Lesson 1: Introduction to Rocket System

李易 博士

Dr.-Ing LI Yi

School of Astronautics

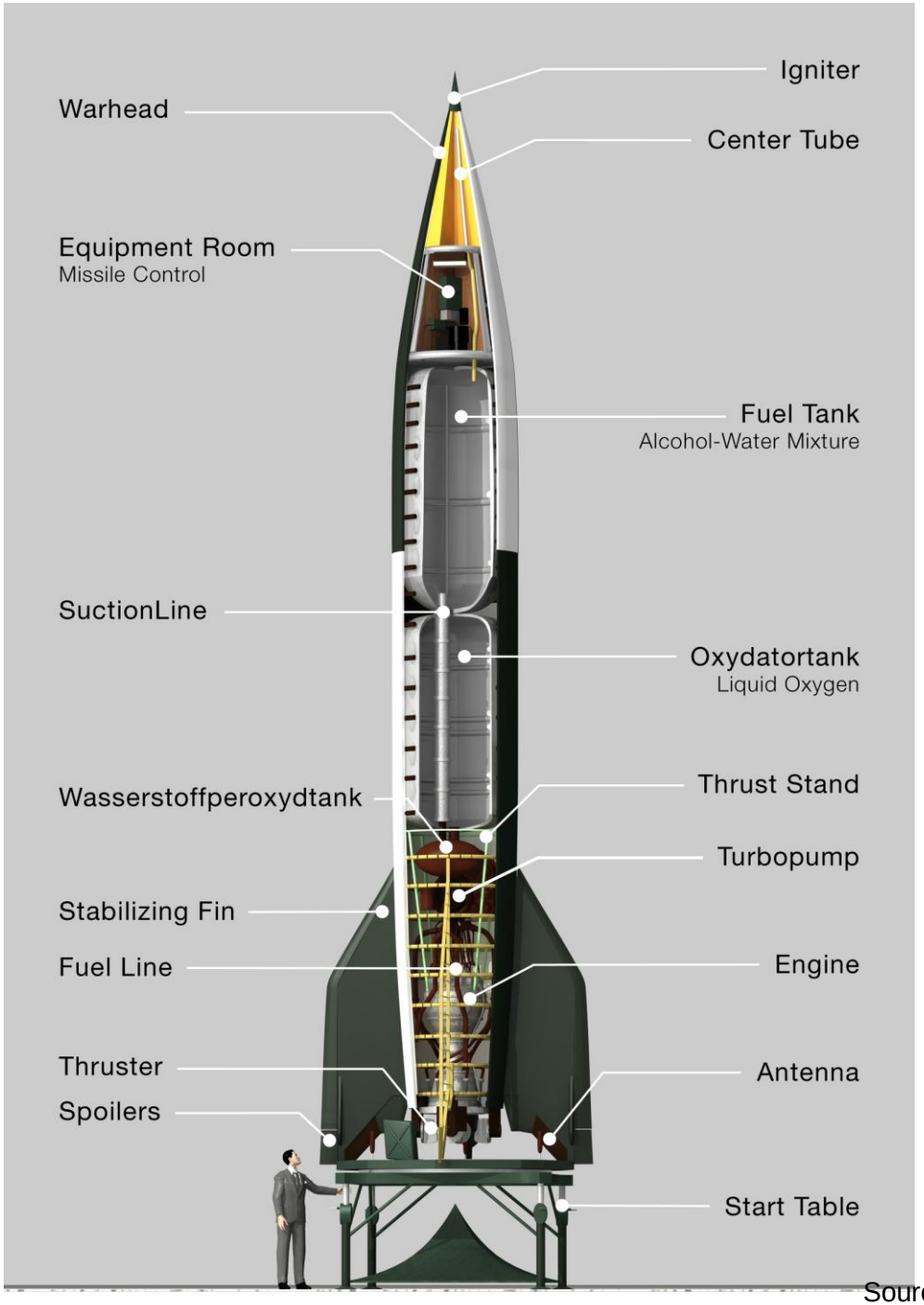
How can a rocket fly?

Propulsion → Motor

Where is it? → Navigation

Where should it fly? → Guidance

How can it fly somewhere? → Control



How can a rocket fly?

Propulsion

Navigation
Guidance
Control

Aerodynamics

Flight
mechanics

Structure

Avionics

Materials

Manufacture

Source: wiki

1. The sounding rocket

How can a rocket fly?

Propulsion → Motor

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1. The sounding rocket

How can a rocket fly?

Propulsion → Motor

Avionics

Materials

Manufacture

sounding rocket：uncontrolled rocket

1. The sounding rocket

How can a rocket fly?

Avionics

Mainframe

Manufacture

sounding rocket：uncontrolled rocket

1. The sounding rocket

The name “sounding rocket” comes from the nautical term "to sound," which means to throw a weighted line from a ship into the water to measure the water's depth.

The term itself has its etymological roots in the Portuguese / Italian / Spanish and French words for *probe*, which are "sonda" and "sonde", respectively.

- Wiki

1. The sounding rocket

In Chinese, the “sounding rocket” is called “探空火箭”

“探（Tan）” means “to probe” .

“空(Kong)” means “space” or “sky”.

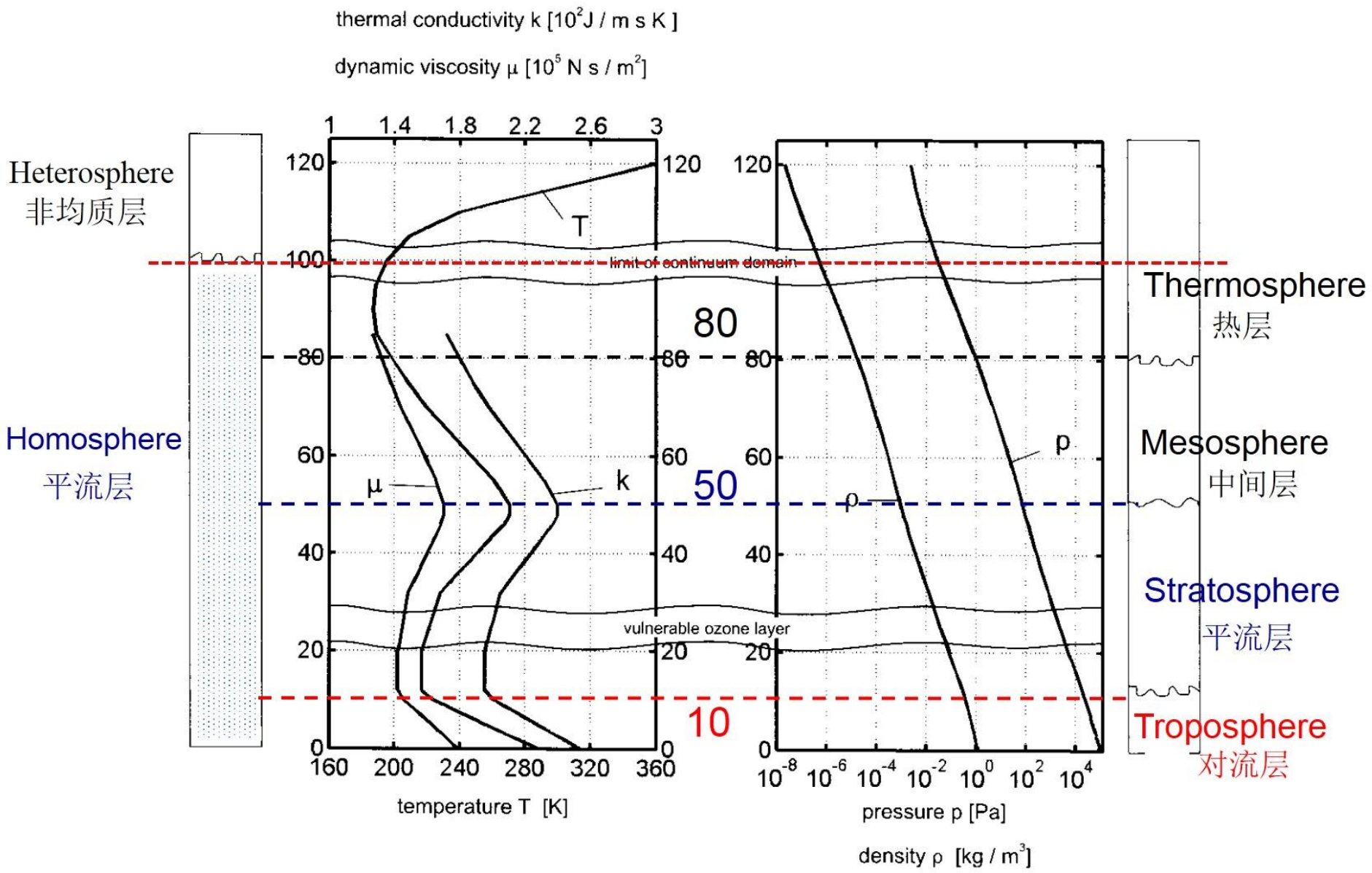
“火（Huo）箭(Jian)” means “rocket”.

1. The sounding rocket

Why sounding rocket?

Place instruments directly into **any regions** in the atmosphere or the space near the earth with a **low cost**.

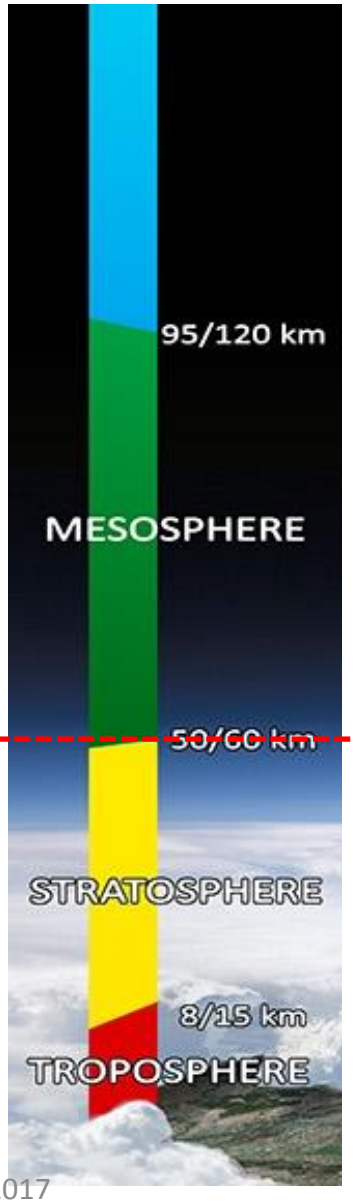
- Space environment
- Micro-gravity experiment
- Biology experiment
- As a testbed for new scientific techniques, scientific instrumentation, and spacecraft technology.



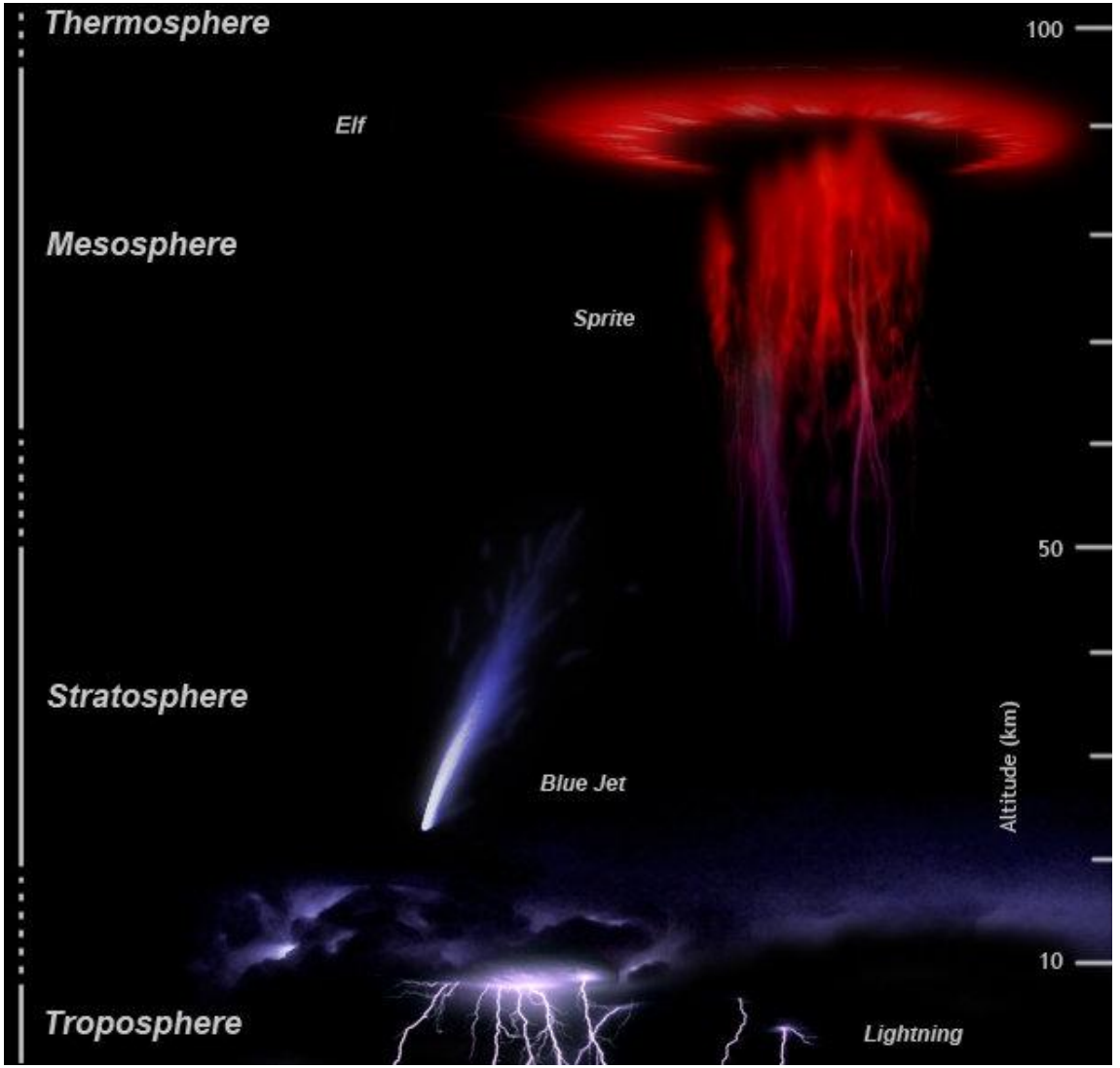
Atmospheric layers

Source: Hirschel

The earth atmosphere



Balloon altitude record: 53.0 km



source: wiki

1. The sounding rocket

Why sounding rocket?

Place instruments directly into **any regions** in the atmosphere or the space near the earth with a **low cost**.

- Suborbital flight (vs. space orbit)
  - low velocity
  - low cost booster
- Uncontrolled or with less control
- Smaller size, launching from temporary sites possible

2. Classification of sounding rockets

Classified by missions

- Space environment
- Micro-gravity experiment
- Biology experiment
- As a testbed for new scientific techniques…

Classified by the propulsion system:

- Liquid
- Solid
- Hybrid

3. Sounding rocket system

- Rocket
- Payload
- Ground facilities

3. Sounding rocket system

Rocket

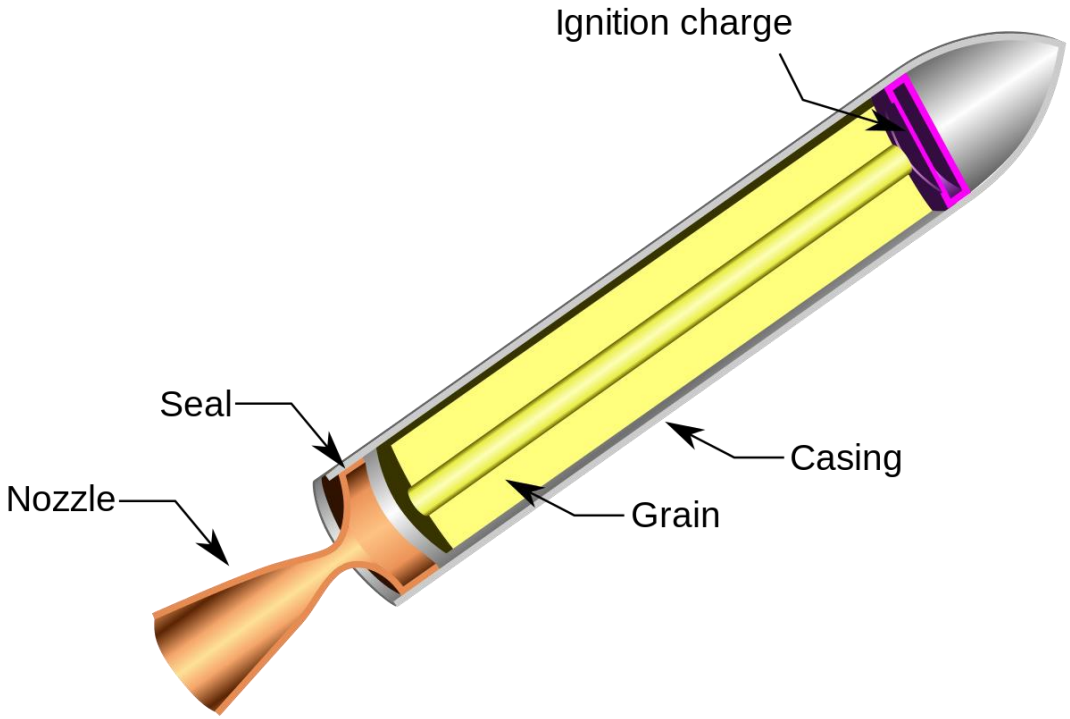
- Propulsion system
  - case, propellant feed system, tank, nozzle…
- Electronic system
- Recovery system
- Structure system (Airframe)

Payload

experiment instruments

3. Sounding rocket system

Propulsion system

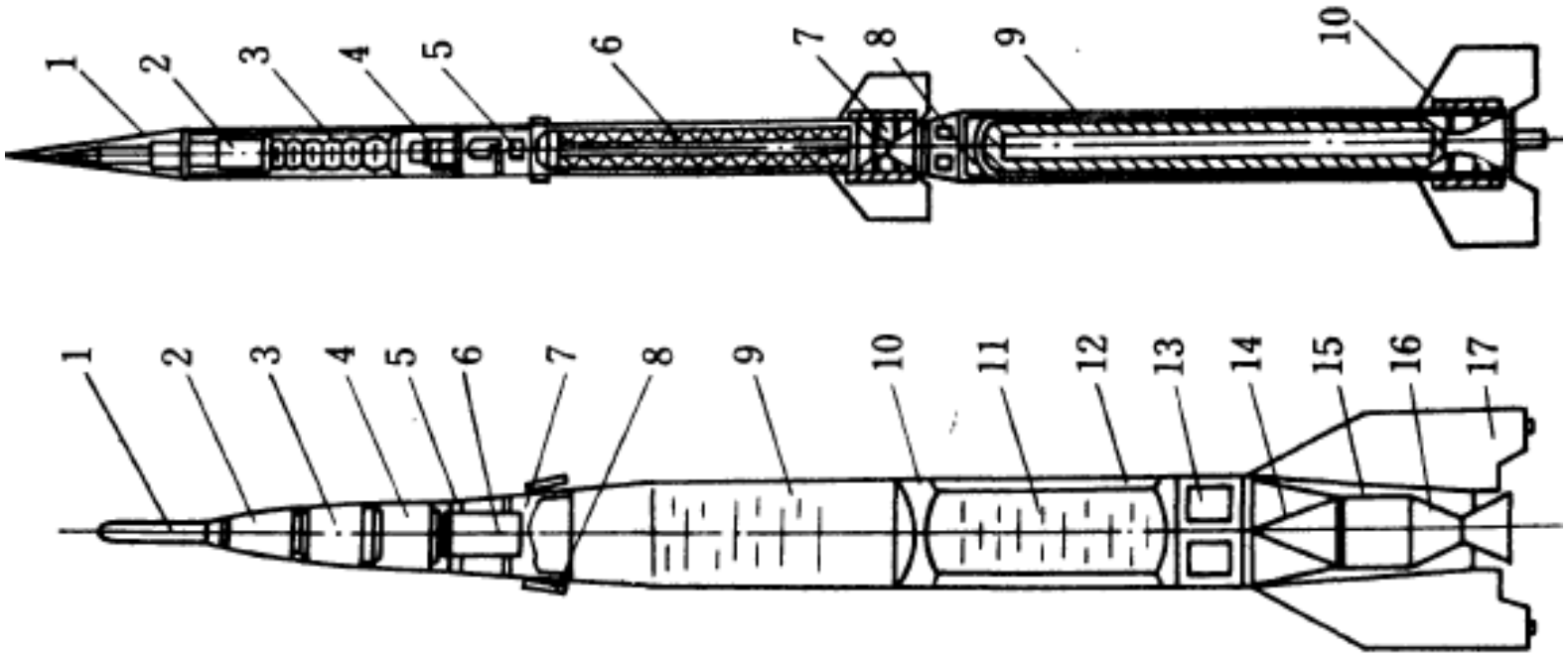


3. Sounding rocket system

Propulsion system

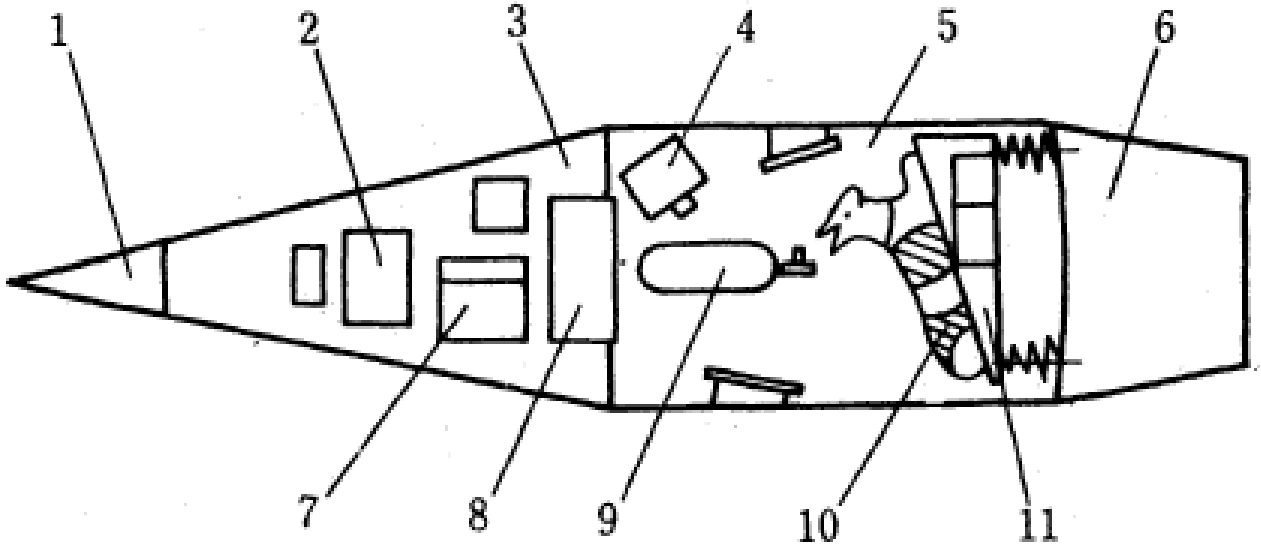
3. Sounding rocket system

Structure



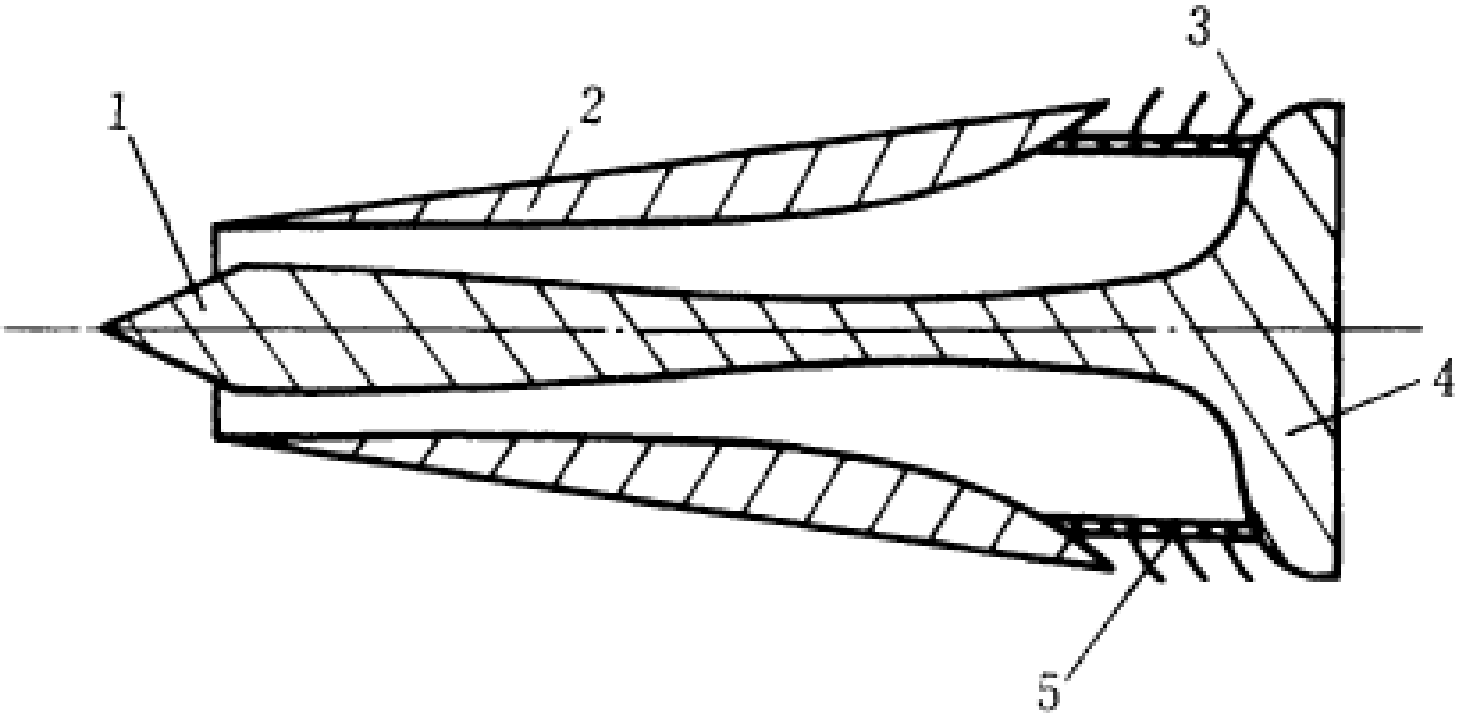
3. Sounding rocket system

Payload



3. Sounding rocket system

Payload



3. Sounding rocket system

Ground facilities

- Launch pad
- Tracking system
- Recovery

4. Overview of sounding rocket

- Wac Corporal, 09.16.1945, by JPL, US
  D=304.8 mm, L=4.88 m, m=313.4 kg, Payload 11.34kg, Apogee 70 km
- 1946-1952, 64 V2 are launched, White Sand Range
- 1945-1957, Aerobee, Viking, Deacon, Cajun…
- Since 1975, SPAR program, US
- Since 1976, Texus program, Germany
- Since 1977, TT-500A, Japan
- China, since 1958

5. Design of sounding rocket

- Tradeoffs
- Conceptual design
- Preliminary design
- Detailed design
- Manufacture
- System integration
- Verification
- Operation