Neil Vanasse

- ***Optical Engineer***
- ***Mechanical Engineer***
- ***Lab-Technician and Test Engineer***

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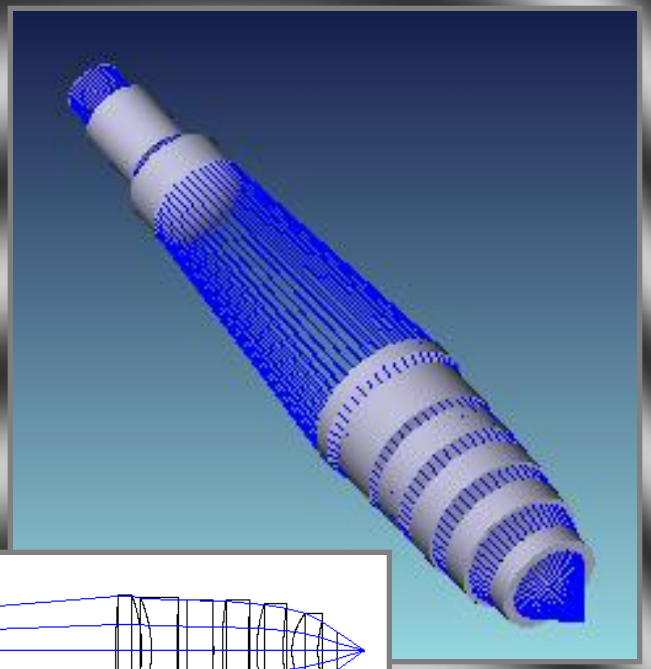
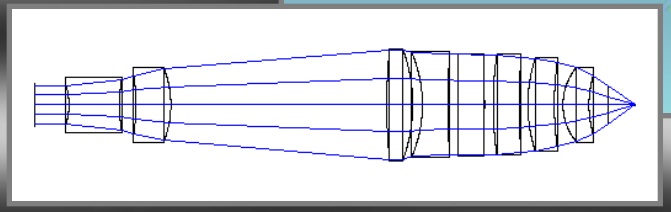
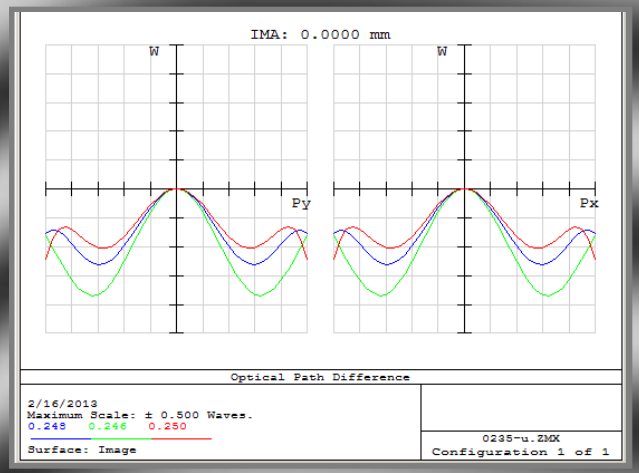
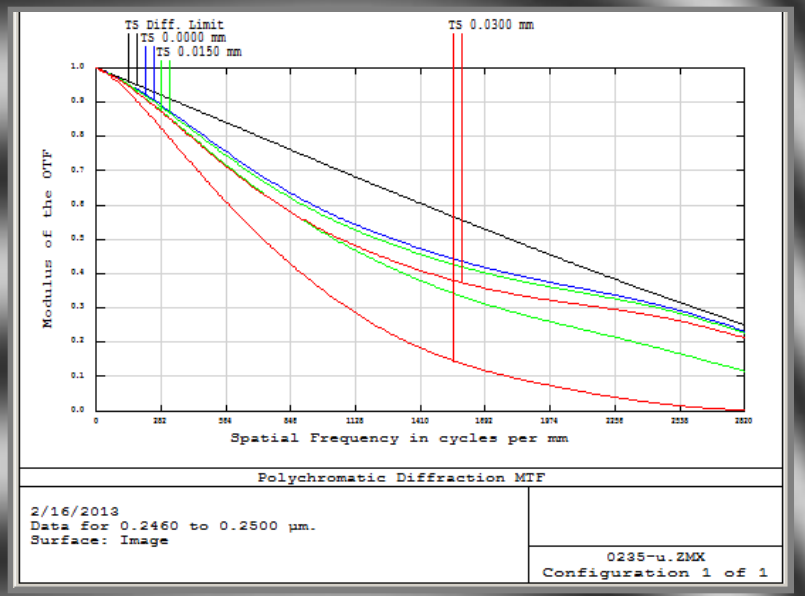
Deep Ultra-Violet (DUV) Microscope Objective

- Completed initial investigation of optical materials that can be used at 248nm
- Preliminary optical design has converged with 8x lenses
  - 8x will be max lenses needed
  - Possible less lenses will be required
- On-axis performance is near diffraction limited
- Color correction included
- Most optical parameters already meeting performance specifications



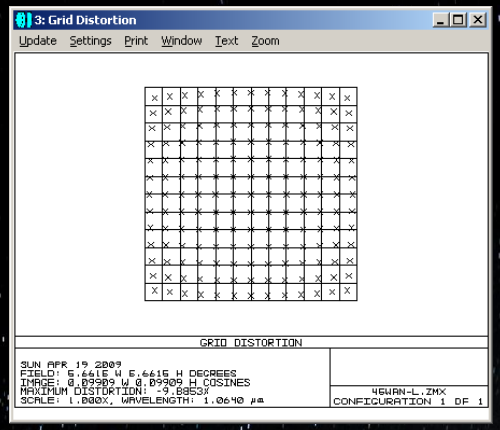


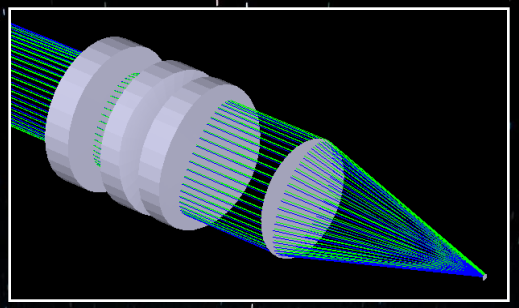


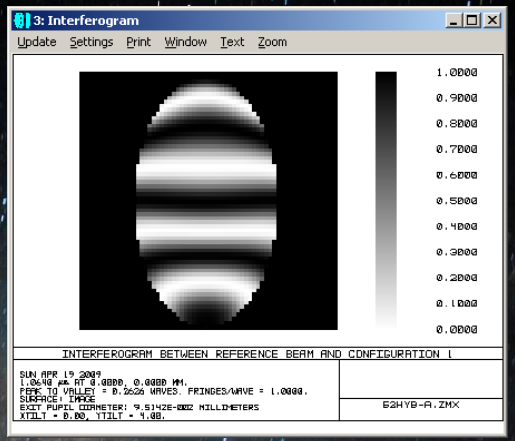


Optical Design for High Power Lasers

- Most laser optic systems require finite conjugate (object is finite distance)
- Usually have extra constraints:
  - Laser must stay collimated
  - Precise magnification
  - Optics must approach the diffraction limit
  - Optic transmission must be less than 0.1%
- Laser optics relax some typical optical constraints
  - Wavelength is monochromatic
  - Large field apertures not needed
- Have designed optical systems with requirements for grid-distortion and field-curvature







Laser Experience:

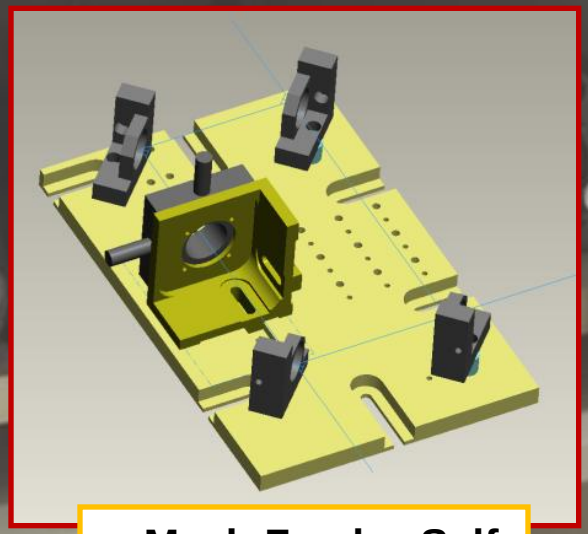
- Laser Gain Dynamics
- Laser modes and Beam Quality
- High Energy (Q-Switched)
- Single Frequency (Injection Seeding)
- Mode locking
- Output Telescope Design

Picture shows <u>Laser Guide Star</u> in use (sodium laser 589nm)

- Actually worked on this laser!

Interferometer

Efficient Alternative to Measuring Phase

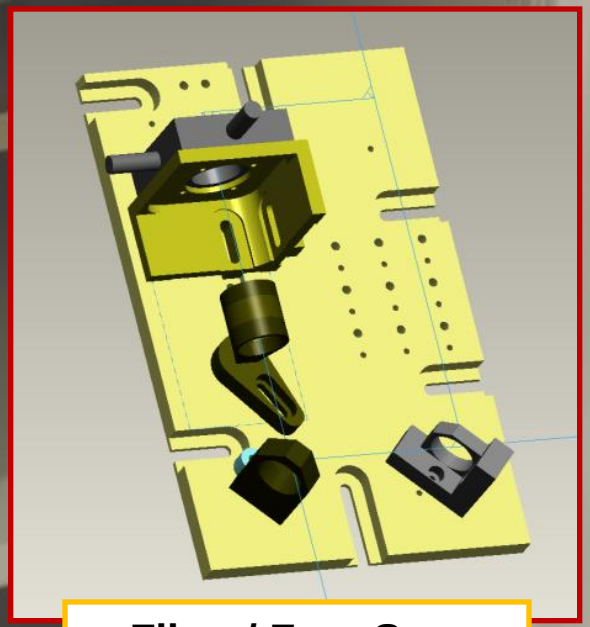


Mach-Zender Self Referencing Mode

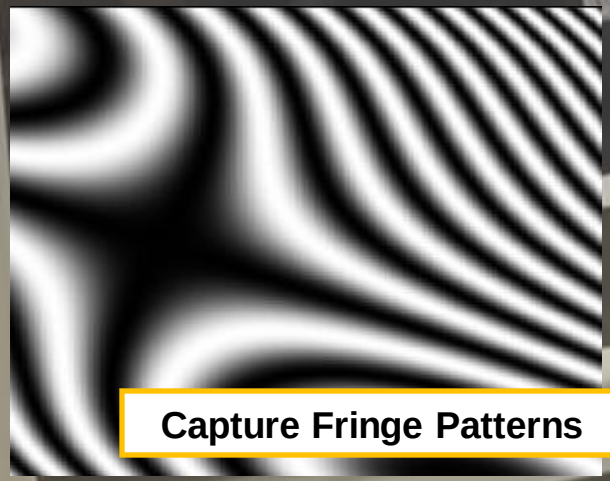
Two operation modes:

- ***Self Referencing Mode***
  - Use the source output as a reference beam
- ***Fiber or Free-Space Mode***
  - Use a Fiber or Free-space laser as a reference
- Can be configured for any wavelength
- Uses standard silicon cameras in most cases
- Compatible with most optical tables and lab supplies
- Versions available for less than $5k

"Years of development for previous customers"



Fiber / Free-Space Reference Mode



Capture Fringe Patterns => And Convert to Phase Maps

Opto-Mechanical for Imaging and Laser Systems

Once an optical design exists: (optics hanging in space)

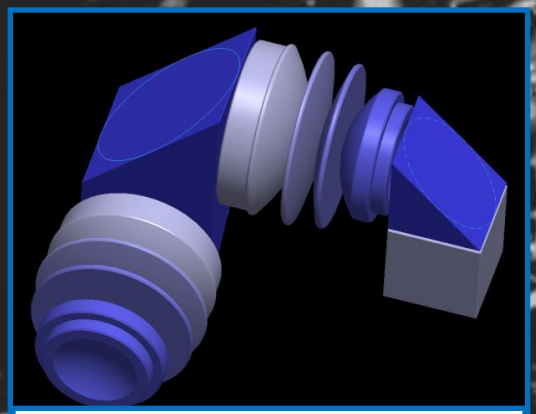
- Operation over temperature and humidity
- Surviving shock and vibration
- Focus adjustment and other user adjustments

All opto-mechanical designs require:

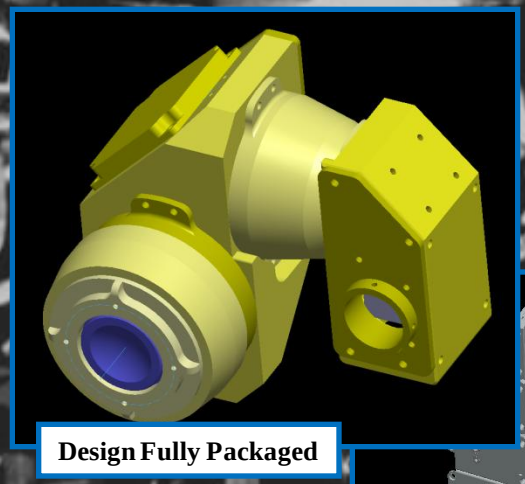
- Characterization of sensitivities
- Correct Degrees Of Freedom (DOF) for adjustment
- A design that can be easily aligned to meet the optical specifications

"Top Down" practices usually result in optimal designs!

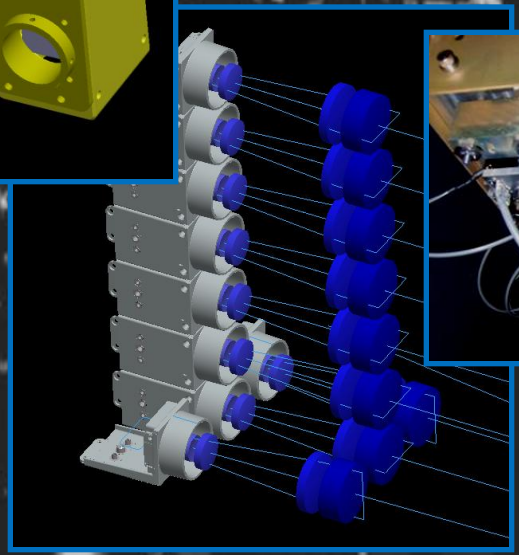
Custom Thermal Controlled Tip / Tilt Mounts for Non-Linear Crystals
Image Courtesy of Arete Associates, Longmont, Colorado

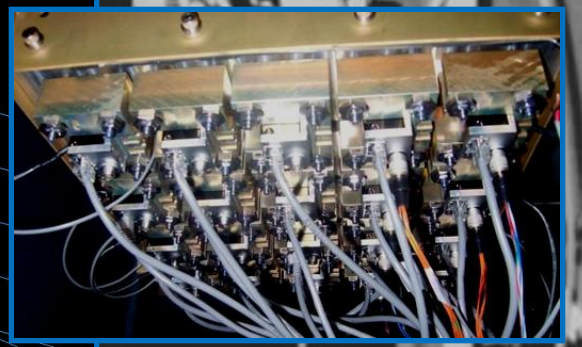


Optical Design (Optics Hanging in Space)



Design Fully Packaged



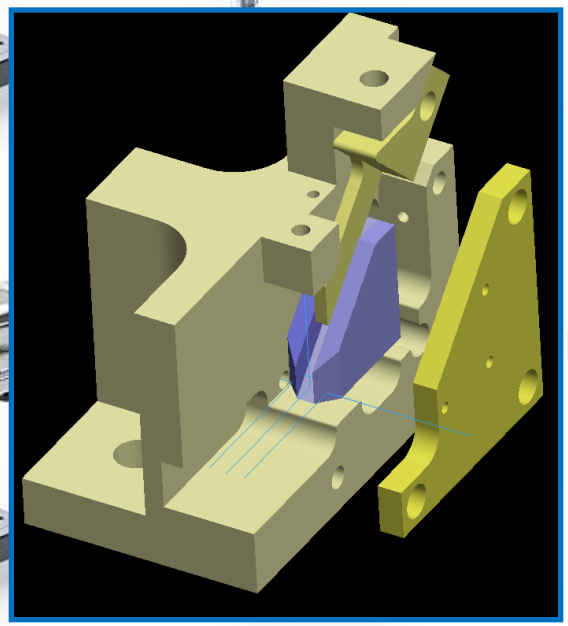


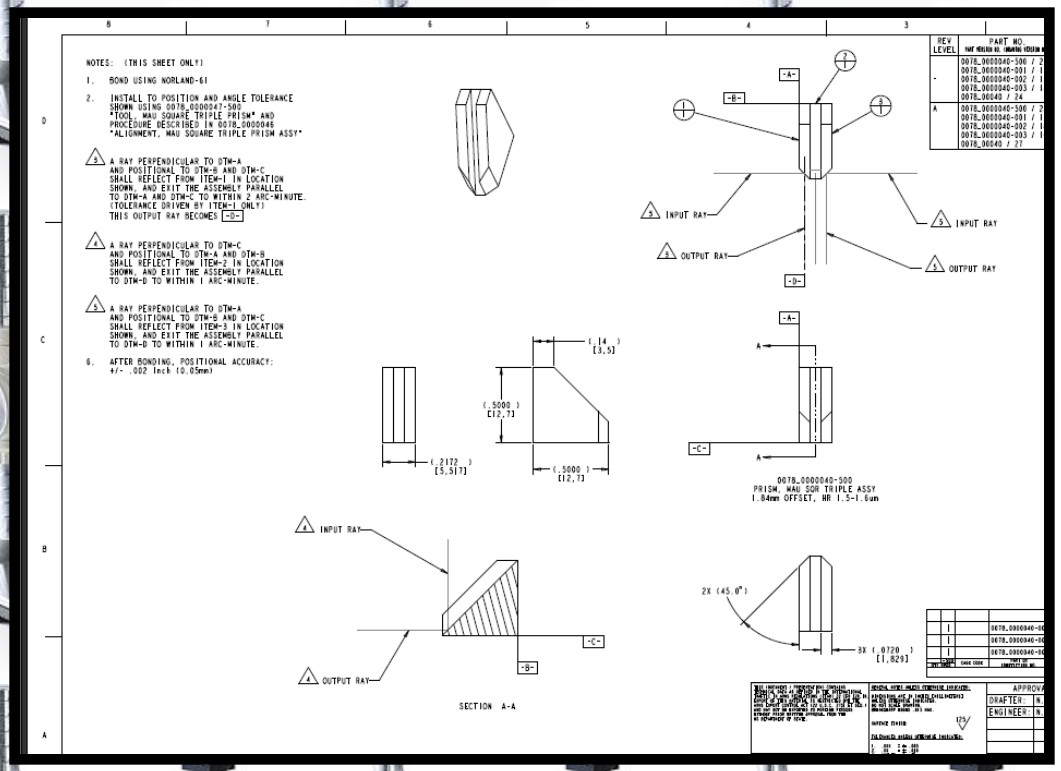
Images Courtesy of Boulder Imaging Louisville, Colorado

Some images of actual hardware
Images Courtesy of Georgia Technology

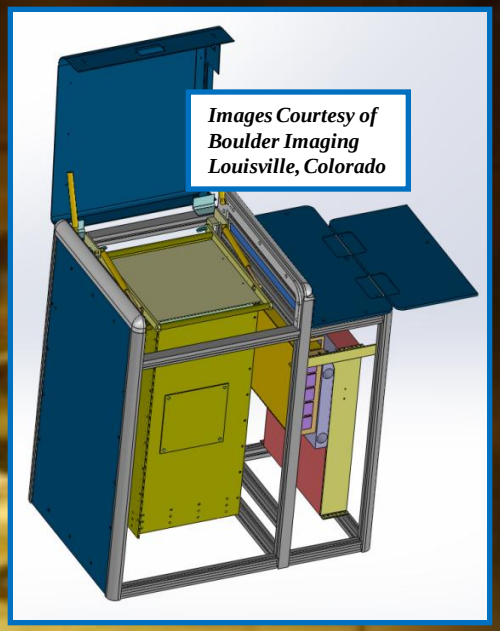
Alignment and Testing of Bonded Assemblies

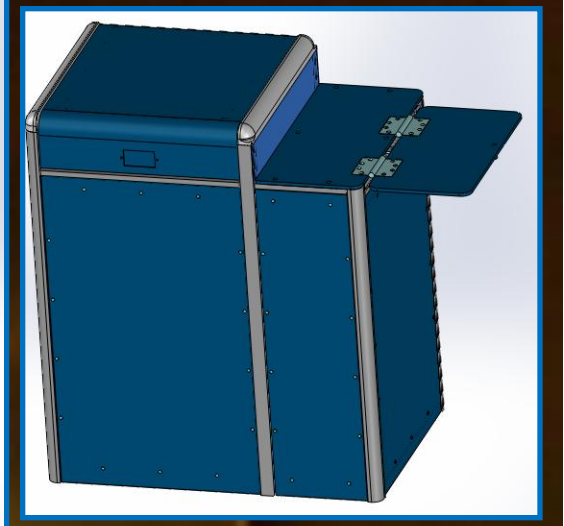
- **Design lenses, mirrors, and prisms per customer specifications**
- **Design required tooling for assembly**
- **Assemble using optical tools (alignment lasers and auto-collimators)**
- **Specify proper testing for assembly verification**





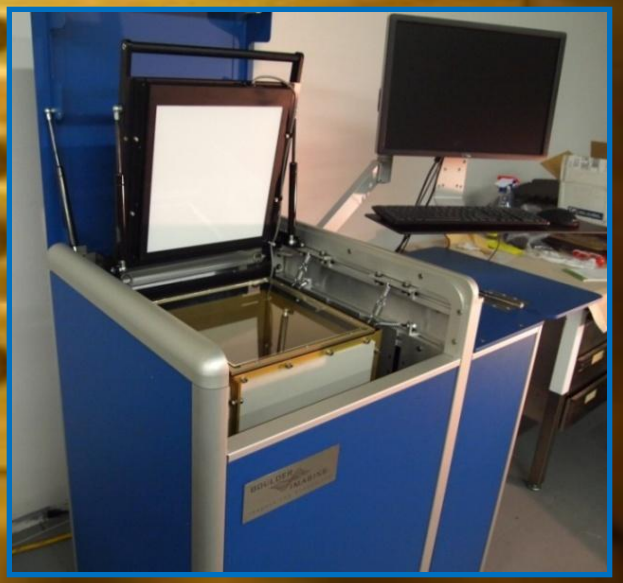
Product Development
for
Optical Instruments





Optical Inspection for 2-Dimensional Profiles

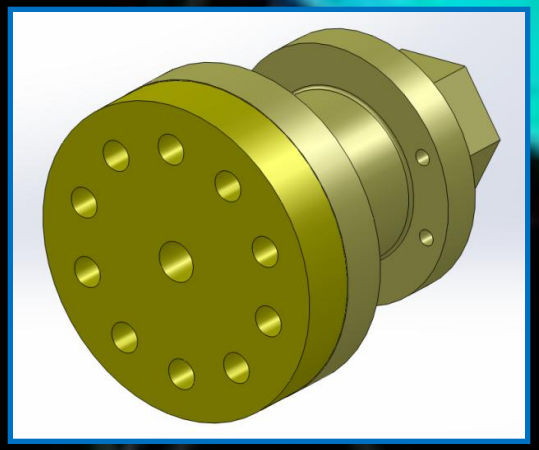
- Able to inspect any part within 12” x 12” square
- 20 camera images stitched together to make a100 megapixel image
- Inspection time less than 10-seconds
- 100% final inspection for the laser cutting, printing, and die-cutting industry



Images Courtesy of Boulder Imaging
Louisville, Colorado

Pressure Test Chamber
Design and Analysis
(for testing high pressure laser windows)

- **8000 psi requirement**
- **Ability to pass 20kW CW laser through window while under pressure**
- **Interrogate window aberrations and surface figure with interferometer**



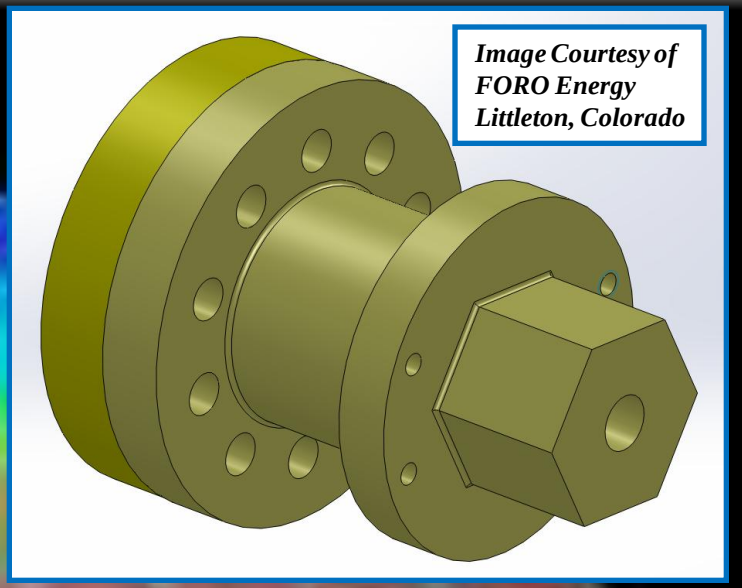


Image Courtesy of FORO Energy Littleton, Colorado

$$defl_{shear\_housing} := \frac{stress_{shear}}{G_{Al}} \cdot length_{flange}$$

$$defl_{shear\_cover} := \frac{stress_{shear}}{G_{Al}} \cdot length_{flange}$$

$$defl_{shear\_total} := defl_{shear\_housing} + defl_{shear\_cover}$$

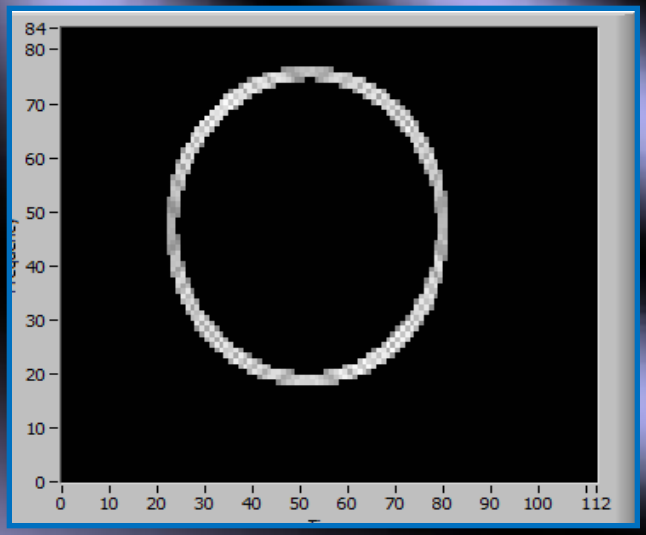
$$number_{bolts} := 10 \qquad force_{bolt} := \frac{force_{pressure}}{number_{bolts}}$$

$$\%_{proof} := 0.4348$$

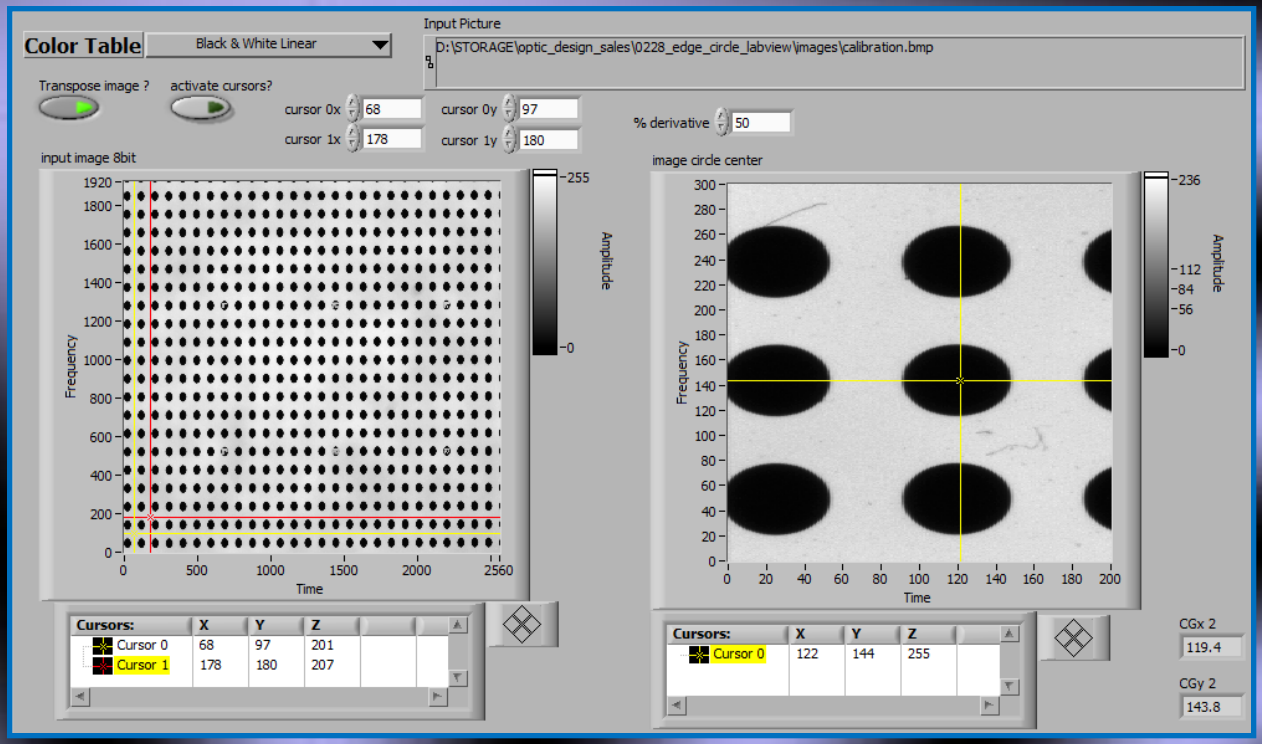
$$safety_{joint} = 2.215$$

Image Processing

- Find "*center of a circle*" using:
  - **Image Derivative**
  - **Center of Gravity**



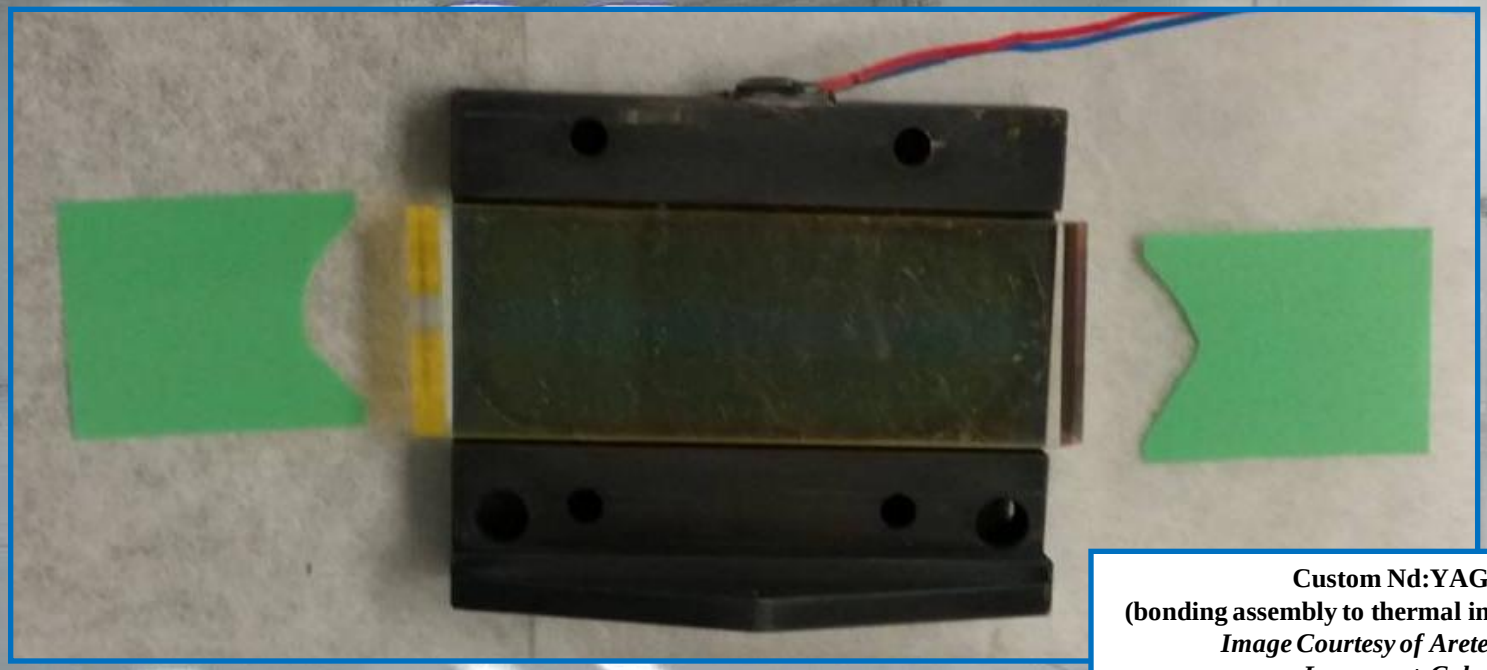
"Many more LabView programs for data reduction and image processing!"



Optical Handling and Assembly

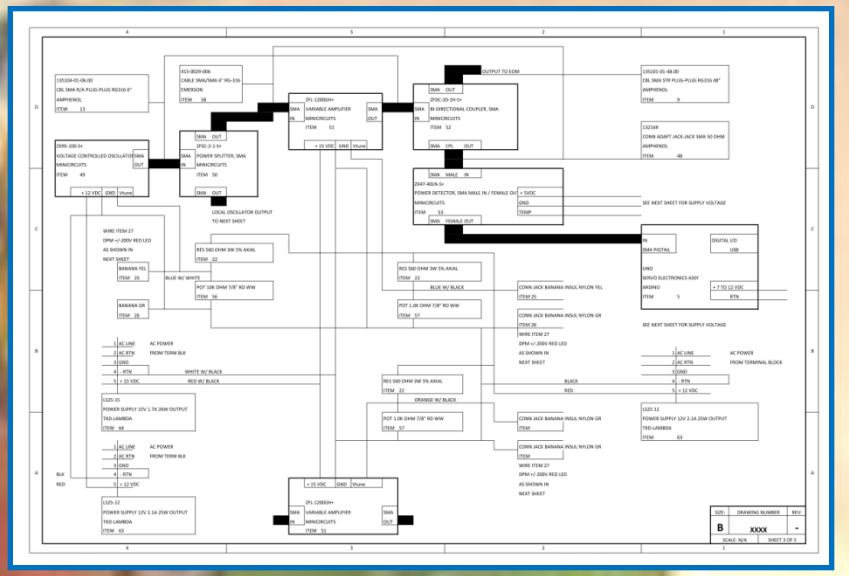
Training:

- **Laser Safety**
- **Optical clean-room procedures**
- **ElectroStatic Discharge (ESD)**
- **Machine Safeguarding**



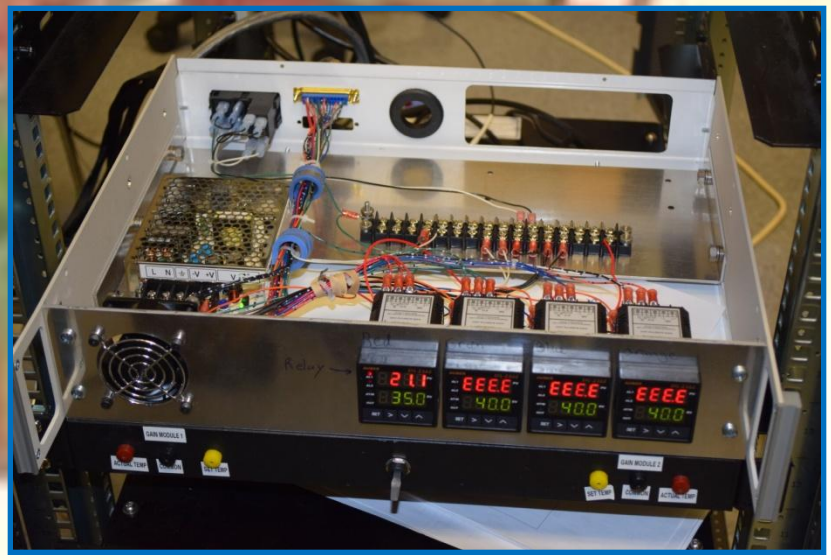
Custom Nd:YAG Slab
(bonding assembly to thermal interface in progress)
Image Courtesy of Arete Associates,
Longmont, Colorado

Electrical Packaging, Schematics, and Cables



Proficient at Packaging Electronics including:

- **Thermal design for PCB components that require heat removal**
- **Electronic assemblies for rugged environments**
- **System schematics for top level electronic designs**
- **Full cable assembly documentation**



Software Currently Licensed

- ZEMAX ray-tracing software, non-sequential
- Solidworks, version 2012
- Pro-Engineer, (PTC) Wildfire 5.0
- LabView (National Instruments)
  - Including “Vision Acquisition” for camera interface

Assembly Skills Include:

- Technician Toolbox
- Scientific Cameras
- National Instruments DAC

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