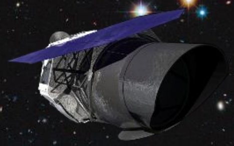
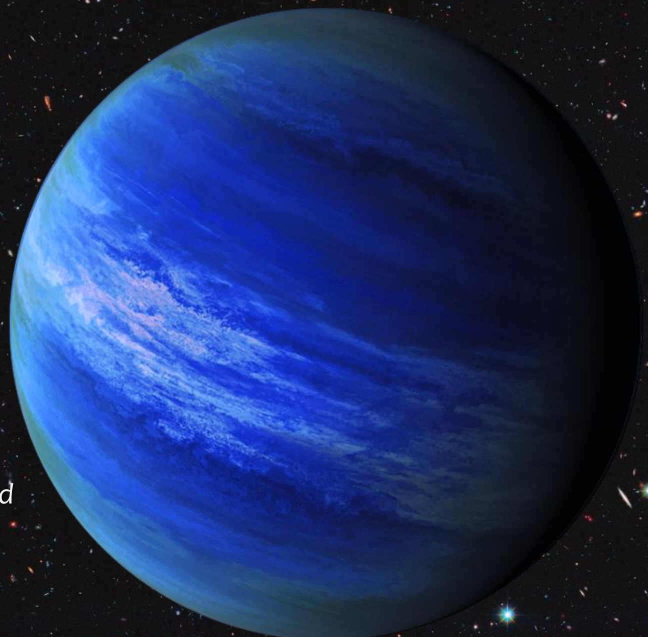


WFIRST CGI SRR/SDR

Phase B Trades



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30 May 2018

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Summary

Design task/trade	Description	Comments
Instrument processing architecture 1.CGI Instrument Control Electronics (ICE) architecture 2.Algorithms & processing implentation	1.Evaluate two FPGAs 2.Distribuite processing load between processor and FPGA 3.Streamline algorithms	New tiger team-recommended architecture has not been tested
DM iteration 2 (3 options)	Choose from 3 options 1.PMN w/ fuzz button interconnect 2.PMN w/ MC spring interconnect 3.MEMs DM with undefined inteconnect	Key decision input are 1.environmental testing of baseline DM with interconnect 2.yield of DMs from Xinetics
IFS to CGI bench mechanical interface	Sub-bench vs. discrete sub-assemblies	
Mask alignment mechanisms design	Rotary vs. linear mechanism and package maturity	To be provided by MPIA
CGI optical bench design	Review the stiffeners architecture to make I&T easier	Bench detailed design will be carried out by ATK
Detector proximity electronics location	Current location requires cable length that fails noise requirement	Impacts optics, mechanical design, electronics design
Detector design variant trade	Evaluate three modified variants compared to the COTS EMCCD	Improve performance margins Technology Infustion

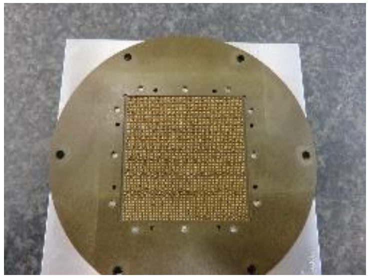
Instrument Processing Architecture

- The WFIRST CGI Avionics Tiger Team (WCATT) recommended a new ICE architecture in order to reduce processing time
- Project has baselined recommended architecture
  - LEON4 processor + Virtex-5QV FPGA
    - HOWFSC
    - CGI command & control
  - Virtex-5QV FPGA
    - LOWFSC
- Key recommendations for Phase B
  - Implement HOWFS Jacobian matrix processing (FFTs) in the FPGA
  - Use existing JPL boards to run benchmark tests
    - Run FFTs (Jacobian processing) in FPGA
    - Compare implementation of non-FFT portion of algorithms in LEON4 vs (LEON4 + FPGA)
    - Verify estimates for knockdown factors used in the processing calculations
  - Evaluate RTG4 FPGA as alternate to Virtex-5

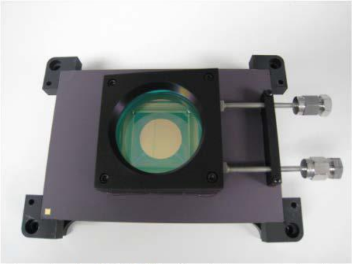
Optimization of algorithms/processing across processor and FPGA(s) using existing flight designs/parts

DM Trade

- Baseline approach is PbMgNb (PMN) type DM with fuzz button interconnect
  - Evaluate performance using Vacuum Surface Gauge & environmental testing
  - Random vibe and thermal cycling
- Interconnect trade – addresses risk of failing environmental testing
  - Option 1: PMN DM with improved Fuzz button interconnect
  - Option 2: PMN with micro-coil spring interconnect



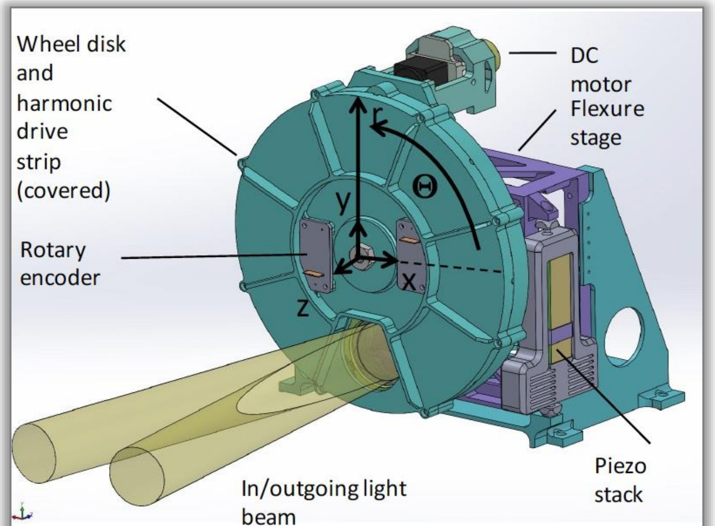
- Downselect among two options Jan 2019 & begin 2nd build
  - Re-run environmental testing prior to flight build
- DM mechanism backup option – addresses risk that PMN DM yield may not be adequate to yield EM and Flight deliverables
  - Backup option: MEMS DM (Boston Micromachines)
  - Currently being evaluated under TDEM & NASA SBIR Phase II-extension
  - MEMS DMs being tested in HCIT vector vortex coronagraph testbed
  - MEMS DM to be random vibration tested at GSFC soon

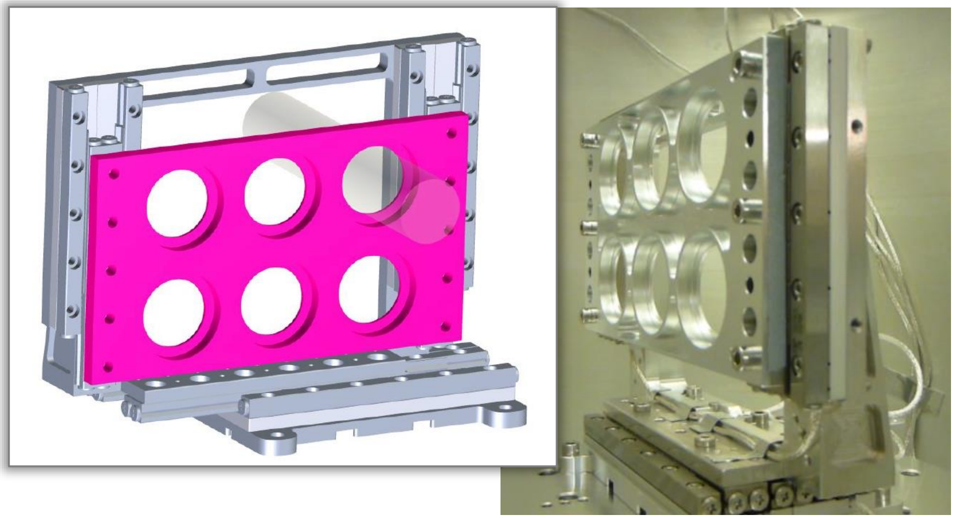


Selection of DM design for separate EM and FM builds

Precision Alignment Mechanism Design Trade

- Provided by MPIA through DLR contribution
- K/D requirements
  - Sensing resolution – 0.1 um/axis
  - Position repeatability & drift – 10 um/axis
  - Minimum incremental motion – 0.25 um/axis
- Prototype Linear stage & encoder performance to be characterized in vacuum using interferometer
- Evaluation of flight version

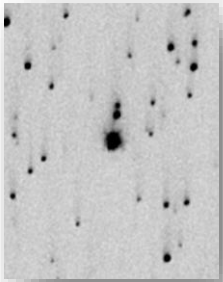


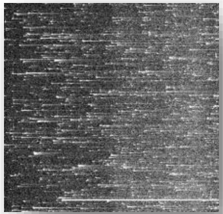


Rotary vs. linear stage design

Detector Design Variant Trade

- The Teledyne-e2v EMCCD (CCD201-20) exhibits increasing image degradation in photon counting mode due to radiation induced traps
- Several design variants are under evaluation to
  - Improve performance margins for CGI technology demonstration
  - Maximize performance of proton-damaged EMCCD for future exoplanet missions
- Variants under evaluation
  1. Visible light shield removed – improves image via less transfers
  2. 4 m narrow channel – improves image via lower trap capture rate
  3. 3 m narrow channel – improves image via lower trap capture rate
  4. Notch channel – improves image via lower trap capture rate
     - Has more heritage than narrow channel
  5. Low noise output amplifier & gain register overspill – mitigates cosmic ray tails
- Downselect among three options April 2019





Selection of best EMCCD design for rad hardness

Summary

- Phase B trades understood
- Will be completed consistent with readiness for PDR

DARE
MIGHTY
THINGS

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