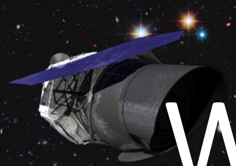
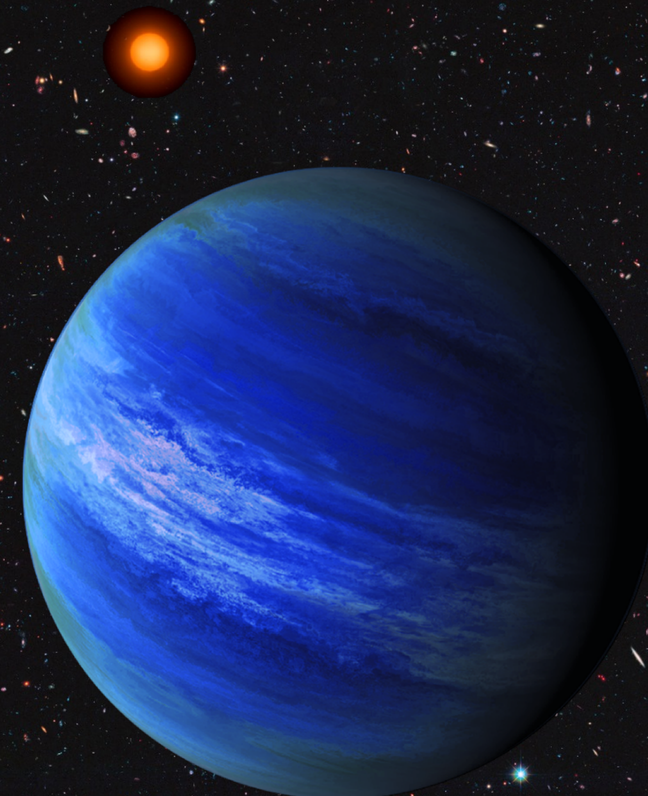


WFIRST Coronagraph Design Update and Phase B Plan



A J Eldorado Riggs

Jet Propulsion Laboratory,
California Institute of Technology

Jessica Gersh-Range, Princeton University

Erkin Sidick, Jet Propulsion Laboratory, California Institute of Technology

WFIRST FSWG #7
May 30, 2020

Overview

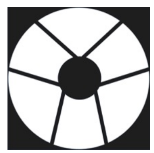
1. Brief SPC Design Updates
   a) SPC-IFS
   b) SPC-WFOV ("Disk")

2. Key Activities in Phase B

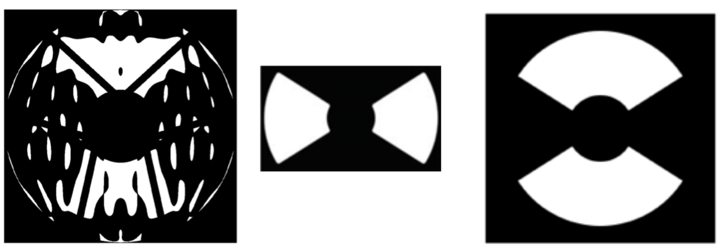
Impact of Pupil Changes on SPC-IFS

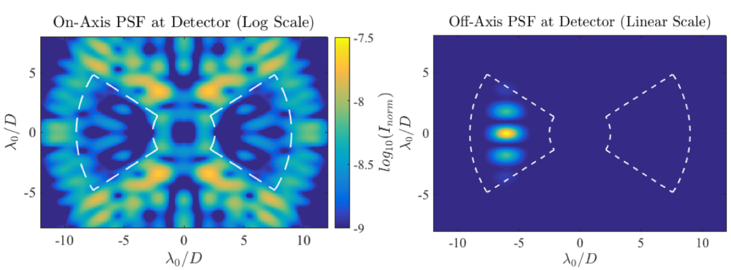
- New SPC design survey with January pupil and varying IWA

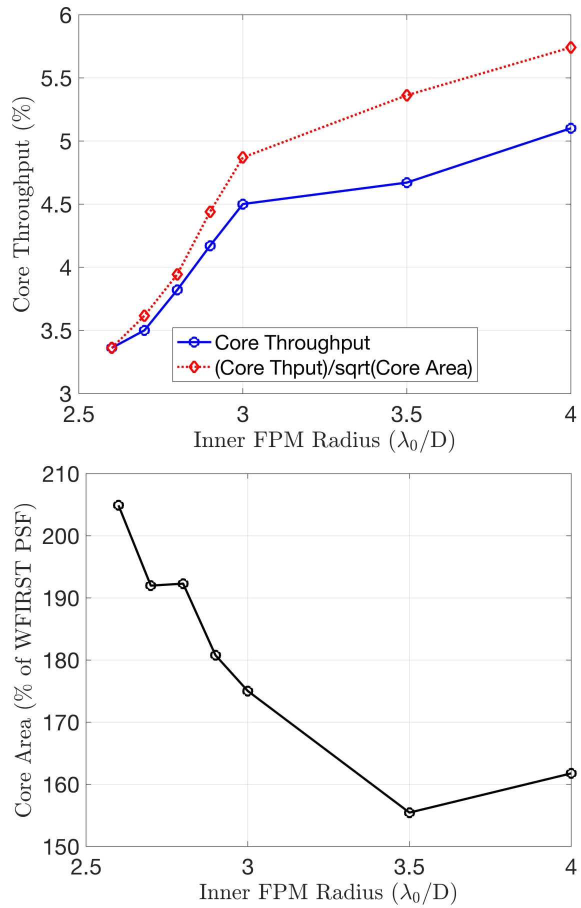
SPC 20170714
(SRR design)



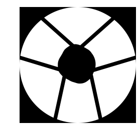
3.85% core throughput







2018-01-03 Pupil
(new COBS and struts)



Survey by Jessica Gersh-Range, Princeton Univ.

Thicker struts → lower throughput and larger PSF core area

➢ ***Larger IWA is only way to mitigate those with SPC***

New SPC-WFOV ("Disk") Design Options

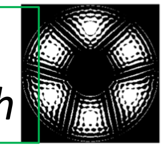
SRR Design:
IWA = 6.8 λ/D
10% BW
1e-9 design contrast

IWA = **5.3 λ/D**
10% BW
1e-9 design contrast

- *Much smaller IWA*

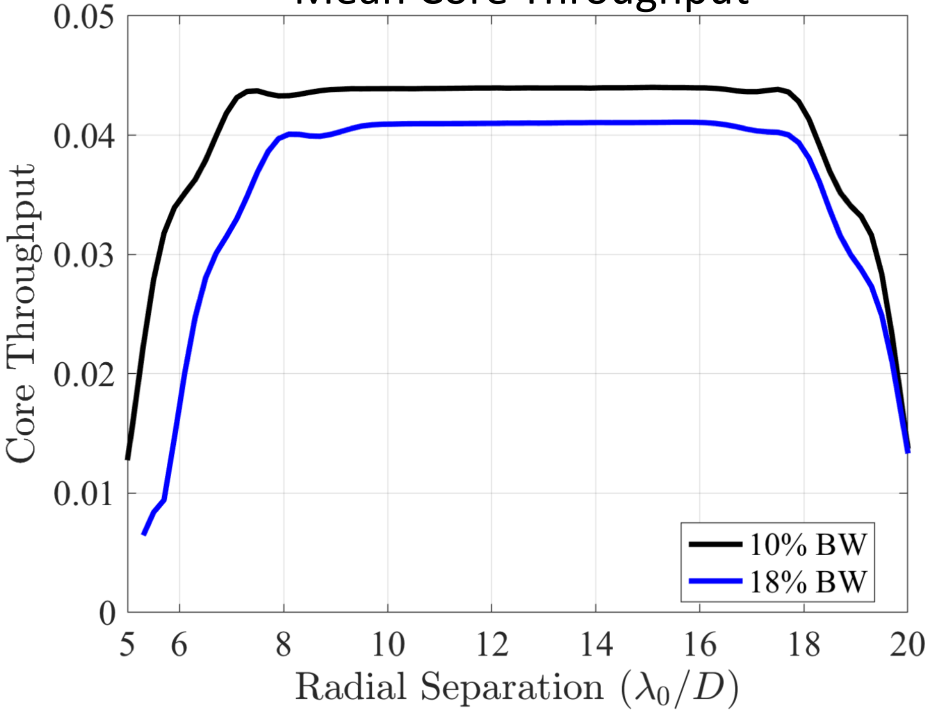
IWA = **6.1 λ/D**
18% BW
1e-9 design contrast

- *Smaller IWA*
- *Larger bandwidth*

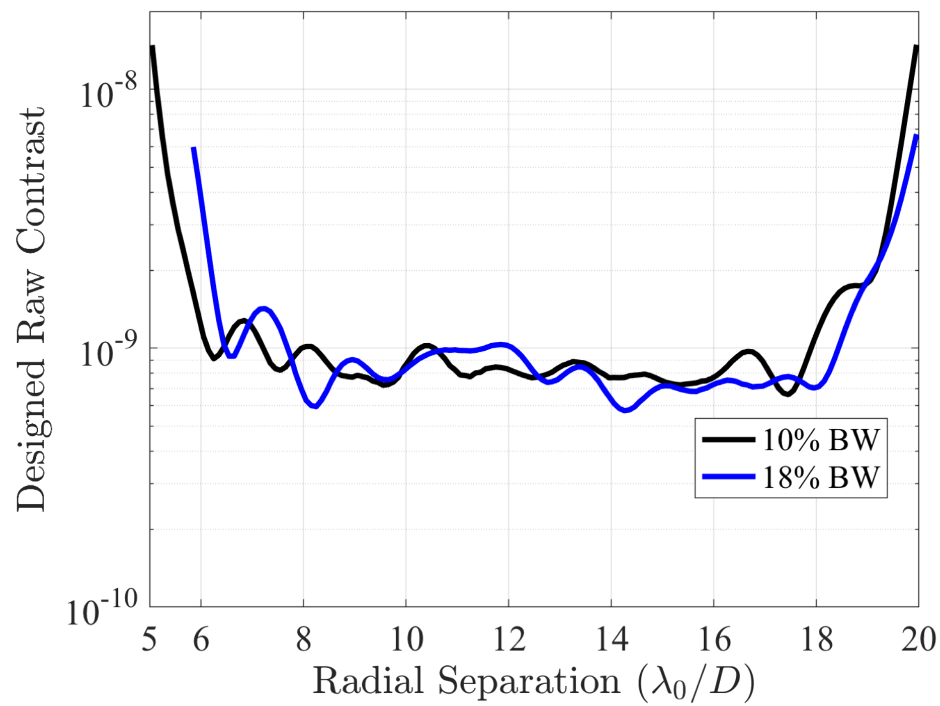


New Possible Designs:

Mean Core Throughput



Mean Designed Raw Contrast



Overview

1. Brief SPC Design Updates
   a) SPC-IFS
   b) SPC-WFOV ("Disk")

2. Key Activities in Phase B

Key Activities in Phase B

1) Anticipating telescope pupil uncertainties/changes:

- Establish clear strategy (to use through delivery of flight masks) on how to use provided pupil information for the design.
- Build robustness to telescope pupil and instrument uncertainties into designs

2) Develop Possible Alternatives to Bowtie SPC for IFS:

- 18-20% bandwidth HLC
- 18-20% bandwidth SP+HLC

3) Collaboration with SITs (e.g., CGI Filters WG)

- Trade studies:
    - Centers and bandwidths of filters
        - For all modes
        - Science and engineering filters
    - IFS:
        - What IWA gives best balance of other performance metrics?

Key Activities in Phase B

4) HLC Occulter Fab Development

- Design, modeling, and testing HLC occulters with extended dielectric and/or multi-height nickel.
- Potentially *much better* throughput and robustness than baselined HLC occulter
  - Try to eliminate need for polarizer at redder bandpass

5) Documentation on code and methodology

- Need reproducible design process

Backup Slides

New Pupil in Phase B

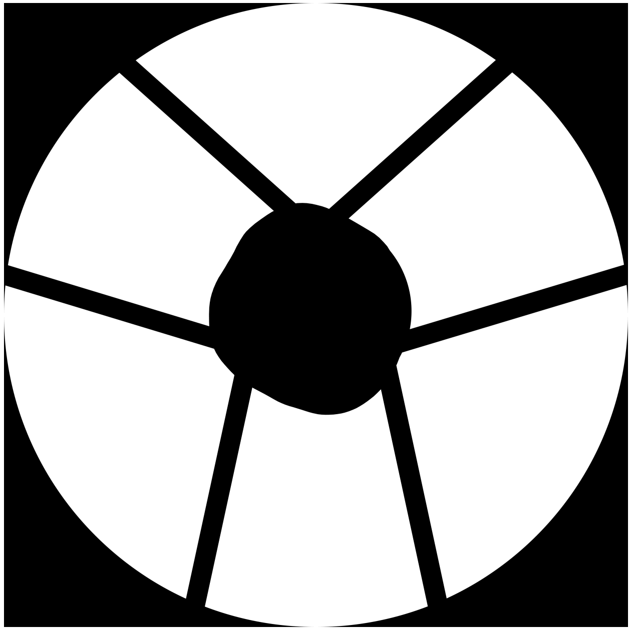
(Preliminary Phase B Pupil)

Phase A (2014)

- 31% OD COBS
- 2.6% OD strut width

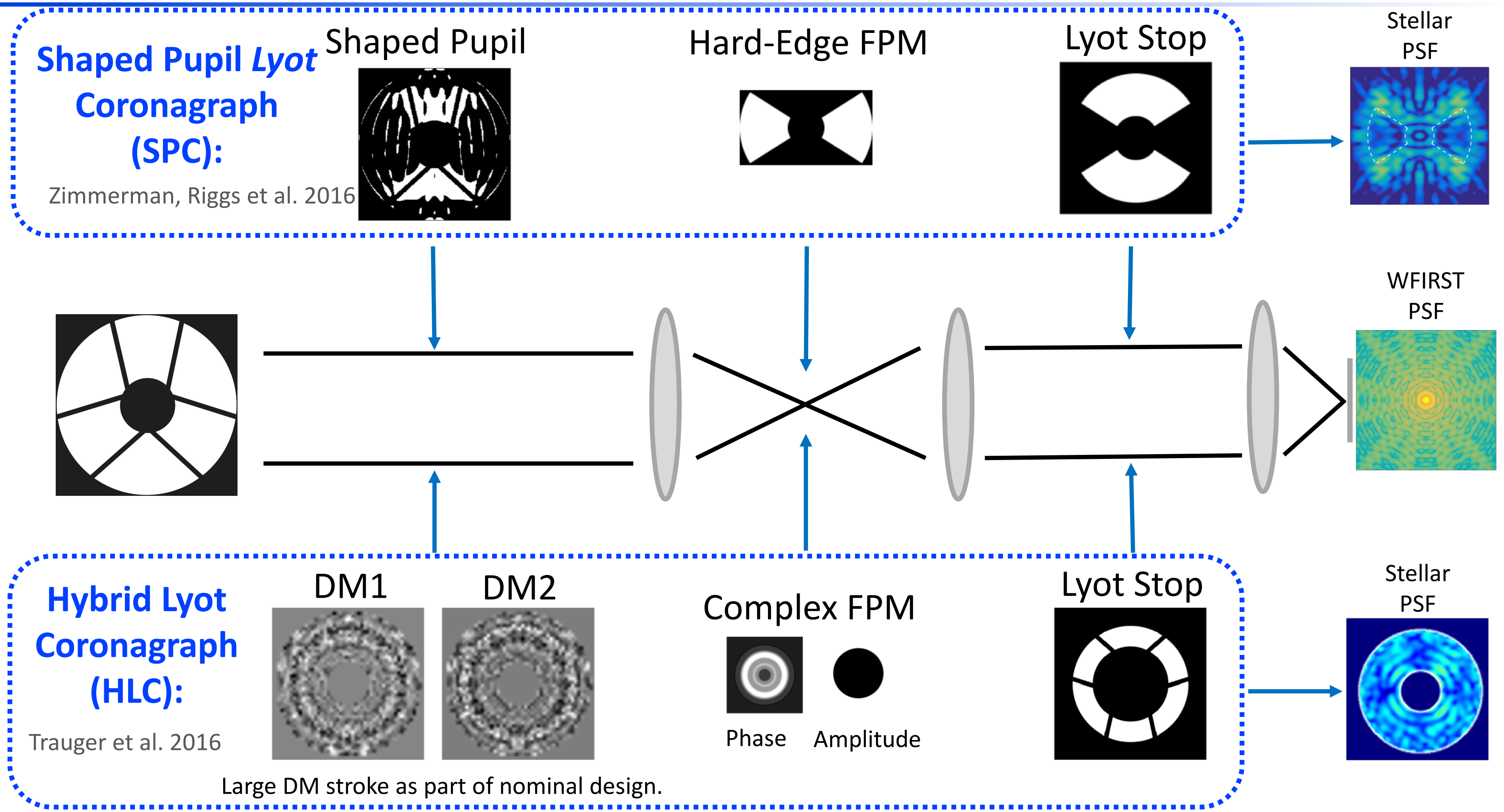
- *Larger, non-circular SM baffle*
- *Thicker struts*

Phase B (2018-01-03)



- **32-36% OD** COBS
- **3.22% OD** strut width

The WFIRST Coronagraphs



Benefits of Each Coronagraph (complementary):

- HLC: Full **FOV**, fewer masks, easier **alignment,** less sensitive to pupil shape errors
- SPC: Broader **bandwidth**, better aber. **sensitivities** (esp. **PM pol.**), lower risk with DMs