NASA Instrument Cost Model
NICM

Telescope Cost Estimating

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What is a Telescope?

- The term TELESCOPE
- There are two camps of telescope people:
  - Camp 1 uses the term telescope to mean the actual "tube" itself, and considers the telescope to be independent of the detector subsystem sitting behind it, called the "backend"
    - Example: Hubble
  - Camp 2 uses the term telescope to mean the entire package: tube + backend = telescope
    - Example: HiRISE on MRO
- Summary:
  - Camp 1: Telescope = Tube
  - Camp 2: Telescope = Tube + backend

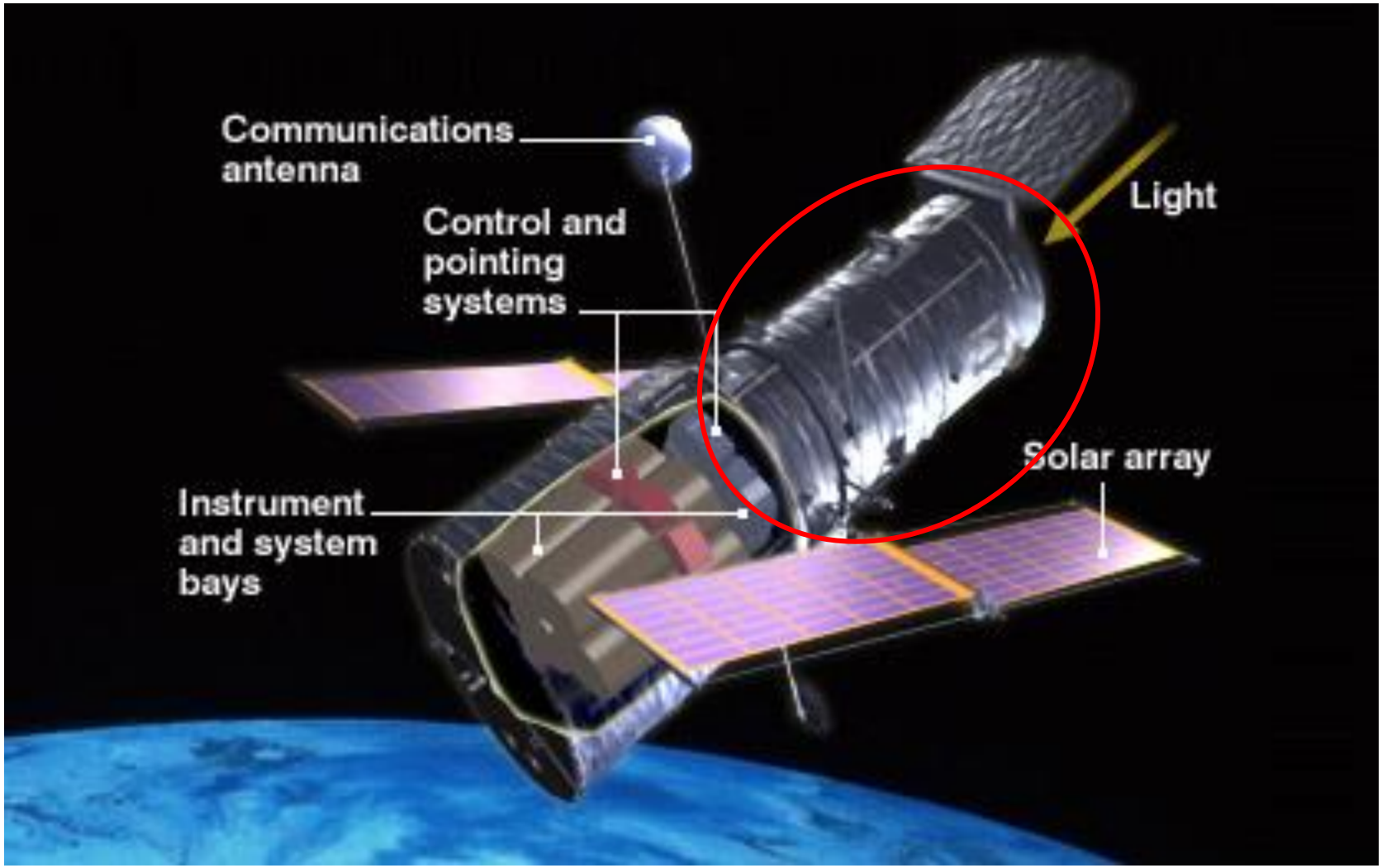
What is an Instrument?

- The term INSTRUMENT
  - How does the term *telescope* line up with the term *instrument*?
  - In NICM:

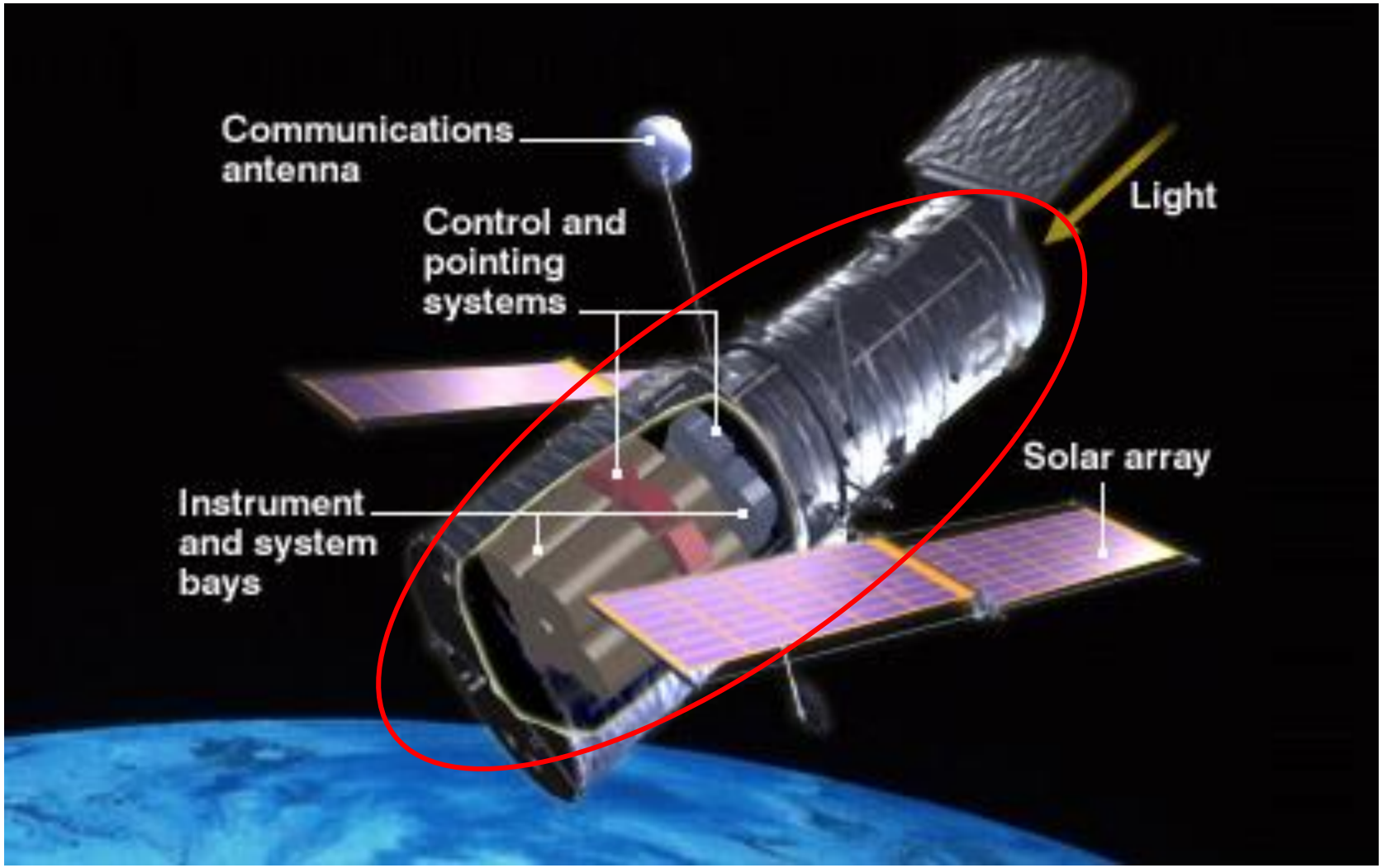
Camp 1: Telescope = Tube ≠ Instrument
Camp 2: Telescope = Tube + Backend = Instrument

This thus creates a 3rd camp as well:
Camp 3: Camp 2 – Tube = Backend = Instrument!

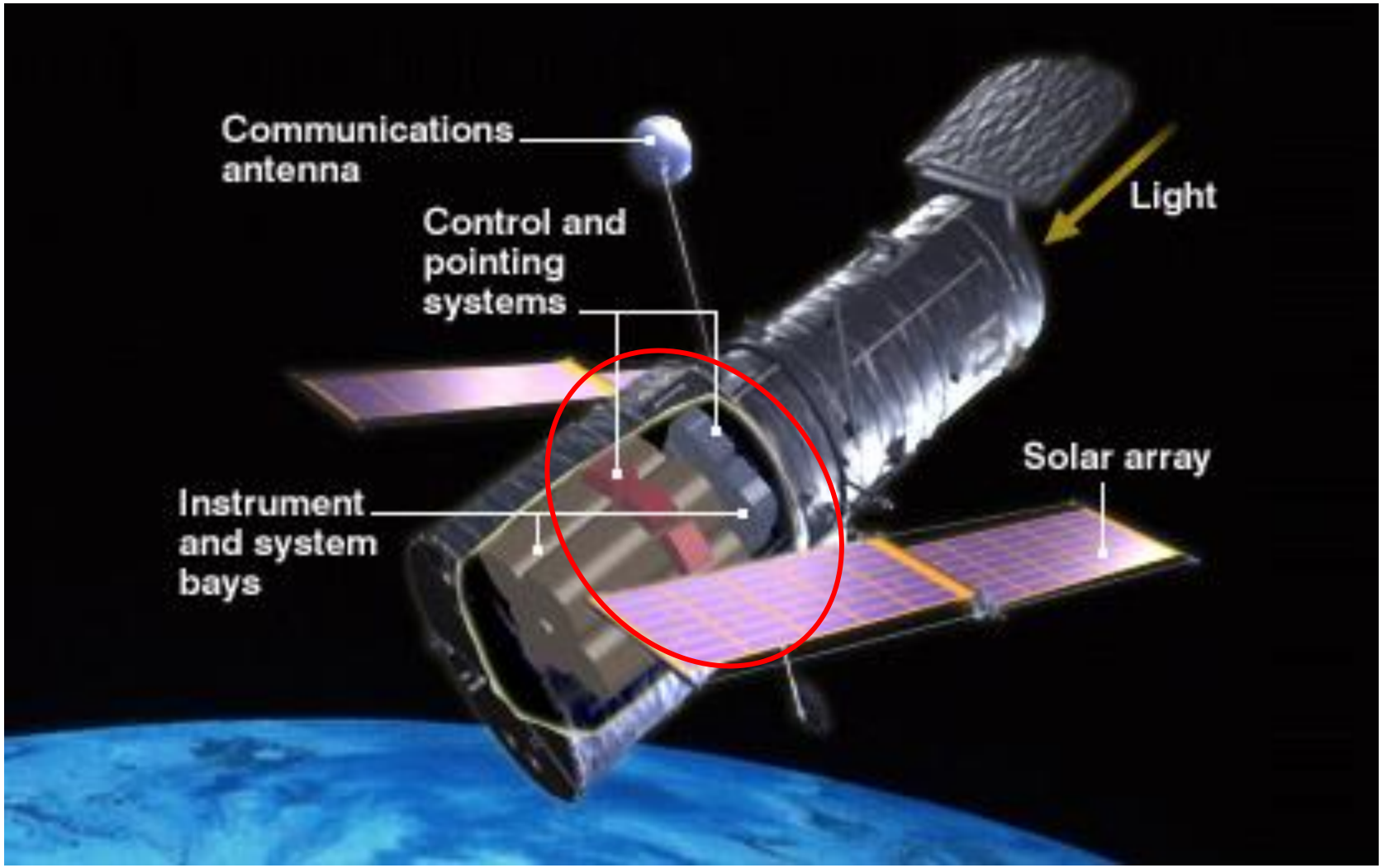
Review: Camp 1



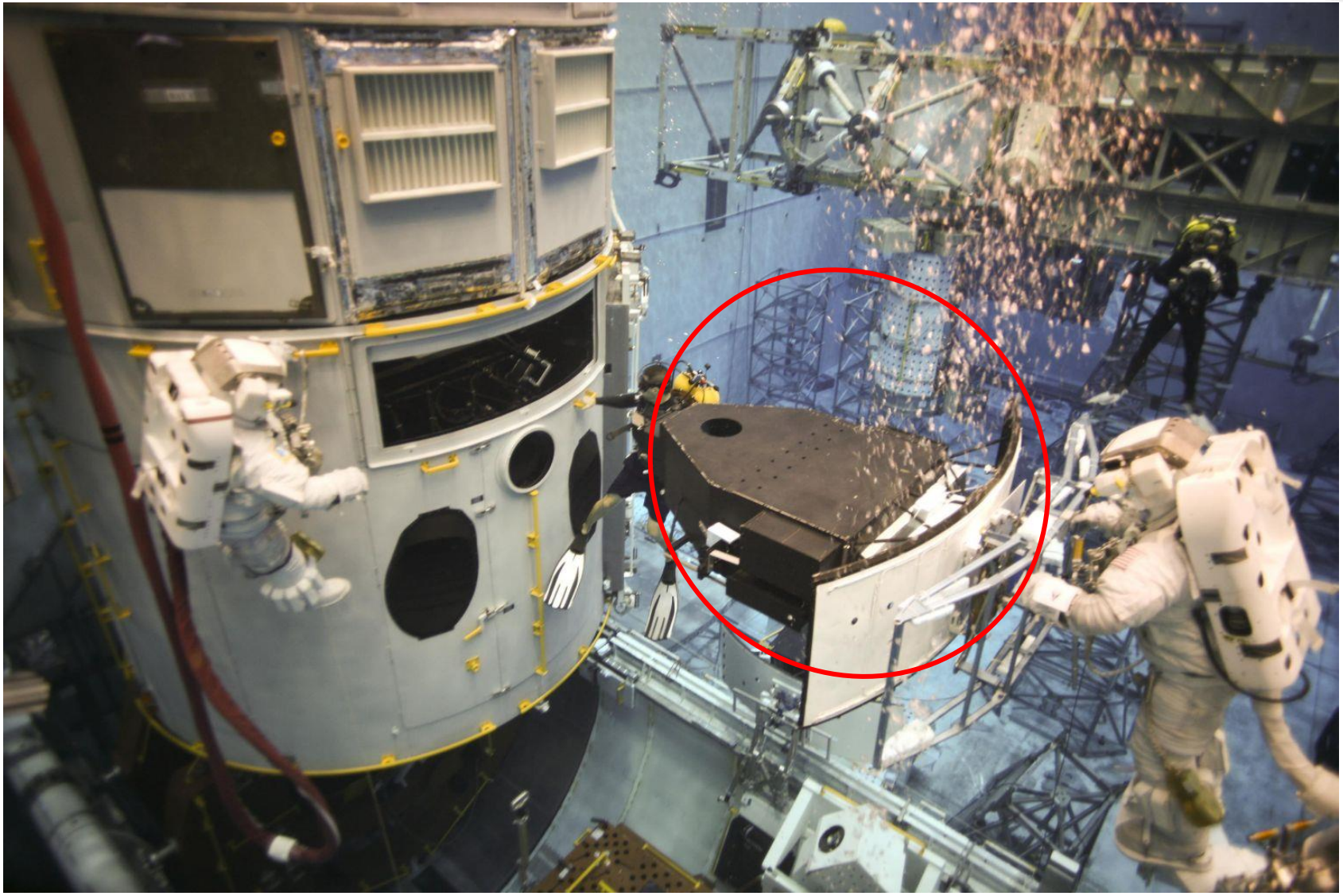
Review: Camp 2



Review: Camp 3



Review: Camp 3

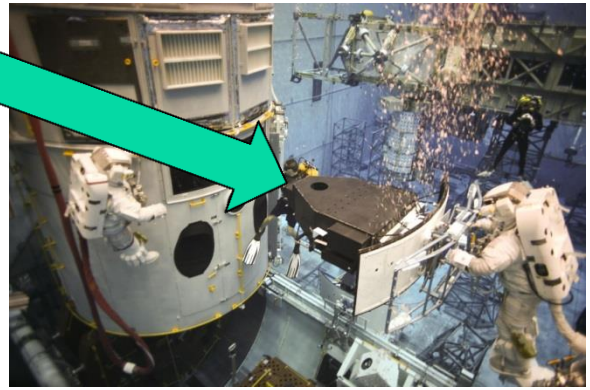


Review: Camp 2

Cost Estimating for Camps 1-3

- Camp 2 instrument are represented/supported by NICM, but only for smaller apertures

- Camp 3 instruments are represented/supported by NICM, but only for much larger apertures.



- Camp 1 is not supported by NICM VI: but they will be in NICM VII!

Camps Divided by Apertures

- Where does this bifurcation point between small and large apertures occur?
  - Within NICM, telescope+backend (Camp 2) instruments are typically of apertures of < 0.25 m
  - For missions requiring > 0.25 m or greater apertures, the instruments in NICM typically represent the backend only (Camp 3).

- But what if a user wants the cost of just the telescope frontend (Camp 1)?

Telescope Cost Model's by Camp and Aperture

		Aperture Bins		
		< 0.25 m	0.25 m to 1.5 m	> 1.5 m
Camp 1	Tube Only	MIT	NICM-T	MSFC
Camp 2	Tube + Backend	NICM	~NICM + NICM-T	~MSFC+NICM
Camp 3	Backend Only	~NICM-MIT	NICM	NICM

- MSFC = Marshall Large Telescope cost model
- MIT = MIT small telescope cost model
- NICM-T = The new NICM Telescope CER for apertures 0.25 m to 1.5 m

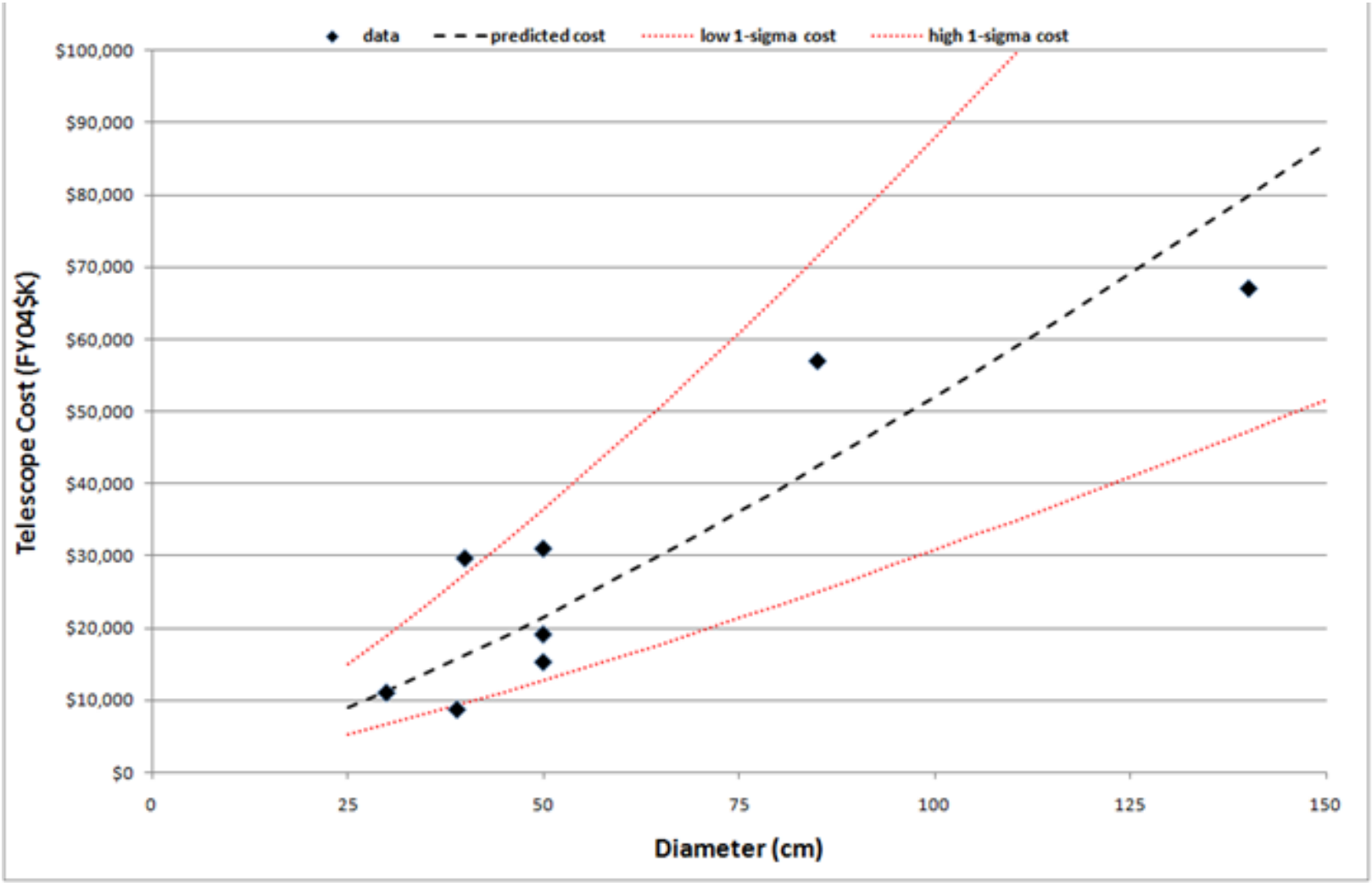
NICM-T: Telescope Data

	Aperture (m)	Band	mass (kg)	Cost $M FY04
FUSE*	39	Infrared	130.9	9
GALEX	50	Infrared	98.8	16
IRAS	50	Infrared	130	31
WIRE	30	Infrared	85.3	11
Spitzer	85	Ultraviolet	133.8	57
WISE	40	Ultraviolet	110.6	80
HiRISE**	50	Infrared	39.7	14
Kepler	140	Infrared	336.1	67

*FUSE had 4 identical telescopes. Numbers here are for 1.
**HiRISE was actually developed as a Camp 2 instrument. The NICM team was able to separate out the telescope mass and cost.

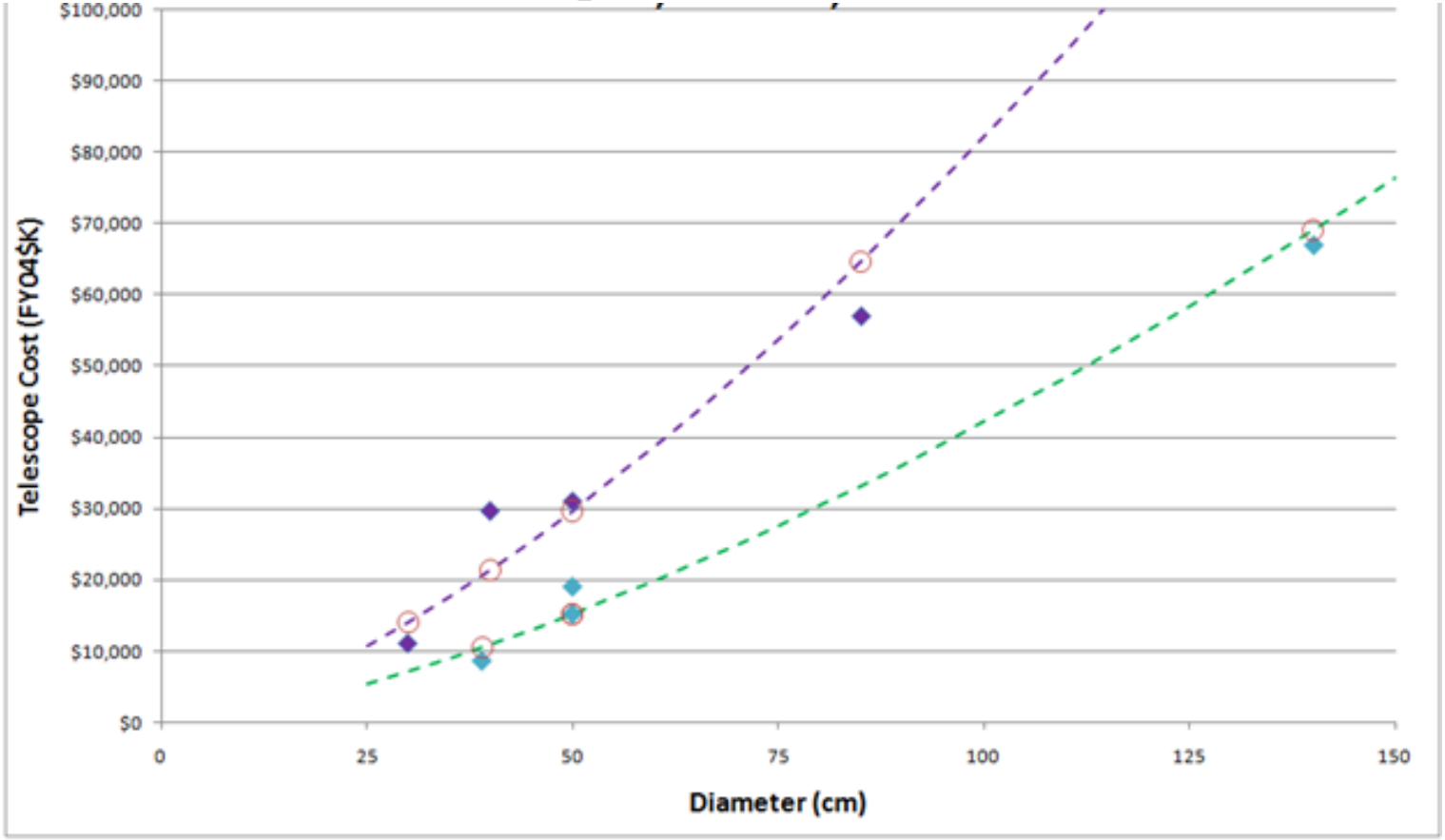
NICM-T: CER Candidate 1

- Cost [FY04$K] = 149.38*(Diameter[cm])$^{1.271}$
- R^2 = 71%, SE = 43%, PE = 52%



NICM-T: CER Candidate 2

- Cost [FY04$K] = {49 Visible/UV, 95.4 Infrared}*(Diameter[cm])$^{1.467}$
- R^2 = 93%, SE = 23%, PE = 37%
- Green: Vis/UV. Purple: IR



NICM-T CERs, Side-by-side Comparisons

- Candidate 1:
  - Cost [FY04$K] = 149.38*(Diameter[cm])$^{1.271}$
  - R^2 = 71%, SE = 43%, PE = 52%

- Candidate 2:
  - Cost [FY04$K] = {49 Visible/UV, 95.4 Infrared}*(Diameter[cm])$^{1.467}$
  - R^2 = 93%, SE = 23%, PE = 37%

NICM-T Conclusions and Next Steps

- Next Steps
  - Collect more telescope data
  - Recalibrate the 2 candidate CERs
  - Install best CER into NICM VII for release

- Conclusion:
  - NICM VII will include a new Telescope CER which will support estimating the cost of a telescope (tube only) for apertures 0.25 cm to 1.5 m, a capability not currently available.