹⁴C⁺ continues through a 90° electrostatic spherical analyzer (ESA) which removes any outstanding interferences and the beam is measured in a solid state particle detector. NEC AMS systems include full computer control with AMS analysis software to provide chronological ages, carbon content in dpm/gm, or pMC (percent modern carbon) values.

NEC AMS systems can support several configurations from a single, 40 sample source, to dual 134 sample sources for a maximum throughput of 2,000 samples to 2% precision per week. Sample wheel loading takes less than 30 minutes with full 40 sample wheels typically measured to precision within about 24 hours. NEC ion sources have no noticeable memory effects and are extremely reliable. NEC has provided more than 125 MC-SNICS sources around the world.

The system proceeds automatically to switch from sample to sample as the required precisions, time constraints, or other criteria are met. The system can be monitored remotely and is fully interlocked in case of power, water or air failure to protect personnel and precious samples.

Carbon Accelerator Mass Spectrometry (CAMS)

Specifications

HV Deck

Voltage Range:	Model 1.5SDH-1: to 0.500 MV
Single Charged Energy Range:	Model 1.5SDH-1: to 1.000 MeV
Voltage Stability:	Better than 1 kV

Primary Components

Beamline Height:	1.5 m
Pumps:	Turbo molecular pumps, rough backing pumps
Vacuum System Base:	$5e^{-7}$ Torr, or better (without beam)
Ion Source(s)/Injector:	Injection voltage, ~50 keV 40 or 134 MC-SNICS (carbon)

Acceptance Test Values

Carbon, Terminal Potential:	0.5 MV
^{12}C - (Pulsed Beam):	Current > 40 μA
Beam Transmission:	> 40%

AMS Ratios

$^{14}\text{C}/^{12}\text{C}$ (abundant ratio $1e^{-12}$)

Precision < 0.2%

$^{14}\text{C}/^{12}\text{C}$ (CO_2 abundant)

Precision < 0.8%

$^{13}\text{C}/^{12}\text{C}$ (abundant)

Precision < 0.2%

$^{14}\text{C}/^{12}\text{C}$ (CO_2 background)

Ratio < $8e^{-15}$

$^{14}\text{C}/^{12}\text{C}$ (background)

Ratio < $7e^{-16}$

NEC will provide Alfa Aesar unprocessed graphite for carbon machine background tests. All acceptance tests are verified using a minimum of three samples.

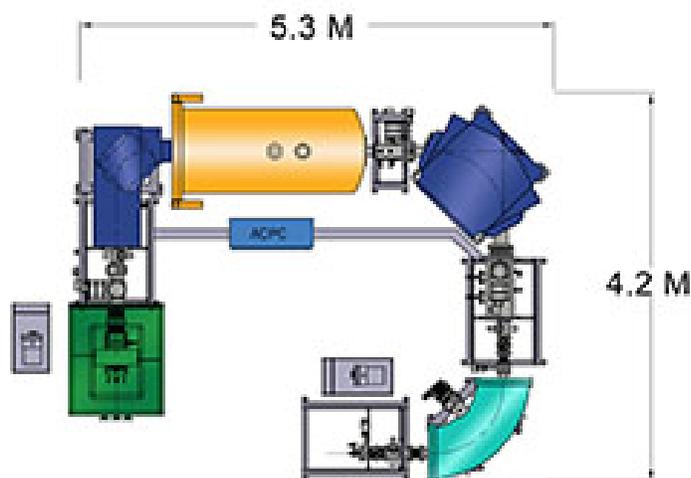
Facility Requirements:

Compressed air: 80 psig

Electrical Power: 20 kVA

Cooling water: 6.0 gpm (22.7 l/min)

(Approximate values based on a single source configuration)



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