

PIMS Update

(Positive Ion Mass Spectrometry)

National Electrostatics Corp.
April, 2018

This newsletter is meant to provide regular updates to customers who have expressed interest in the PIMS system. Previous updates can be found on the NEC website.

NEC, along with SUERC and Pantechnik, have been working hard these last few months to characterize PIMS performance. The end goal is a simple gas-only system that will meet or exceed traditional graphite AMS results without the need to make solid samples. This requires accurate and precise demonstration measurements of known-age samples over a wide dynamic range from background to 'hot' samples with low background. Recent results show these.

1) Dynamic Range:

The majority of AMS labs only run samples between background and 1 times Modern. We are proud to announce that we have successfully tested discrete samples ranging from background CO₂ to 102 times modern and achieved correct results. The discrete samples were injected using a ten-sample NEC CO₂ interface. As you can see in Figure 1, the samples measured on the PIMS match nominal radiocarbon values very closely.

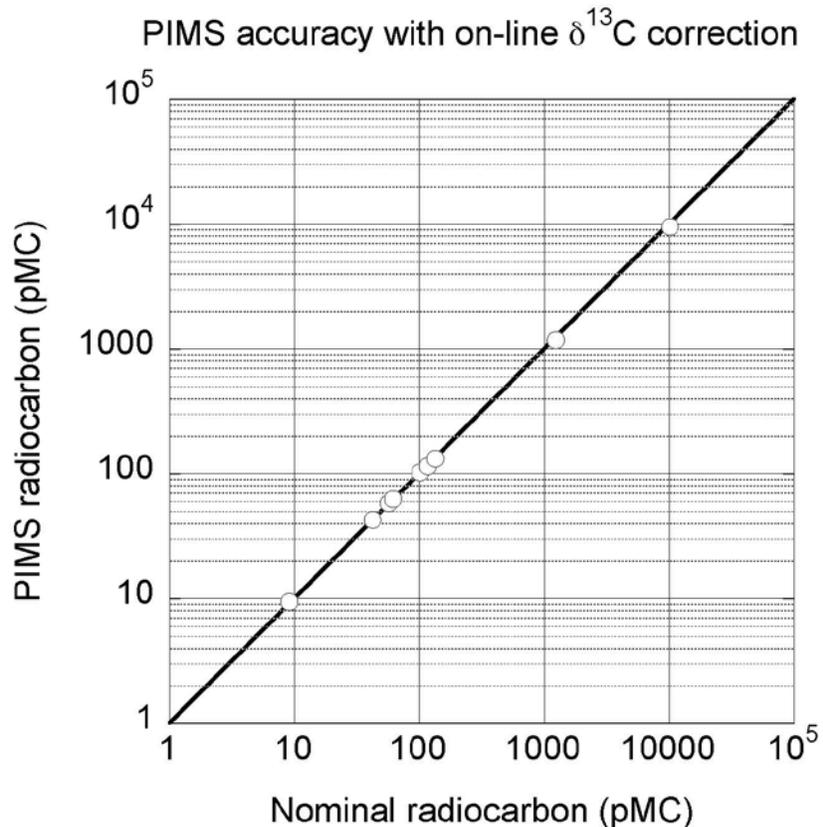


Figure 1

2) Reproducibility

In order to be competitive in the AMS community, PIMS needs to be able to show stability comparable with a modern AMS system. For comparison, NEC's CAMS system can routinely reach better than 0.2% precision. Figure 2 shows data where the stability of the PIMS system was 0.12%. Many customers measuring samples related to earth science expect precision of 0.3% or lower, while customers in the pharmaceutical industry expect values to be within 10%.

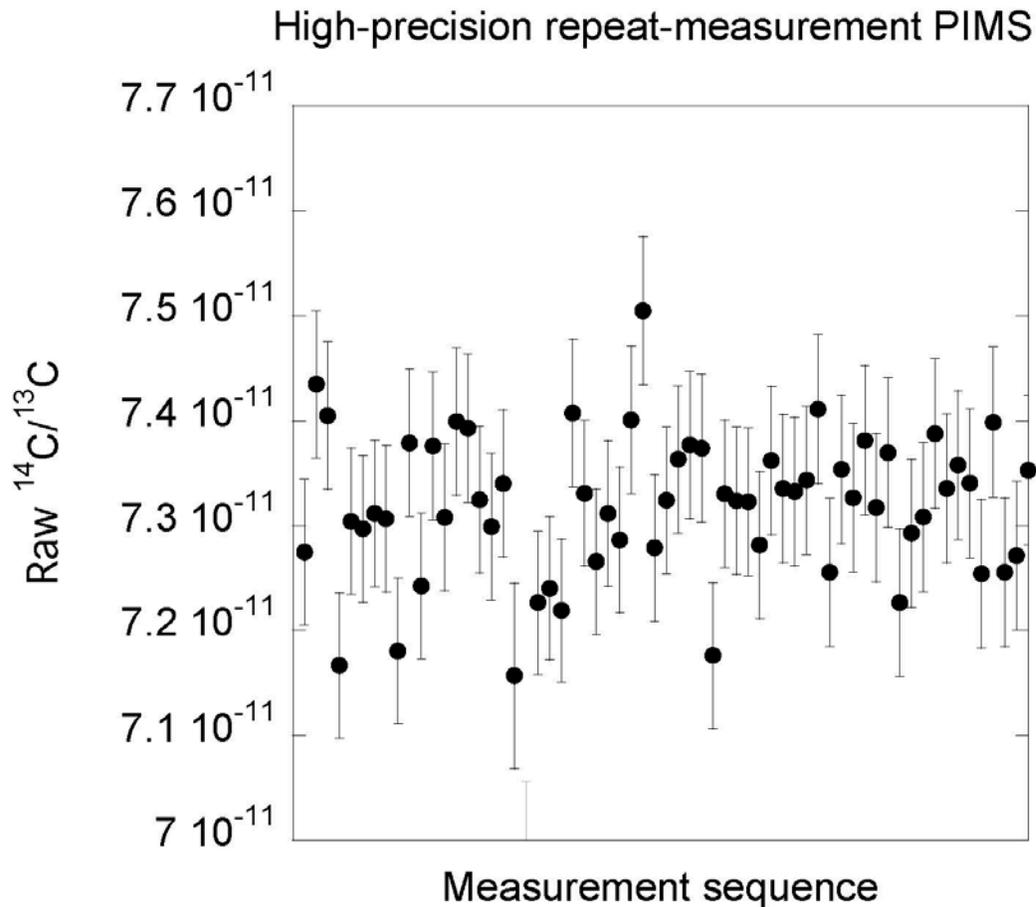


Figure 2

3) Background Values and Full Data Sets

Figure 3 is actual raw $^{14}\text{C}/^{13}\text{C}$ data from a single run. It shows PIMS over five orders of magnitude of sample radiocarbon content above the >50 kyrs BP background. Gas samples were repeatedly measured and the reference 100 pMC CO_2 was analyzed in triplicate confirming analysis stability.

Repeated ^{14}C -PIMS of samples ranging over five orders of magnitude radiocarbon specific activity

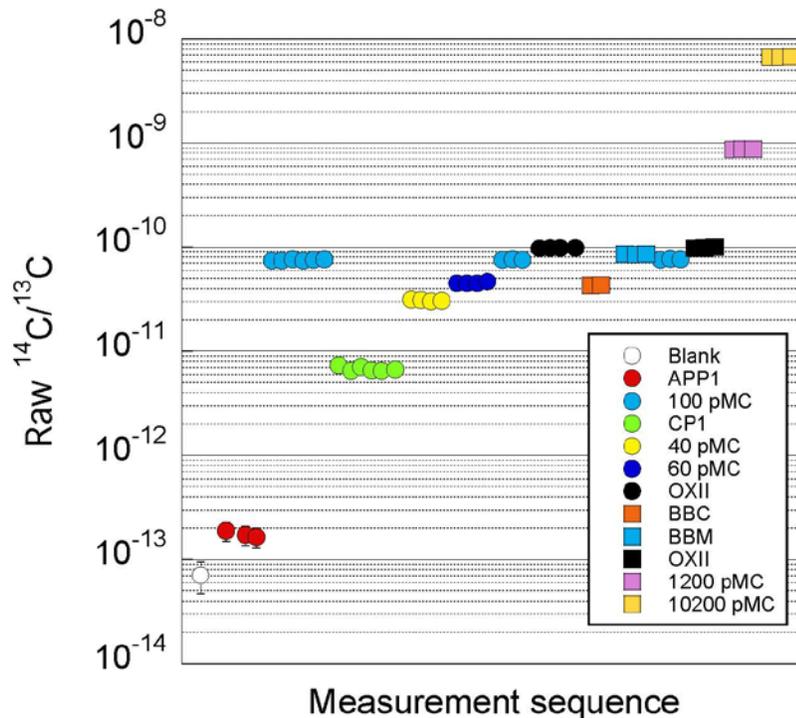


Figure 3

What's next for PIMS?

Figure 4 shows the system in its current state before we shipped the system to SUERC. Additionally, the next generation ion source, the Microgan from Pantechnik, has been completed and produced $^{12}\text{C}^+$ beams of over 2 times that of the Nanogan for injection into the charge exchange cell. With the projected increase in beam currents, achieving results of better than 0.3% precision should take only a few minutes for most samples. With the ability to inject discrete samples, there will be no need to load between 40 and 200 samples in order to run the system.

The PIMS prototype will be reassembled in SUERC in early April 2018 and tested with the new ion source. Data will be presented during the Radiocarbon conference in Trondheim, Norway. Make sure to register for the conference now, if you have not already. The link is: <https://www.ntnu.edu/radiocarbon-2018/home>



Figure 4

Once the system is reassembled and tested, the next most important development will be to create CO₂ gas interfaces to EAs, autosamplers, and other types of standard analysis machines.

Email or call us with any questions you may have about the system. Stay tuned for future updates and more data in the coming months!

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