Terrestrial Planet Finder (TPF)

Presented by

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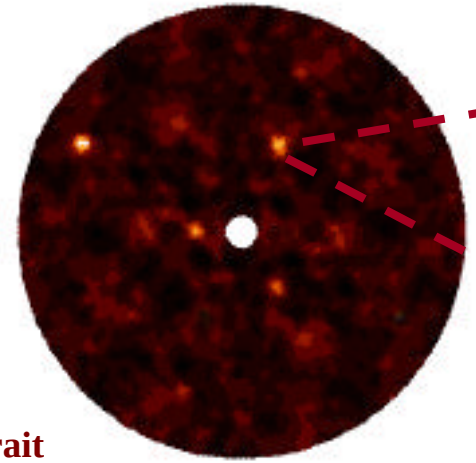
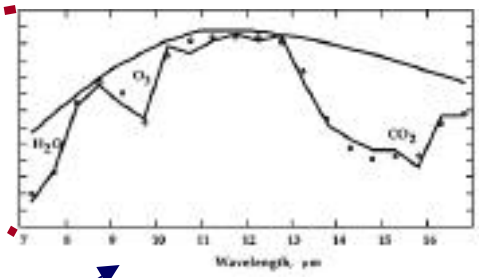
Terrestrial Planet Finder (TPF) – Objectives

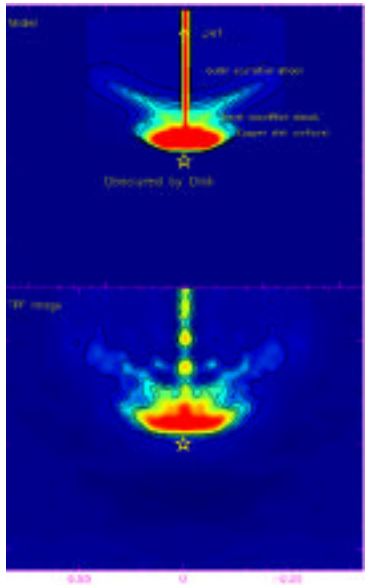
- Detecting and characterizing planetary systems



Family Portrait



Planet Characterization



mas Imaging

- Ultra-high resolution (milliarcsecond) astrophysics

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TPF Science

Planet Detection (1/2 mission life)

- **Survey ~200 stars within 50 light years**
  - Detect Earths in ~ 2 hours
  - Resolution ~ 3/SNR=5
- **Follow-up on ~ 30 stars**
  - Detect atmosphere (CO_2, H_2O) in ~ 2 days
  - Resolution ~ 20/SNR=10
- **Follow-up on ~ 5 stars**
  - Detect primitive life (O_3, CH_4) in ~ 2 weeks
  - Resolution ~ 20/SNR=25

General Astrophysics (1/2 mission life)

- **Image ~ 800 targets (1 per day)**
  - 0.75 milli arcsecond at 3 µm

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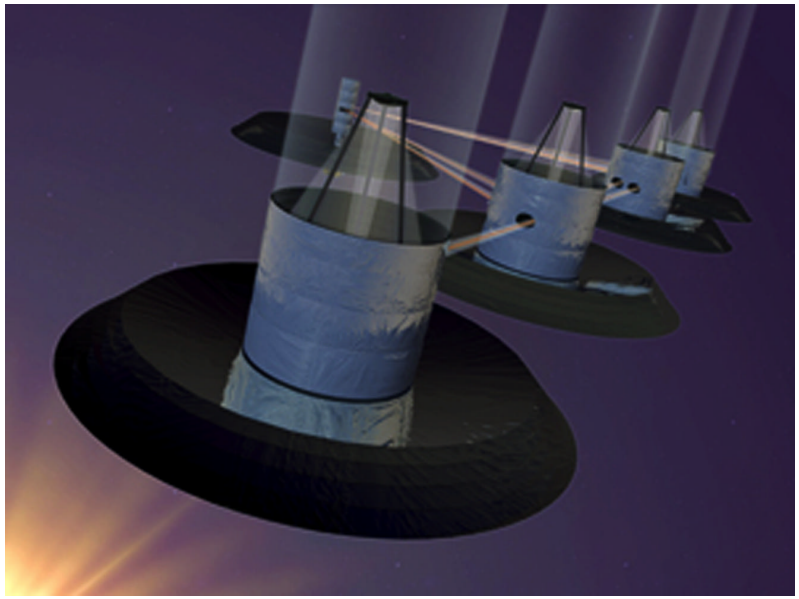
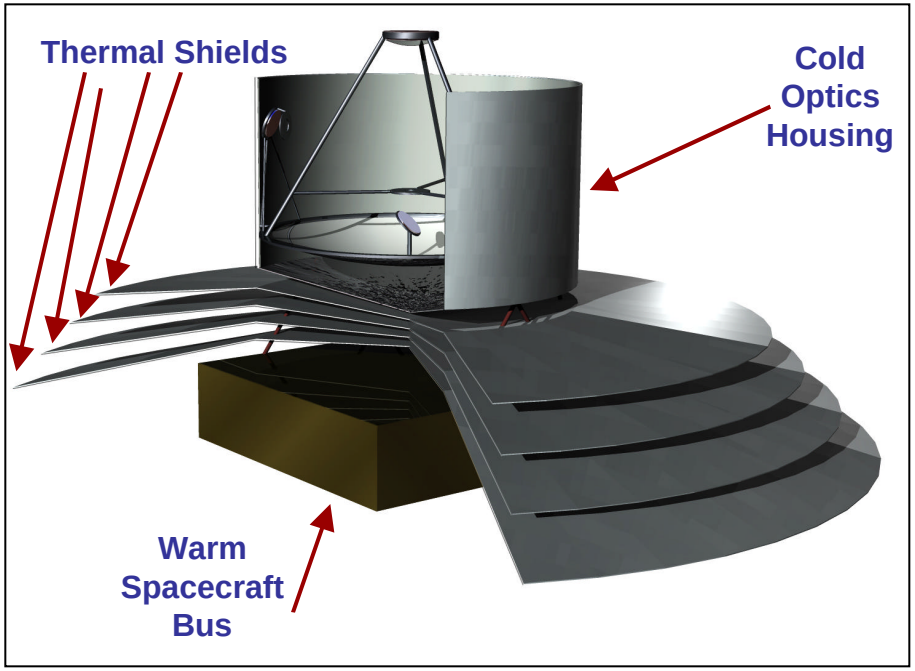
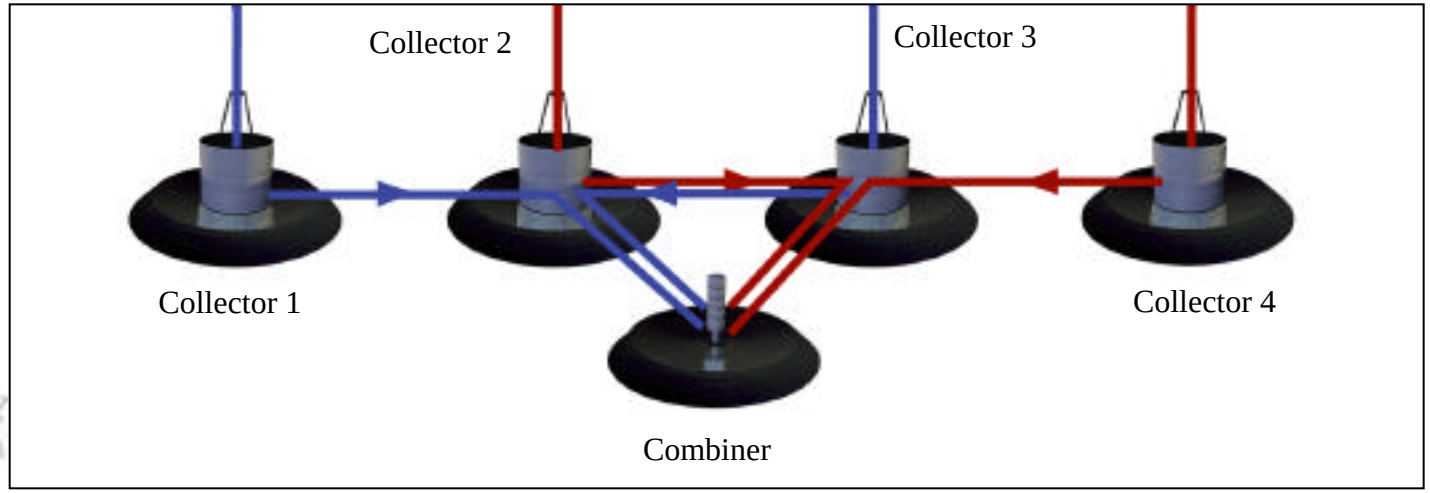
One Concept







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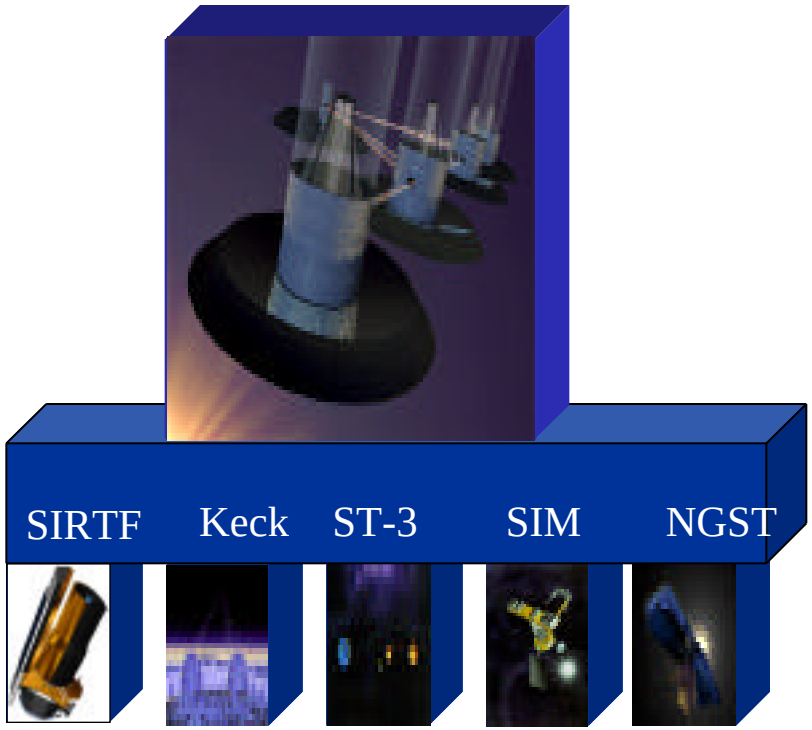
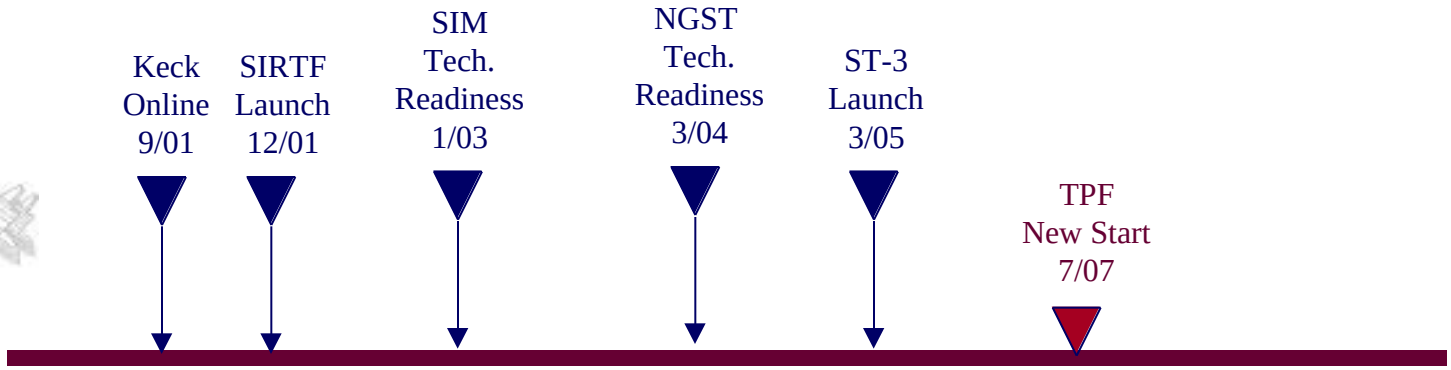
TPF — Enabled by Technological Investment in Prior ASO Missions



Formation Flight	ST-3	✓
Large Lightweight Primary	NGST	✓
Interferometer System	SIM	✓
Passive Cooling	SIRTF/NGST	✓
Starlight Nulling	Keck/SIM	✓
Synthesis Imaging	Keck/SIM	✓
Cryo Optics	NGST	✓
Beam Transport	ST-3	✓



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TPF Implementation

A Collaborative Effort Between JPL and GSFC

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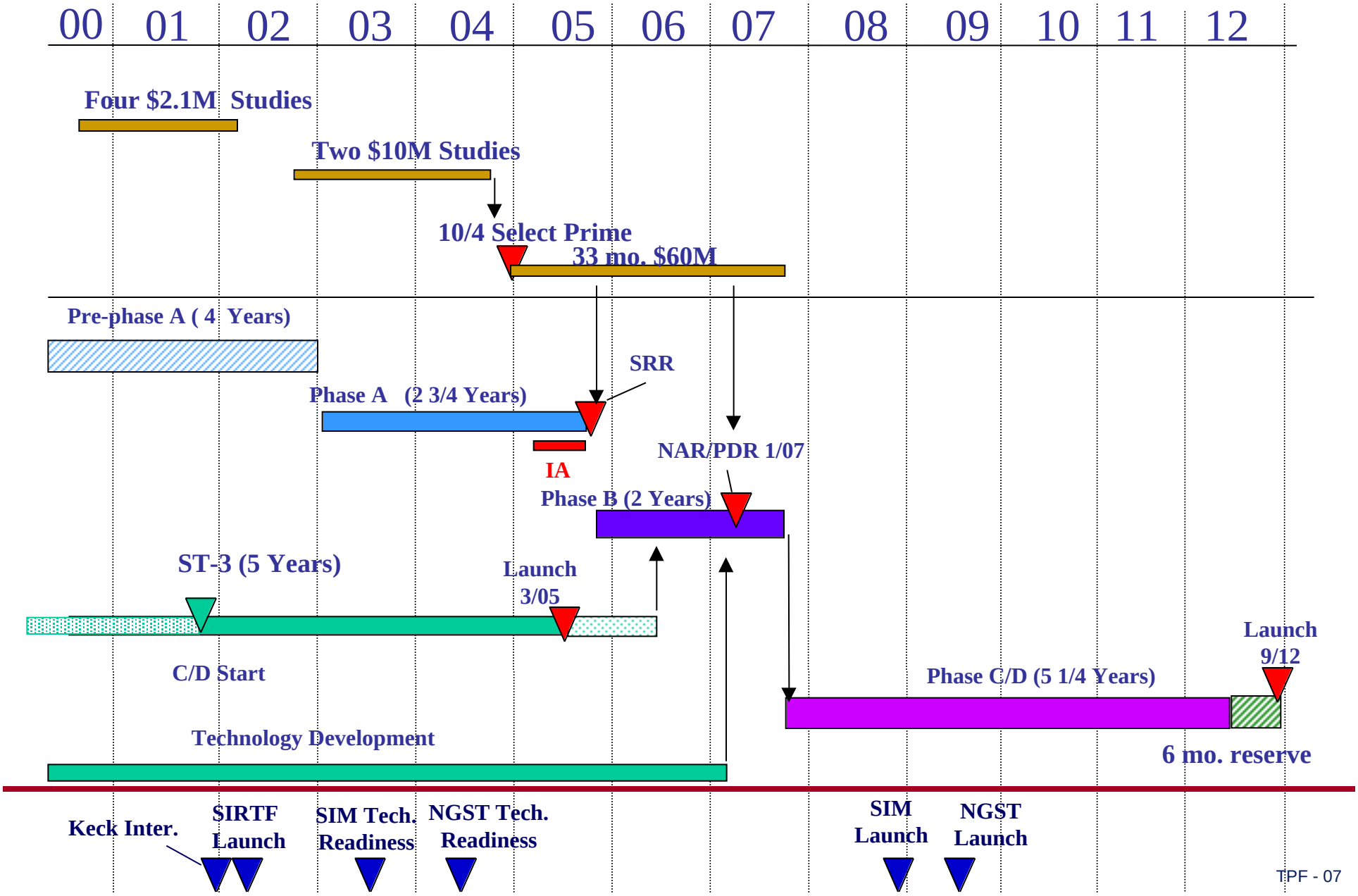
- TPF will be a collaboration between JPL and GSFC each bringing to the project technological expertise garnered on prior Origins missions.
  - JPL will have the overall mission responsibility
  - GSFC will provide TPF elements which draw heavily on NGST technology -- such as large cold optics.
  - This partnership builds on current JPL support to GSFC on NGST and will carry forward to future Origins missions

TPF Schedule Overview



TPF Industrial Contracts

Architectural Studies

- TPF contracts were awarded in April to four industrial/academic consortia
  - Comprehensive look at all realistic architectural approaches to TPF
    - No preconception of the “right” answer
  - In total 16 industrial concerns and 30 universities participating

- Team leads are:

  1- Ball Aerospace – Boulder, CO

  2- Lockheed Martin Space Systems – Sunnyvale, CA

  3- TRW – Redondo Beach, CA

  4- SVS, Inc. – Albuquerque. NM

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Phased Structure of the Contracts

Phase One (9 months)

- Broad architectural studies
- Heavy participation by the scientific community in this phase
  - RFP emphasized need for industry/academia partnering
- At the end of this phase, two architectures will be selected for further studies by each team
  - One selected by the team itself; one selected by JPL
  - Down select will be at a large TPF workshop attended by broad science/industry community

Phase Two (13 months)

- Industrial partners will perform in-depth, system level assessment of the selected concepts

What We Want to Get Out of These Contracts?

- Identification of all viable concepts
- Penetration of the design for the most promising concepts to allow visibility into
  - Major system trades between competing design concepts
  - Technology development approaches
  - Effective leveraging strategy off of TPF precursor missions
  - Next level refinement of the programmatic issues
    - Cost, cost profile
    - I&T issues and identification of any required special facilities
    - Launch strategy
    - Schedule related issues
    - Recommendations on acquisition and international partnering strategies

TPF Studies – 75 World-Class Scientists from 30 Academic & Research Organizations

Ball Team

STScI
Dr. Bob Brown
Dr. Ron Allen
Dr. Pierre Bely
Dr. Chris Burrows
Princeton
Dr. Ed Turner
Dr. David Spergel
Penn State
Dr. Jim Kasting
Harvard CfA
Dr. Wes Traub
UCSD
Dr. Andreas Quirrenbach
UCSC
Dr. Jerry Nelson
Carnegie
Dr. Alan Boss
Rutherford-Appleton
Dr. Alan Penny
U of Florida
Dr. Charlie Telesco
U of Colorado
Dr. John Bally
Dr. Peter Bender
Dr. Tim Brown
Dr. Web Cash
Dr. Tuck Stebbins
Joint Astronomy Center
Dr. Tim Hawarden

Lockheed Team

U of Arizona
Dr. Roger Angel
Dr. Jonathan Lunine
Dr. Neville Woolf
Lockheed
Dr. Adrian Roche
Dr. Alan Title
NASA-Ames
Dr. Dave DesMarais
NASA/GSFC
Dr. John Mather
Princeton
Dr. James Gunn
SDC
Prof. James Westphal
STScl
Dr. Peter Stockmen

SVS Team

NOAO
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Franklin & Marshall
Dr Dana Backman
Obs. de Haute-Provence
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Dr. Antoine Labeyre
Laboratoire d'Astrophysique de Marseille
Dr. Jean Lucien Boit
Dr. Pascal Dargent
Dr. Roger Malina
Obs. de Marseille
Dr. Kjetil Dohlen
Paris Observatory
Dr. Jean Schneider
NASA/GSFC
Dr. Bill Danchi
Dr. Dan Gezari
Dr. Richard Lyon
Dr. Harvey Moseley
Berkeley
Dr. Charles Townes
Harvard CfA
Dr. Peter Nisenson
Hawaii
Dr. Oliver Guyon
Dr. Francois Roddier
UCLA
Dr. Suvi Gezari
Cornell
Dr. Martin Harwit
Testex
Dr. Bob Stachnik
Maryland
Dr. Johannes Staguhn

TRW Team

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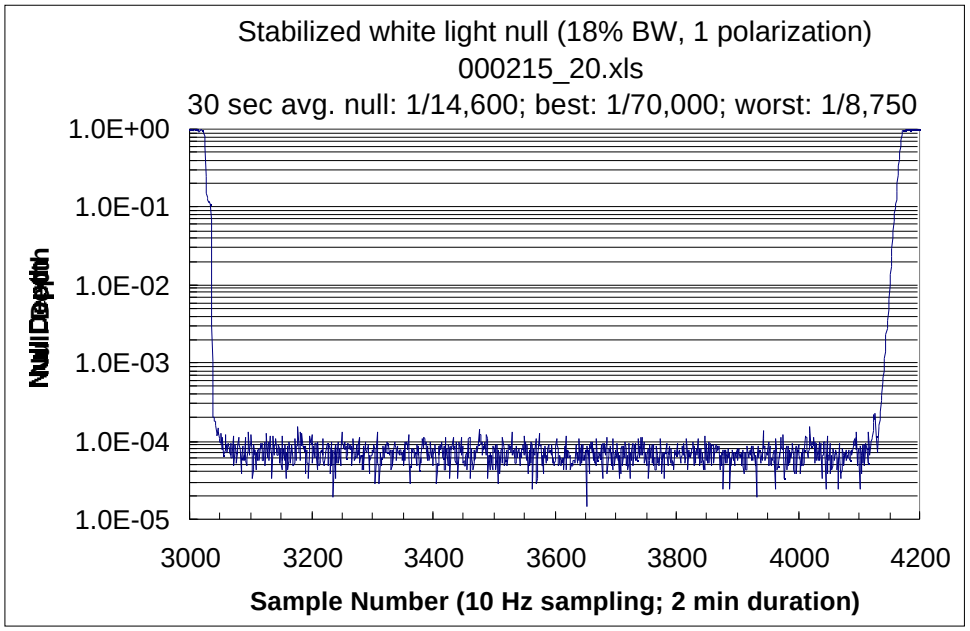
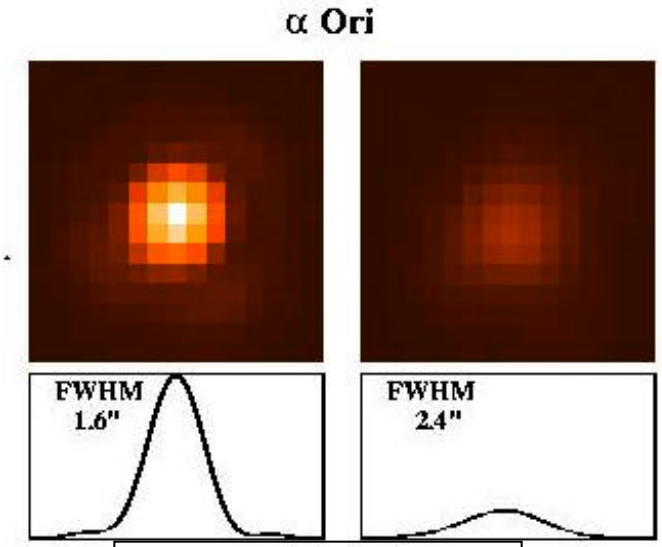
UCB
Dr. Frank Shu
UCSC
Dr. Douglas Lin
LLNL
Dr. Charles Bennett
CWRU
Dr. Craig Copi
Dr. Glenn Starkman
NRAO
Dr. Richard Simon
Obs. de Paris
Dr. Vincent Coude' du Foresto
MPI
Dr. Thomas Herbst
USNO
Dr. Ken Johnston
Penn State
Dr. Daniel Weedman

Progress on Nulling

- University of Arizona and JPL working on interferometric nulling
  - Laser → white light
  - Optical → infrared
- JPL laboratory experiment
  - 500,000:1 for visible laser
  - >15,000:1 for 18% bandwidth (1 polarization)
  - Demonstrates path length control needed for TPF, SIM
- UofA telescope demonstration
  - 25:1 at MMT
  - New nulling camera being tested on new MMT



Serabyn et al., JPL



Hinz et al., U of A

TPF Organization — Lean

TPF SWG

TPF Pre-project

Dan Coulter, Manager
Chas Beichman, Scientist
Chris Lindensmith, System Engineer
GSFC Interface at GSFC
Jeff Cornish, Contract Negotiator

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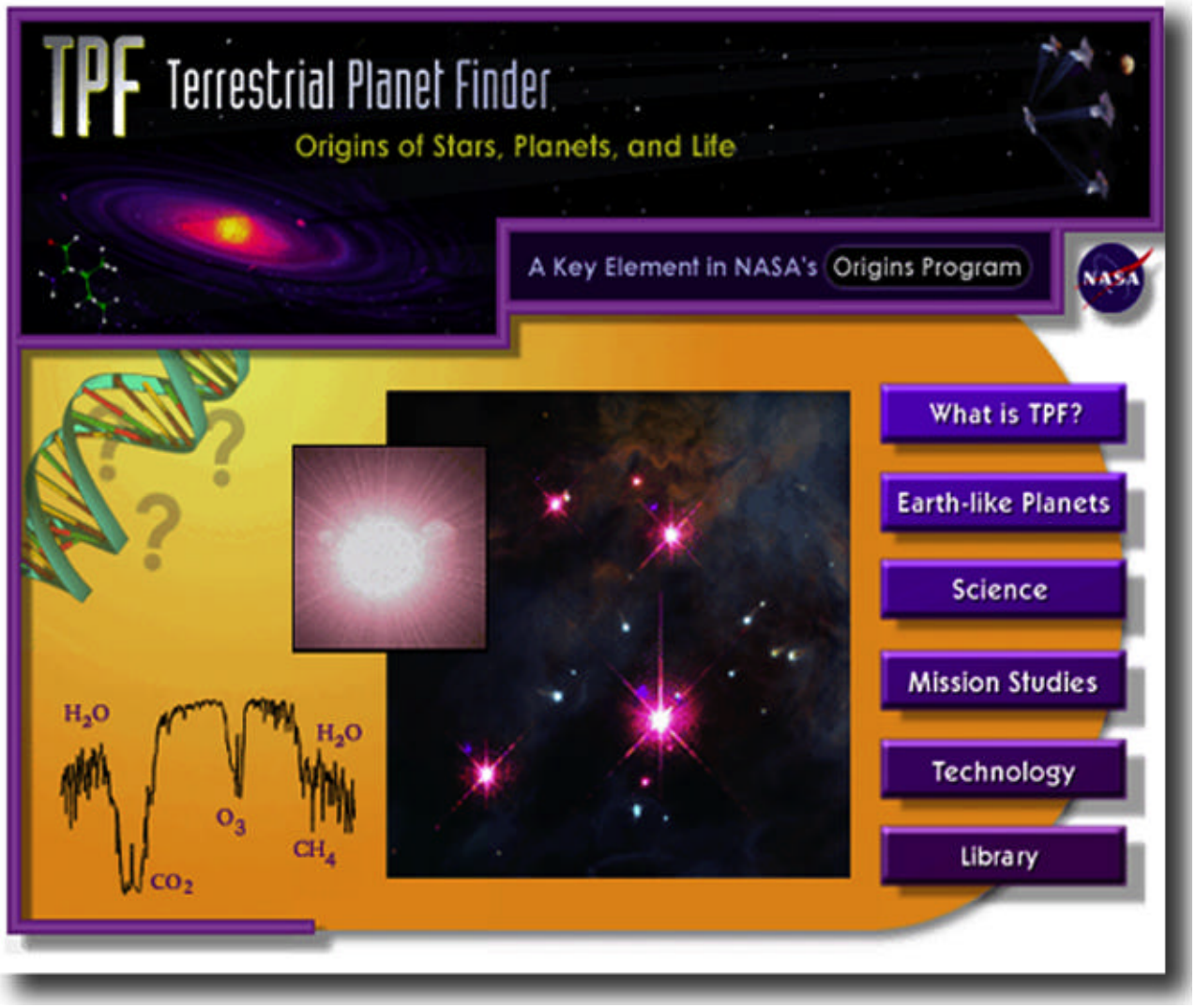

For more information about the Terrestrial Planet Finder (TPF), check out our web site:

http://tpf.jpl.nasa.gov