Cryogenic Selective Surfaces—How Cold Can We Go?
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### The Concept

- **The Payload Bay doors of the Space Shuttle**
  - Temperatures with a realizable selective surface?
  - World materials are not ideal. The key question is, Can we reach cryogenic temperatures?
  - Hibbard (1961) showed we could reach 40 K with ideal materials. But real-world materials are not ideal. The key question is, Can we reach cryogenic temperatures with a realizable selective surface?

**First Try - Second Surface Mirrors**

- A common selective surface is a second surface mirror, where a material that is transparent in the visible, but dark in the far-IR, is placed onto a mirror.
  - We modeled materials such as sapphire, CaF2, and MgF2 on silver.

**Second Try - Dielectric Mirrors**

- Dielectric mirrors are multi-layer reflectors that have achieved better than 99% reflectivity over bands as long as 300-1100 nm. If we could extend this they might yield the solar reflectance needed to reach cryogenic temperatures.

**Third Try - Diffuse Scatterers - Solar White**

- A possible cryogenic selective surface is composed of diffuse particles of a material like MgF2 or BaF2. Such a surface would appear white to most of the solar spectrum, i.e. “Solar White”.

**Failure**

- **Expected Temperature**
  - Temperatures too high due to blue/UV absorption by silver.

**Likely Failure**

- **Expected Temperature**
  - Might succeed under substantial funding, but high risk of failure.

**Possible Success**

- **Expected Temperature**
  - A selective surface that reaches cryogenic temperatures!
  - Now we can move on to applications.