

The design, implementation, and performance of the Astro-H SXS aperture assembly and blocking filters



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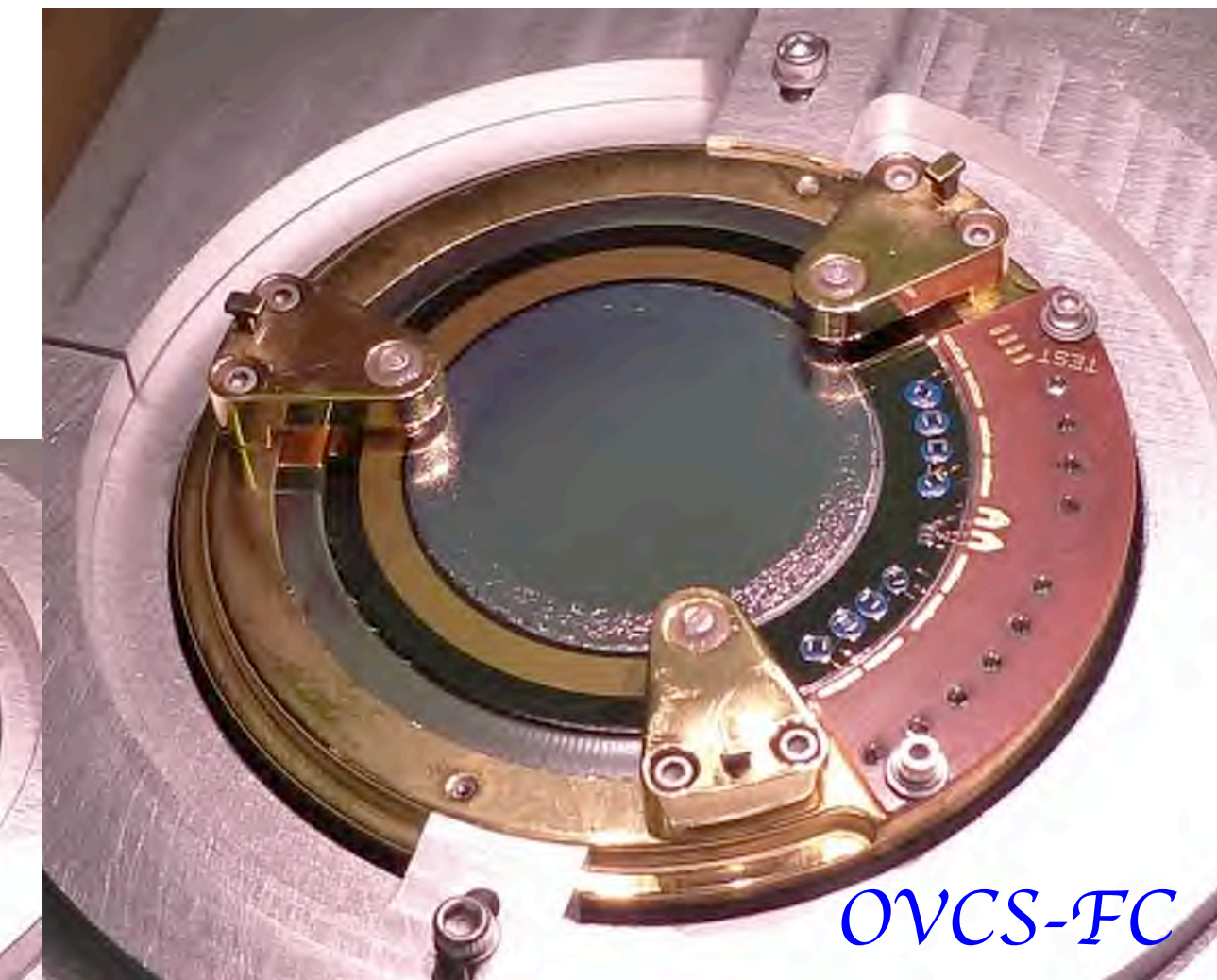
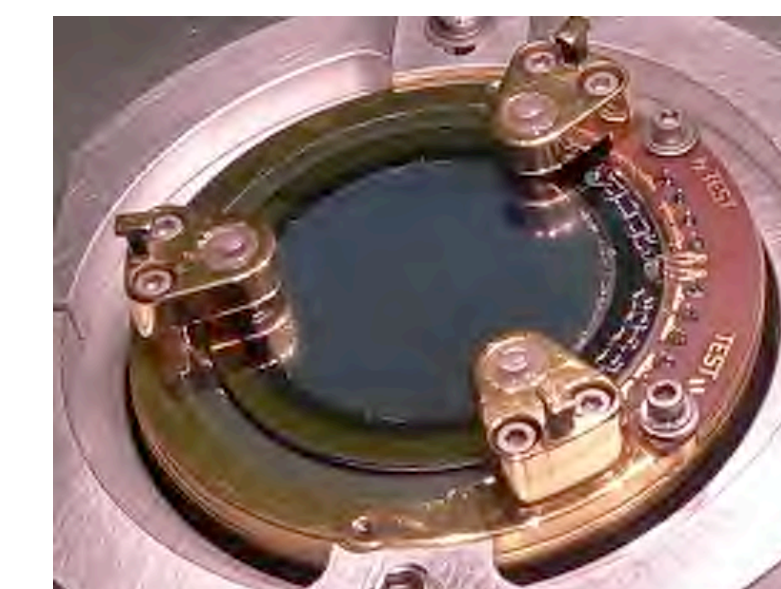
INTRODUCTION

The calorimeter array of the JAXA Astro-H (renamed Hitomi) Soft X-ray Spectrometer (SXS) was designed to provide unprecedented spectral resolution of spatially extended cosmic x-ray sources and of all cosmic x-ray sources in the Fe-K band around 6 keV. The properties that make the SXS a powerful x-ray spectrometer also make it sensitive to the entire electromagnetic band. If characterized as a bolometer, it would have a noise equivalent power (NEP) of $< 4 \times 10^{-18} \text{ W}/(\text{Hz})^{0.5}$. Thus it was imperative to shield the detector from thermal radiation from the instrument and optical and UV photons from the sky. Additionally, it was necessary to shield the coldest stages of the instrument from the thermal radiation emanating from the warmer stages. These needs are addressed by a series of five thin-film radiation-blocking filters that block long-wavelength radiation while minimizing x-ray attenuation. The SXS aperture assembly is a system of barriers, baffles, filter carriers, and filter mounts that supports the filters and inhibits their potential contamination. The three warmer filters also were equipped with thermometers and heaters for decontamination.

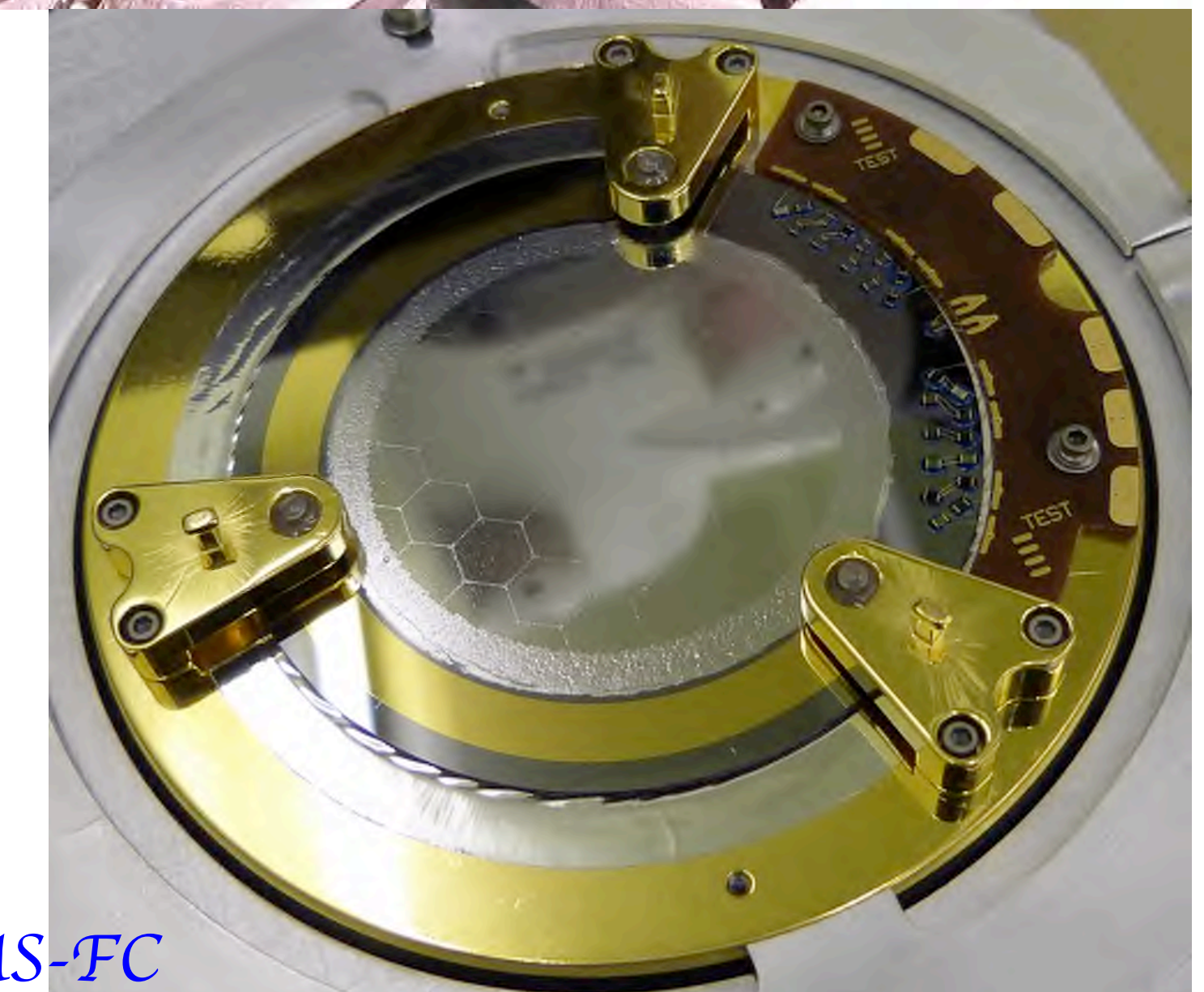
DESIGN

- Thin gamma alumina/titanium foil tube minimizes the thermal conductance between the DMS and the OVCS. The OVCS-M is recessed into the dewar far below the opening in the actual OVCS, to maximize the isolation.
- Heat sinking of the OVCS-M to the OVCS is achieved via three thermal straps made of high-conductivity copper.
- OVCS-M, the IVCS-M, JTB, DAL, and CTS physically isolated.
- Low-emissivity coatings minimize radiation heat transfer. Nested contamination baffles also act as radiation baffles, minimizing radiative heat transfer between shield-mounted hardware.
- Filter heaters on the DMS filter allow continuous heating of the filter to prevent absorption of organic contamination from the spacecraft.
- Filter heaters on the OVCS and IVCS filters enable contingency decontamination of the filters to remove water ice.
- Filter mounts provide low-conduction contacts to minimize heater power and dewar heat transfer during heater operation.

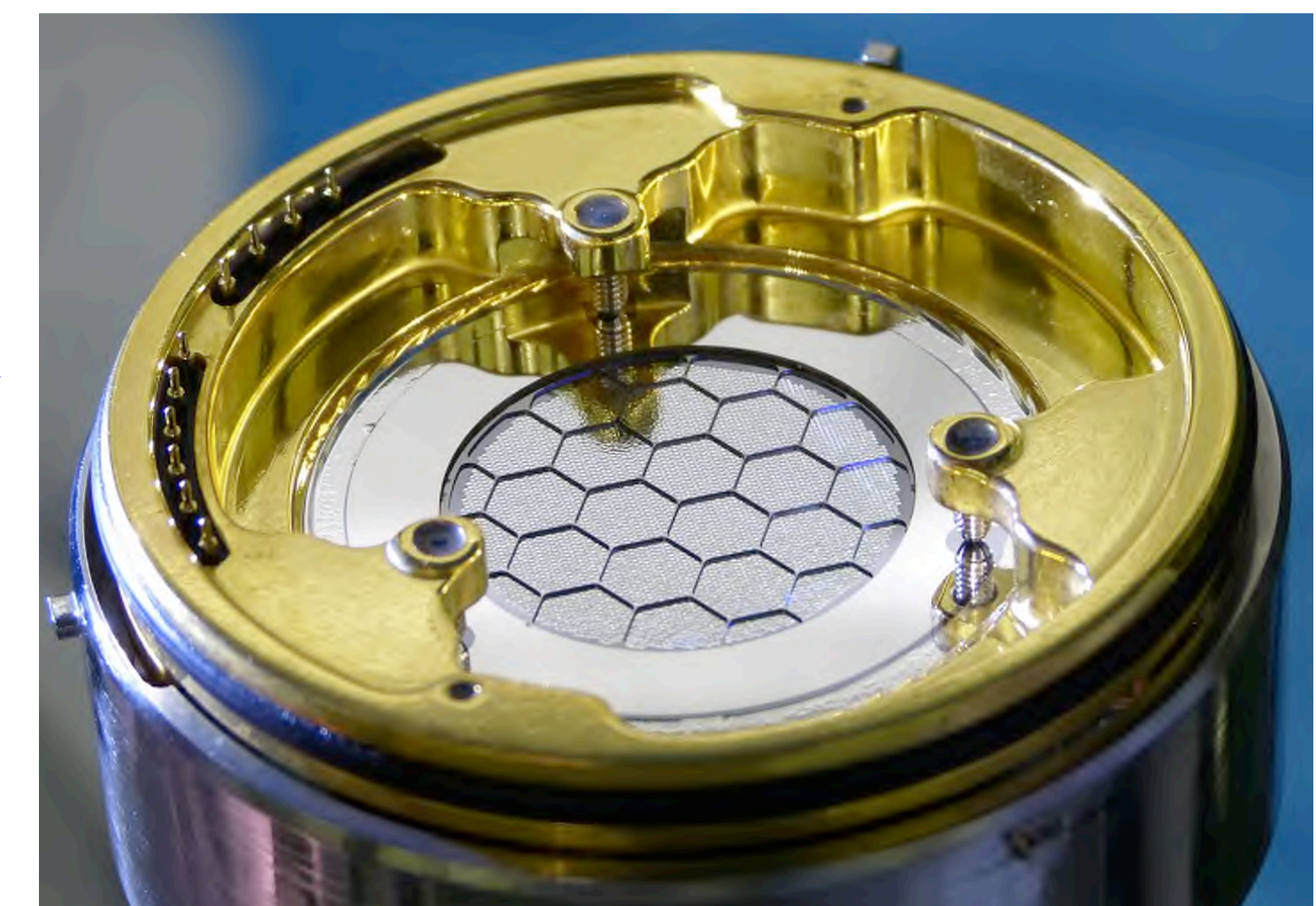
IVCS-FC



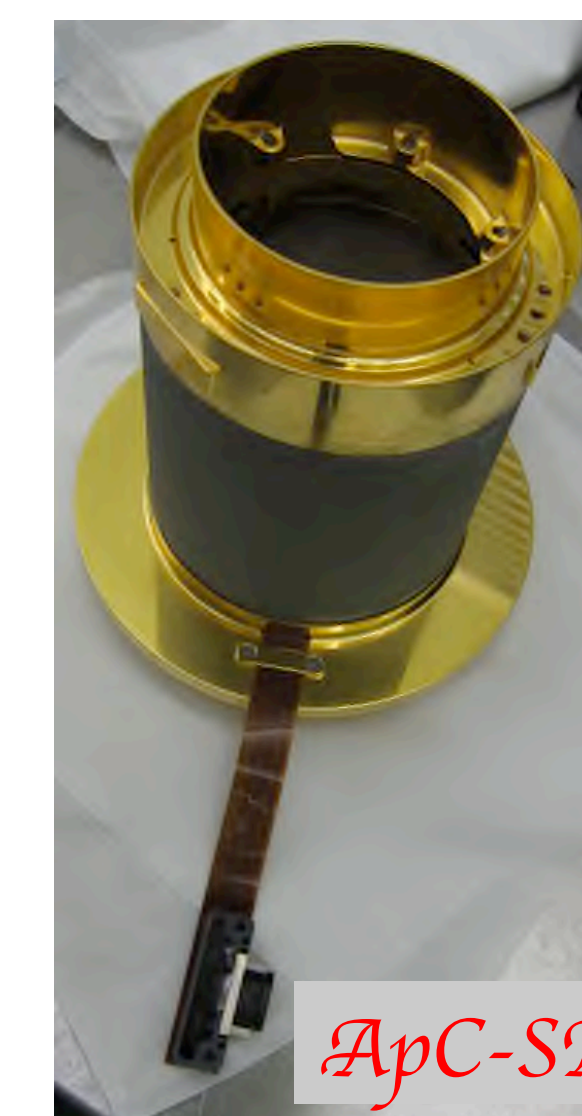
OVCS-FC



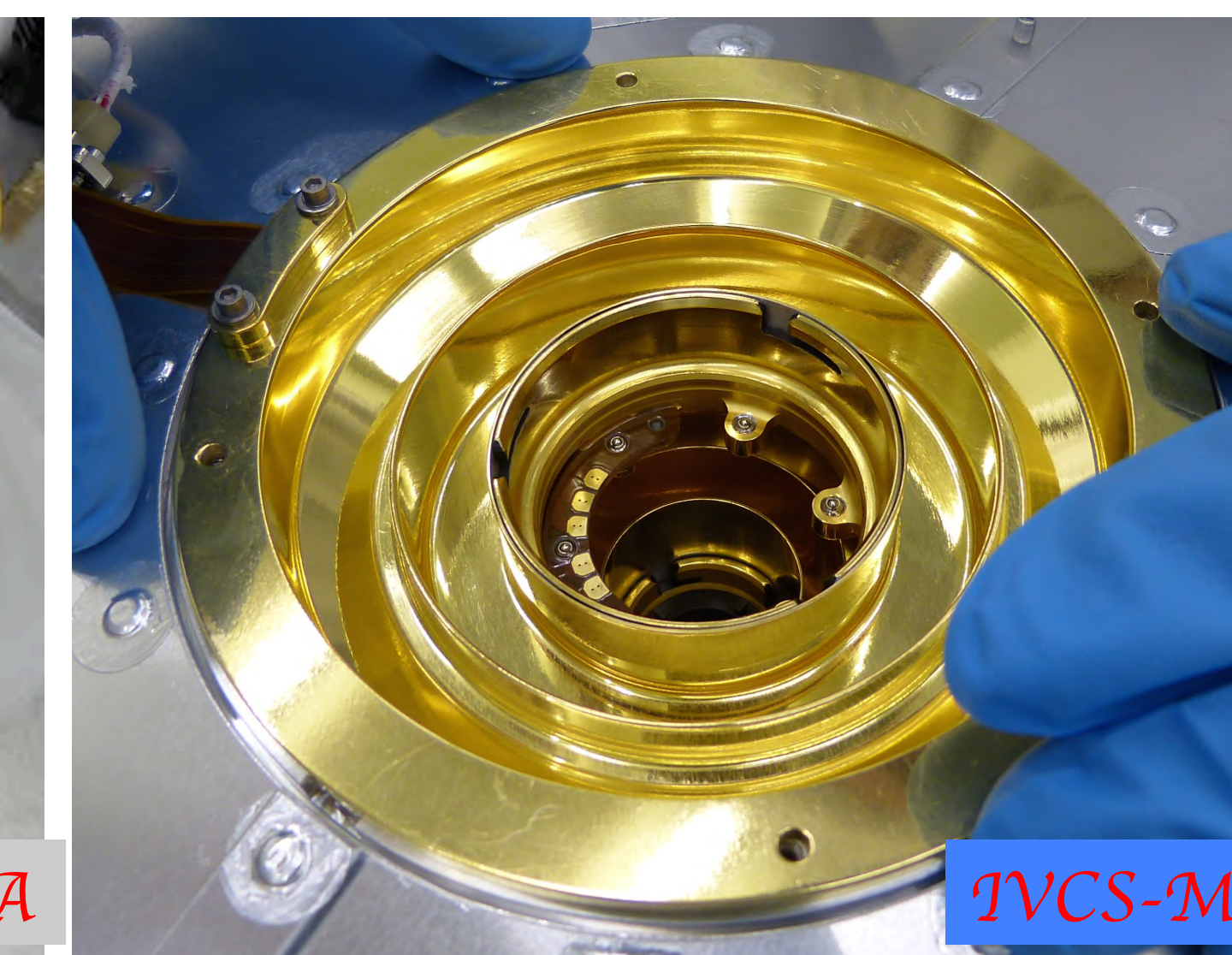
DMS-FC



OVCS-FC back



ApC-SA



IVCS-M

Aperture Assembly (ApA)

Aperture Cylinder Sub-Assembly (ApC-SA)

- DMS-Mount (DMS-M)
- Aperture Cylinder Tube (ApC-T)
- OVCS-Mount (OVCS-M)
- Thermal Straps (TS)

Dewar Main Shell-Carrier (DMS-Car)

- DMS-Carrier Components
- DMS-Moisture Shields (DMS-MS)
- DMS-Filter (DMS-F)

Outer Vapor Cooled Shield-Carrier (OVCS-Car)

- OVCS-Carrier Components
- OVCS-Moisture Shields (OVCS-MS)
- OVCS-Filter (OVCS-F)

Inner Vapor Cooled Shield-Mount (IVCS-M)

Inner Vapor Cooled Shield-Carrier (IVCS-Car)

- IVCS Carrier Components
- IVCS Moisture Shields (IVCS-MS)
- IVCS Filter (IVCS-F)

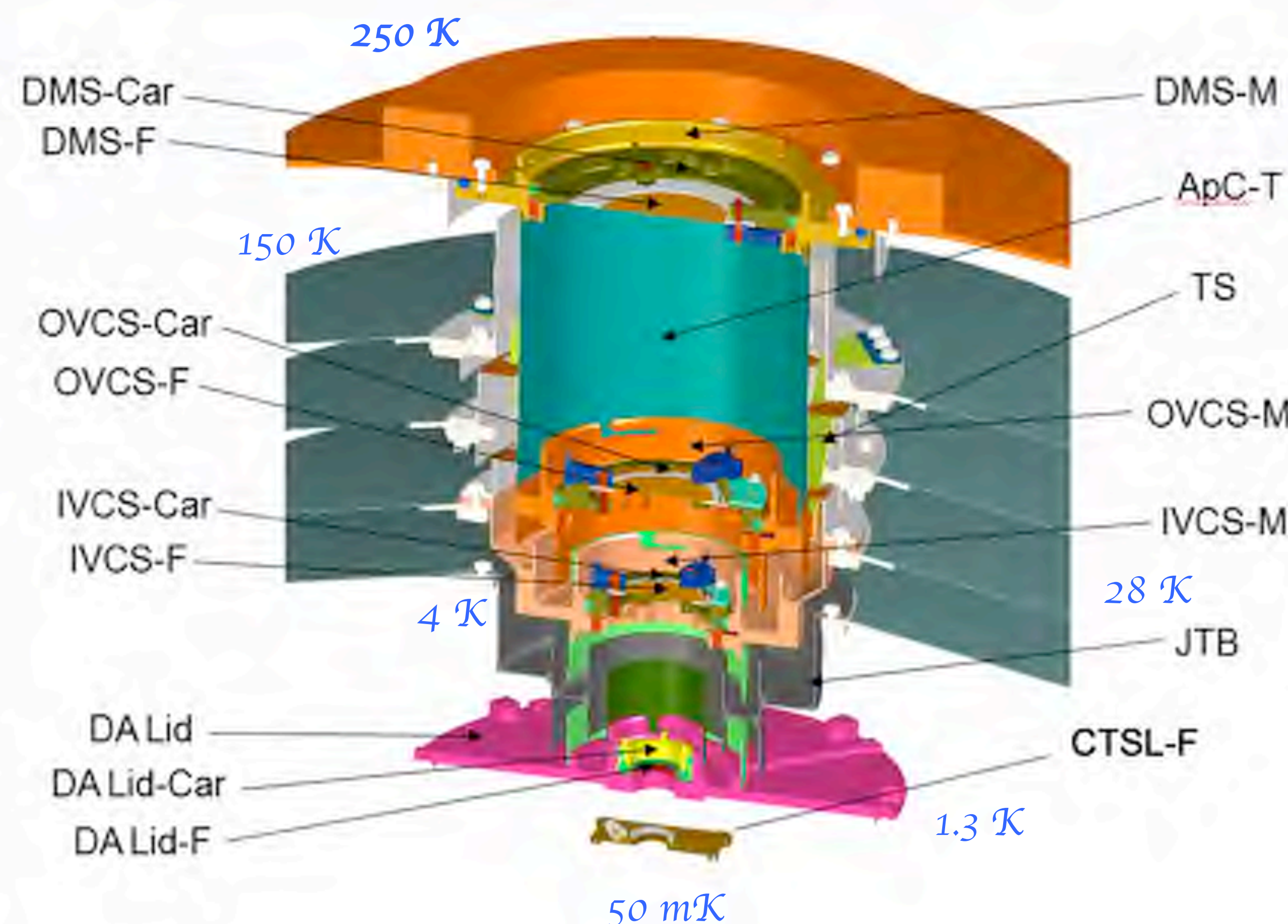
Joule-Thomson Baffle (JTB)

Detector Assembly Lid (DA Lid)

Detector Assembly Lid-Carrier (DA Lid-Car)

- DA Lid Filter (DA Lid-F)

Calorimeter Thermal Sink Lid Filter (CTSL-F)



TAKE-AWAY

1. Throughout the project, management of particle cleanliness was a continuous preoccupation.
2. Many lessons learned. Future designs should require less precision of the hand-assembly steps.
3. The Hitomi/SXS ApA passed in-orbit functional test. Superb early detector performance indicates filters survived launch.