“Analytic” DRMs

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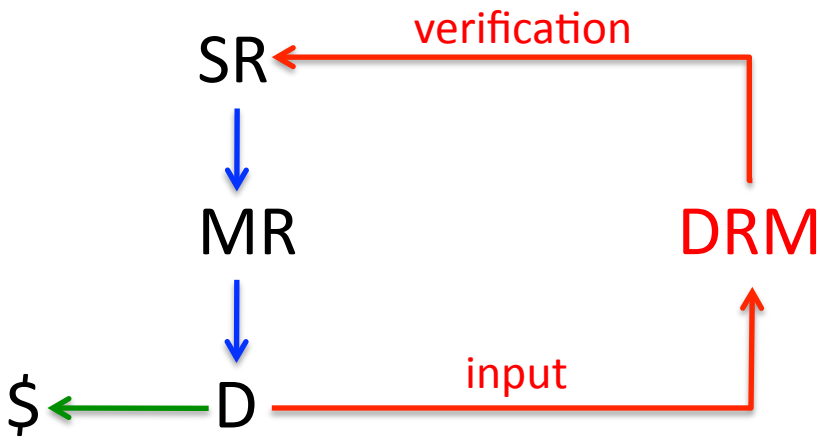
Scope

- Formalism
- Example
- Benefits
- WFIRST?

Formalism of An Analytic DRM



umbrella for on-going "mission studies"
science-operational perspective
end-to-end, systems-level approach
key trades identified & worked
liens & issues identified & addressed
MC simulation of schedule competition
high research standards (general skepticism)
peer-reviewed publication of mini-studies

Design Specifications

Instrument
fov
sampling
filters
e.t.c.
...

Telescope
aperture
aberrations
...

Spacecraft
stay-out zones
pointing
performance
data management
...

Sci. Ops
scheduling
algorithm
turnaround of
results
...

Calibrations
standard
calibrations
models of ναtυρε
...

A DRM for *TPF-C*

A Design Reference Mission for the Coronagraphic *Terrestrial Planet Finder*

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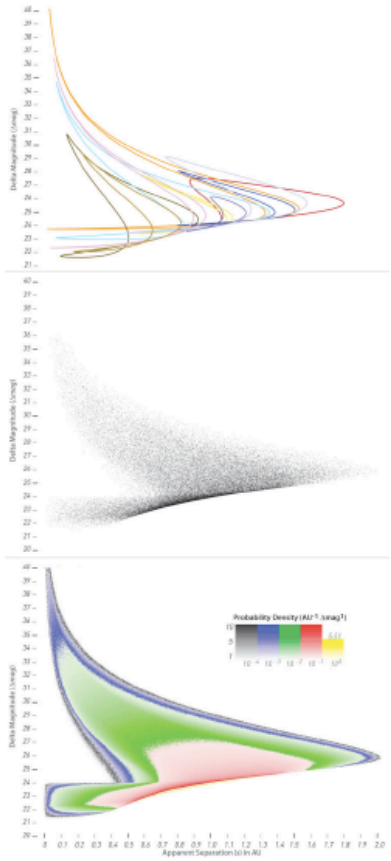

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http://www.stsci.edu/~RAB/papers/TPFC_DRM.pdf

Also: Brown, R. A., and Soummer, R. 2010, ApJ 715, 122

TPF-C DRM

1 Introduction

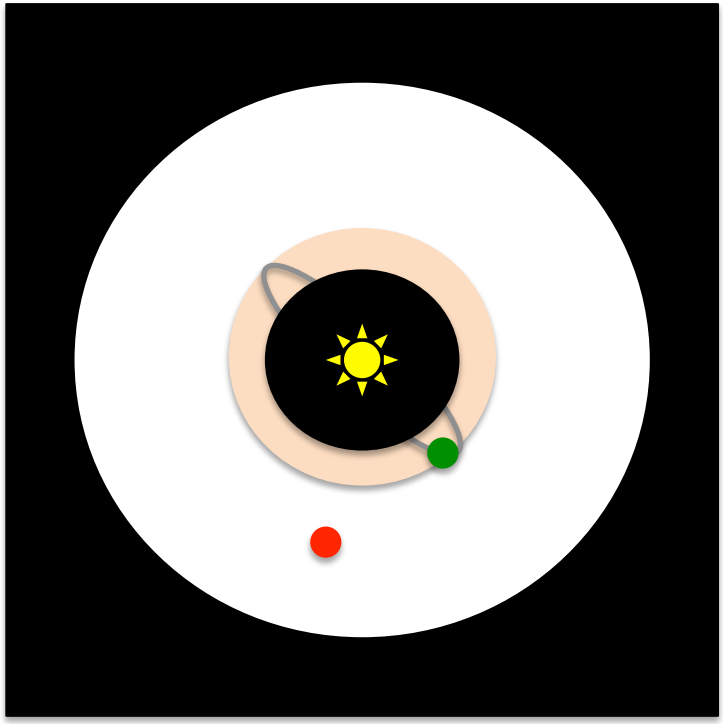
The first purpose of this design reference mission (DRM) is to explore the range of parameters for which the current concept of *TPF-C* can robustly perform its intended research. We want to understand the correct scale of the mission. §2 Mission Models, §3 Algorithms, and §4 Modeling Results serve this motivation and establish the analytic foundation of the DRM.

A second purpose is to identify systematic effects and selection biases that may shape or constrain the science of *TPF-C*. We want to know what needs to be compensated, calibrated, or further investigated to reduce risk or alleviate concern. §5 Systematic Effects and Selection Biases serves this motivation.

A third purpose of this DRM is to reveal the essential character of science operations for *TPF-C*. We want to develop the instrument and spacecraft taking ground operations and the science process into account, which for *TPF-C* will involve rigorous considerations. §6 Science Operations considers *TPF-C* end to end in terms of science-systems engineering.

This mixture of perspectives, tools, and motivations is useful at the current early stage of the *TPF-C* project. It should provide a general understanding of how it all is supposed to work and what issues at the intersection of flight hardware, ground operations, and science still must be addressed as the project moves forward.

TPF-C



Science challenge

Discover & obtain R~70 spectra at O_2 A-band of > zero "Earths" (delMag>25) in HZs ((0.7-1.5)$L^{1/2}$ AU) around nearby stars with high confidence of success.

Some DRM findings

- unknown eta(L) sets mission scale (D)
- key design trade is n vs. D (IWA=n lamda/D)
- starved for nearby stars
- early orbit prediction for scheduling is nearly impossible
- disambiguation by common apparent motion is difficult
- speckle instability sets detection limit (limDelMag ~26)

Benefits

- End-to-end verification that design meets quantified science requirements
- Backbone connecting all parts of the system and project
- Identification of tall poles
- Evaluation of trades by bottom-line impacts
- MC simulations if schedule is a random walk

Relevant for WFIRST?

- No schedule competition based on findings?
- No quantified SRs? (Level-of-effort program.)
- No complex, cross-system trades?
- No concern about mission vulnerability to optimistic assumptions?
- No skepticism about claims?

No? Well, maybe not, then...