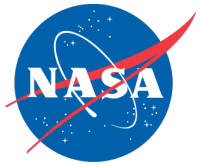
ADVANCED CONCEPTS

X-Ray Surveyor

Requirements Worksheet



National Aeronautics and Space Administration
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Design Approach

- Custom bus design
- Optimize all subsystems based on analysis from the discipline experts using appropriate tools
  - Makes the cost estimate more straightforward – if we modified an existing bus, determining the cost of modifications could be difficult

Margin Philosophy	
Spacecraft subsystems mass	30%
Payload mass	30%
Spacecraft power	30%
Payload power	30%

General Mission Requirements

Requirement	Requirement (Goal)	
Launch Year	2030	
Spacecraft Lifetime	5 years	
Consumables	20 years	
Orbit	SE-L2 or Chandra-type	
Risk Class	A	
Pointing	Radial	Roll (boresight)
Accuracy	30 arcsec	TBD
Knowledge (Derived requirement)	4 arcsec (p/y) RMS 99%	TBD
Stability	1/6 arcsec per 1 sec	TBD
Dithering	Lissajous figure, up tp +/- 30" amplitude with 8 bits resolution; periods 100 to 1000 seconds subject to derived rate constraint; arbitrary phase (8 bits: amplitude, rate and phase are to be independently commanded in yaw and pitch.*	

* Rationale is to allow calibration to be averaged over a set of pixels, instead of calibrating every single pixel individually, AND to allow filling in what might be small gaps between elements in a focal plane array.

General Mission Requirements

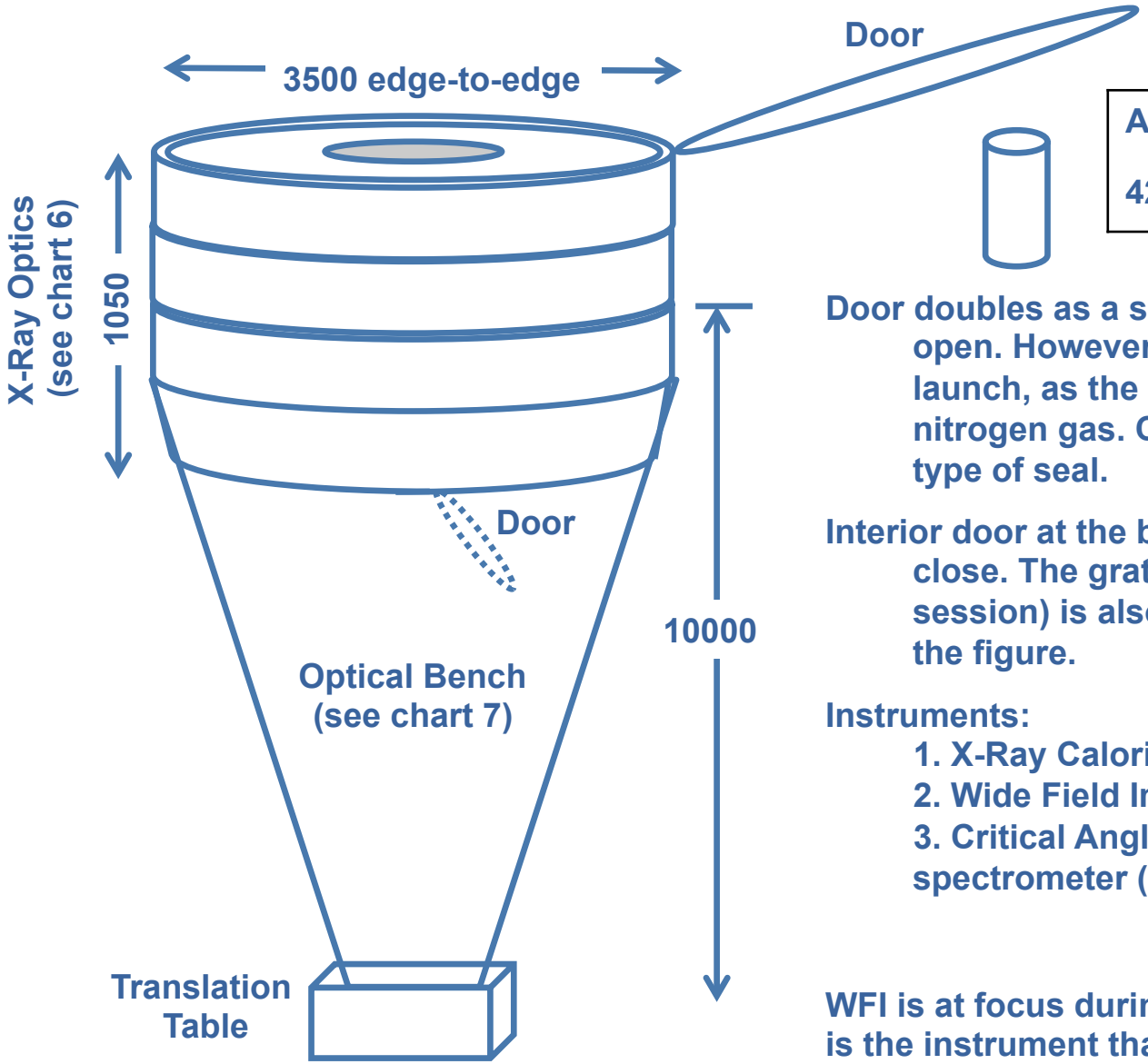
Requirement	Requirement (Goal)
Slew rates for normal observing (and #/day)	90 deg/30 minutes
Slew rates for TOO* (and #/day)	1 TOO per week. Slew rates same as above.
Uninterrupted observation time	100000 s
Downlink frequency	1 – 3 downlinks per day
Data downlink volume per day	240 Gbits (flexible, want to save cost; are there breakpoints?)
Data storage requirement	Sufficient for 48 hours of data
Data processing/compression	Assume that instruments provide data processing/compression. Spacecraft only provides storage for data to be downlinked.
Avoidance angles	
Sun	45 degrees; but the rest of the sky must be accessible (this may affect the solar array articulation mechanisms)
Other	na (We aren't doing a sky coverage analysis, so only the sun avoidance angle will affect the design to first order)
Door operation	Once open, does not need to close again.

* Target of Opportunity: an unscheduled observation of interest, such as a sudden X-ray emission from an interstellar or intergalactic source.

General Layout

Lengths in mm

Not to scale



Aspect Camera Assembly	
42.8 kg	14 W

Door doubles as a sunshade. It does not close once open. However, it must hold nitrogen before launch, as the optics are purged positively with nitrogen gas. Can leak, but must have some type of seal.

Interior door at the back of the optics must open and close. The gratings (CAT grating for this design session) is also back there, but not shown in the figure.

Instruments:

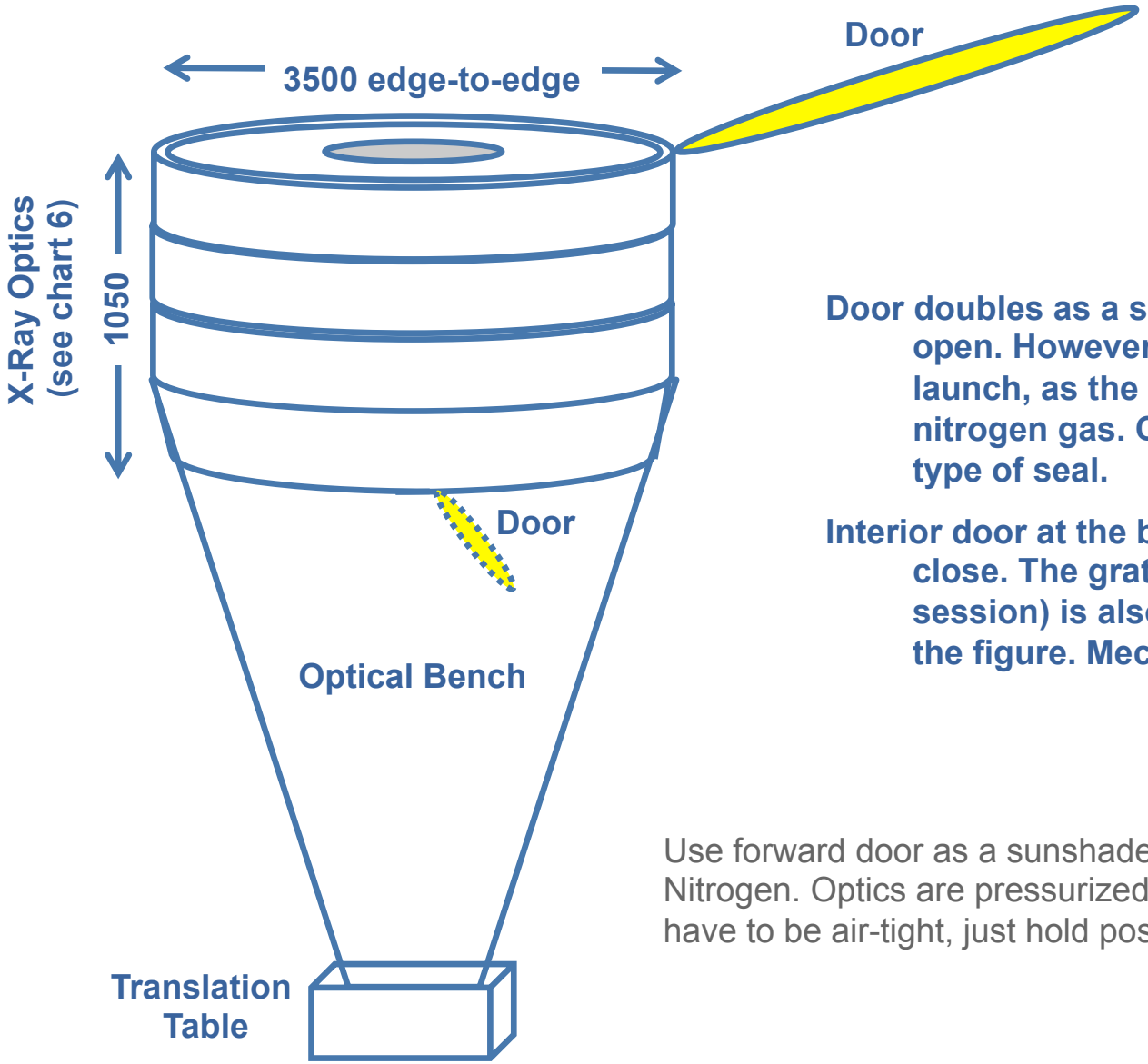
1. X-Ray Calorimeter (on table)
2. Wide Field Imager (on table)
3. Critical Angle Transmission Grating spectrometer (fixed)

WFI is at focus during launch; if there is a failure this is the instrument that needs to be in the focal plane.

General Layout

Lengths in mm

Not to scale

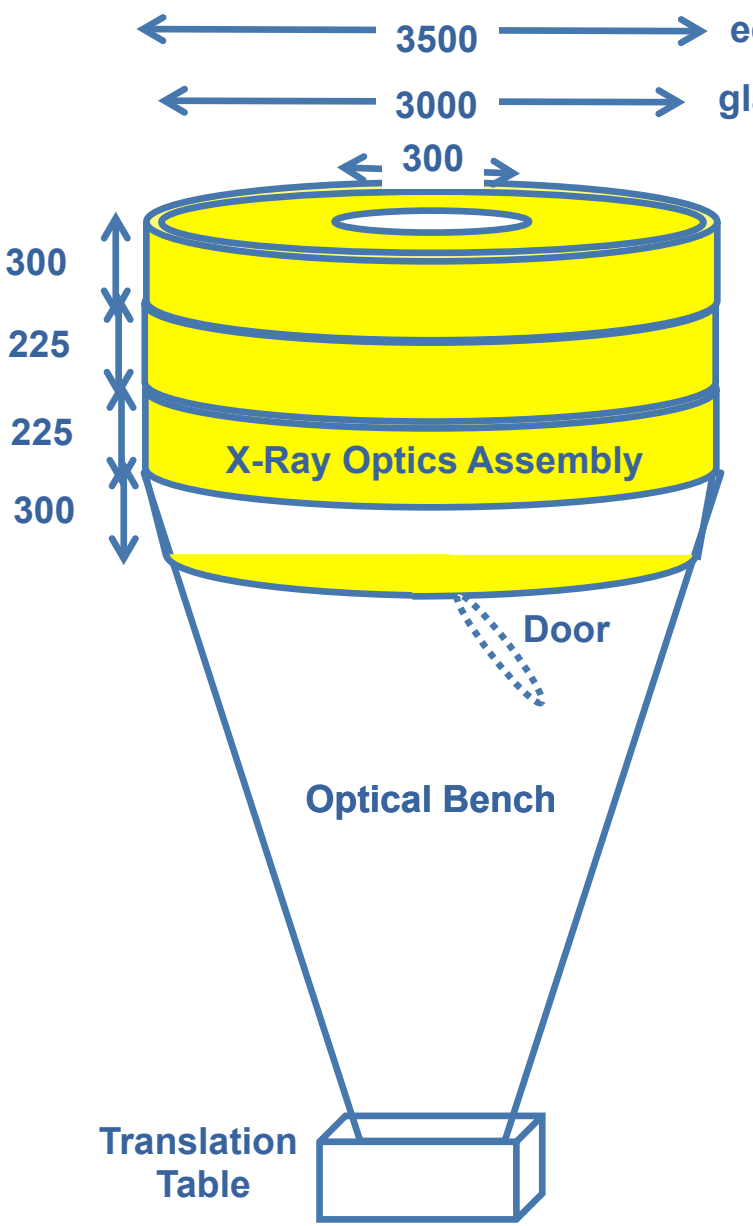


Door doubles as a sunshade. It does not close once open. However, it must hold nitrogen before launch, as the optics are purged positively with nitrogen gas. Can leak, but must have some type of seal.

Interior door at the back of the optics must open and close. The gratings (CAT grating for this design session) is also back there, but not shown in the figure. Mechanism heritage: Chandra.

Use forward door as a sunshade.. Door will have to hold Nitrogen. Optics are pressurized before launch. Does not have to be air-tight, just hold positive pressure.

General Layout



pre-collimator

optics

optics

post-collimator
(outer shape follows shape of optical bench, not shown, so bottom diameter smaller that top)

Lengths in mm

Not to scale

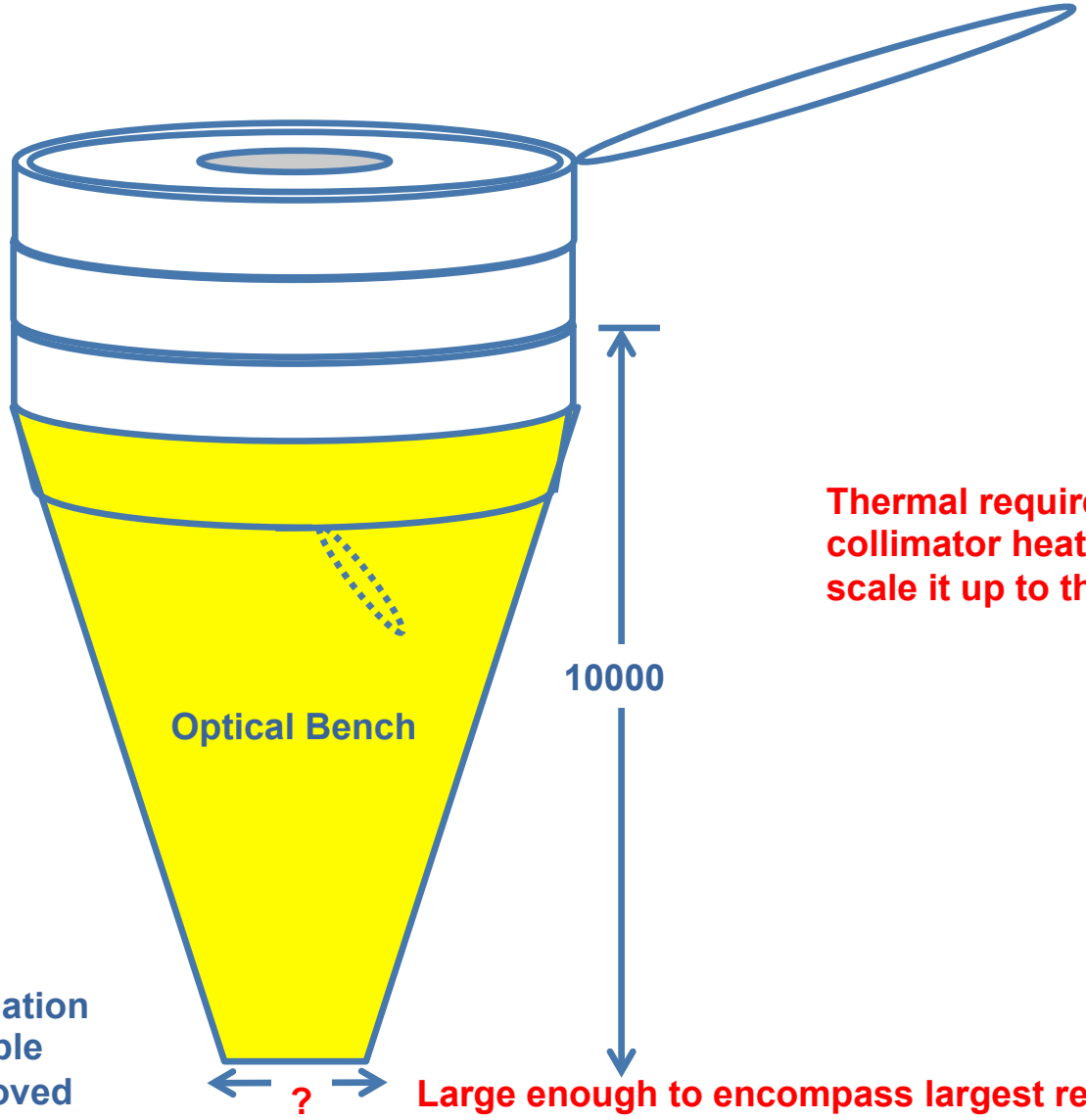
Thermal requirements:
21 C +/- 0.5 C

X-Ray Optics Assembly	1250 W	890 kg
Adjustable Optics	10 W	
Control Electronics	30 W	

General Layout

Lengths in mm

Not to scale



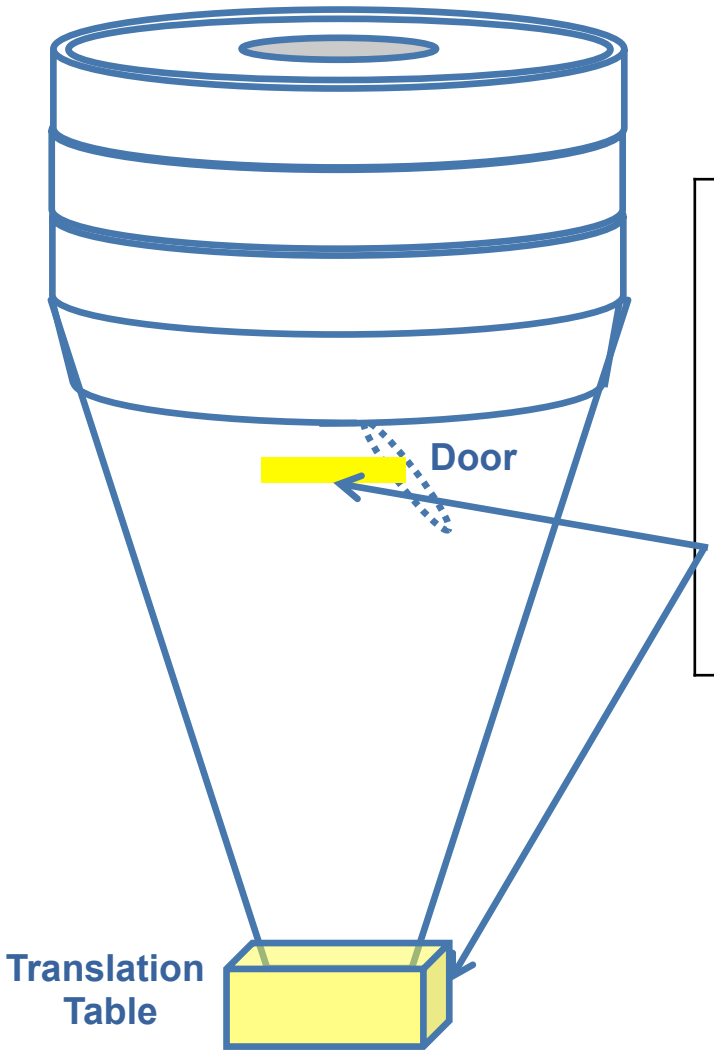
Thermal requirements (200 W bench + post collimator heaters for Chandra; can we scale it up to this design?)

Large enough to encompass largest readout.

General Layout

Lengths in mm

Not to scale



Power profile: 1300 W calorimeter. 500W survival. Always on. Standby 800W. WFI power is about 45W, including all drive electronics. 250W to heat focal plane to room temp (with cal in standby).

X-Ray Calorimeter	1300 W (800 W standby, 500W survival)	890 kg
Wide Field Imager	45 W	107 kg
Critical Angle Transmission Grating spectrometer		
Power to heat focal plane	250 W	

Instruments:

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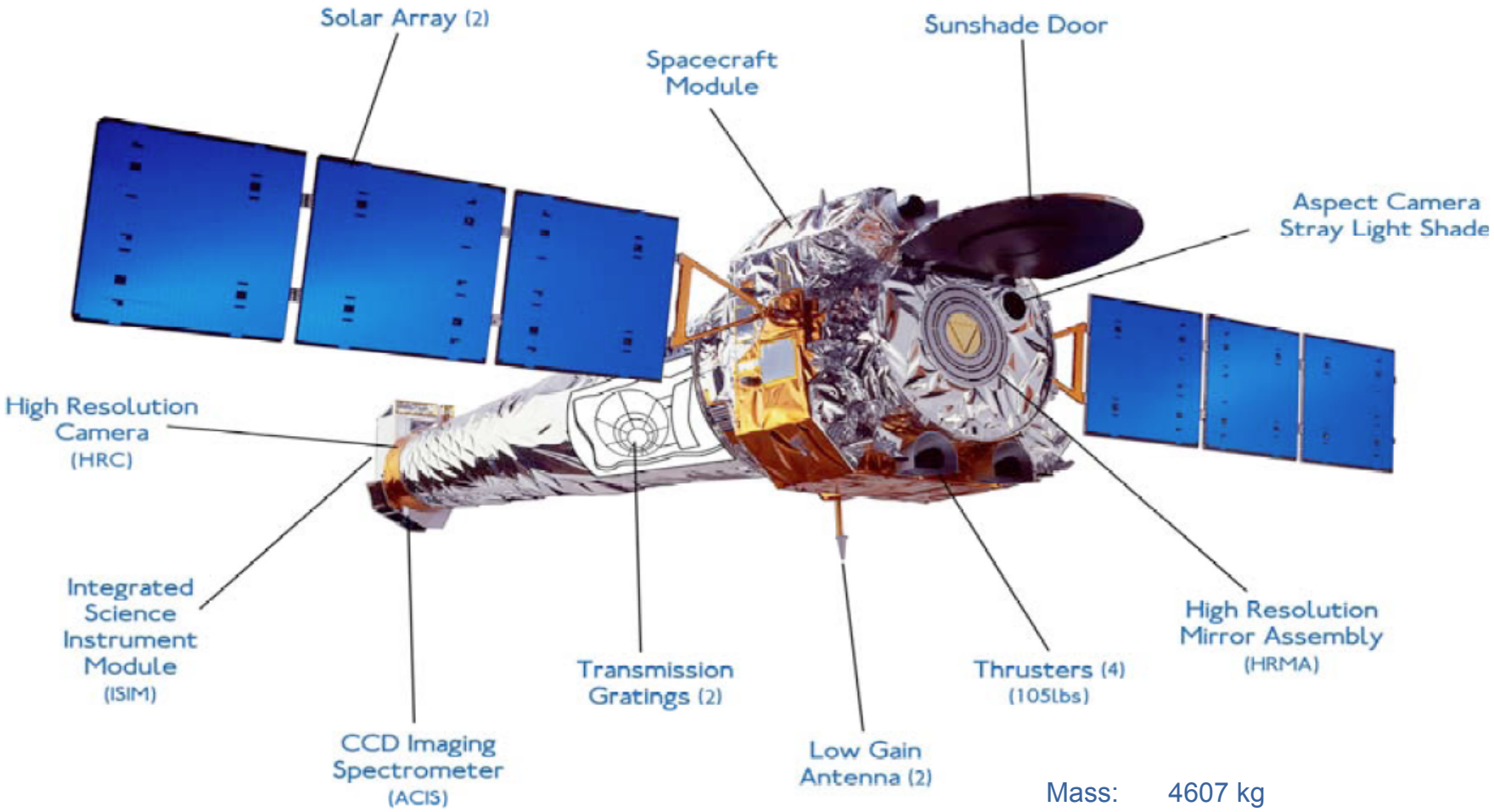
Chandra Reference



Mass: 4607 kg
121 kg unused reserve

Power: 2900 W actual at launch
1350 used
2100 W EOL spec (5 yr)
2000 actual (14 yr)
1100 used