Common Instrument Interface (CII)

Thermal Interface Guidelines

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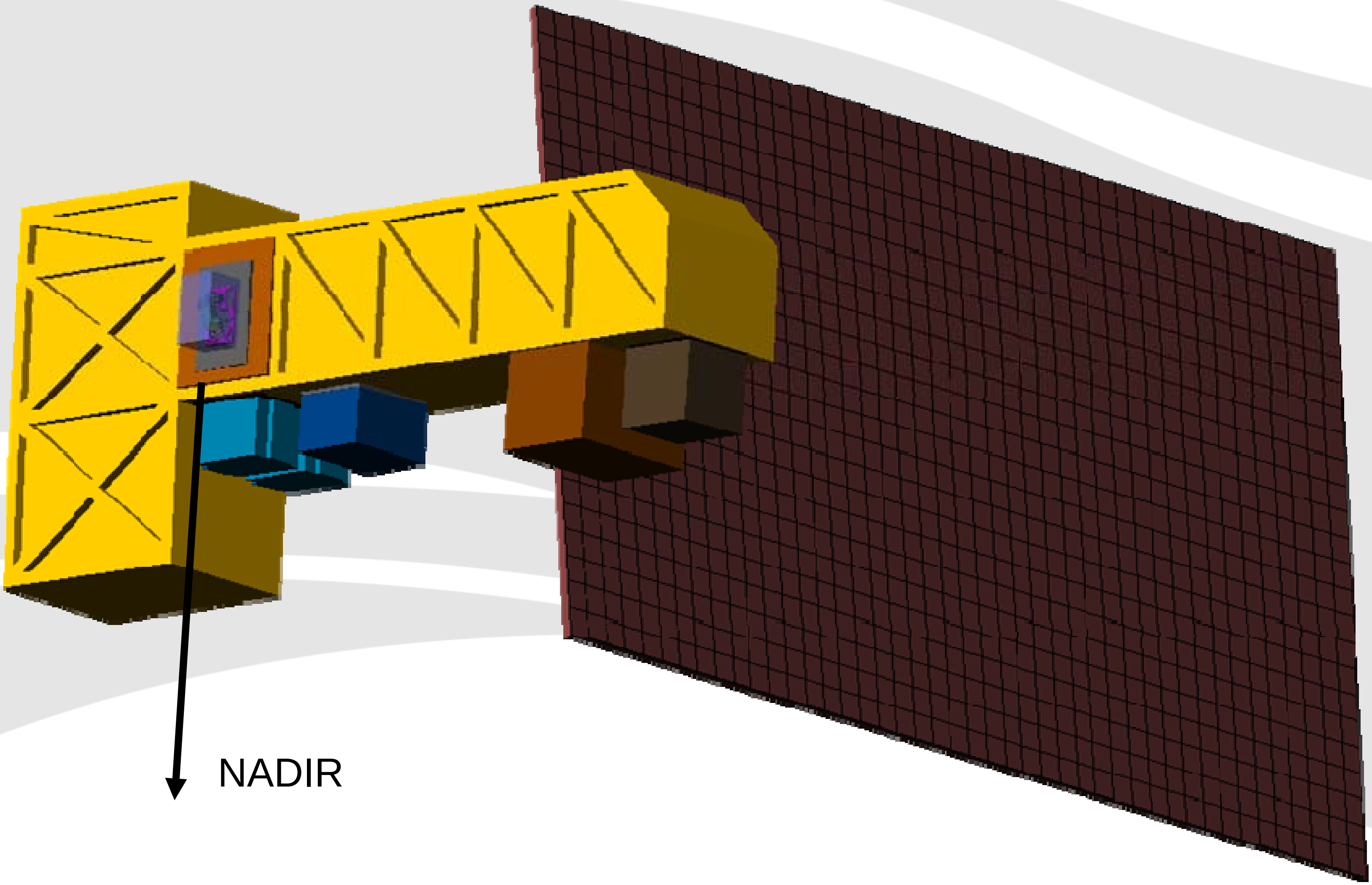
CII Thermal Interface Guideline Drivers

- To enable EV Instruments to be easily integrated on a mission of opportunity
- To enhance flexibility of the thermal interface to allow accommodation on a wide range of Earth orbiting S/C
- Strive for minimal imposition on the spacecraft provider (minimize request for temperature channels, survival heater power, potential sources of jitter, testing restrictions (HPs), etc.)
- Implementation details should be worked out between the S/C and instrument in an ICD once paired.

Typical LEO Earth Orbiting Satellite



S/C & Instrument Configuration Assumptions

- Instruments are typically Nadir Pointing or observing the earth's limb
- Location on S/C would easily accommodate a typical rectangular volume
- There is limited mass and volume as identified in the guidelines for a secondary payload.
- The instrument should be designed as a self-contained assembly with its own on-board electronics and thermal control.

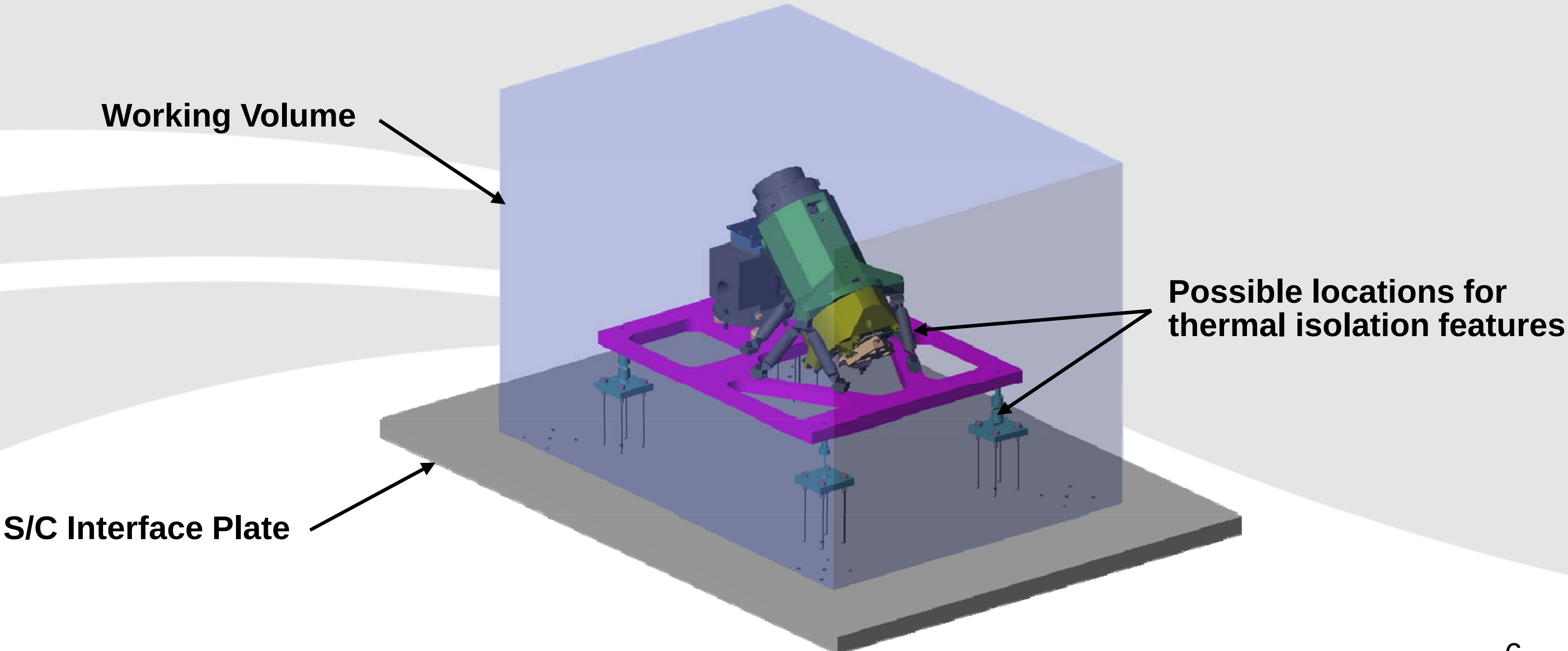
CII Thermal Design Guidelines

- Thermally isolate the instrument from the S/C[1]
- Minimize radiation heat transfer with neighboring instruments
- Maintain the instrument configuration such that it can be located in one physical S/C location. The Instrument should not require several discrete locations to house the instrument on the S/C
- Minimize survival heater power needs
- Remain flexible with regards to radiator locations to best meet a wide range of orbits and orientations
- Assume there will be no temperature monitoring of the Instrument through the S/C[1] . However, assume there will be temperature monitoring at the S/C interface (on the S/C side).
- Operational temperature control is to be handled entirely by the Instrument

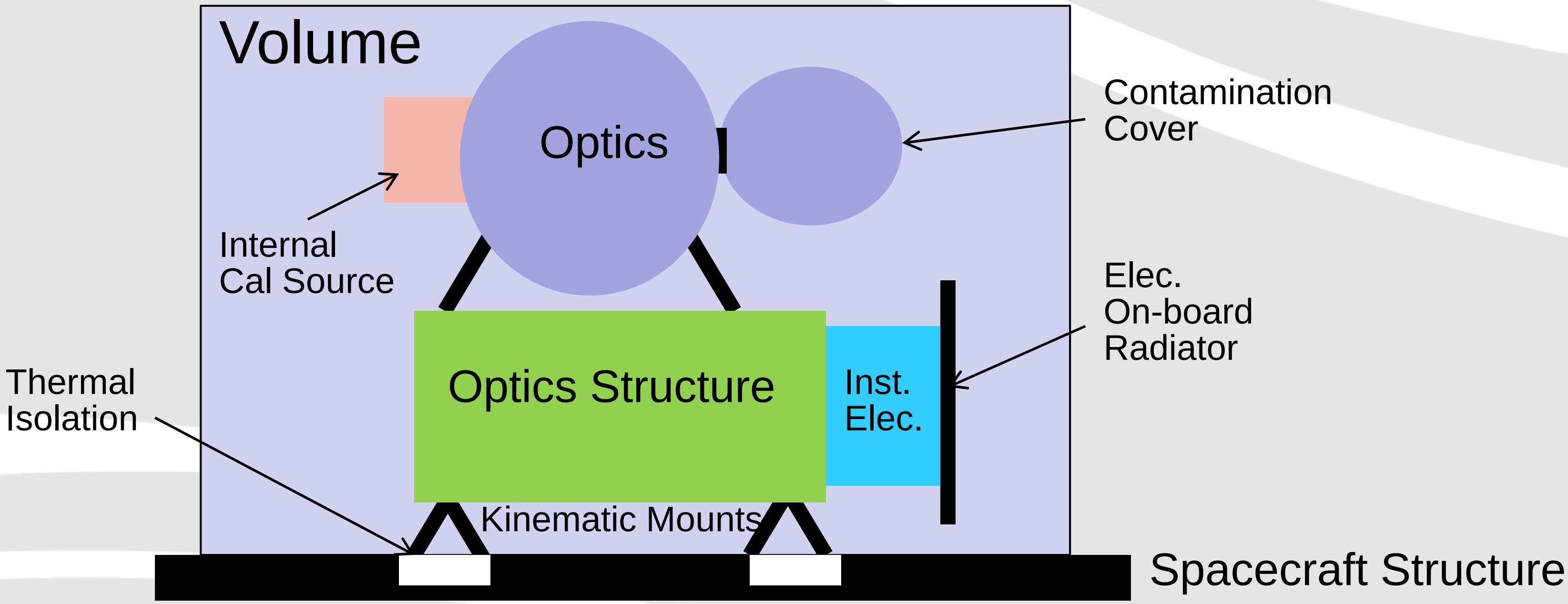
[1] Once paired with a S/C, the Instrument may negotiate exceptions to the noted guidelines but cannot be assumed beforehand.

Design Guideline

- Instrument is thermally isolated from the S/C
  - Pros
    - Instrument integration on the S/C is simpler and instrument will have more opportunities to avail of
    - Makes for independent development and V&V
  - Con
    - Does not take advantage of possible resource sharing such as the heat capacitance and thermal stability associated with a large bus interface plate.



Guideline Diagram



Thermal Interface Guidelines

		Function	Guideline
THERM-	3	Thermal Design at the Mechanical Interface	The conduction heat transfer at the Instrument-Spacecraft mechanical interface should be less than 15 W/m2.
THERM-	4	Thermal Design at the Mechanical Interface	The radiation heat transfer between the Instrument and S/C should be less than 3 Watts (TBR).
THERM-	6	Survival	The Instrument should be capable of surviving arbitrary pointing orientations for a minimum of 3 (TBR) orbits with survival power only without permanent degradation of performance.
THERM-	9	Temperature Maintenance	The Spacecraft temperature range at the mounting interface should be: [0C,+30C] op and [-20C,+50C] non-op (TBR)
THERM-	10	Temperature Monitoring	The Spacecraft should monitor the temperature of the Spacecraft at the Instrument-Spacecraft mechanical interface on the Spacecraft side.
THERM-	12	Thermal Hardware	Instrument thermal control hardware including blankets, temperature sensors, louvers, heat pipes, radiators, and coatings should be provided and installed by the Instrument provider
THERM-	14	Thermal Hardware	Thermal hardware used to close-out the interfaces between the Instrument and Spacecraft, such as close-out MLI, should be the responsibility of the Spacecraft provider.

Thermal Interface Guidelines

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THERM-	15	Thermal Hardware	Instrument survival heaters should be provided and installed by the Instrument provider.
THERM-	16	Thermal Hardware	The Instrument should control Instrument survival heaters via mechanical thermostats.
THERM-	17	Thermal Hardware	Instrument survival heaters should obtain survival heater power from the Spacecraft survival heater bus and should be limited to no more than 20% of the average Instrument power.
THERM-	19	Thermal Models	The Instrument provider should supply the Project with a reduced node geometric and thermal math model in compiance to the following: - model format should be in Thermal Desktop v. 5.2 or later or Space Systems Thermal v. 7.x or later; - model units should be SI; - radiating surface elements should be limited to < 200; - thermal nodes should be limited to < 500; - the GMM and TMM should be documented with a benchmark case in which the Project may use to verify the model run; - the model should be capable of steady-state and transient analysis.

Thermal Interface Guidelines

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THERM-	20	Thermal Models	The Instrument provider should supply the Project with documentation describing the reduced node thermal model. The documentation should contain the following: - the node(s) location at which each temperature limit applies; - a listing of electrical heat dissipation and the node(s) where applied; - a listing of active thermal control, type of control (e.g., proportional heater), and the node(s) where applied; - a listing and description of any boundary nodes used in the model.
THERM-	22	Launch Thermal Environment	The Instrument should be designed for the launch heating profile as specified in the ICD.
THERM-	26	Thermal Verification	A minimum of 7 (TBR) cycles should be conducted with dwells of 4 hrs (TBR) to the appropriate temperature extremes (proto-flight, qual, or flight acceptance).
THERM-	27	Thermal Verification	A minimum of 7 (TBR) cold and hot starts at the appropriate temperature extremes (proto-flight, qual, or flight acceptance) should be demonstrated.