TRW Space & Electronics Group

TRW TPF Preliminary Architecture Review Introduction

Michael Wehner

TRW Team Roles

• TRW	Prime, system engineering, spacecraft
• Kodak	Optical technology
• ITT	Modeling, instrument technology
• LLNL	Modeling, instrument technology
• SEE	Orbit analysis
• SDL	Instrument technology
• Science	Phenomenology, concepts,astrophysics, concept assessments

TRW Team Members

INDUSTRY		SCIENCE TEAM	
Name	**Company/Role**	**Name**	**Organization**
Mark Abrams	ITT PM	Craig Copi	Case Western Reserve University
Charlie Bennett	LLNL	Vincent Coude du Foresto	DESPA, Meudon, FR
Arthur Buettner	Kodak Mech Engr	Alan Dressler	Carnegie-Mellon University
Mike Busby	Consultant	James Graham	UC Berkeley
Steve Cain	ITT (not currently active)	Tom Herbst	Science Team
Suzi Casement	TRW Science	Ken Johnston	US Naval Observatory
Doug Cohen	ITT	James Larkin/Liz Gire (student)	UCLA/UCLA
Marty Flannery	TRW Payload	Doug Lin	Lick Observatory
Brent Helleckson	SEE L2 orbit expert	Bertrand Mennesson	Science Team (I/F)
Richard Hertel	ITT	Frank Shu	UC Berkeley
Pete Jarecke	TRW Payload	Richard Simon	NAAO
Peter Jones	Kodak Optical SE	Glenn Starkman	Case Western Reserve University
Keith Kroening	TRW Payload Support	John Trauger	JPL
Don Kwak	TRW Configuration	Steve Vogt	Lick Observatory
John Lesveaux	Kodak PM/Mech Eng	Dan Weedman	Self
Ray Manning	TRW Dynamics	Ned Wright	UCLA
Gary Matthews	Kodak		
James McCarthey	TRW		
Stewart Moses	TRW System Engineer		
Jeff Nienberg	TRW Thermal		
Vinod Patel	Kodak Optical SE		
Bill Sharp	ITT		
Michael Wehner	TRW Program Manager		

Executive Summary

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- TRW team performed objective trade on architectures applicable to TPF mission
  - All concepts are technically very challenging
- We normalized planet detection/characterization across all architectures, then assessed them per the JPL evaluation criteria
  - Technology, cost, risk, reliability/robustness, astrophysics, legacy
- All five architectures studied fall into two classes
  - Direct Imagers: Simultaneous coverage of u-v plane (telescopes)
  - Synthetic Imagers: Sequential coverage of u-v plane (interferometers)
- We find Direct Imagers (DI) have advantages over Synthetic Imagers (SI) (given normalized detection/characterization performance)
  - Technical complexity of SI daunting on many fronts vs. large system sizes required for DIs
  - Legacy of SI to future missions (LifeFinder, Planet Imager) not clear
  - DI have high general astronomy utility; SI more specialized
- TRW wishes to further investigate Direct Imagers during Phase 2
  - Interferometer challenges better understood; DIs need additional work

Five Architecture Classes Investigated

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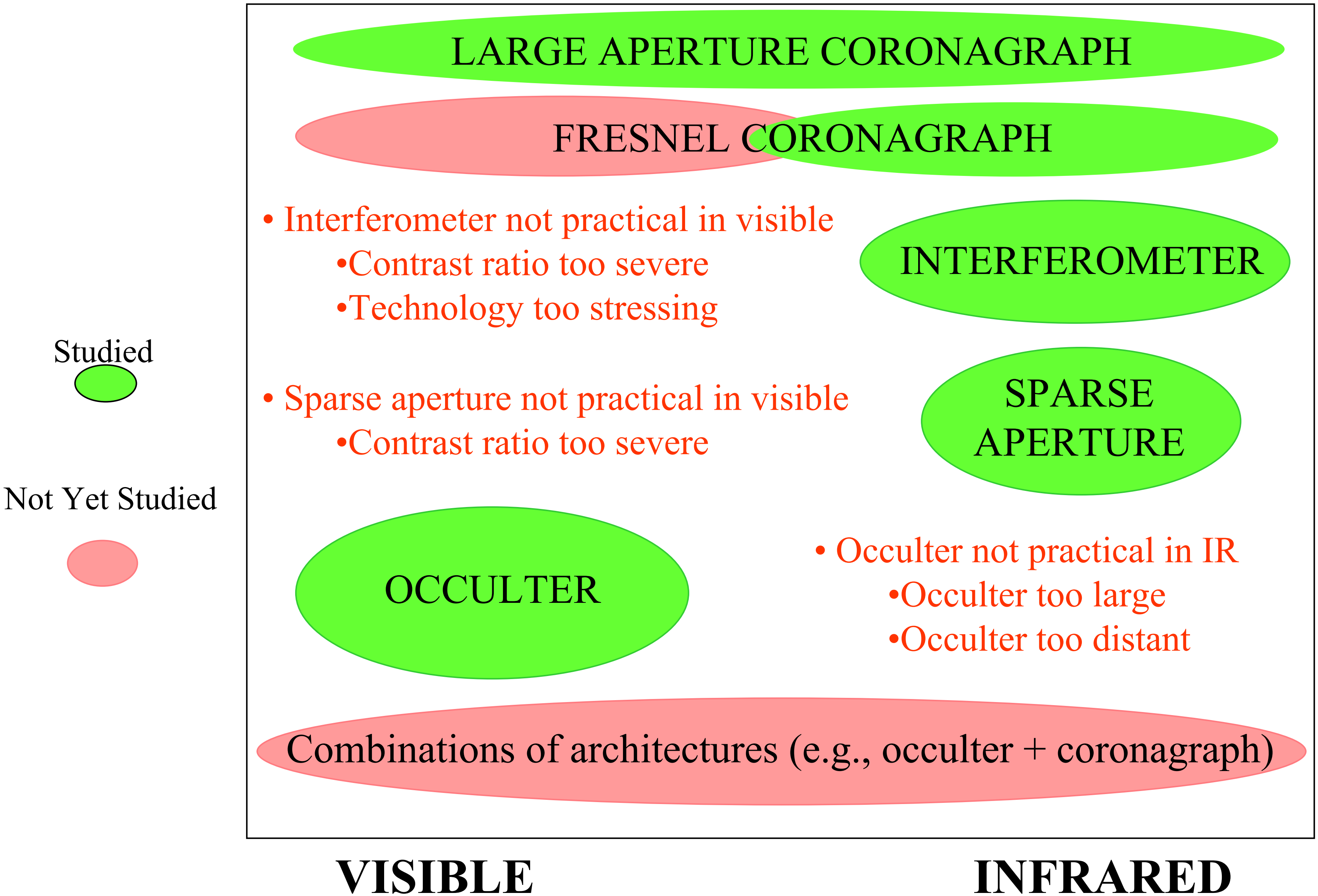
- Large Aperture Coronagraph (IR (visible possible))
  - ~30 m diameter primary with excellent mid-frequency figure
  - Cryogenic operation using NGST optics and cooling technology
  - Coronagraph with deformable optics, Lyot stop and apodized spot
- Fresnel Coronagraph (IR (visible possible))
  - ~30 m fresnel lens primary
  - 'Eyepiece' satellite formation flown at distance of 6 km
  - 1.5 m optics, fresnel correction lenses, Lyot and coronagraph spots
- Sparse Aperture (IR)
  - ~100 m primary with ~100 subapertures (2-4 m), random positions
  - 'Eyepiece' satellite formation flown at 500 meters
- Free Flying Occultor (visible)
  - ~70 m apodized occultor formation flown 100,000 km away
  - 8 m primary diffraction limited in the visible
- Nulling Interferometer (IR)
  - Oasis 1-3-3-1 with 4 meter apertures, cryogenic operation
  - 70 meter class baseline

Total TPF Trade Space Is Vast - More To Do

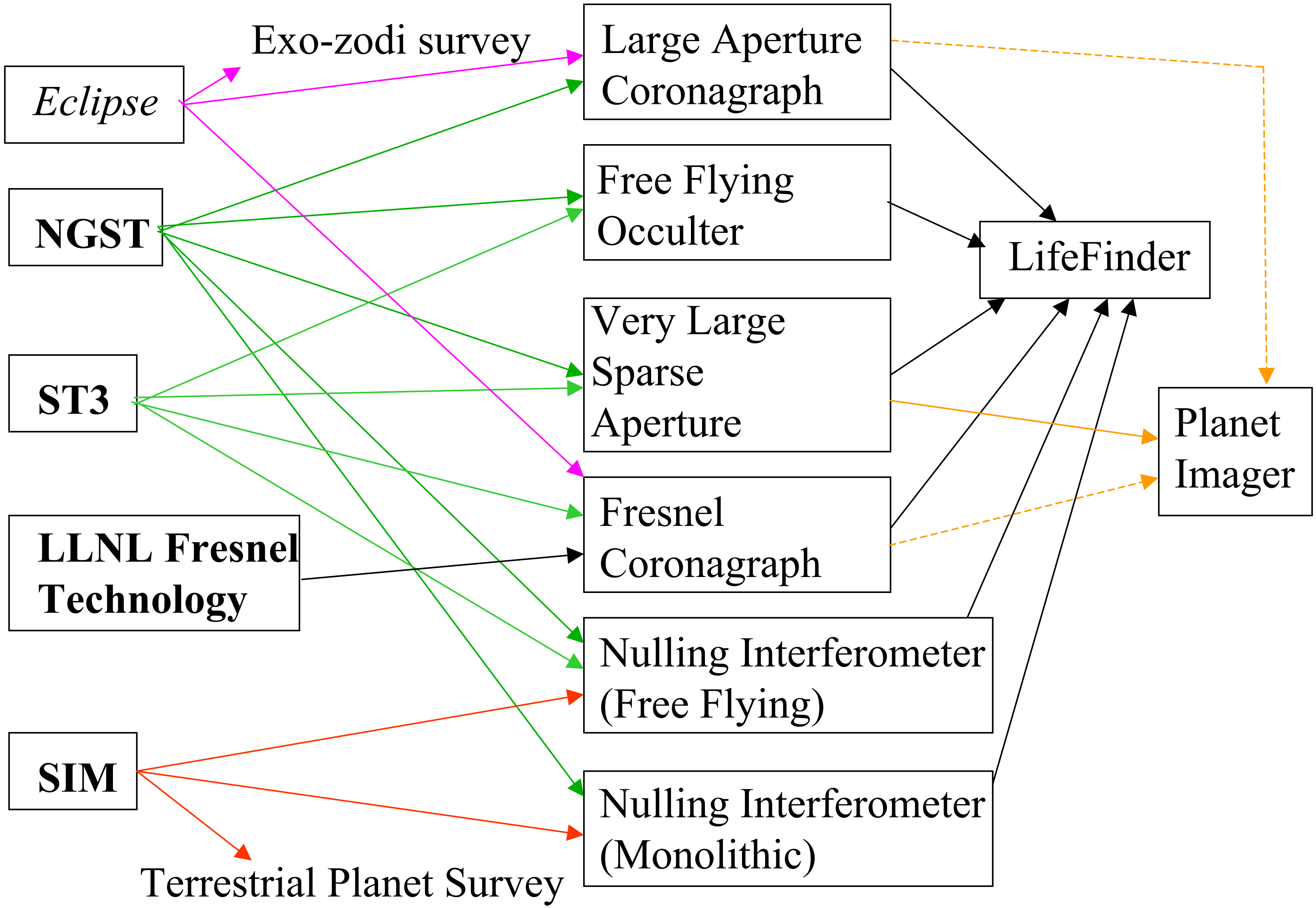


TPF Terrestrial Planet Finder

Program Roadmap

TRW

Current or *Potential* Programs



Roadmap to Briefing

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- Introduction
- TPF Requirements
  - Phenomenological implications and derived requirements
- TRW Study Results Summary
  - Rationale for architecture selection decisions
- Detailed Architecture Evaluation
  - Science Utility
  - Technical Risk
  - Legacy
  - Reliability/Robustness
  - Architecture Prioritization
- Architecture Briefings
  - Coronagraph; fresnel lens; sparse aperture; interferometer; occulter
- Summary

Agenda

• Introduction	10 minutes	**Wehner**
• Requirements	15 minutes	**Casement**
• Study Results	10 minutes	**Moses**
• Architecture Comparisons	20 minutes	**Moses**
• Coronagraph	30 minutes	**Casement**
• Fresnel Lens	30 minutes	**Bennett**
• Sparse Aperture	30 minutes	**Flannery**
• Interferometer	30 minutes	**Larkin**
• Occulter	30 minutes	**Starkman**
• Summary	5 minutes	**Wehner**
• Discussion	30 minutes	**All**