



# Size Distribution and Cloud Condensation Nuclei Activation Ratio of Fabricated Organic Ice Nuclei

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## Overview

Ice Nuclei (IN) created by modifying bacterial, killing the bacterial, and removing the insides so that only the outside shell remains (bacterial ghosts) are termed fabricated organic ice nuclei (OIN). The OIN are atomized and measurements of their size distribution and cloud condensation nuclei (CCN) activation ratios are made to determine their effectiveness as immersion ice nuclei. The size distribution is measured using a TSI Scanning Mobility Particle Sizer Spectrometer (SMPS) and a TSI Aerodynamic Particle Sizer. The activation ratio is measured using a DMT Cloud Condensation Nuclei Counter (CCNC) operated at 0.6 % supersaturation and a TSI Condensation Particle Counter (CPC). The OIN have a bi-modal number concentration size spectrum with one peak at approximately 700 nm, which correspond to unbroken bacterial, and a second peak that is 100 times larger between 10 and 100 nm, which likely corresponds to bacterial that have broken apart. While the CCN to CPC (> 10 nm) activation ratio is 0.44, the summation of all aerosols larger than 40 nm approximately equals the CCN concentration at a 0.6 % supersaturation, which is similar to ammonia sulfate aerosol and indicates that the OIN are immersion ice nucleation. Additional laboratory experiments are being conducted to investigate better methods of creating aerosol OIN that can be used for laboratory measurements. During the summer of 2018 experiments are planned to determine the effectiveness of OIN as an immersion and contact ice nuclei.

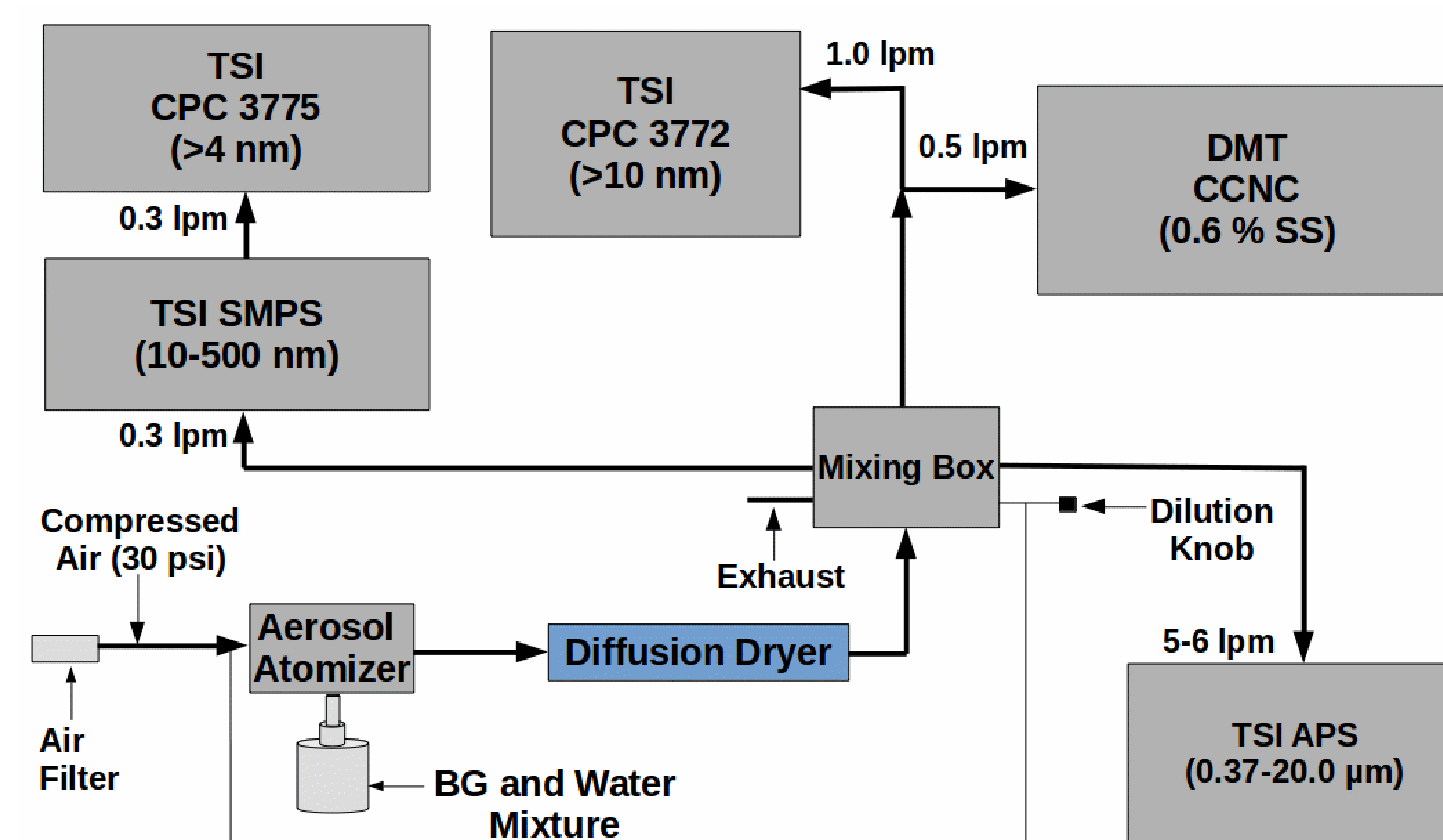
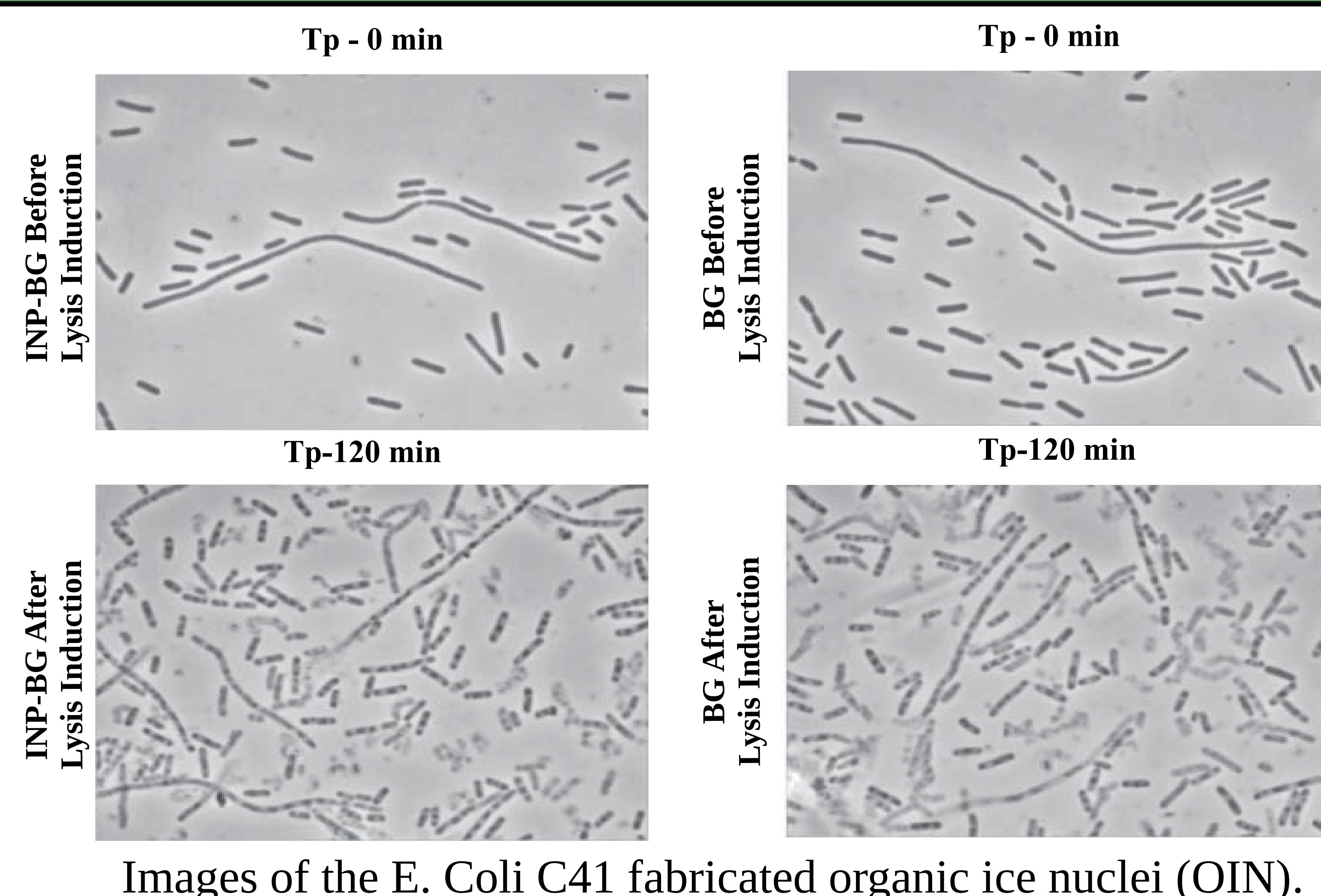
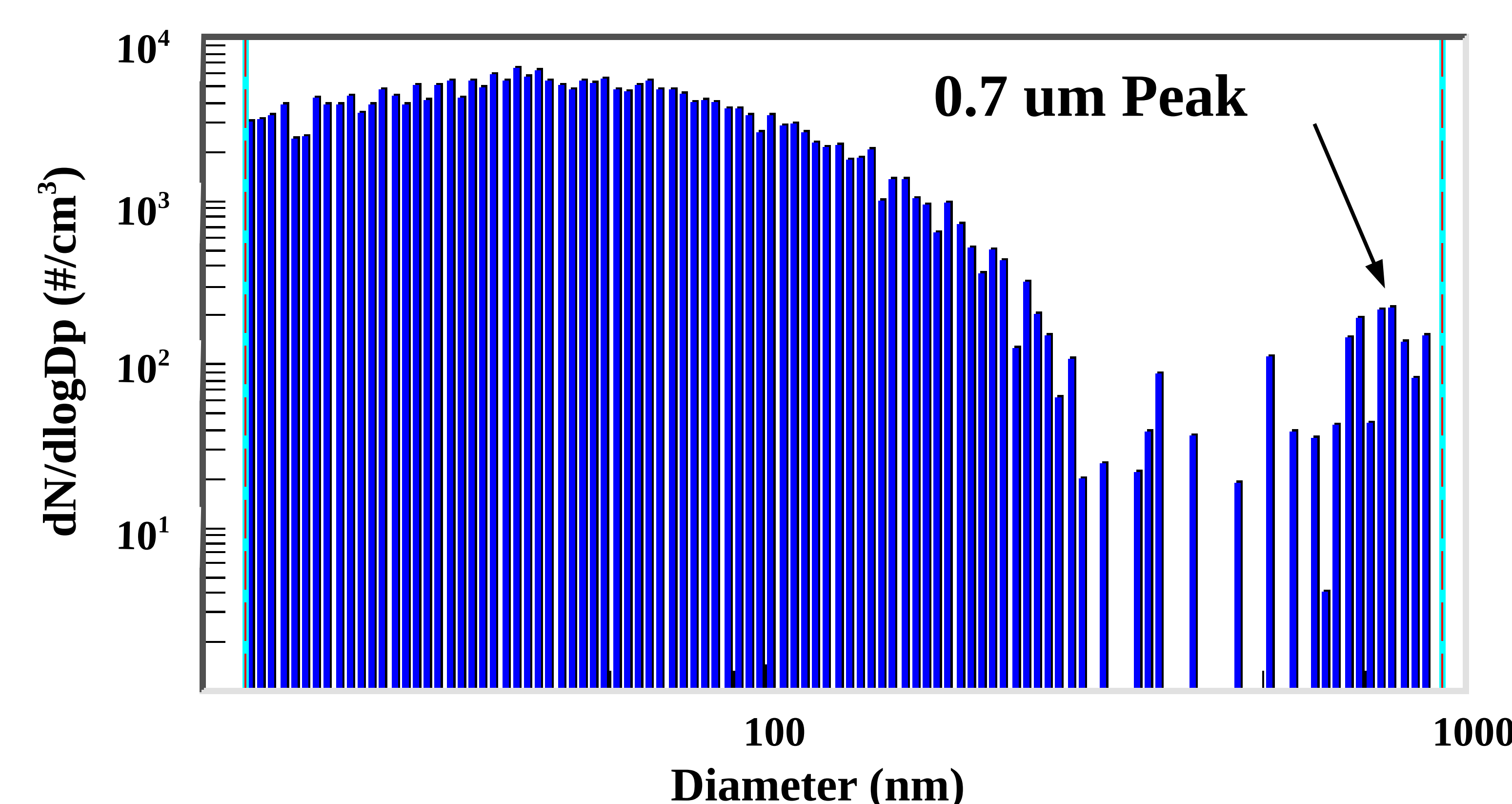


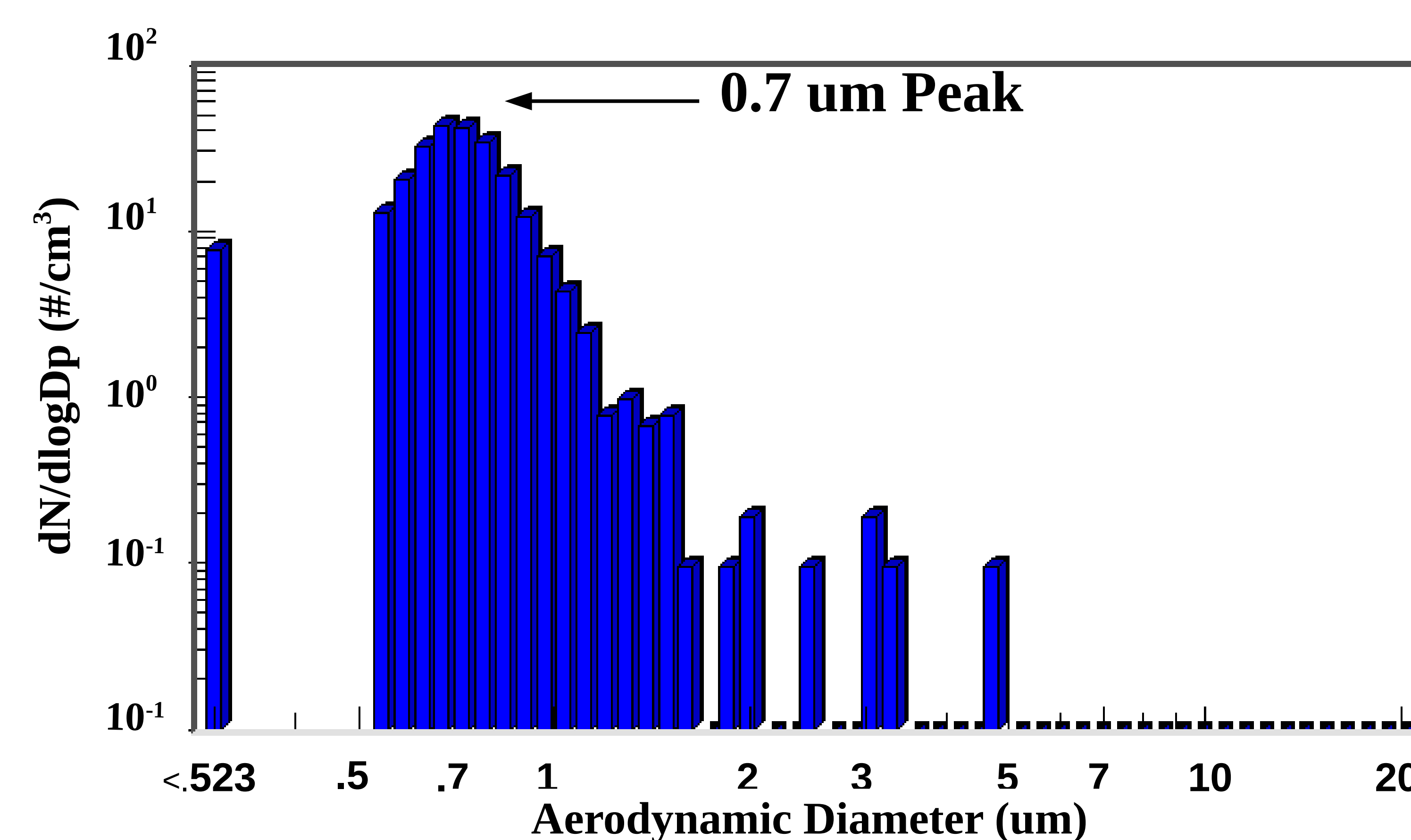
Image showing the instrument setup for obtaining the size distribution and CCN activation size of fabricated organic ice nuclei (OIN).



Images of the E. Coli C41 fabricated organic ice nuclei (OIN).



Scanning Mobility Particle Sizer (SMPS) measurements of the E. Coli C41 fabricated organic ice nuclei (OIN).



The particle size spectrum of the E. Coli C41 bacteria ghosts using an Aerodynamic Particle Sizer (APS).

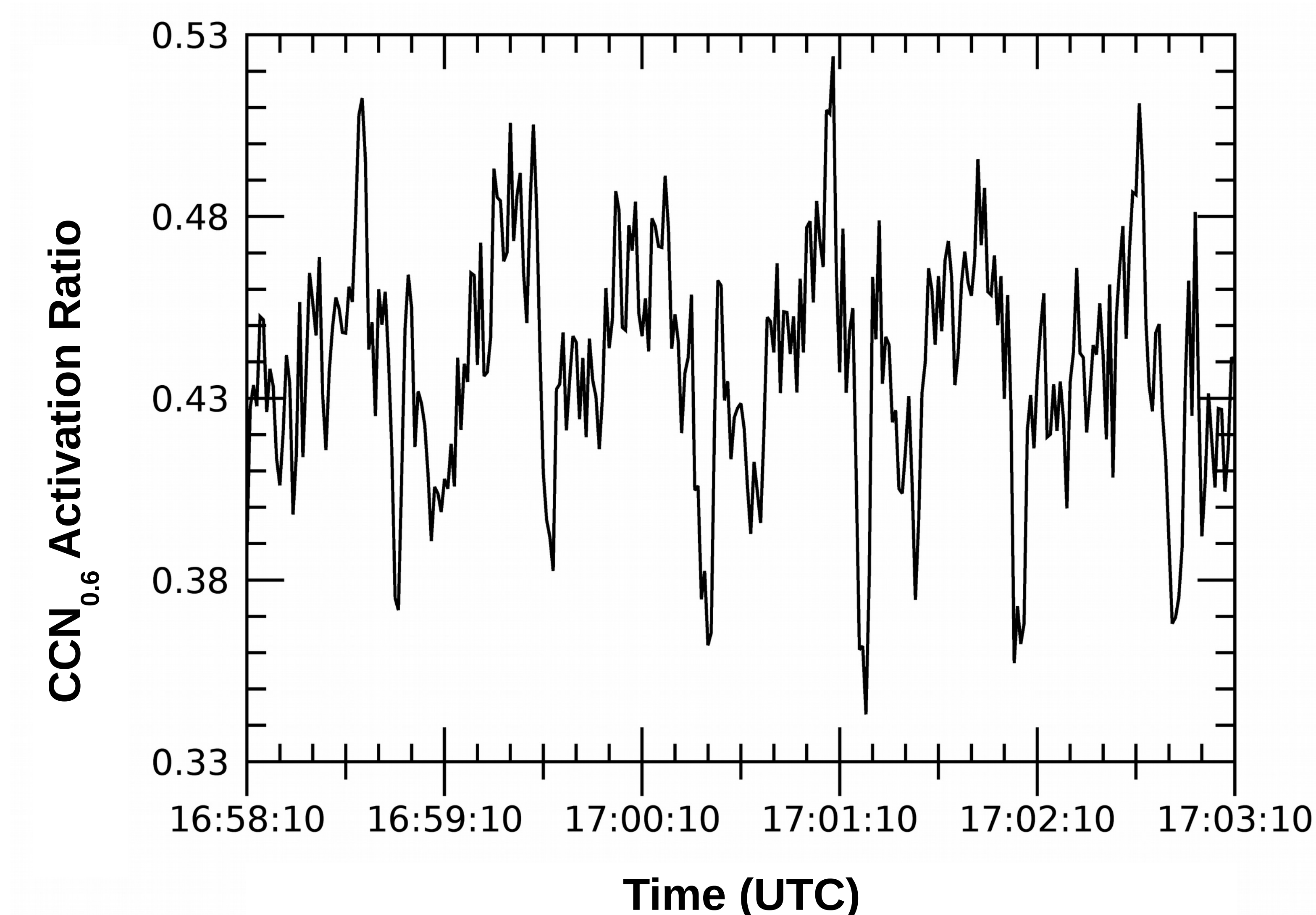


Image showing the CCN activation ratio of the E. Coli C41 fabricated organic ice nuclei (OIN), which is obtained from concurrent CCNC measurements at 0.6 % supersaturation and Condensation Particle Counter (CPC) measurements. The mean CCN activation ratio is 0.44 +/- 0.03.

## Results

- The size distribution is bimodal with a peak at 70 nm and 0.7 μm, with the 70 nm peak 100 times larger.
- Approximately 44 percent of the fabricated organic ice nuclei (OIN) activates as cloud condensation nuclei which indicates the potential for good immersion ice nuclei.

## Future Work

- Develop software to combine the APS and SMPS data to better combine the two size peaks.
- Test different generation methods for creating the fabricated organic ice nuclei (OIN) aerosols.
- Conduct ice nucleation experiments to determine the effectiveness of OIN as immersion and contact ice nuclei.

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