McLean Seminar

Sec.3Exercise6 2024.5.24

6 What are the three main methods for manufacturing very large mirrors for astronomical telescopes? Give an example of a telescope which uses each method.

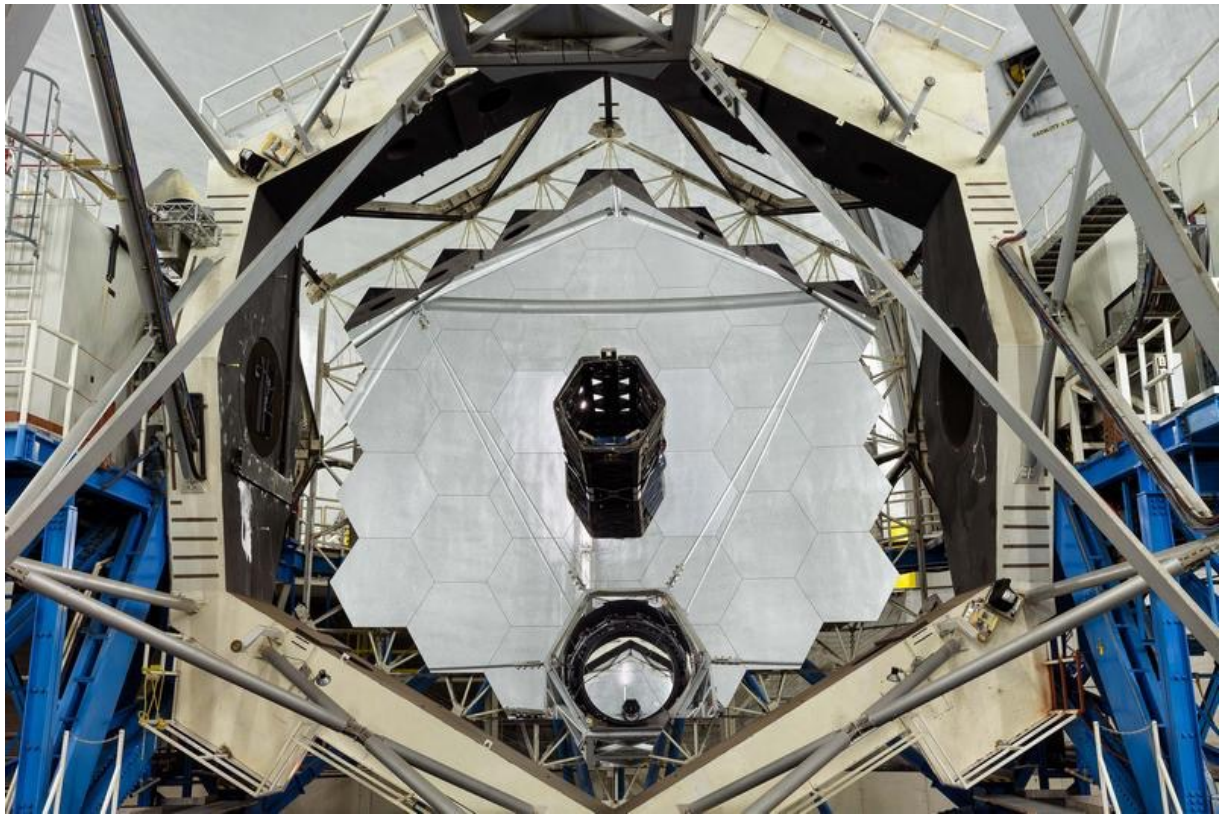
1. Segmented mirror

- A large monolithic mirror can be affected by gravity, leading to the surface distortion. Therefore, the method of gathering many segments into one mirror is used for very large mirrors.

Example: Keck I Telescope (1993)

Its 10m primary mirror is composed of 36 segments. Each mirror segment can be moved by the actuators at a rate of twice per second to maintain the global shape of the hyperboloid to within 50nm.

Keck I Telescope



https://www.keckobservatory.org/media/photos/

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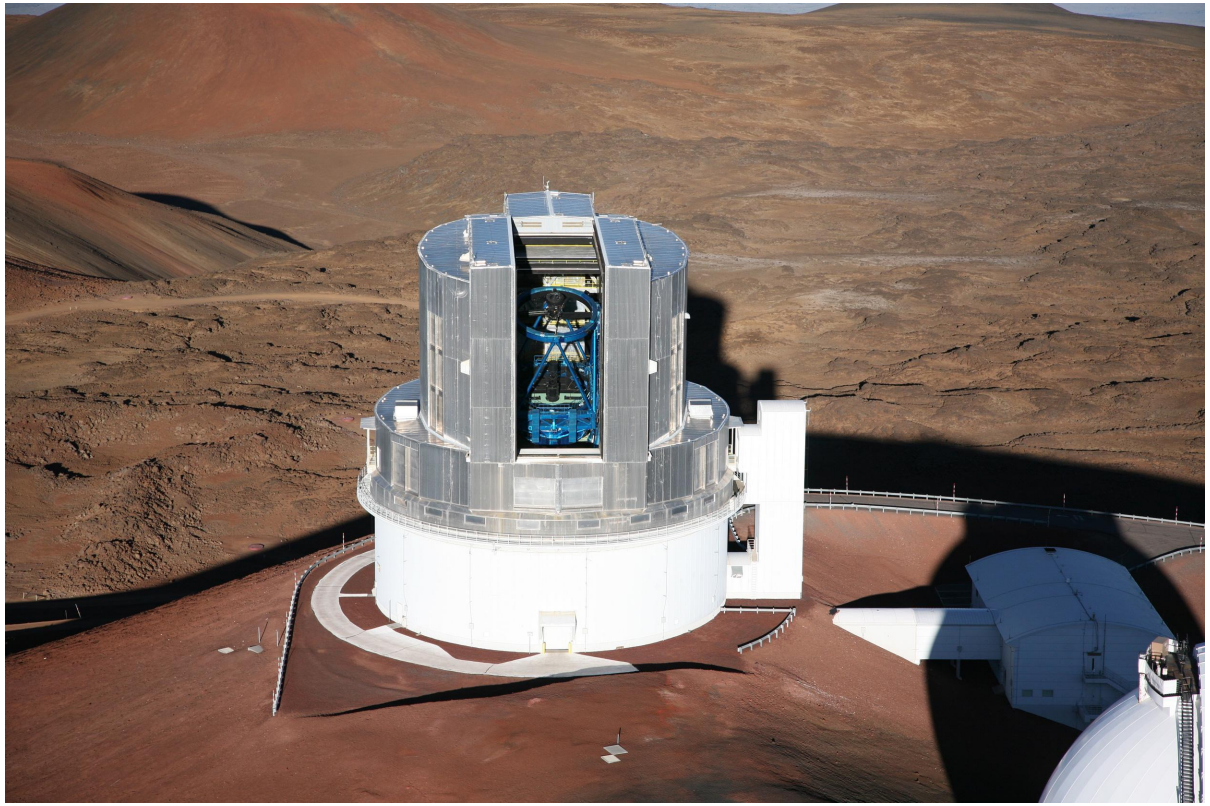
2. Thin-meniscus mirror

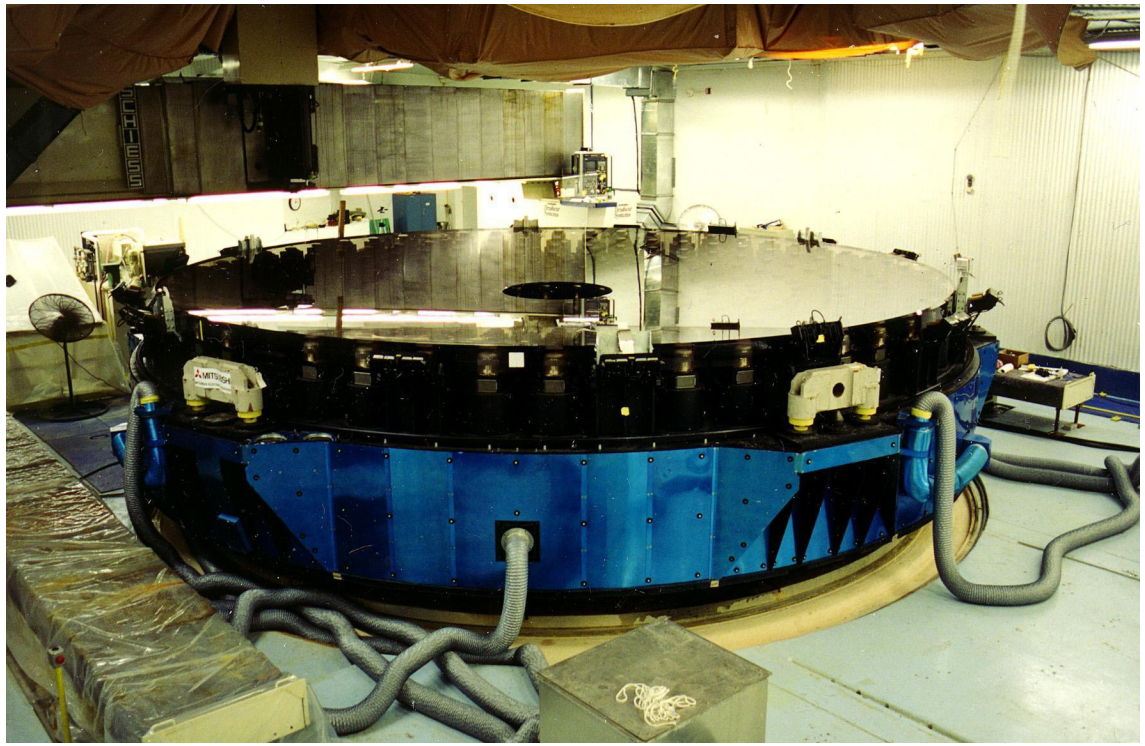
- Adjustable pistons in the back of a mirror can exert small forces that compensate for the surface distortions due to gravity, thermal change, and so on under computer control. (active control system, ACS)
- By making a mirror into meniscus, its weight and heat capacity can be small.
- Its figure easily changes, and computer control also becomes easier.

Example: Subaru (2000)

This telescope has an 8.2m thin-meniscus mirror of 20cm thick and a computer control system which compensates mainly for gravity.

Subaru Telescope





https://subarutelescope.org/en/gallery/

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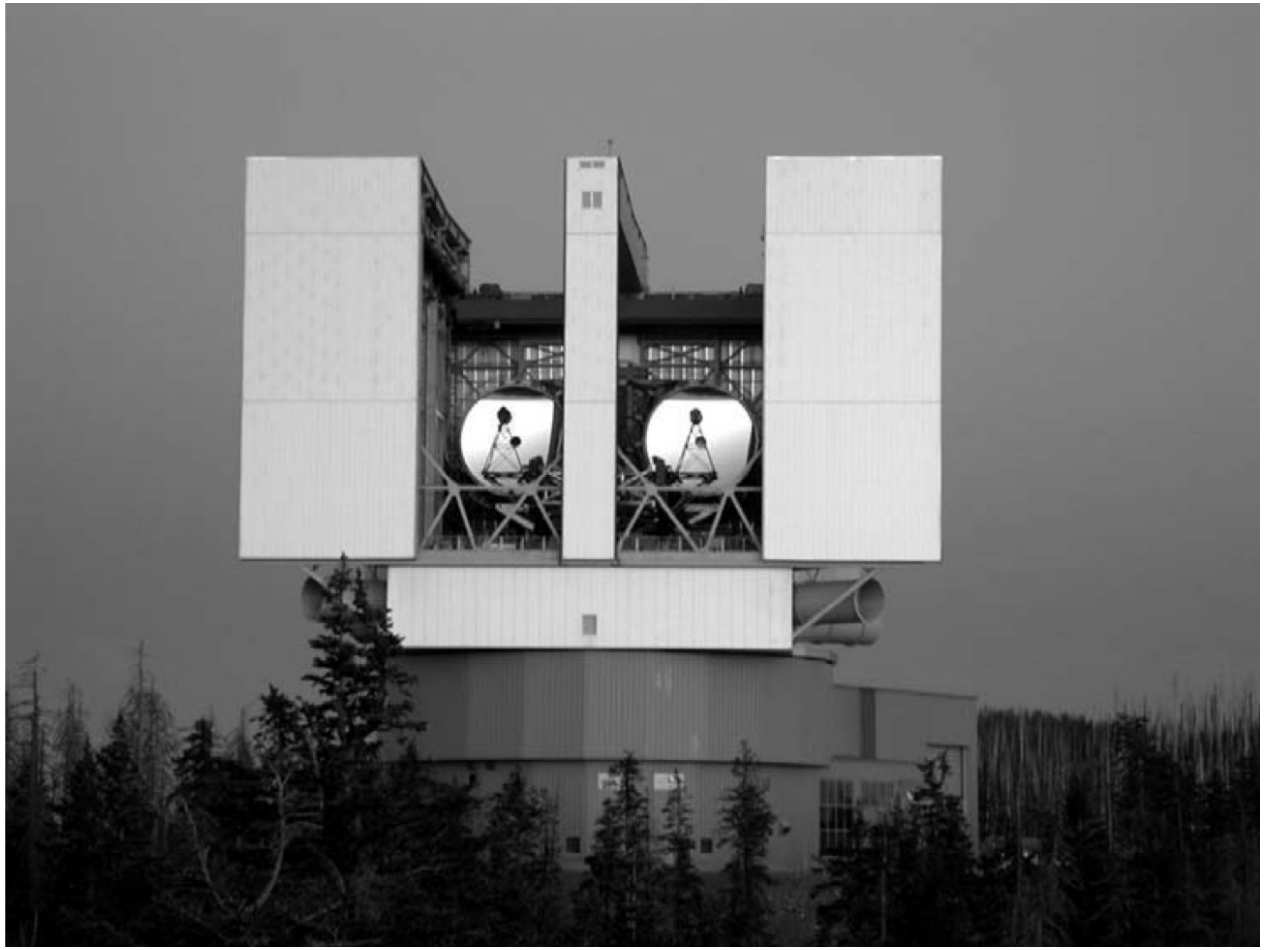
3. Spin-cast honeycomb mirror

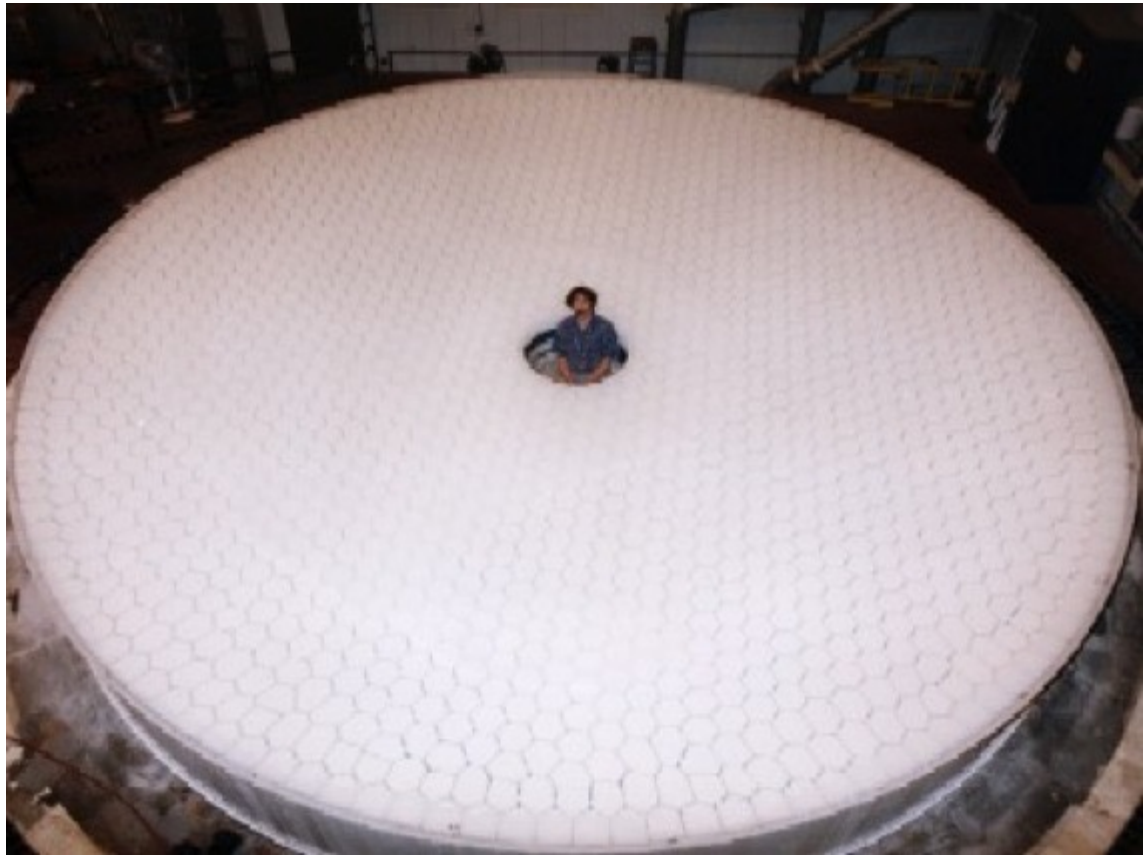
- By melting the glass in the rotating furnace and cooling it, deep curved parabolic mirror can be made more easily than polishing directly. (spin-casting)
- Also, honeycomb construction on the back surface makes the mirror very stiff and yet lightweight, so a mold made with a hexagonal block is put in the furnace.

Example: The Large Binocular Telescope (2005, 2008)

This telescope has a pair of 8.4m spin-cast honeycomb primary mirrors providing an interferometric baseline of 22.8m which corresponds to a resolution of 5mas at 500nm.

The Large Binocular Telescope





https://mirrorlab.arizona.edu/content/lbt-1-casting