Spectrometer for Ice Nuclei (SPIN)

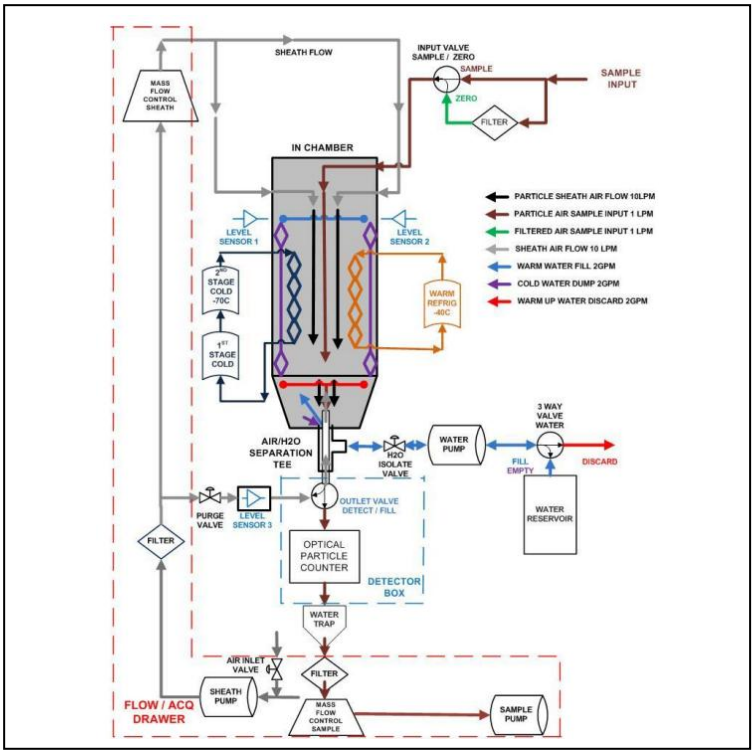
Real time measurement of ice nucleating particle (INP) concentrations

INTRODUCTION:

The SPIN is a state-of-the-art instrument designed for real-time, in-situ measurement of ice nucleating particles (INPs) under atmospherically relevant conditions.

Based on the continuous flow diffusion chamber (CFDC) concept, SPIN simulates supersaturated and sub-saturated environments using a controlled temperature and humidity gradient, allowing for the activation of ambient aerosols into ice crystals.

By replicating natural freezing processes, SPIN supports investigations into primary ice nucleation mechanisms in cold and mixed phase clouds.



OBJECTIVES:

- To quantify INP Concentrations.
- Characterization of INP Activation Conditions.
- To study Aerosol–Cloud–Climate Interactions.

DATA OUTPUT:

- INP Concentration (INP/L) at different supersaturations and at different lamina temperatures.

KEY SPECIFICATIONS:

- **Measured Particle Size Range:** 1 – 20 µm
- **Particle Residence Time in Chamber:** 10 – 12 seconds
- **Sample Flow:** 1 lpm
- **Sheath Flow:** 10 lpm
- **Time Resolution:** 1 Hz
- **Measured Parameters:** Particle size and Particle phase (ice vs. water)

MEASUREMENT AND WORKING PRINCIPLE:

The SPIN operates on the Continuous Flow Diffusion Chamber (CFDC) principle. In this setup, aerosol-laden air flows through a vertically oriented chamber formed by two concentric, ice-coated cylindrical walls maintained at different sub-zero temperatures. The resulting temperature gradient generates a controlled supersaturation within the annular flow region, simulating cloud conditions with the desired supersaturation and lamina temperature.

As the sampled air passes through this environment, ice-nucleating particles (INPs) activate and grow into detectable ice crystals. These crystals are subsequently measured using a polarization-based optical particle counter.

By precisely controlling the temperatures of both walls, users can achieve the desired supersaturation and lamina temperature.

KEY FEATURES:

- Real-Time Detection of Ice Nucleating Particles (INPs)
- Wide Temperature and Supersaturation Range
- Controlled environment for simulating mixed-phase and cold clouds.

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