

Exoplanet Host Star Characterization with QWSSI

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WHAT IS QWSSI?

Quad-camera

- Four cameras make use of almost all photons collected by telescope

Wavefront-sensing

- Photons not used for speckle imaging provide assessment of blurring function of atmosphere & enable next-gen image processing

Six-channel

- Four channels in the visible (577, 658, 808, 880nm) and two in the near-IR (J-short, and J-long or H-short)

Speckle

- Rapid-frame imaging freezes out atmospheric blurring
- No deformable mirror or other expensive control loops

Imager

- Diffraction-limited imaging at the 4.3-m DCT

Exoplanet Hosts with QWSSI

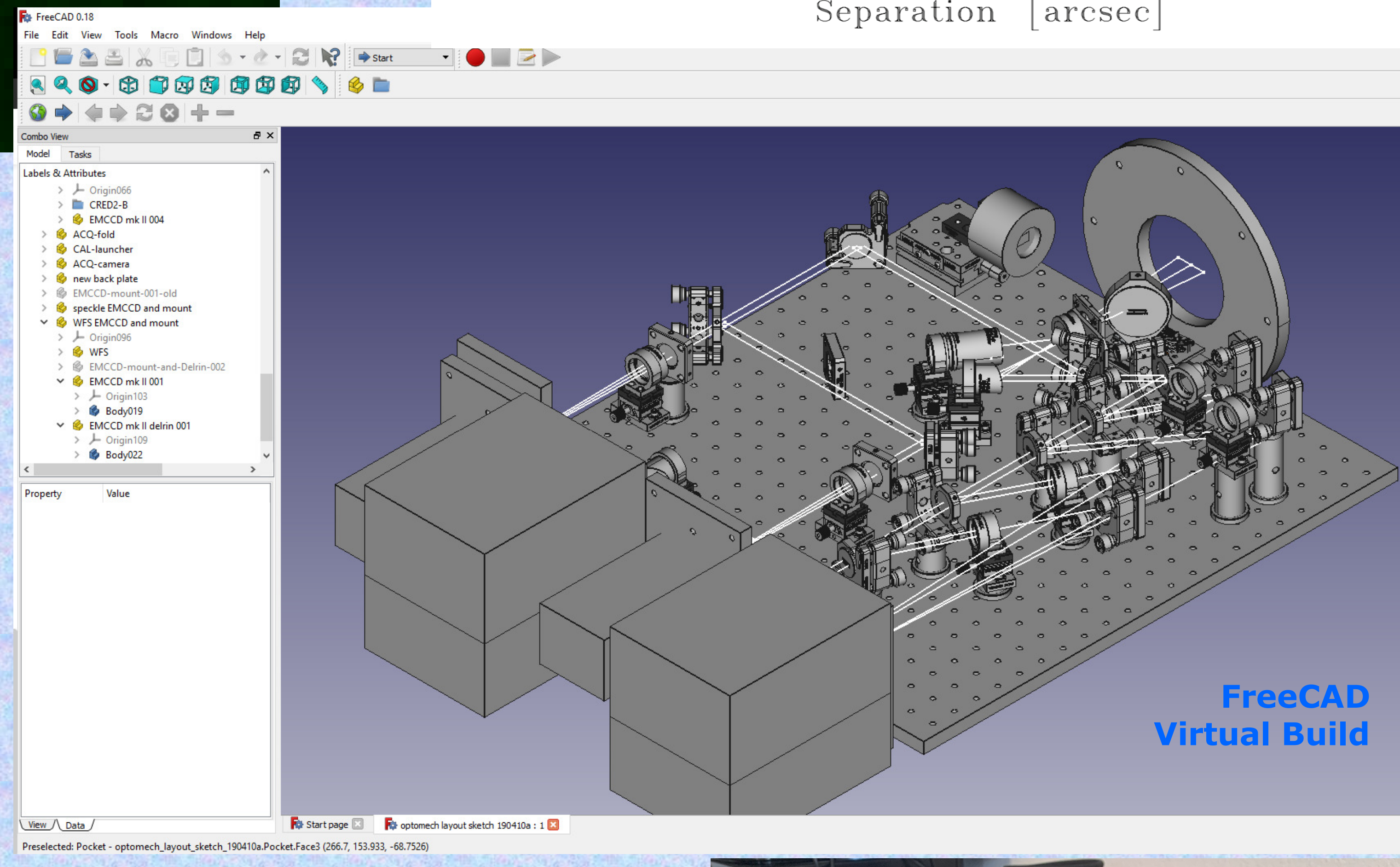
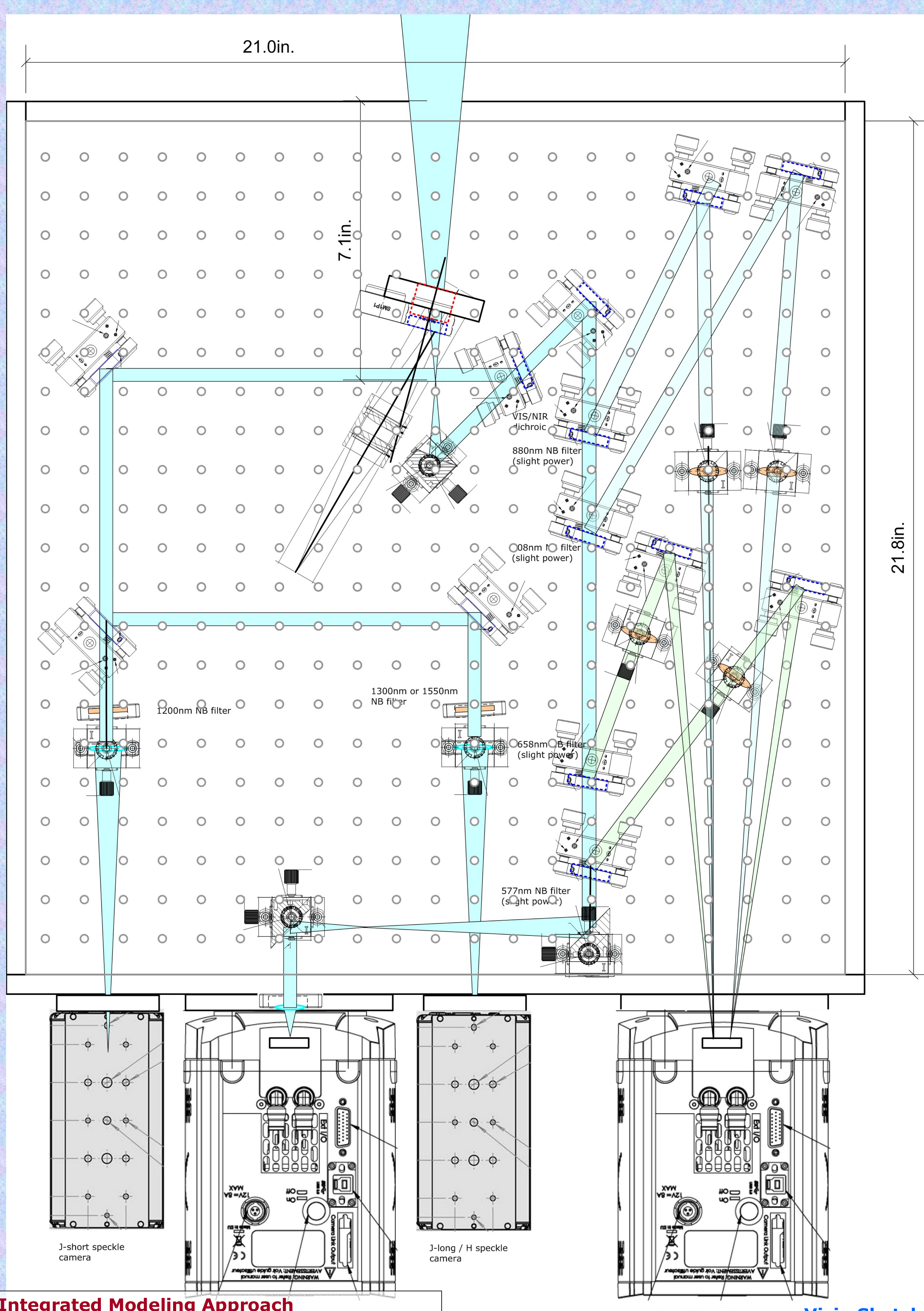
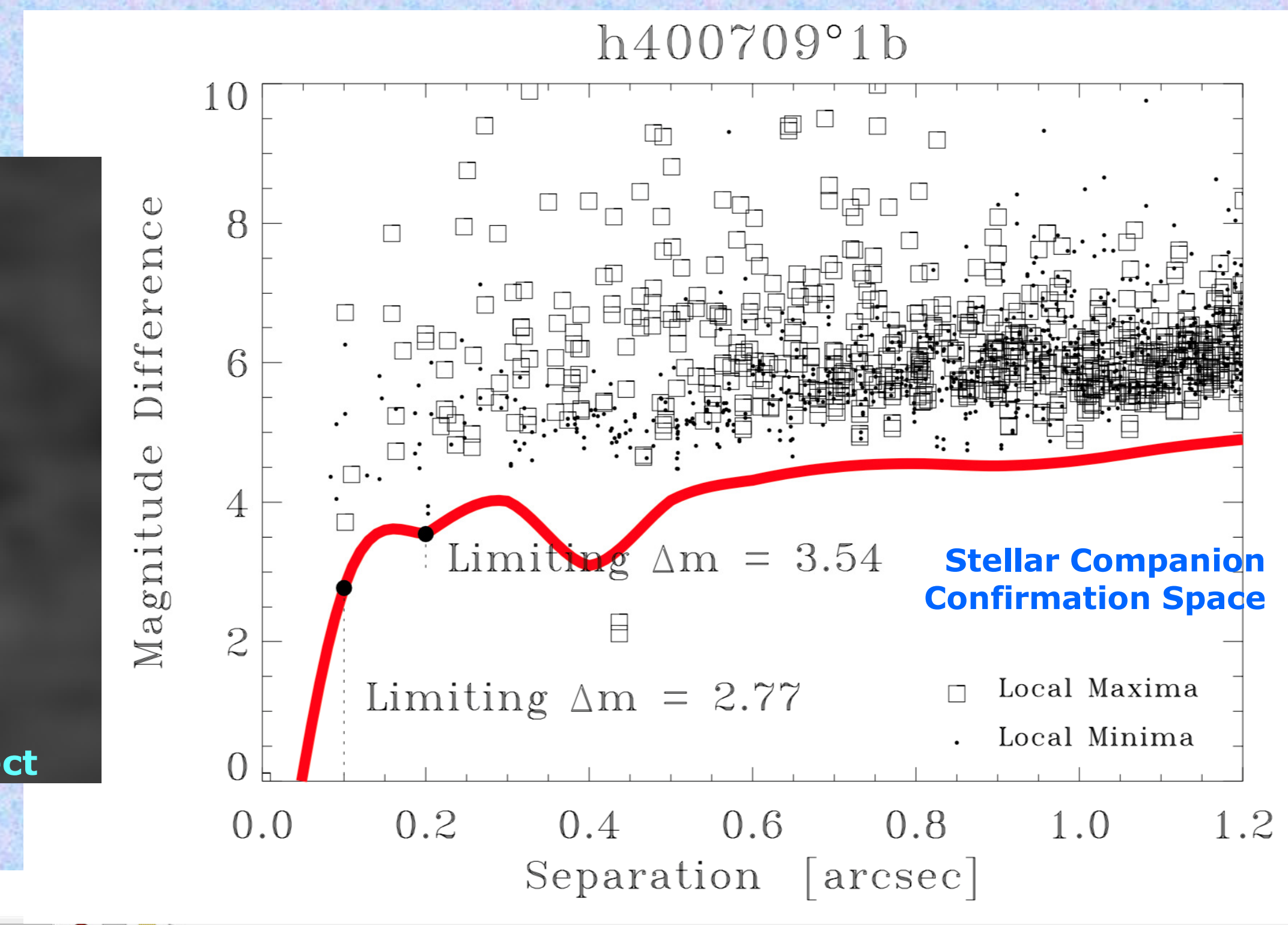
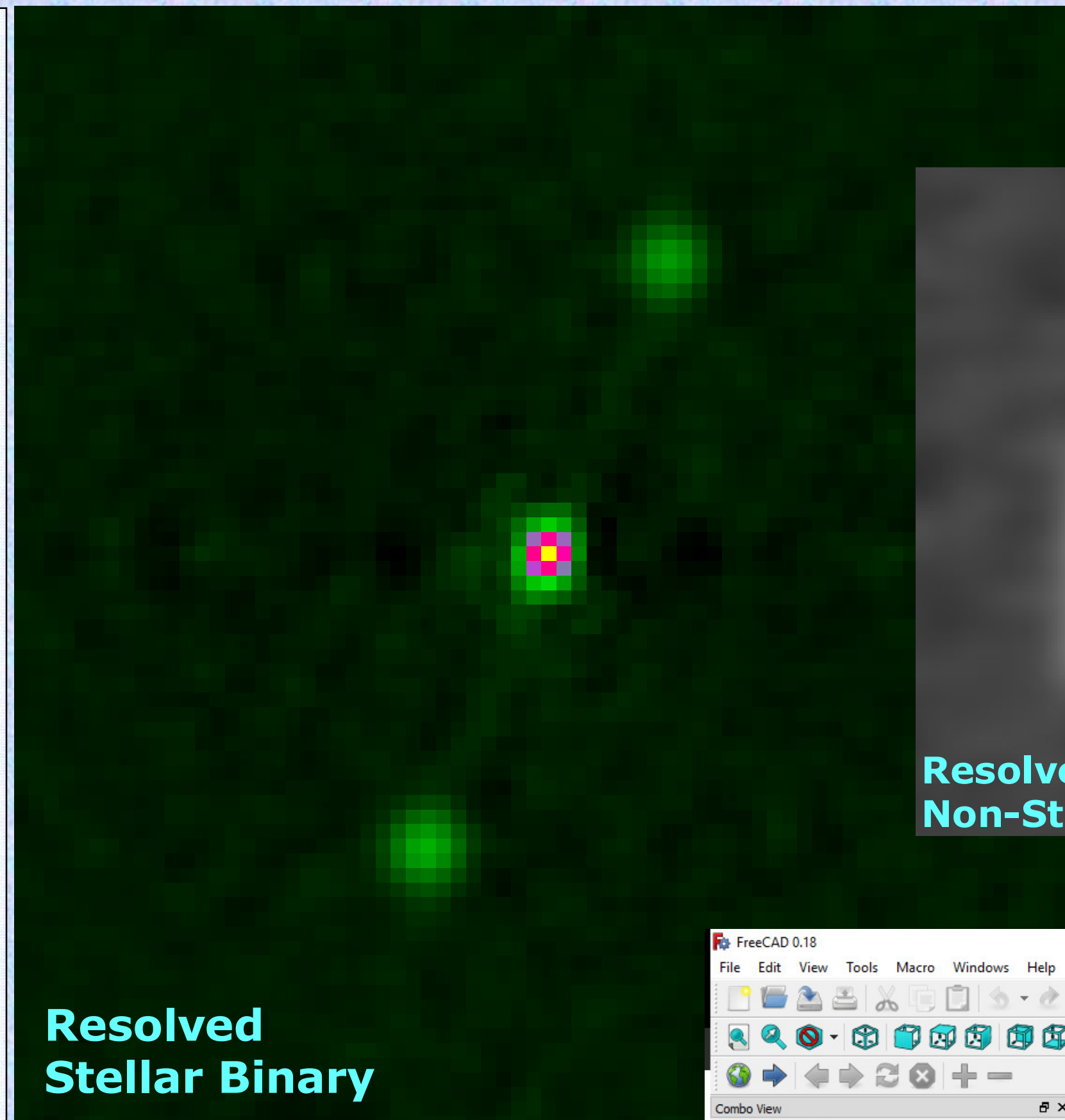
Screening for / Detection of Multiplicity

- Essential for confirmation of exoplanet candidates from Kepler, K2, TESS
- Follows on proven techniques from DSSI, NESSI, 'Alopeke, Zorro

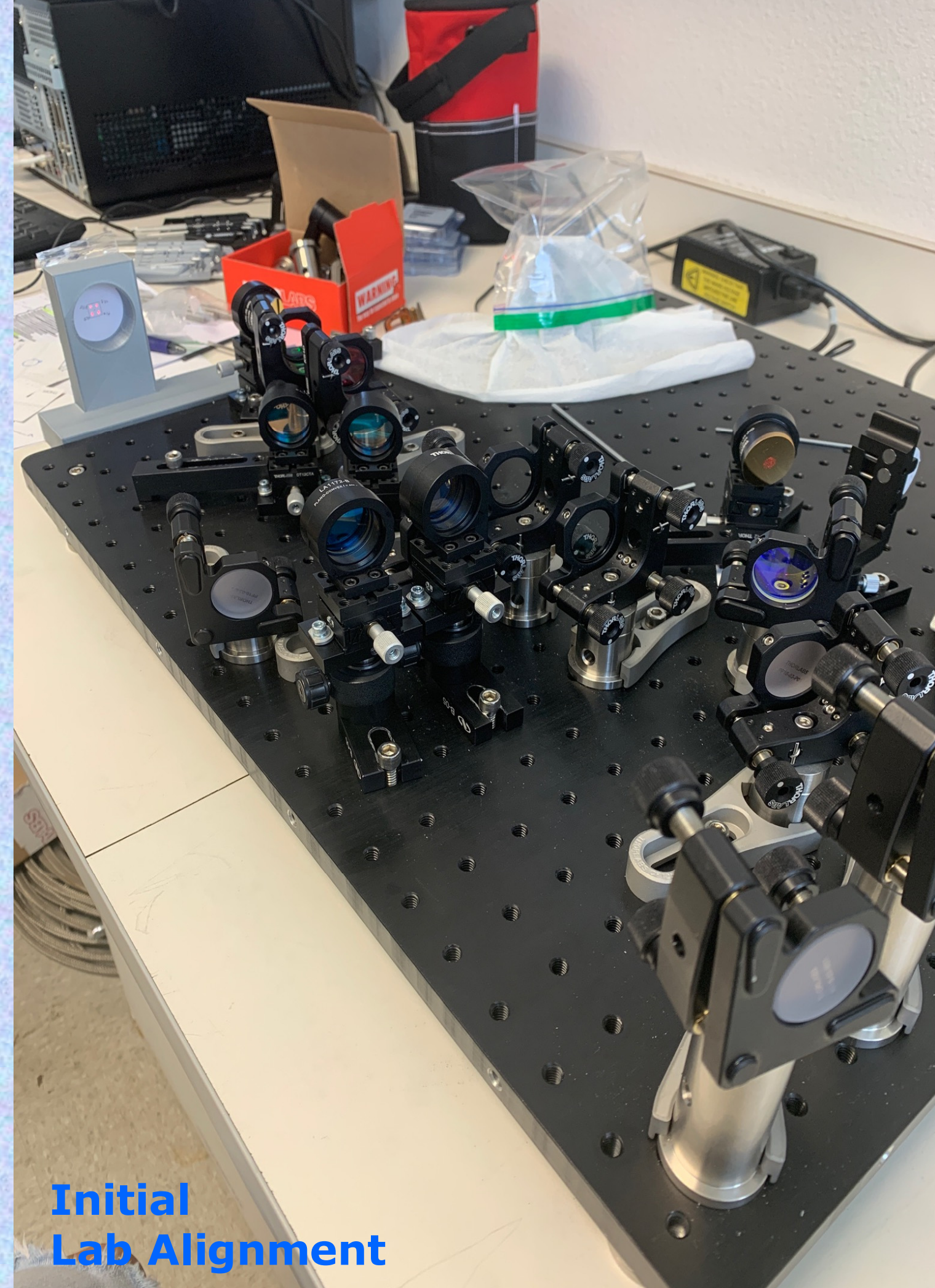
Optimization for M-dwarfs

- Filter selection
- Near-IR channel expands detection space for companions

Exploit proven next-gen image reconstruction routines

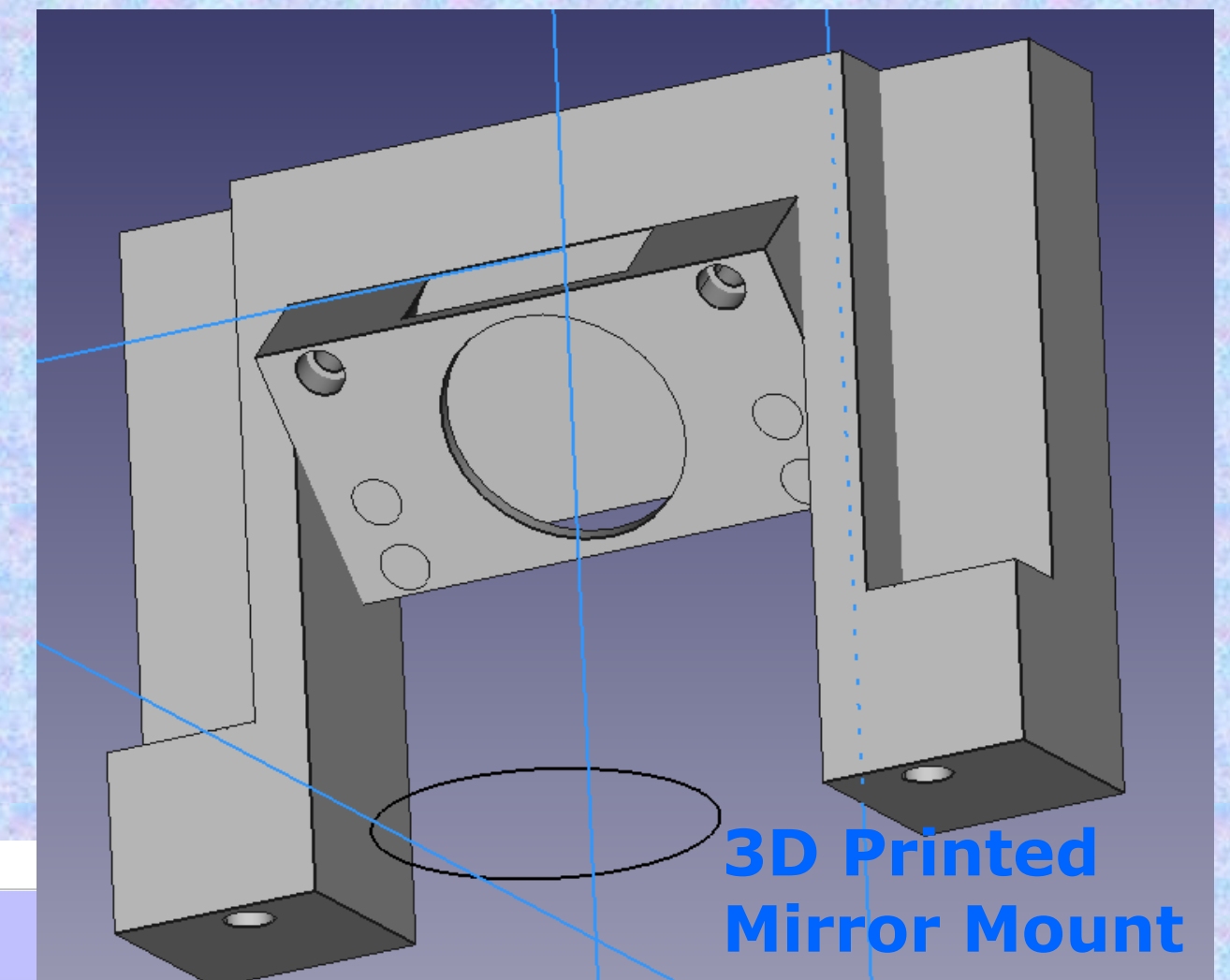
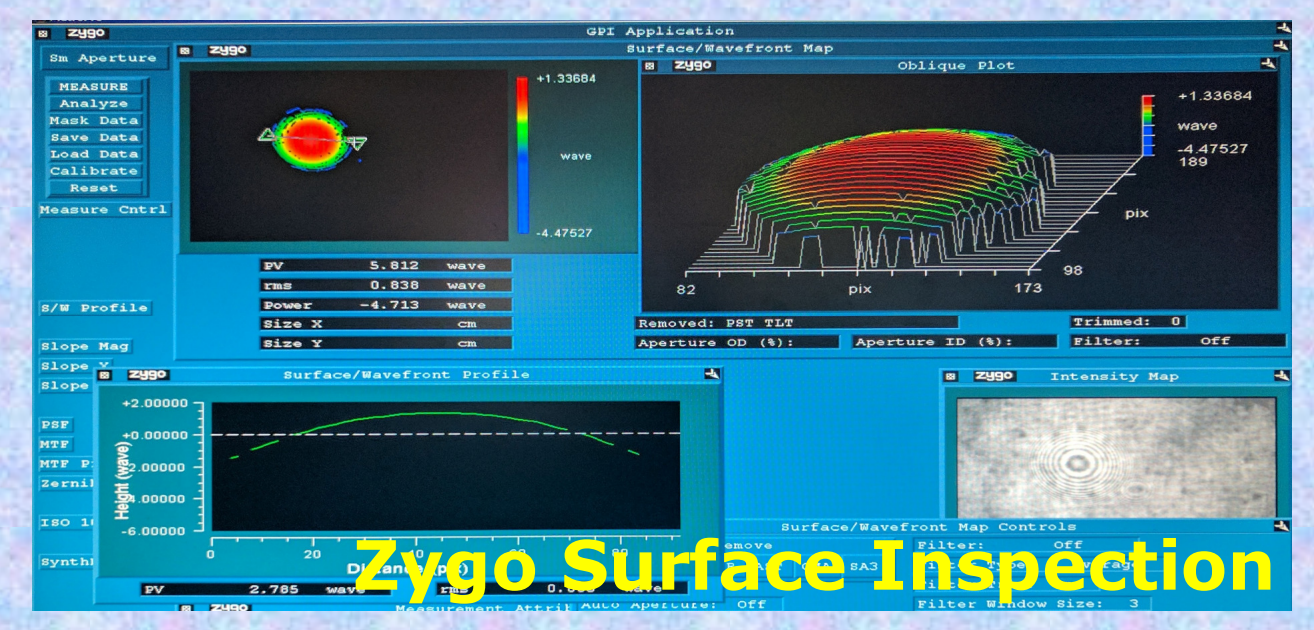


- ### Current Status
- Design**
 - Mechanical design & drawings, complete
 - Optical modeling & design complete
 - Procurement**
 - All optical elements, detectors purchased
 - Shop work**
 - Instrument enclosure fabbed, anodized
 - Timing module**
 - Prototype unit built, production unit nearing completion
 - Alignment**
 - Initial alignment of OAPs, notch filters complete
 - Next up**
 - Testing on PW1000 1-m telescopes
 - Transition of instrument to 4.3-m DCT

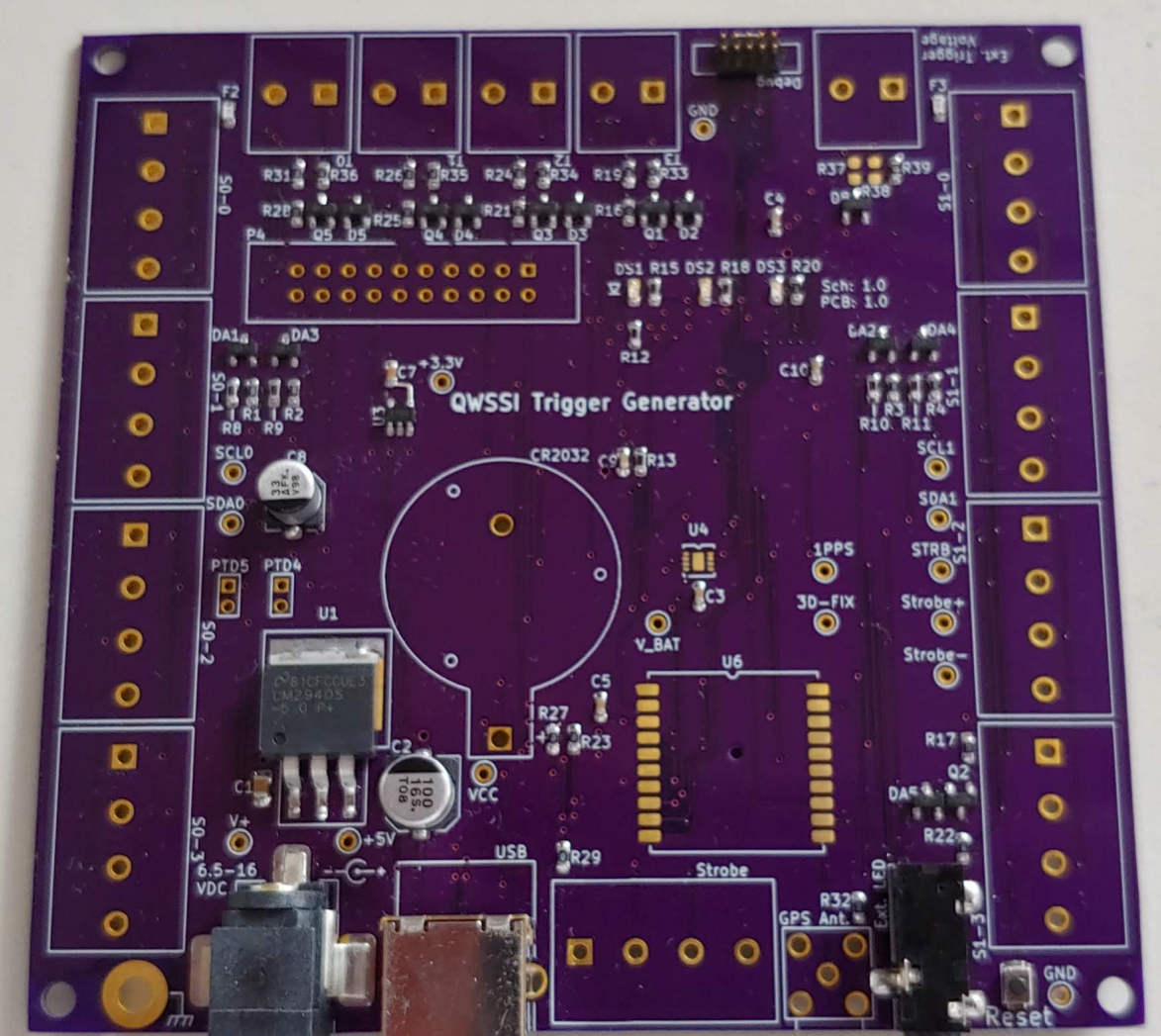
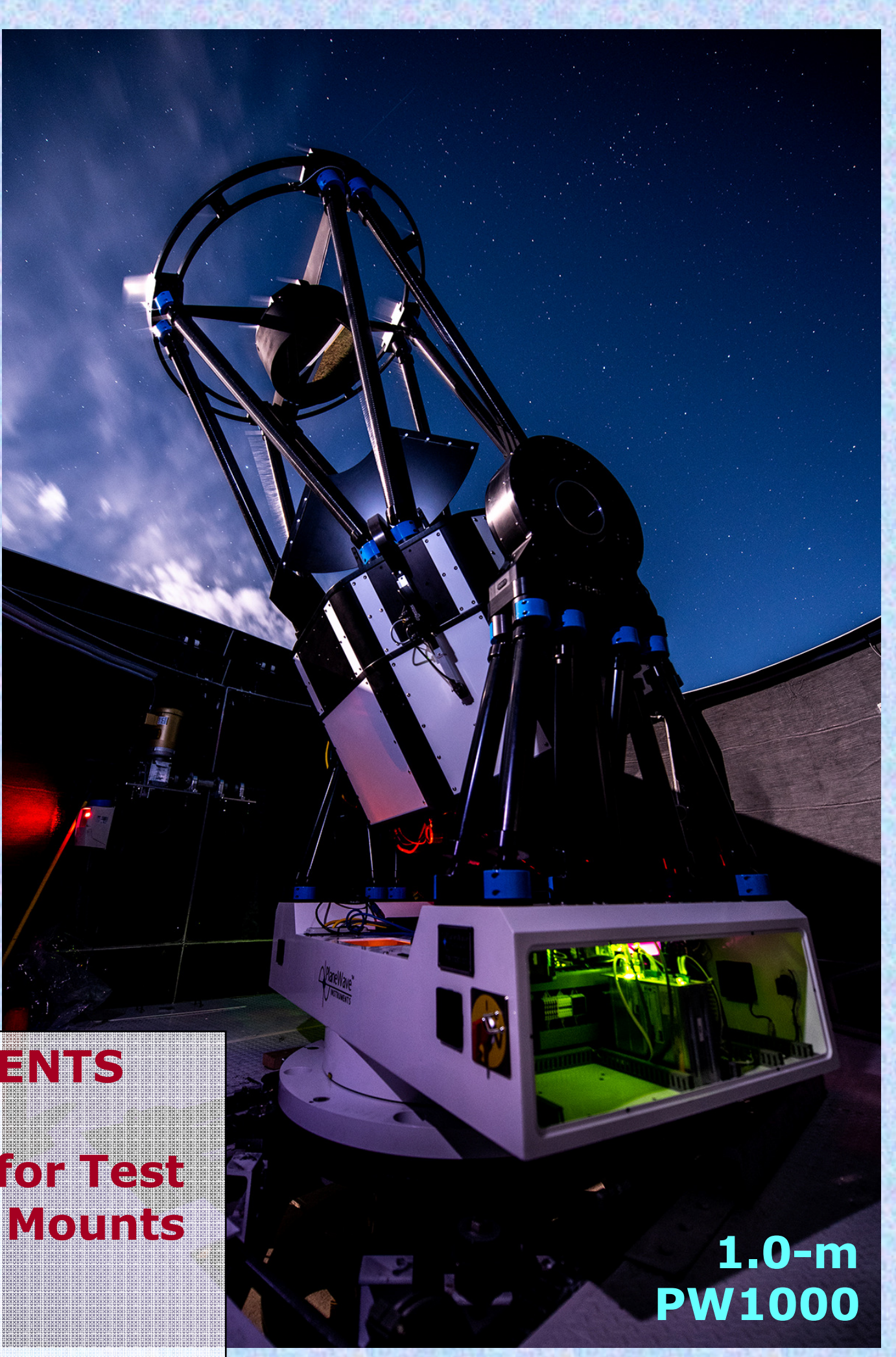


Integrated Modeling Approach

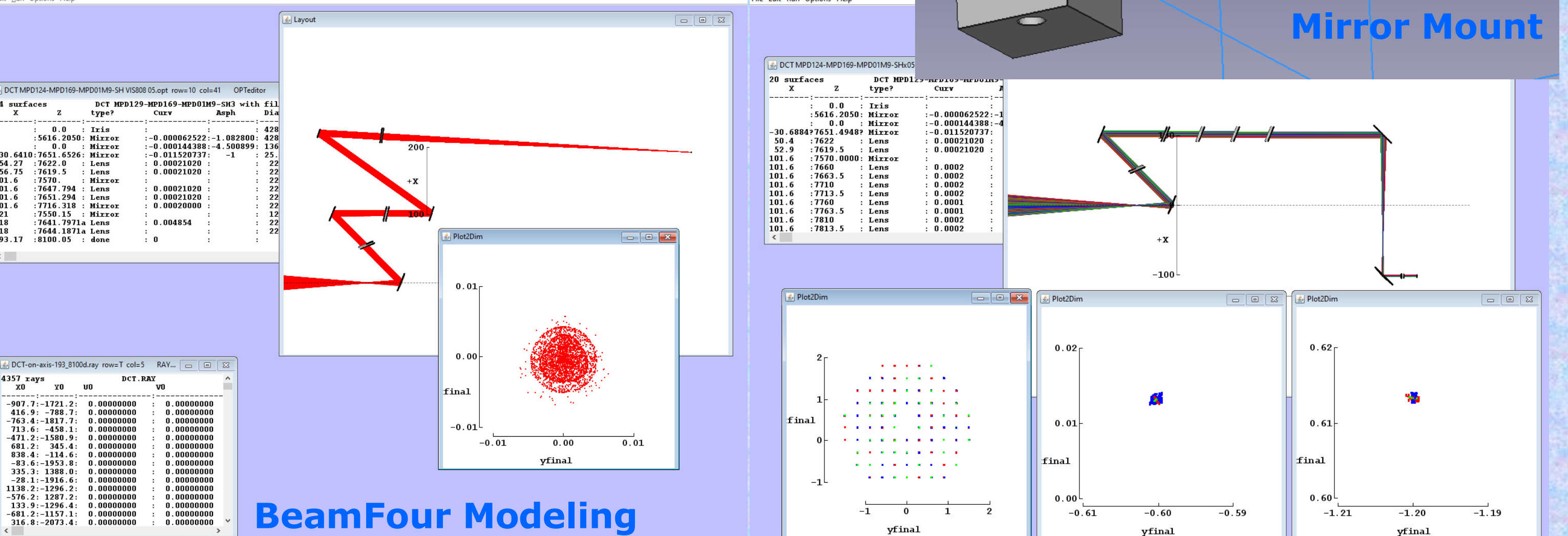
- Visio**
 - 2D sketching software
 - Rapid layout assessment
 - Included as part of MS Office suit site license
- FreeCAD**
 - 3D modeling software
 - Downloadable CAD files from vendor
 - Instead of SolidWorks: no expensive license fee, **free**
- BeamFour**
 - Ray-tracing software
 - Detailed assessment of spot
 - Wavelength dependence tracking
 - Extensive glass library available
 - Downloadable optical prescriptions from vendor
 - Instead of Zemax: no expensive license fee, **free**



- ### INNOVATIVE ELEMENTS
- Use of 3D Printing for Test Fixtures, Optical Mounts**
 - Rapid prototyping
 - Typical print time is 5-15 hours
 - Direct design-to-fit**
 - FreeCAD drawings can be matched to available space, optical elements
 - COTS Approach**
 - No custom optics
 - Rapidly available (~1 week)
 - Low cost (10x - or more - lower than custom)
 - Zygo Testing of Optics**
 - Assessment of low-cost elements
 - Surface assessment at the fraction of a wavelength level
 - Allows characterization, use of low-cost COTS filters



- ### Timing Module
- Synchronization**
 - All detectors will run in lock-step with each other
 - Good for 2 EMCCDs, 2 InGaAs detectors
 - Staggered cadence for WFS**
 - Can sample multiple WFS frames for each speckle frame



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ONLINE RESOURCES

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