

6.2 Zeolite Solution Crystallization Diagnostics Facility (ZSCDF)

6.2.1 Facility Overview

ZSCDF (Zeolite Solution Crystallization Diagnostics Facility) shall allow the investigation of aggregation processes in liquids, especially the formation of porous silicas from Ordered Liquid Phases (OLP). It is using dynamic light scattering (DLS) as principal technique, and a miniaturized viscosity sensor for the monitoring of structural changes in the liquid medium.

ZSCDF consists of an Electronics Unit (EU) and a Process Unit (PU), accommodated in the European Drawer Rack (EDR). Both units are based on H/W of the Protein Crystallization Diagnostics Facility (PCDF), which returned from ISS after a successful mission in 2009. The modifications for ZSCDF include the experiment cells and a Light Scattering Electronics with Single Photon Detectors and fast correlators.

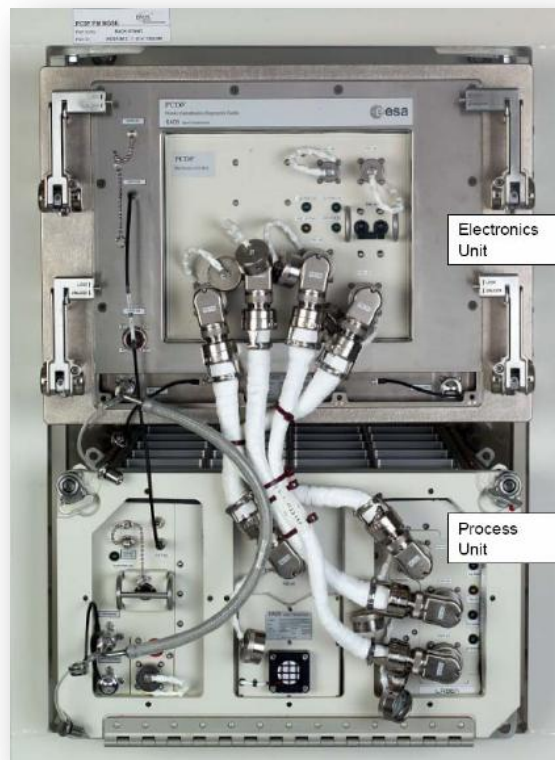


Figure 6-6: Electronics Unit and Process Unit of PCDF

6.2.2 Facility Design

The ZSCDF Electronics Unit comprises the Power and Data Electronics (PDE) and the Light Scattering Electronics (LSE).

The PDE controls the experiments by commands from ground, or autonomously by pre-defined scripts. All scientific and housekeeping data are sent to ground in real-time.

The LSE contains Avalanche Photo Diodes for detection of single photons, which are received from the experiment via optical fibers. The signals are routed to fast correlators, which calculate the auto-correlation functions (ACF). Three optical channels can be measured in parallel.

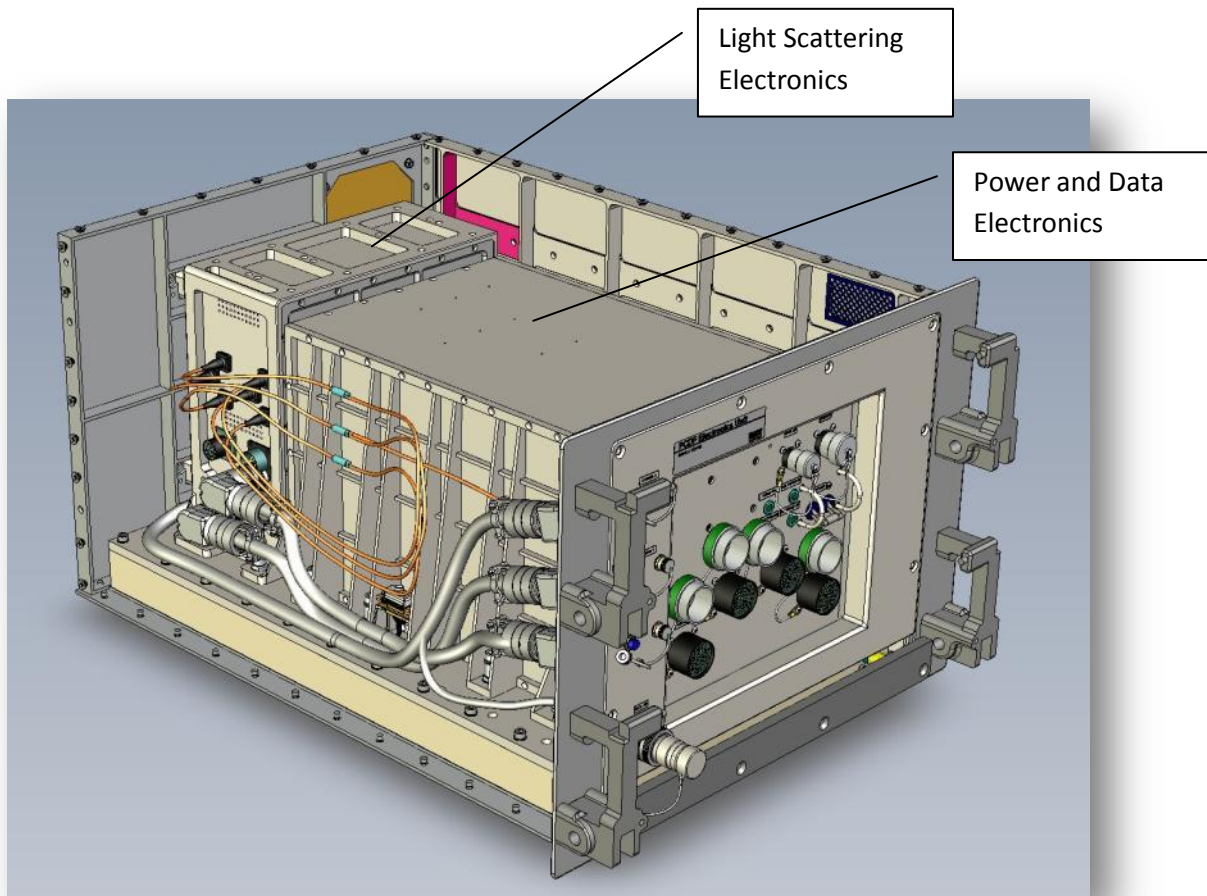


Figure 6-7: ZSCDF Electronics Unit

The ZSCDF Process Unit houses the experiments with the diagnostics tools.

Two experiment cells are contained in the Experiment Unit, which provides 3 levels of containment. They have mechanisms for independent injection of two liquids into a reaction volume, a stirrer, and the sensor head (quartz crystal resonator) for viscosity measurements. The cells can be thermally controlled from 20 °C to 95°C.

For light scattering measurements, each cell is equipped with a laser diode of 100 mW optical power at 660 nm, and collection optics at three scattering angles (45°, 90°, 170°).

In addition, photo diodes allow the measurement of the turbidity of the samples.

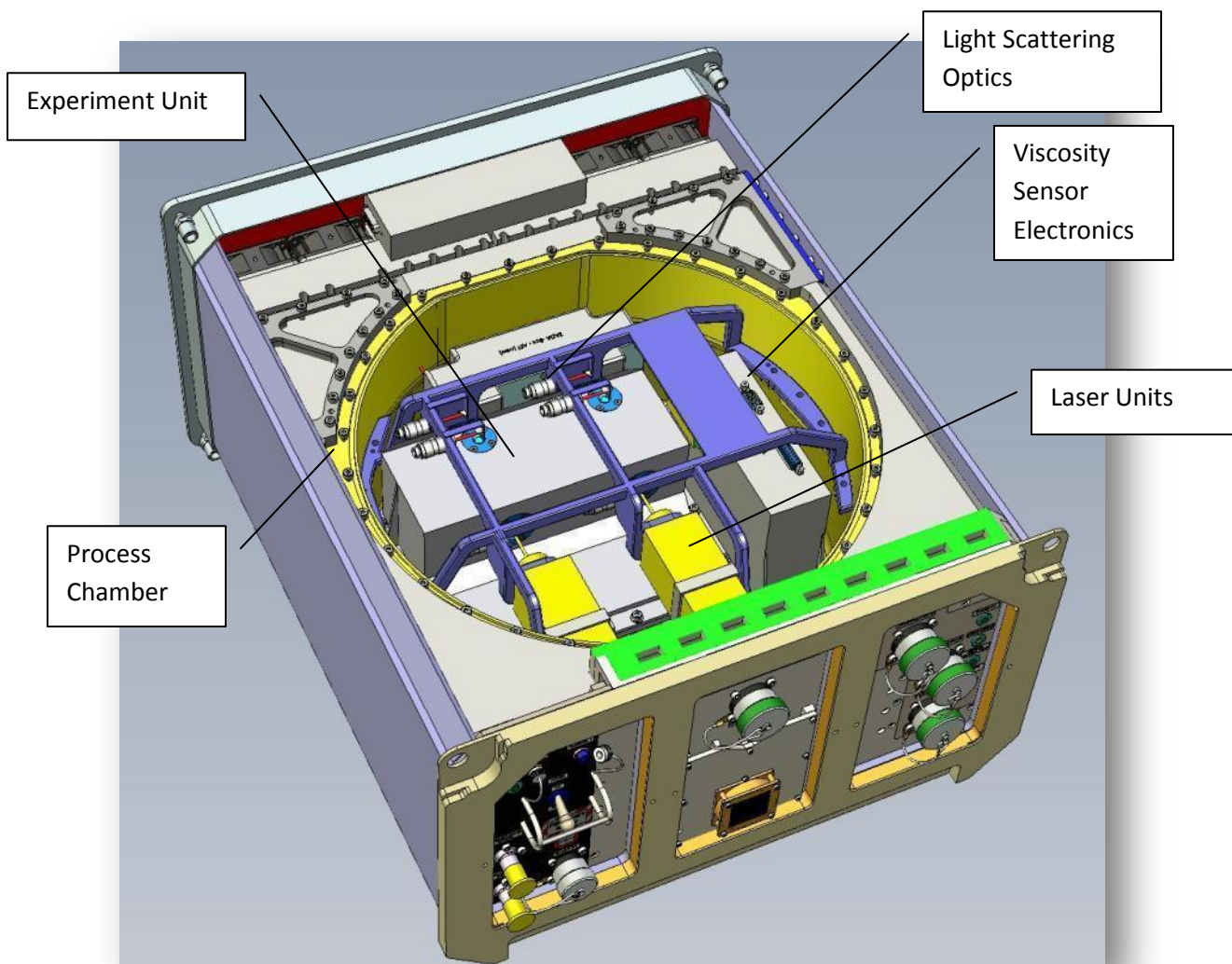


Figure 6-8: ZSCDF Process Unit

6.2.3 Main Experiment Features

Experiment Cells	
	2 Zeolite Experiment Assemblies (ZEA) in a common housing, with 3 levels of containment
Liquid Volumes	Reaction Volume ~1.5 ml Injection Volume 1 ~2.0 ml Injection Volume 2 ~1.5 ml
Injection	Measurement accuracy 0.5% Minimum step size 5% Injection rate ~1 ml/min
Stirring	Frequency ~2 Hz Total time max 500 min.
Internal Leak Rate	Before activation < 1µl/10 days After activation < 1 µl/day
Thermal Control	Range 20 - 95 °C Stability < 0.5 °C Gradient over cell < 0.1 °C/cm Ramp +10 °C/min for heating
Optical Diagnostics	
	<p><u>Polarized DLS:</u></p> <ul style="list-style-type: none"> • Simultaneously at 3 angles (45°, 90°, 170°) • 50 ns cross correlation for all angles simultaneously • Optical Laser power 100 mW at 660 nm • Detector: Avalanche Photo Diodes <p><u>Turbidity measurements</u></p> <ul style="list-style-type: none"> • Laser intensity measurements at cell entrance and exit
Viscosity Measurement	
	<p>Miniaturized sensor head (Quartz Resonator)</p> <p>Range 1.2 - 20 cP Precision 0.1 cP</p>
Facility Control	
	<ul style="list-style-type: none"> • Remote from ground, or by script
Data Transfer	
	<ul style="list-style-type: none"> • Housekeeping Data • Autocorrelation functions • Scattering Intensity • Viscosity Spectra

Table 6-2: ZSCDF Technical Data

Qualification Status: Designed for use on ISS