

## 第5章 流体物理実験装置の開発

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### Development of Fluid Physics Experiment Facility for JEM

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**ABSTRACT** Fluid Physics Experiment Facility (FPEF) is one of the Multi-user experiment facilities equipped in Japanese Experiment Module pressurized module. FPEF will be mainly used for fundamental fluid physics experiments of moderate temperature Marangoni Convection research in Liquid Bridge. Marangoni Convection is induced by the difference of surface tension when a temperature gradient occurs inside the free surface viscous fluid. The heating disk made of sapphire glass with Indium Tin Oxides (ITO) heater and the cooling disk with peltier cooler controls the gradient of sample (Silicon oil).

#### 1. Introduction

FPEF will be integrated in # 4 Rack Assembly (Fig.1) and consists of the core section and the mission section. The mission section called Experiment Cell is exchangeable according to the purpose of experiment. (Fig.1) And the core section has observations, a control equipment, and systems to support experiments.

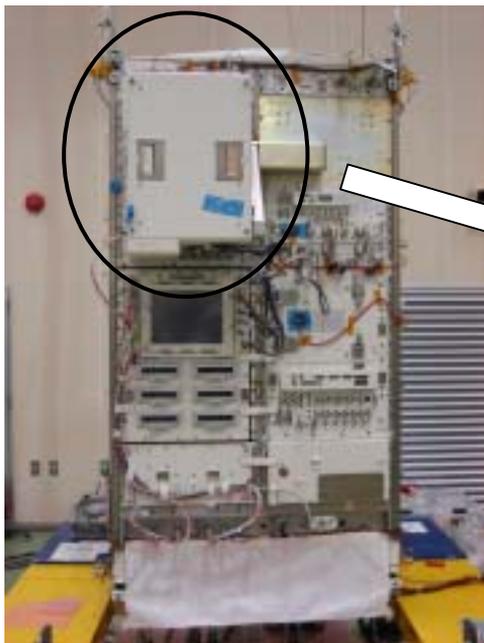


Fig.1 #4 Rack Assembly



Fig.2 FPEF Core section

In Experiment Cell, Liquid Bridge made of silicon oil is formed between the heating disk and the cooling disk by moving the cooling disk. Liquid Bridge is cylinder. (Fig.2) The heating disk made of sapphire glass with Indium Tin Oxides (ITO) heater and the cooling disk with peltier cooler control the gradient of Liquid Bridge temperature.

## 2. Specification

FPEF has observations and a measurements as follows.

### (1) 3D Flow Field Observation

3D Flow Field Observation assembly set in the core section has 3 CCD cameras. (Fig.3) Those cameras fixed on different angle observe the particle in Liquid Bridge through Heating Disk. Users can obtain the velocity vector by PTV. PTV (Particle Tracking Velocimetry) is the field measurement method based on digital image processing.



Fig.3 3D Flow Field Observation

### (2) Liquid Bridge Over View Observation

Liquid Bridge Over View assembly (Fig.4) set in the core section has a CCD camera and supply the color image.

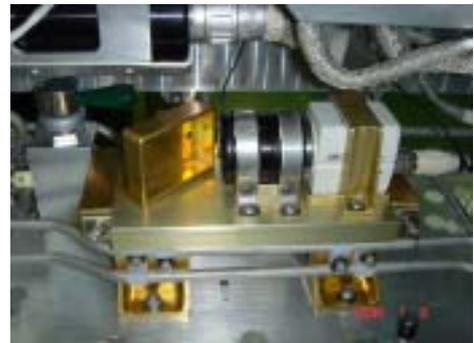


Fig.4 Liquid Bridge Over View Observation

### (3) Surface Temperature Measurement

Surface Temperature Measurement assembly (Fig5) set in the core section has a infrared image camera and supply monochrome image.



Fig.5 Surface Temperature Measurement

### (4) Ultrasonic Velocity Profile Measurement

Ultrasonic Velocity Profile Measurement assembly set in the Experiment Cell supply velocities at 150 point in Liquid Bridge.

### (5) Surface-flow Rate Observation

Surface-flow Rate Observation assembly set in the Experiment Cell supply the image of Liquid Bridge surface. User can obtain surface-flow rate by analyzing Photochromic dye actuation with GN2 laser in the image.

To support experiments, following equipments are integrated in FPEF.

- FPEF Control Equipment
- Motor Driver
- Strobe Lamp
- Ar Gas Supply System
- Video Switcher
- Cooling Water System
- Waste Gas system

The specifications of FPEF are as Table.1.

### 3. Conclusion

Currently , FPEF Flight model have already launched by space shuttle 1J/A mission. And interface test to JEM system will be performed in this summer. FPEF will be operated for three years. During the operation, many significant results of experiments will be expected.

**Table.1 Specifications of FPEF**

<b>FUNCTION</b>	<b>ITEM</b>	<b>SPECIFICATION</b>
Liquid Bridge	Diameter	30, 50 [mm]
	Length	30 : 0 ~ 60 [mm] 50 : 0 ~ 65[mm]
Temperature Control	Heating Disk:	Up to 90 [ °C ]
	Cooling Disk:	Down to 5 [ °C ]
Atmosphere Control	Pressure	Up to 98 [kPa] @GAr
Liquid Bridge Temperature	Surface (infrared imager)	0 to 100 [ °C ]
	Inside (thermocouples)	Accuracy ± 0.1 [ °C ]
3D Flow Field	3 CCD cameras:	Effective pixels: 768 (H) x 494 (V)
Liquid Bridge Over View	CCD camera	Effective pixels: 768 (H) x 494 (V)
Surface Flow	Photochromic dye actuation with GN2 laser	Focus depth: ± 0.5mm
		Resolution: 60 [ μ m ] (Max.)
Internal Flow Field	UVP sensors	Measurement points:150 (Max.)
		Space resolution: 0.47mm/5Hz(Min.)
		Frequency: 5Hz (Min.)
Other utilities supplied for the Mission Section	Power	+24V (1ch), 12V (1ch), ± 15V (2ch)
	Video output	NTSC (2ch)
	Gas supply	Ar
	cooling water	16.1 ~ 23 [ °C ]