

Webinar #9: Regional Activities of the  
Hypergravity/Microgravity Webinar

**Micro and Hyper Gravity R&D  
Activities in China**

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## **1.Introduction**

## **2.R&D in Microgravity**

## **3.R&D in Hypergravity**

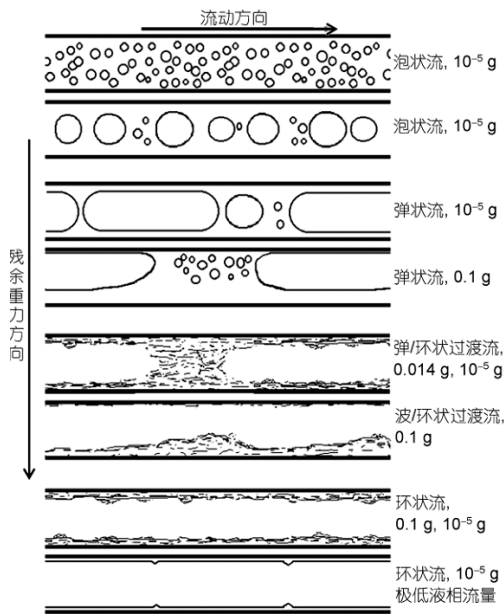
## **4.Research Institute**



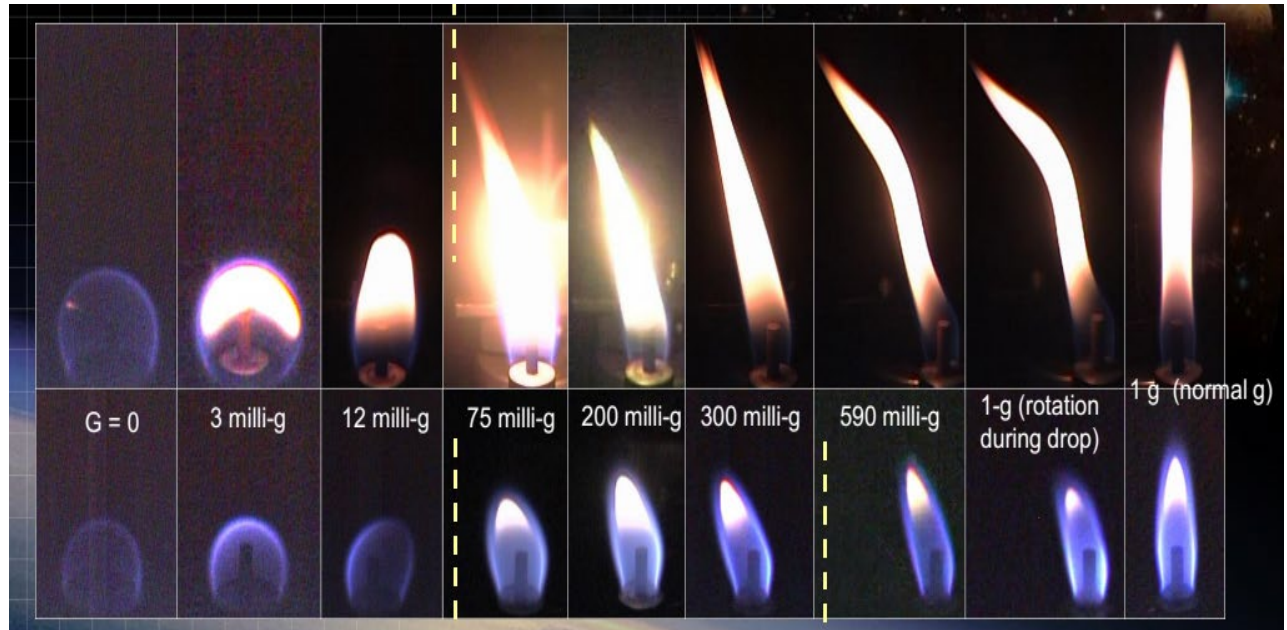
# 1. Introduction

## ■ study

Microgravity: Inertial acceleration is offset with gravitation, leading to absence of apparent gravitation ( $10^{-4} \sim 10^{-6}g$ ), which means static pressure, condensation, buoyancy and induced heat and mass transfer decrease dramatically.



Typical Multiphase Flow Pattern



Flame forms under various gravity conditions



# 1. Introduction

## ■ study

Hypergravity: The basic principle of overweight force engineering technology is to make use of the unique flow behavior of multi-phase flow system under the condition of overweight force to strengthen the relative velocity and contact between phases, so as to achieve efficient mass transfer process and chemical reaction process. The way to obtain excess force is mainly by rotating the whole of the equipment or components to form a centrifugal force field, the multi-phase flow system involved mainly includes gas-solid system and gas-liquid system.



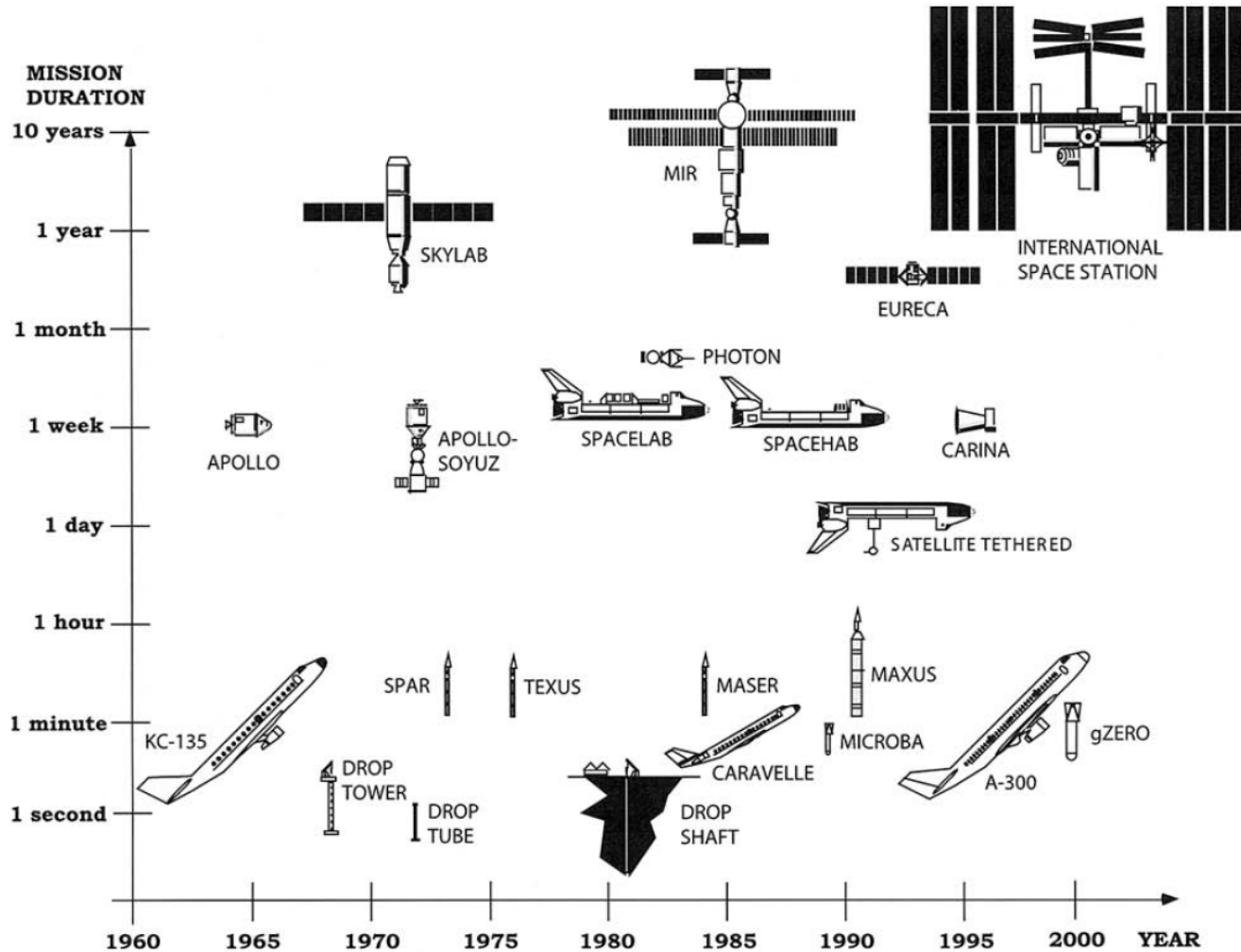
**Centrifuge**



**Astronauts overloads training**



## 2. R&D in Microgravity



Various Microgravity simulation facilities



**1.Introduction**

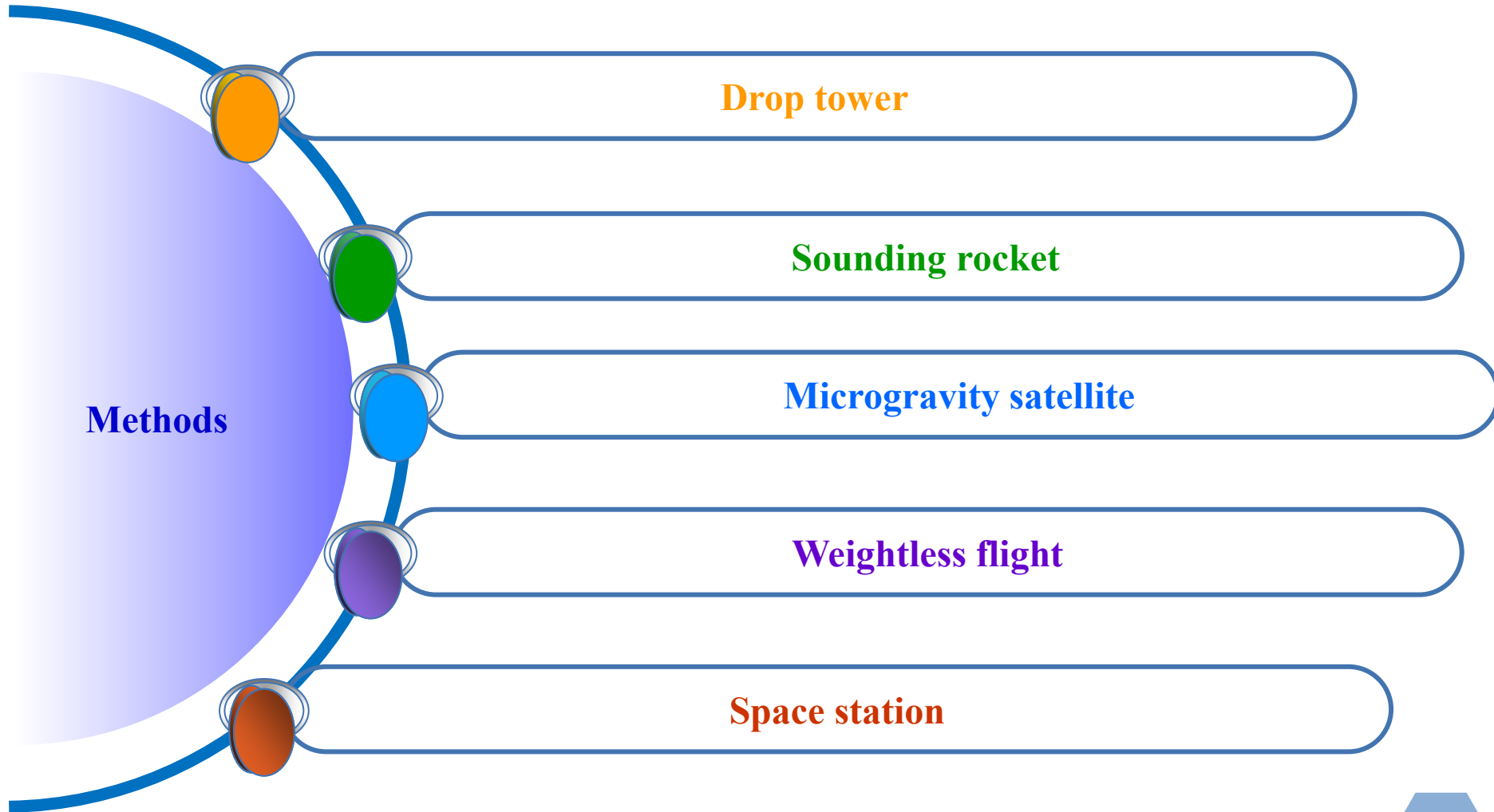
**2.R&D in Microgravity**

**3.R&D in Hypergravity**

**4.Research Institute**



## 2. R&D in Microgravity







## 2. R&D in Microgravity-Facility

### ■ National Microgravity Laboratory

- Height: 116m
- Microgravity level:  $10^{-5}g$
- Time duration: 3.5s
- Fluid physics, combustion of non-metal material, fluid management.







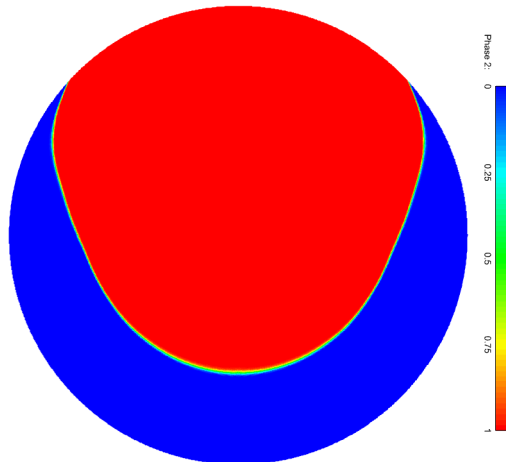
## 2. R&D in Microgravity-Facility

### ■ Bise 54m Drop tower

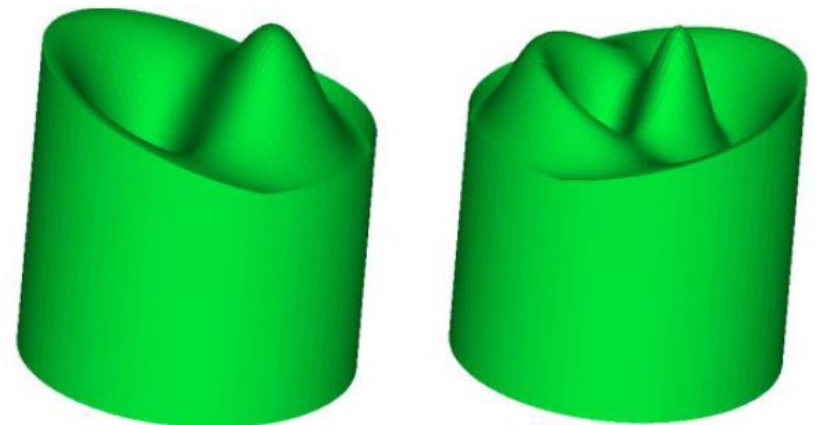
- Dated back to 1970s
- A drop tower with height of 57m, microgravity time of 2.8s
- microgravity level of up to  $10^{-4}g$
- reorientation, sloshing and other liquid management problems in rockets



**BISE Drop Tower**



**Liquid Evaporation**



**Fluid sloshing**

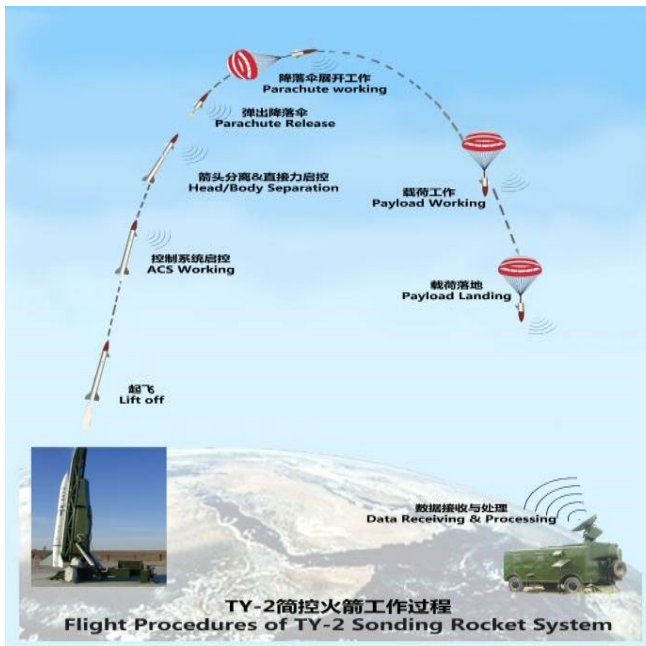




## 2. R&D in Microgravity-Facility

### ■ sounding rockets

- payload of 0.5 to 260 kg
- altitude of 550 km
- $10^{-5}g$ , 6.5min
- material science, life science tests



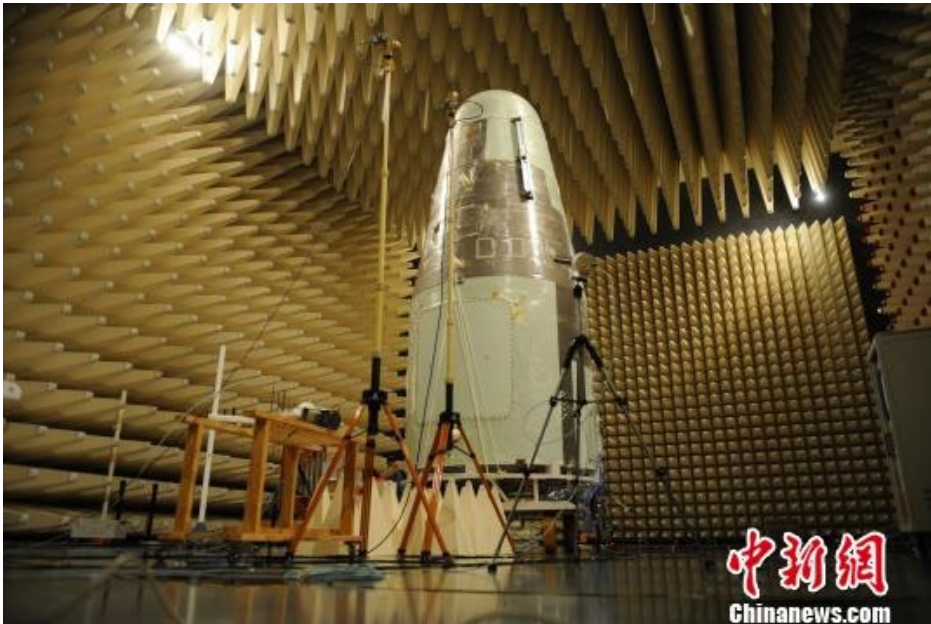
Sounding Rocket



## 2. R&D in Microgravity-Facility

### ■ Shijian Recoverable Microgravity Satellites

- The total mass is about 3.3 tons
- Microgravity level  $10^{-6}g$
- Duration 16 days
- 19 scientific experiments



Shijian-10 Satellite

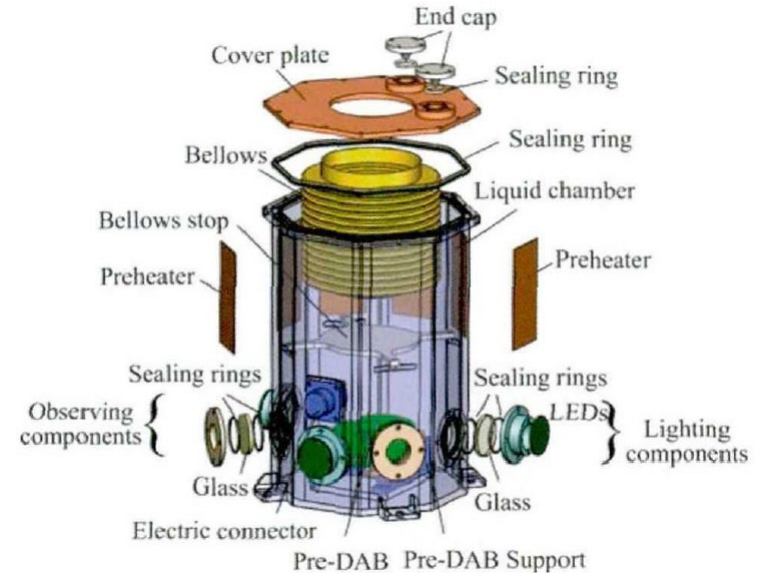




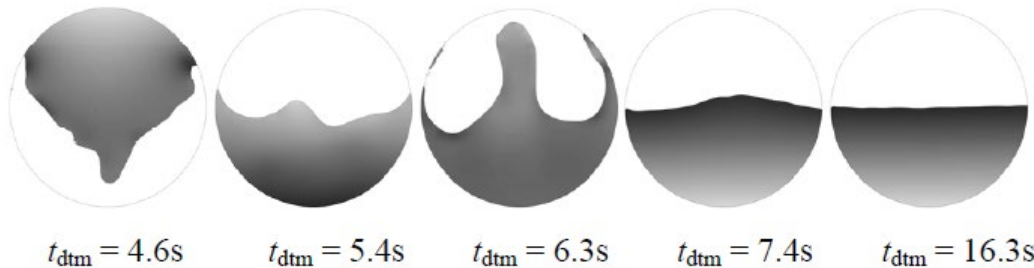
## 2. R&D in Microgravity

### ■ Fluid physics under Microgravity

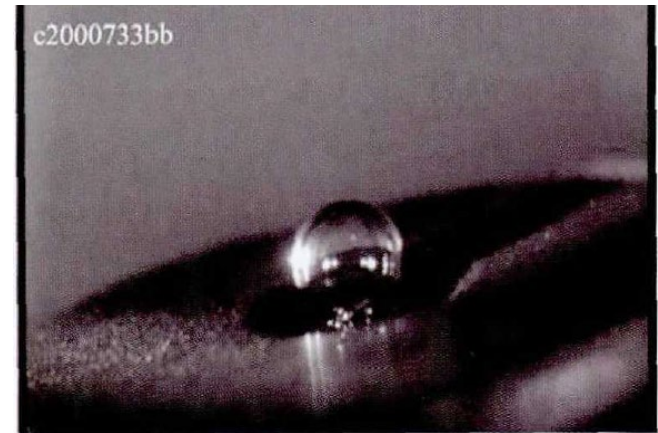
- Thermal capillary convection and its evolutionary process
- Multi-phase fluid dynamics
- Complex fluid behaviors



**Fluid behavior analysis device**



**Liquid-air interface evolution**



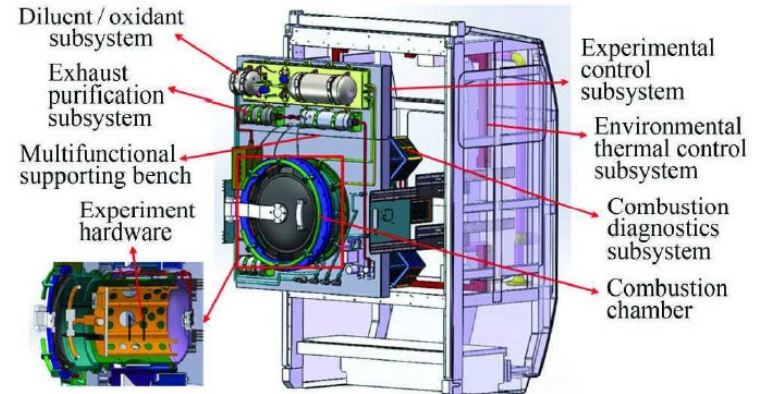
**Liquid droplet evaporation**



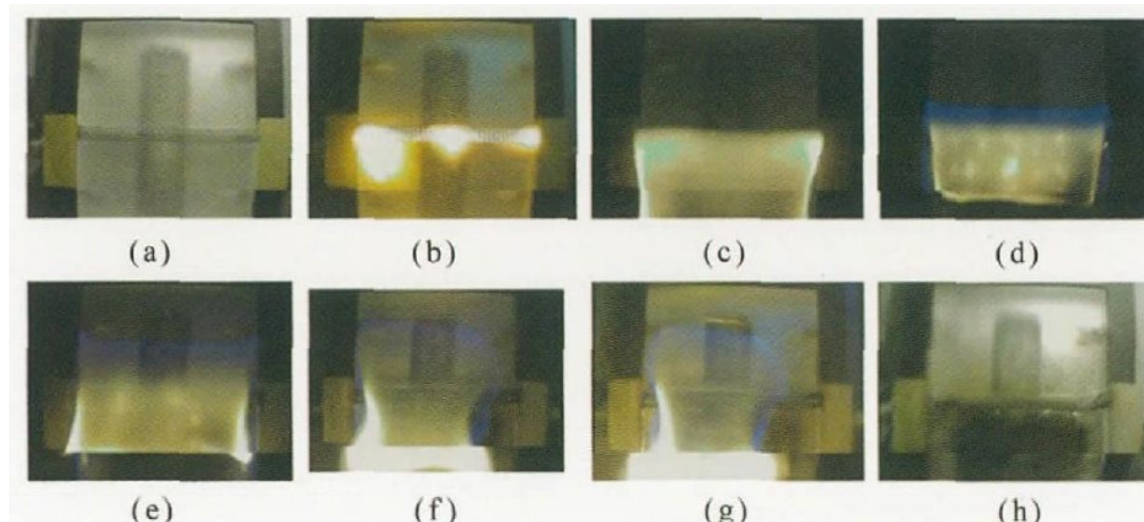
## 2. R&D in Microgravity

### ■ Combustion

- Ignition and flame propagation
- Smoke generation
- Smouldering of porous medium



Combustion experimental system in Space Station



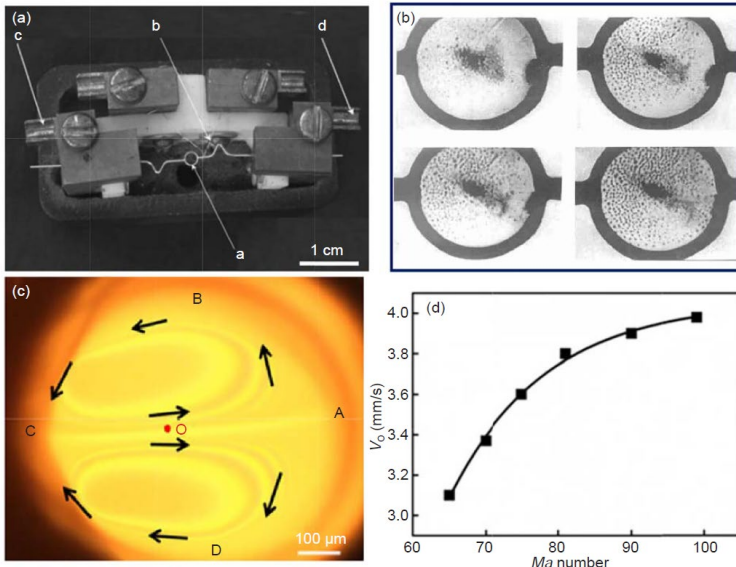
Ignition and flame propagation process of solid material on SJ-10



## 2. R&D in Microgravity

### ■ Materials Science under Microgravity condition

- China is developing a new generation of space materials experimental devices for the space station, such as high temperature materials science laboratory cabinets and container-free materials test cabinets.



Marangoni convection in high temperature melt



Tiangong-2 space material experiment

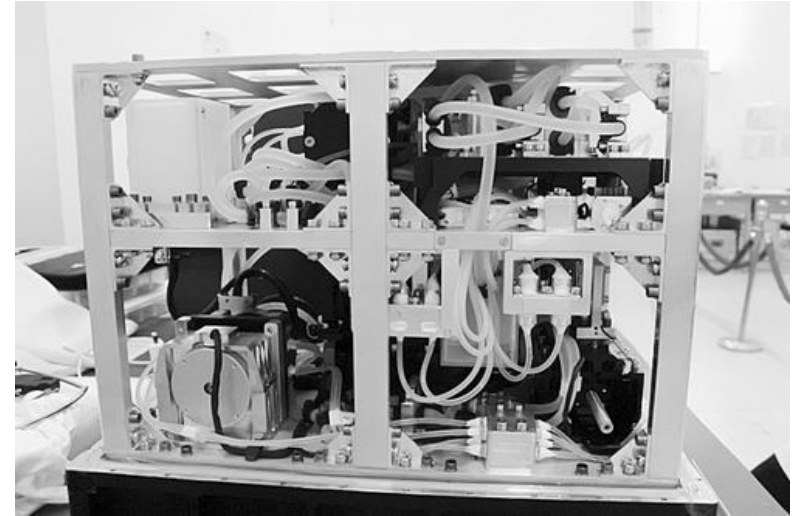




## 2. R&D in Microgravity

### ■ Biology

- space microgravity on the structure, interrelationship, expression and synthesis, manipulation and regulation of genomes, proteomics
- Plants growth in Microgravity condition



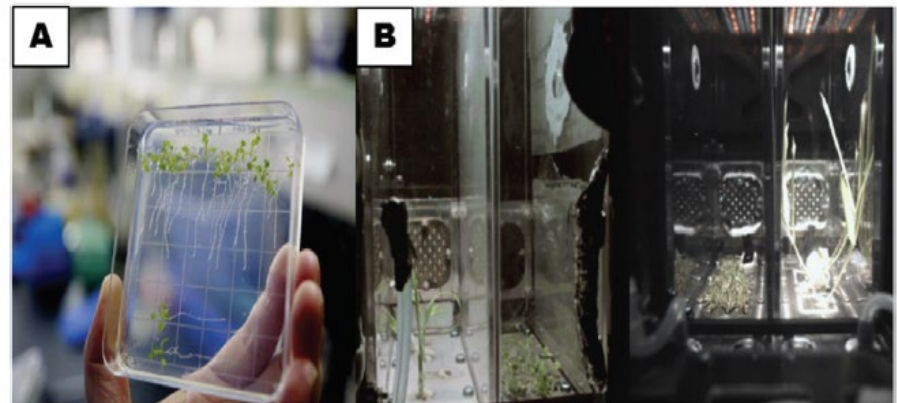
Stem cell Incubator on SJ-10



(a) Space-based test plant



(b) Ground-based test plant



Mini plant incubator of Tiangong-2 spacecraft

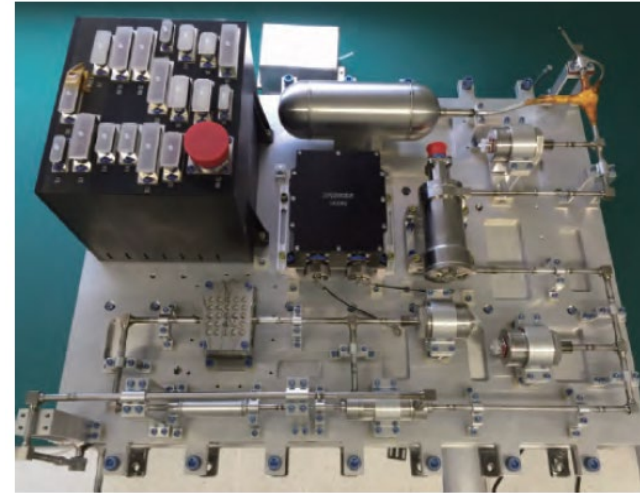




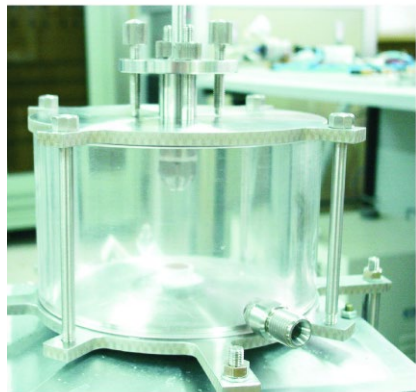
## 2. R&D in Microgravity

### ■ Applications

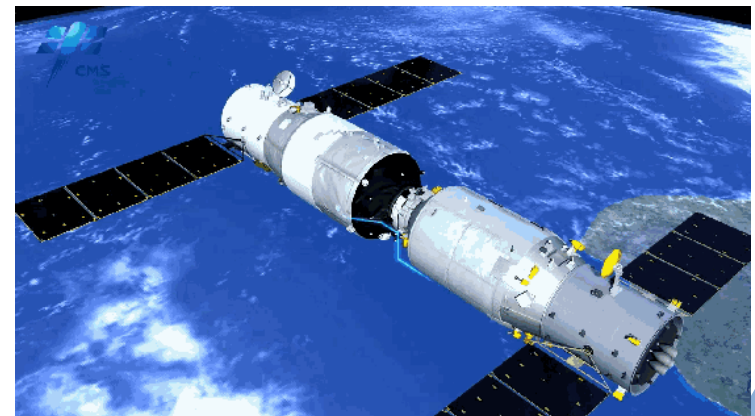
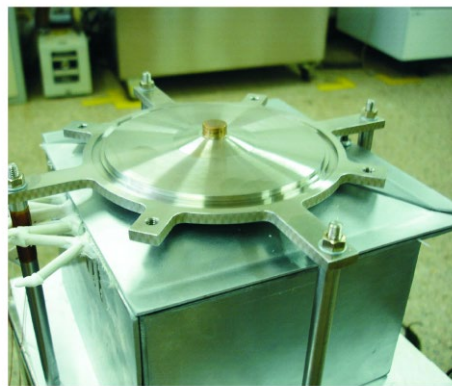
- Reduced-gravity assisting the two-phase fluid circuit
- Closed-loop Spray Cooling System
- On-orbit refueling system



two-phase fluid circuit thermal management



Closed-loop Spray Cooling System



TG-1 on-orbit refueling



**1.Introduction**

**2.R&D in Microgravity**

**3.R&D in Hypergravity**

**4.Research Institute**



### 3. R&D in Hypergravity

#### ■ Zhejiang University Centrifugal Hypergravity Experiment Facility

- a capacity of more than 1500g\*t
- a maximum centrifugal acceleration of 1500g
- a maximum load of more than 30t.
- slope and high dam, geodesic engineering, deep sea engineering, deep earth engineering and environment, geological processes, material preparation





### 3. R&D in Hypergravity

#### ■Bise Centrifugal Hypergravity Experiment Facility

- a capacity of more than 400g\*t
- Structural response under hypergravity loads

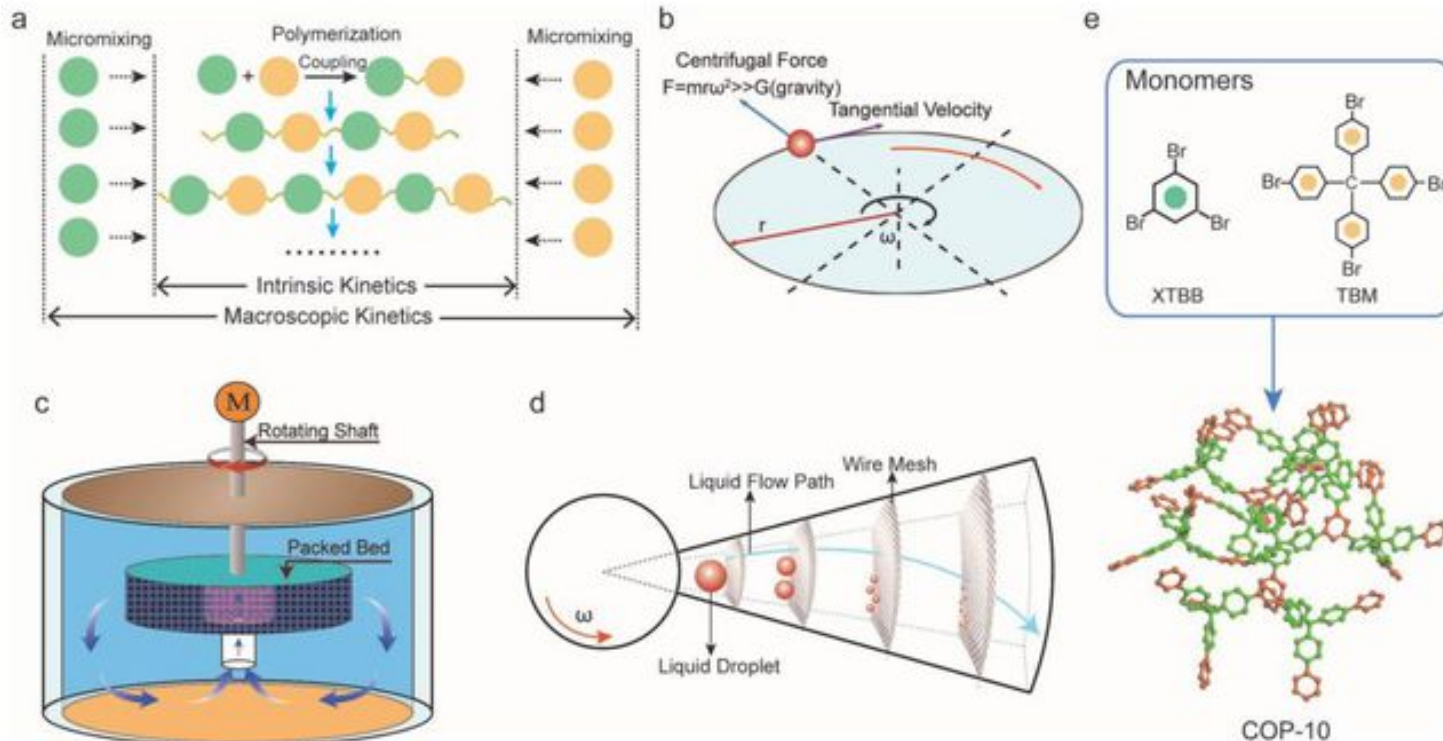




# 3. R&D in Hypergravity

## ■ Research Center for High Gravity Engineering and Technology

- Dust removal, desulfurization, deoxygenation of boiler water
- ammonia-containing wastewater treatment







## 4. Research Institute

### ■ **Microgravity**

#### ➤ **Institute of Mechanics, Chinese Academy of Science**

<http://www.imech.cas.cn/>

**Graduate Program included**

**In charge of operation of the 3.5s drop tower in Beijing**

#### ➤ **Technology and Engineering Center for Space Utilization, Chinese Academy of Science**

<http://www.csu.cas.cn/>

**Graduate Program included**



## 4. Research Institute

### ■ Microgravity

#### ➤ Xi'an Jiaotong University

<http://www.xjtu.edu.cn/>

**Graduate Program included**

#### ➤ Tsinghua University

<https://www.tsinghua.edu.cn/>

**Graduate Program included**

#### ➤ Beihang University

<https://www.buaa.edu.cn/>

**Graduate Program included**





## 4. Academic Research

### ■ Hypergravity

#### ➤ Zhejiang University

<https://www.zju.edu.cn/>

Graduate Program included

#### ➤ Beijing University of Chemical Technology

<https://www.buct.edu.cn/>

Graduate Program included

#### ➤ South China University of Technology

<https://www.scut.edu.cn/new/>

Graduate Program included

#### ➤ University Of Science & Technology Beijing

<https://www.ustb.edu.cn/>

Graduate Program included



**Thank you  
for your attention!**