CGI Filters & Observing Modes

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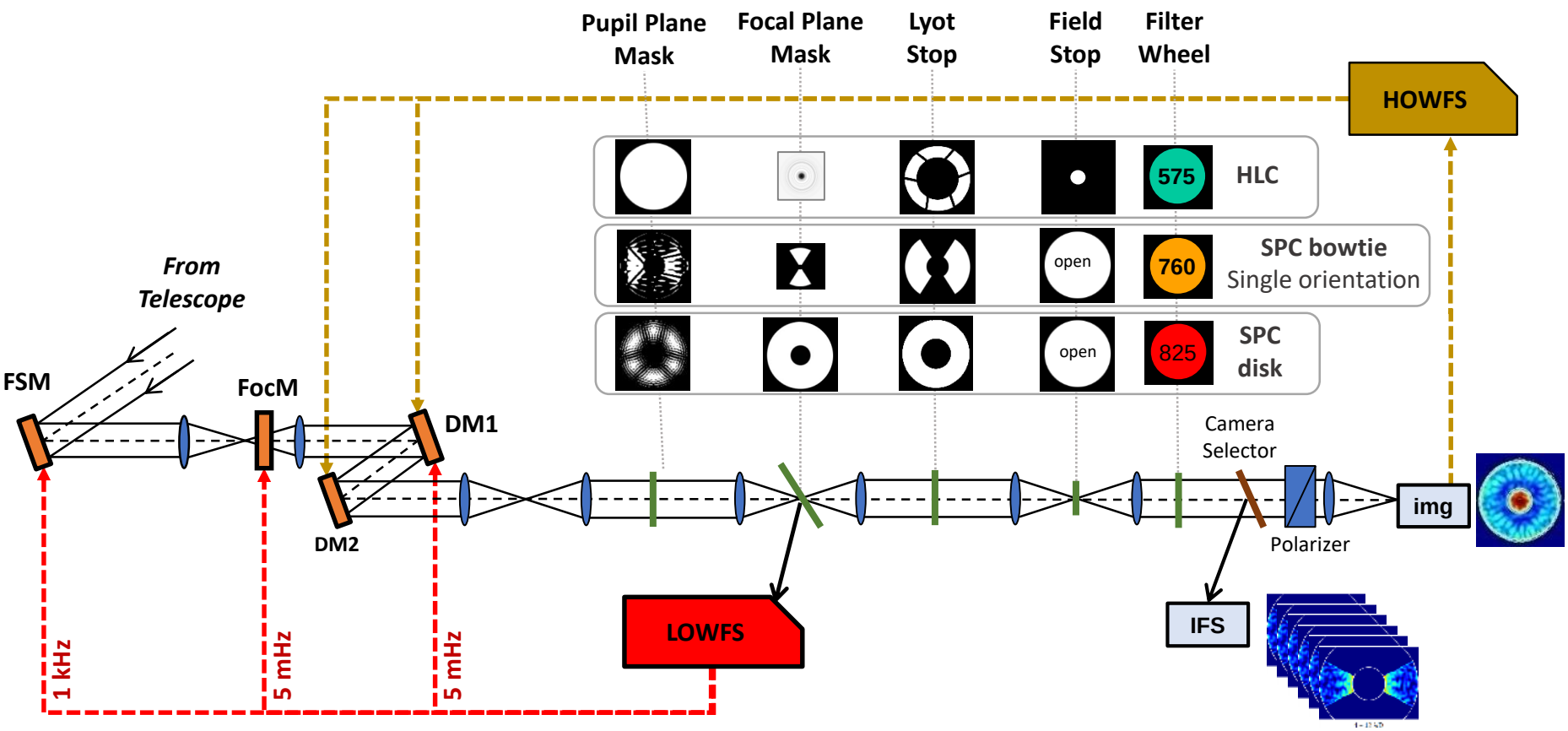
May 30, 2018

WFIRST
WIDE-FIELD INFRARED SURVEY TELESCOPE
DARK ENERGY • EXOPLANETS • ASTROPHYSICS

3 fully commissioned observing modes



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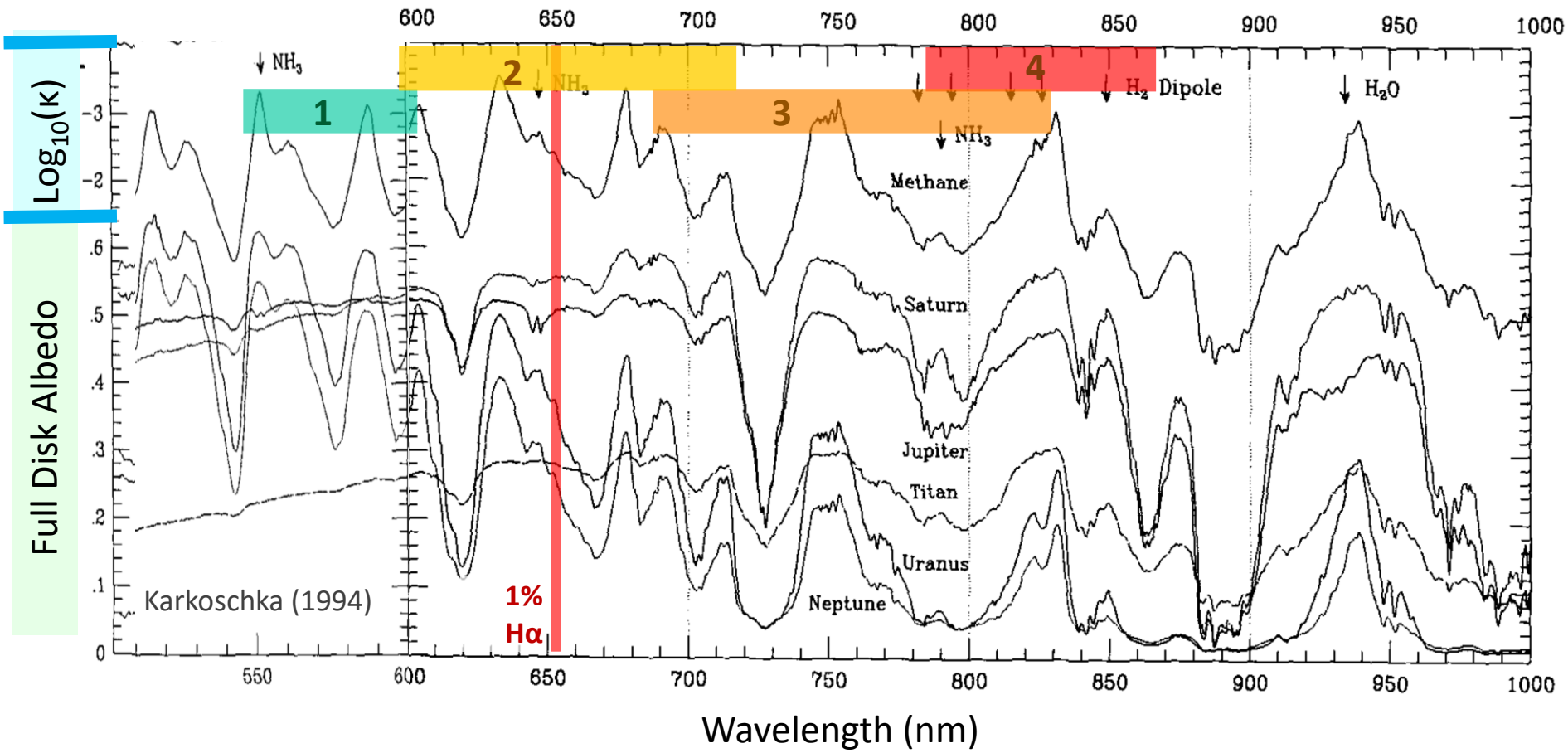
CGI Science Filters



λ_1=575 nm, 10% (annular, 3-9 λ/D)

λ_2=660 nm, 18% (bow-tie / IFS, 3-9 λ/D)

λ_3=760 nm, 18% (bow-tie / IFS, 3-9 λ/D)

λ_4=825 nm, 10% (annular, 3-19 λ/D)

Current questions

- **Do we have the right science filter set?**
  - Imaging filter = **yes**.
  - IFS filters = maybe?

- **Are we commissioning the right 3 modes?**
  - **Yes:** 1 wide FOV img for disks; 1 narrow FOV img for planets; 1 IFS for planets (IFS doesn't help disks).

- **Are we prioritizing the right coronagraph development?**
  - Considering broadband HLC & SPC wide FOV masks

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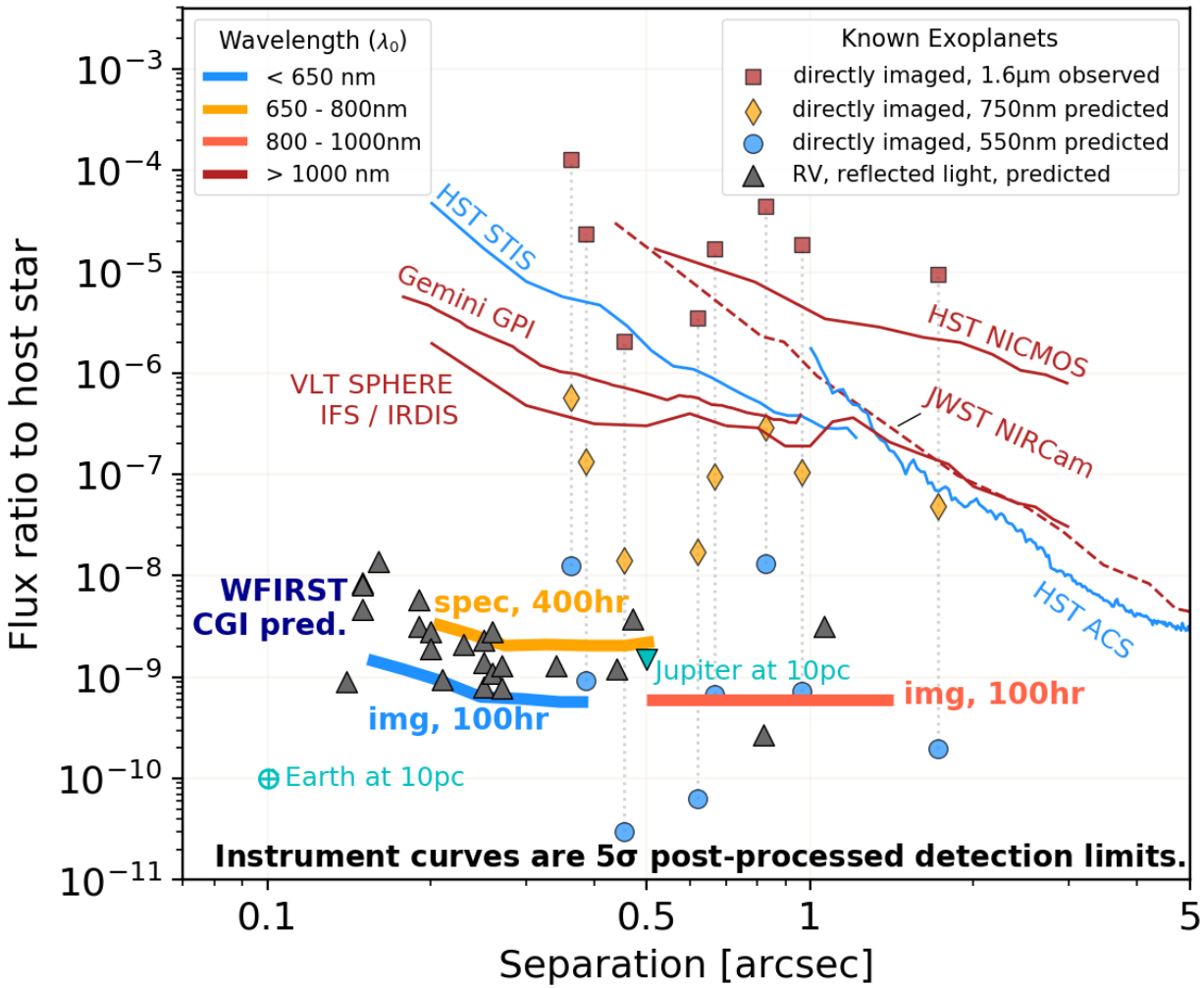
Prioritize deeper 10% HLC or developing 15-18% HLC?



Spectroscopy is the tall tent pole!

Broadband:

- **Increases collected photons in imaging mode**
- **Possible replacement for IFS mode if can reach 18% @ higher throughput than SPC bowtie**

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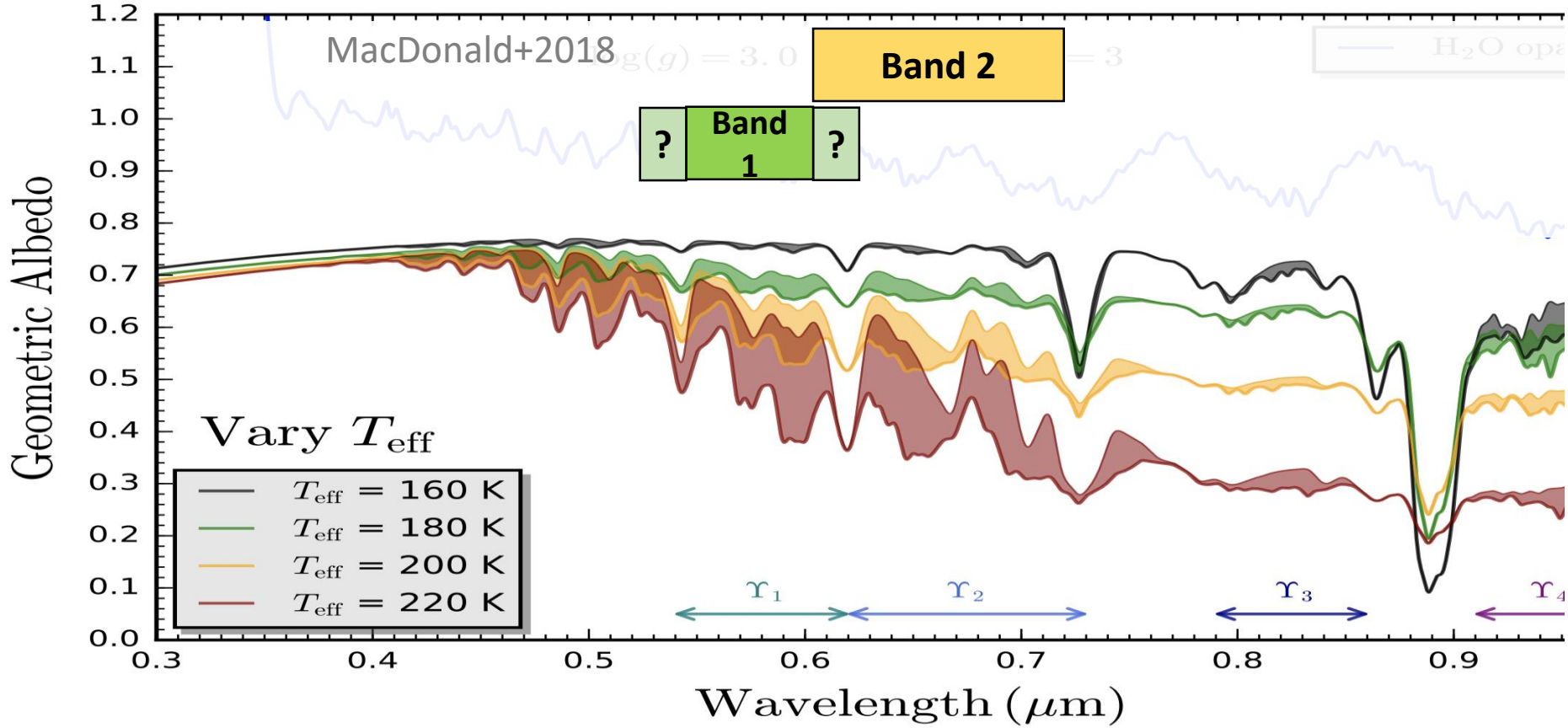
Band 1 = 15%?



Extend bluer = no overlap with Band 2, but worse pol. aberrations (how much?)
Will need updated HLC design/simulations for final decision.

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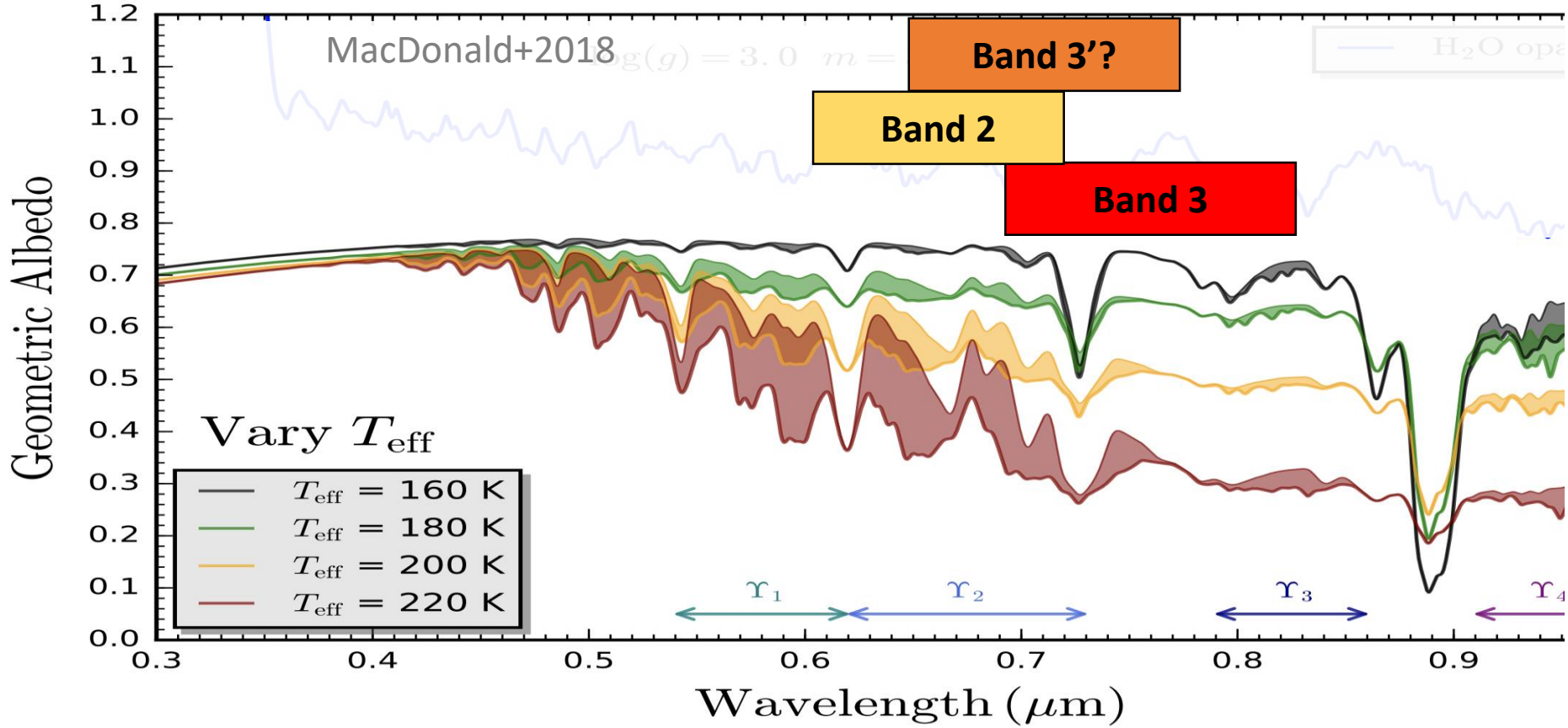
Which 18% IFS band? *(coronagraph agnostic)*



760nm = CH4

660nm = much better CGI throughput (detector QE) => **2x more spectra**

Ongoing: different 18% band that could get CH4 & higher yield (Band 3')?

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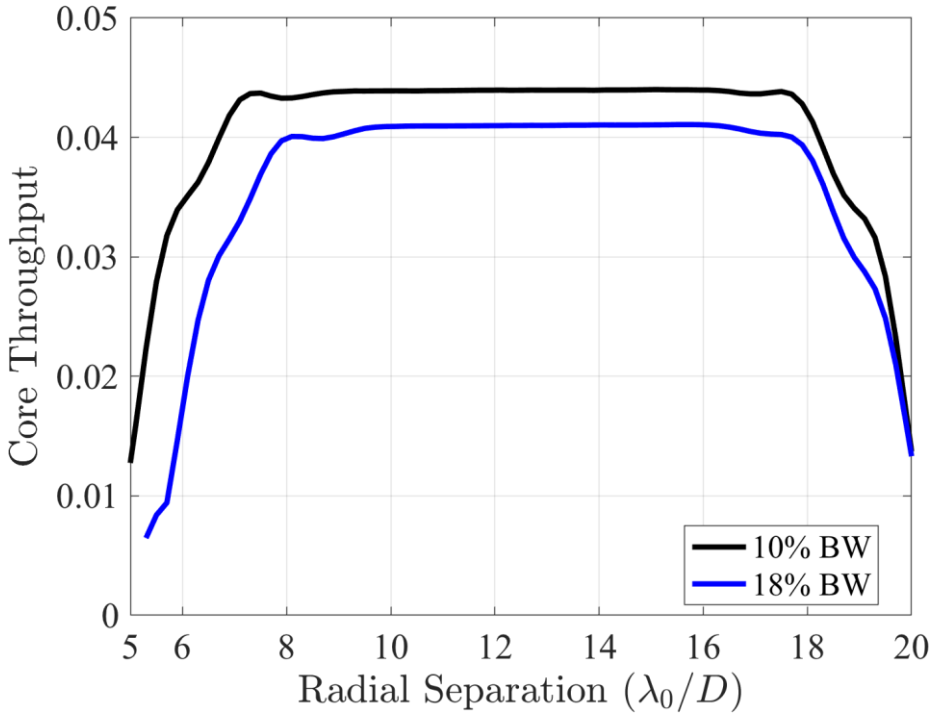
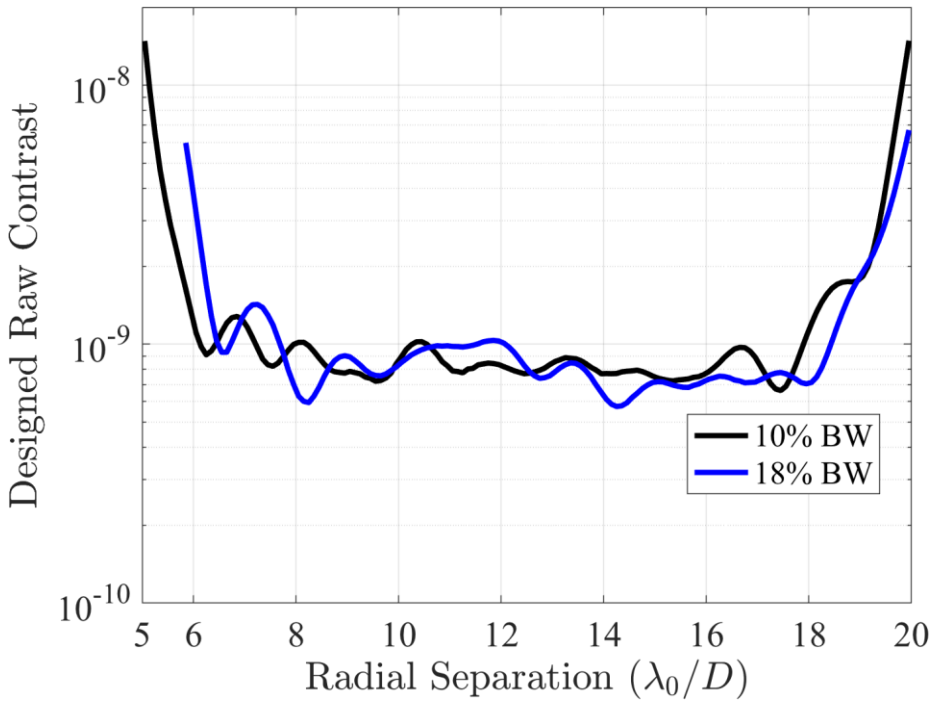
SPC annulus (wide FOV): IWA vs bandwidth

Mean Core Throughput



Mean Designed Raw Contrast



Ongoing: evaluate planet & disk flux for realistic spectra

Open questions

- SPC design priorities: broadband vs narrowband
- More quantitative justification for IFS filter location & bandwidth.
  - As part of **next data challenge & DRMs (1-2mo??)**
  - Re-evaluate 15% IFS if broadband HLC can't reach 18% (later)
- Can engineering filters be multi-purposed?
  - Halpha = **yes**, though needs quantitative study
  - Others (WFSC) = ?
- If we could install a 5th science filter, what should it be?
- PDR ~ 1yr from now

Backup slides

CGI Full Filter List

	Band #	λ (nm)	BW	Δλ (nm)	λ_{min} (nm)	λ_{max} (nm)
CGI Science Bands	1	575	10.1%	58	546	604
	2	660	18.2%	120	600	720
	3	760	18.4%	140	690	830
	4	825	9.9%	82	784	866
CGI Imaging Engineering Bands	1a	555.7	3.5%	19.3	546	565.3
	1b	575.0	3.4%	19.3	565.3	584.7
	1c	594.3	3.3%	19.3	584.7	604.0
	4a	797.7	3.4%	27.3	784.0	811.3
	4b	825.0	3.3%	27.3	811.3	838.7
	4c	852.3	3.2%	27.3	838.7	866.0
CGI IFS Engineering Bands	2a	656.3 (TBR)	1%	6.6	653.0	659.6
	3a	710 (TBR)	1%	7	706.5	713.5
	4a	825 (TBR)	1%	8.2	820.9	829.1

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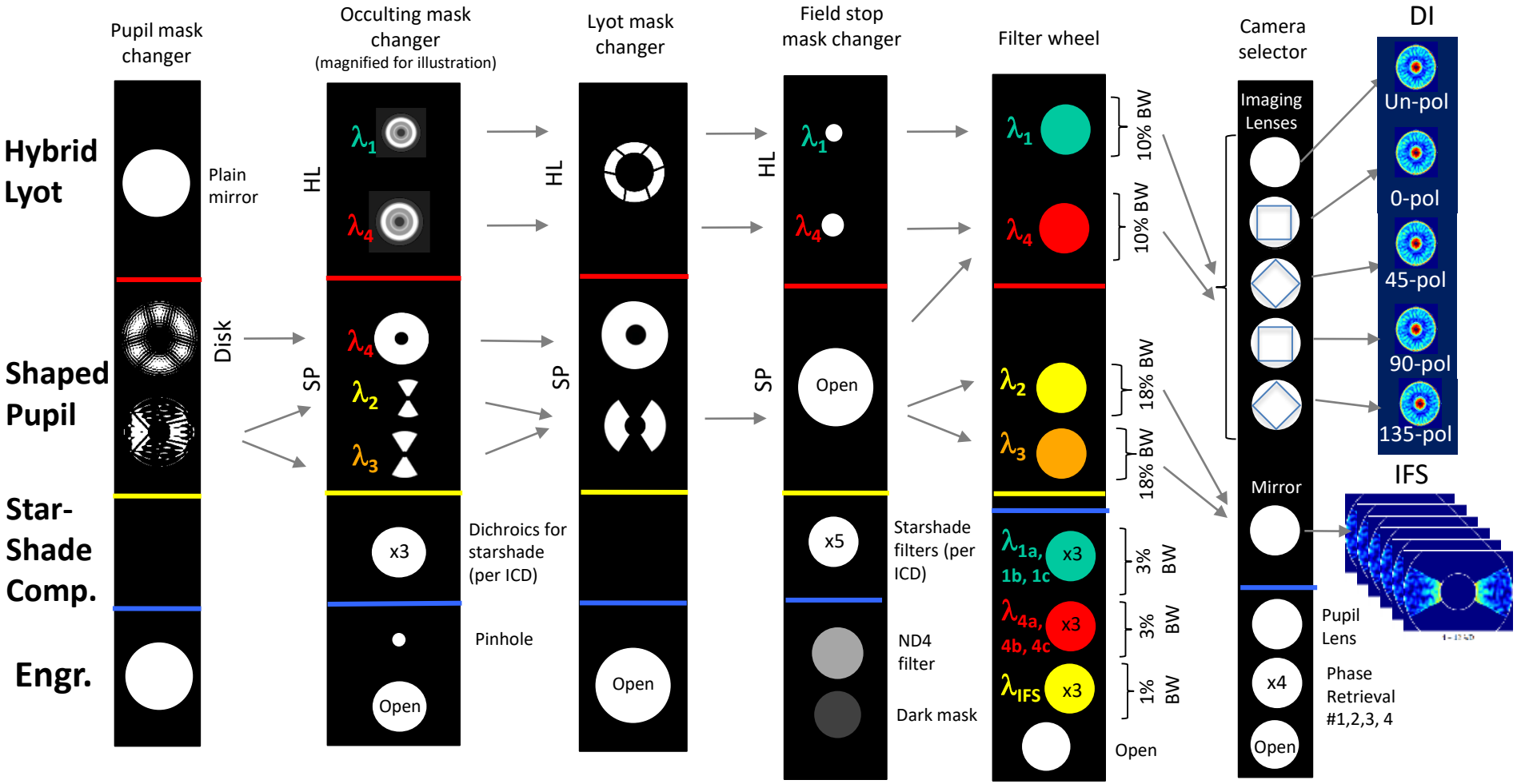
CGI Baseline



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CGI Modes Table

CGI Filters	λ_{center} (nm)	BW	Channel	Masks	Working Angle	Can use w/ linear polarizers	Starlight Suppression Region	Tested before launch?
1	**575**	**10%**	**Imager**	**HLC**	**3-9 λ/D**	**Y**	**360°**	**Y**
2	660	18%	IFS	SPC	3-9 λ/D		130°	
2	660	18%	Imager	SPC	3-9 λ/D	Y	130°	
3	**760**	**18%**	**IFS**	**SPC**	**3-9 λ/D**		**130°**	**Y**
3	760	18%	Imager	SPC	3-9 λ/D	Y	130°	
4	825	10%	Imager	HLC	3-9 λ/D	Y	360°	
4	825	10%	IFS	HLC	3-9 λ/D		360°	
4	825	10%	IFS	SPC disk	6.5λ/D - 0.8”		360°	
4	**825**	**10%**	**Imager**	**SPC disk**	**6.5-20 λ/D**	**Y**	**360°**	**Y**

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Starshade Filter List

Starshade Science Bands

λ (nm)	BW	Δλ	λ_{min} (nm)	λ_{max} (nm)	mode
488.5	26.0%	127	425	552	img
707.5	26.1%	185	615	800	img
728	19.8%	144	656	800	IFS
884.5	26.1%	231	769	1000	img
910	19.8%	180	820	1000	IFS