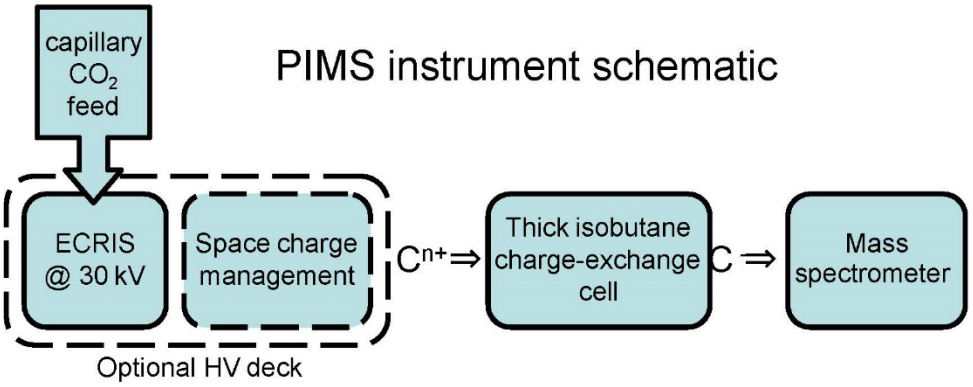
PIMS Update

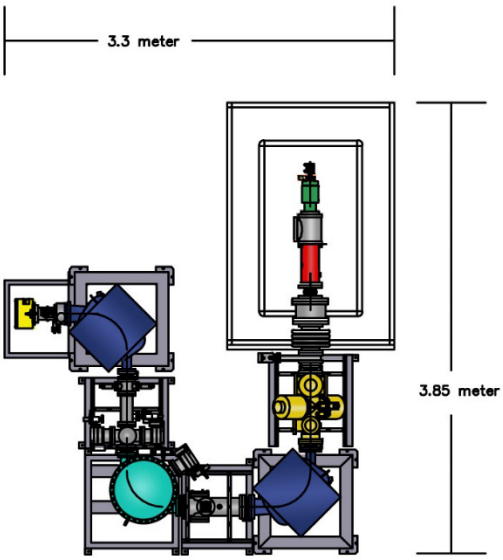
(Positive Ion Mass Spectrometry)

Friday, November 3, 2017
National Electrostatics Corp.

This newsletter is meant to provide monthly updates to customers who have expressed interest in the PIMS system. Below is a diagram explaining the principles of the PIMS instrument:



The concept behind PIMS is a revolutionary new idea for radiocarbon data analysis. In a traditional radiocarbon system, the processed carbon (graphite) is extracted from the source as a negative ion beam. The beam is accelerated and stripped of electrons, yielding a positive ion beam. While this works very well to measure solid samples, the graphitization process is time consuming and labor intensive.



When CO_2 is injected into a gas ready ion sputter source in an attempt to remove the graphitization process, the extracted beam currents are approximately 10% of graphitized solid samples. This causes longer measurements times and worse precision than traditional graphite measurements.

Instead of using processed graphite samples, the NEC PIMS system uses only CO_2 gas and creates a positive ion beam. The prototype has been under development at NEC since 2016. The basic layout of the PIMS is on the left.

The current system starts with an ECR (Electron Cyclotron Resonance) ion source resting at 100 keV. The next major components are the charge exchange cell (changing the positive ion beam into a negative ion beam), two bending magnets, and one Electrostatic Spherical Analyzer (ESA). These components remove the unwanted interference isobars, allowing background measurements that are comparable with traditional graphite AMS systems. On the right, one can see measurements for background CO_2 gas for charge states +1 and +2.

We have operated the system with a number of modern and background samples, and produced $^{14}C/^{12}C$ data similar to existing CO_2 AMS systems. An additional benefit of the ECR Ion Source (ECRIS) is that the source is self-cleaning and no memory affects are visible. (on the lower right).

The current schedule for the rest of the year includes optimizing the PIMS design and layout, as well as fine-tuning the injector voltage. The current goal is to lower the injection voltage and total beam energy to around 30 keV. Currently, the ion source creates over 3 milliamps of beam current, but the charge exchange cell efficiency is on the order of 10%. The "high energy" beam currents are on the order of those created by a traditional CO_2 AMS system. The goal is to create beam current equal to existing solid sample AMS systems, and we hope to be there soon.

Stay tuned for future updates and more data in the coming months!

- Michael Mores and the NEC Sales Team
  sales@pelletron.com