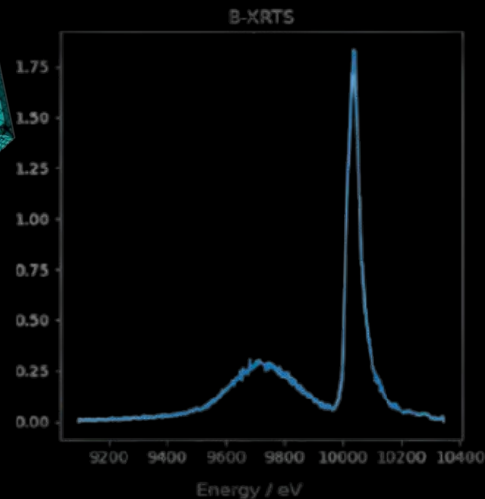
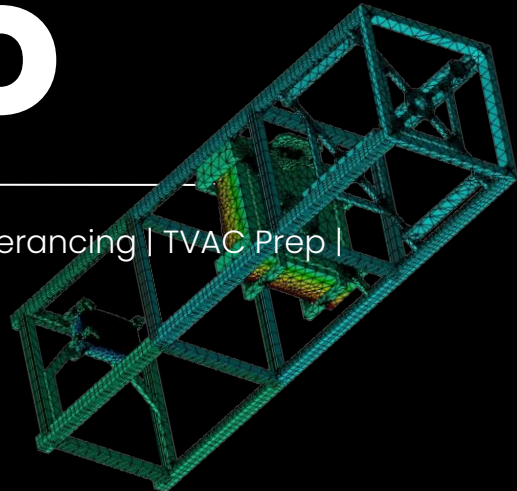
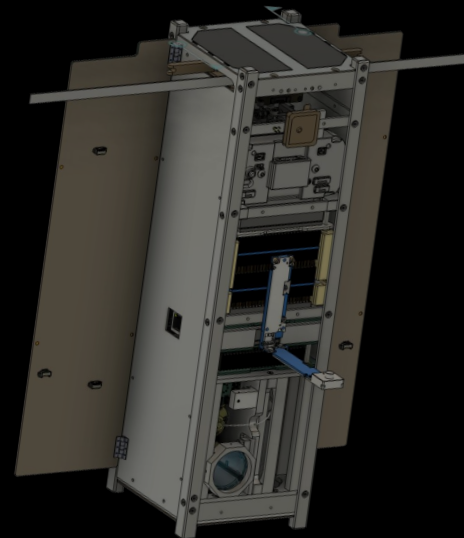
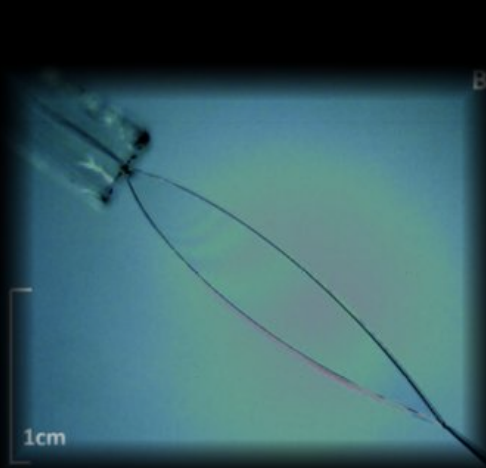


Asher Goodman

Project Portfolio

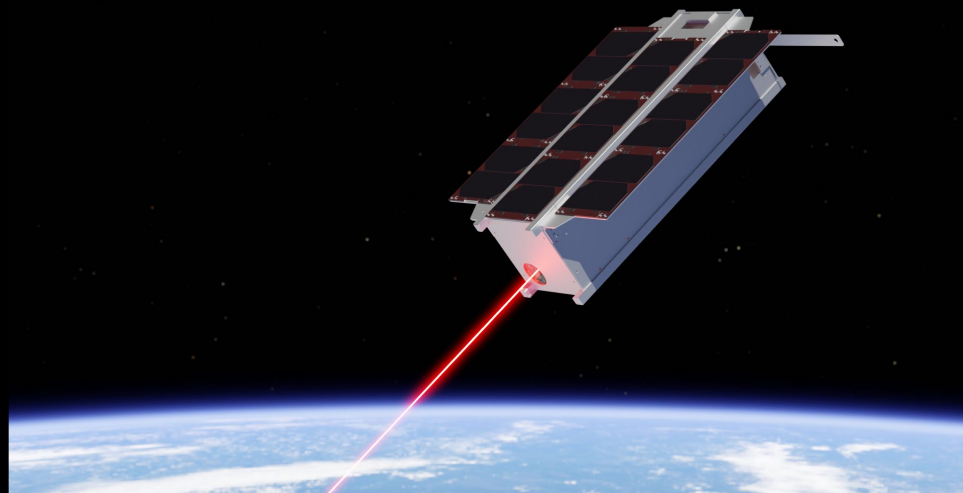
Skills: Fusion 360 | CNC Machining | Precision Tolerancing | TVAC Prep |
Finite Element Analysis | Experimental Physics

Email: acgoodman@uchicago.edu
LinkedIn: [linkedin.com/in/asher-goodman/](https://www.linkedin.com/in/asher-goodman/)



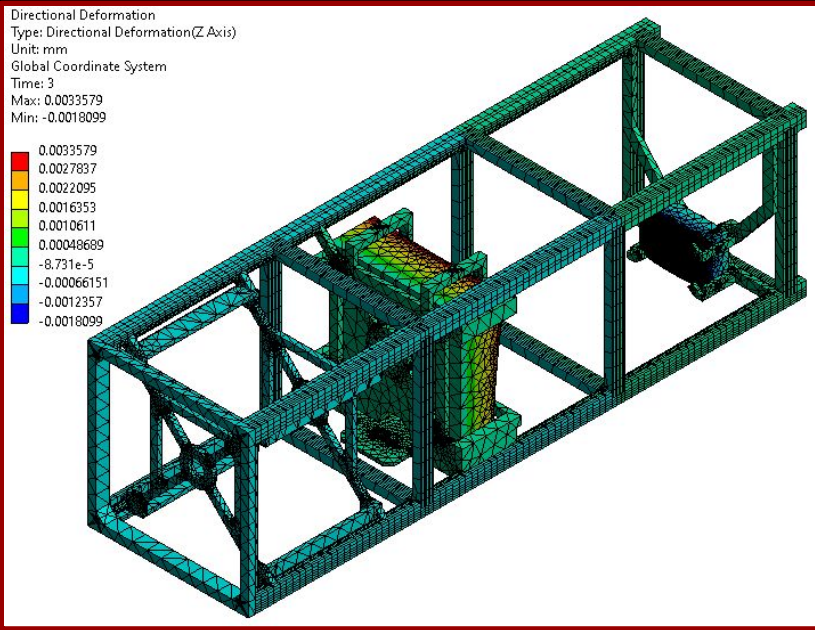
PULSE-A Satellite

- Integrated payload and mechanical interfaces within a 3U bus design
- 3D modelled and constructed thermal vacuum testing rig, which is to be tested at Fermilab
- Goal of becoming the first entirely undergraduate team to establish optical space-to-ground communication
- Project funded by NASA CSLI, and undergoes regular design reviews from engineers from JPL, Fermilab, etc.

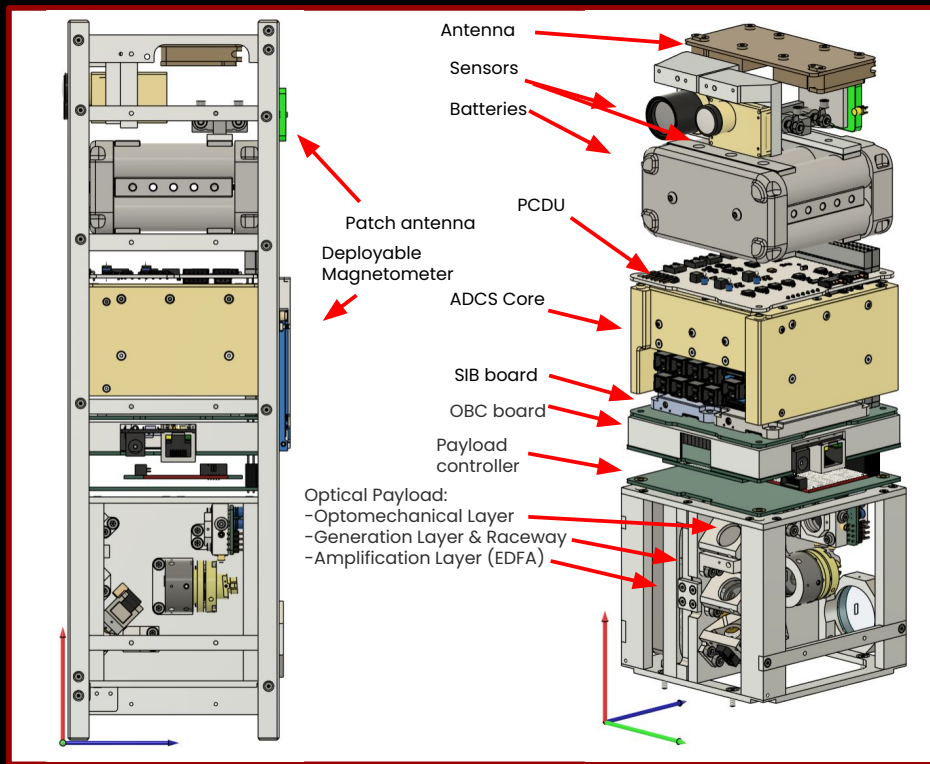


Rendering of deployed PULSE-A CubeSat

PULSE-A Satellite



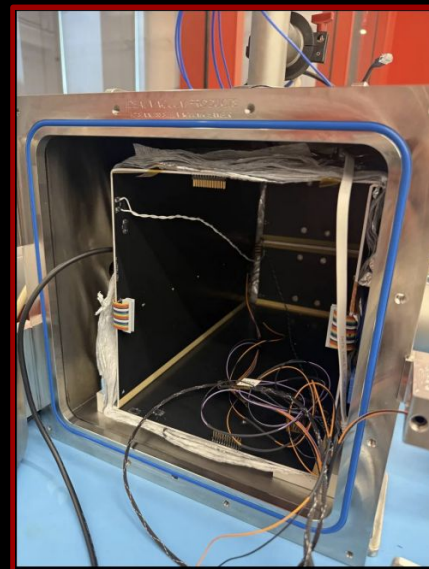
Using Ansys Mechanical to simulate launch vibrations, find natural vibration modes, and perform stress tests on satellite frame



Working on modelling connections between component interfaces

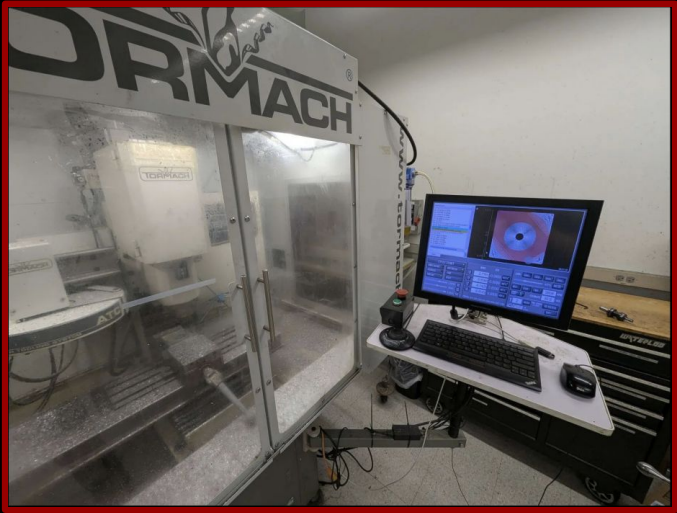
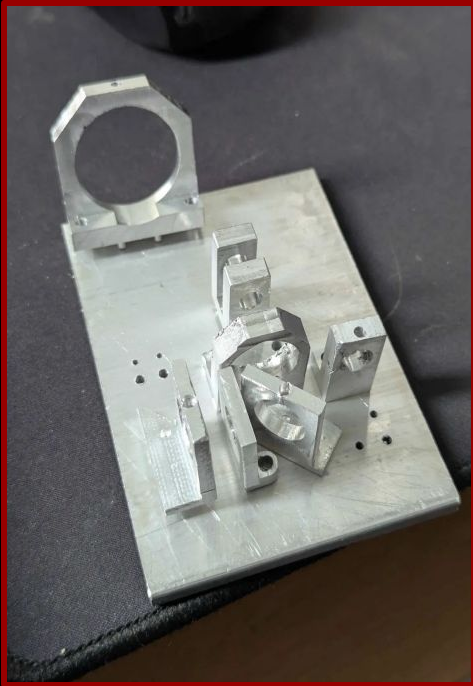
PULSE-A Satellite

- Worked with thermal subteam to design thermal vacuum testing frame
- Open frame and thin wire-suspended design help minimize thermal conduction
- Made of aluminum & PEEK plastic to reduce outgassing
- To be implemented at Fermilab TVAC facility



TVAC to be used at Fermilab

PULSE-A Satellite

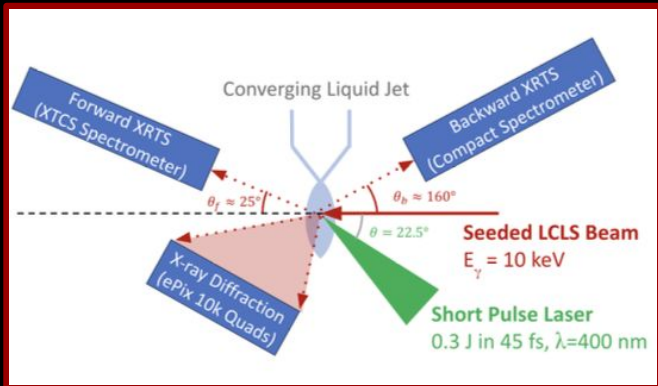


CNC Machining Process

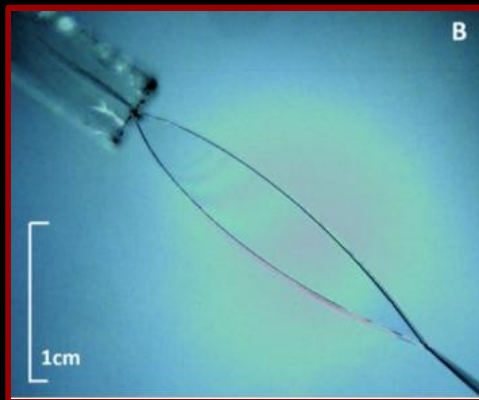
Aluminum frame components and optomechanical layer prototype made with CNC

Inertial Fusion Energy (IFE) Research Intern

Last summer, I contributed to research in the High Energy Density Science division of SLAC National Accelerator Lab.



Experimental setup: a short pulse laser is used to ionize water jet target. Femtoseconds later, an X-ray beam is fired at the target; its diffraction pattern informs the effectiveness of ionization.

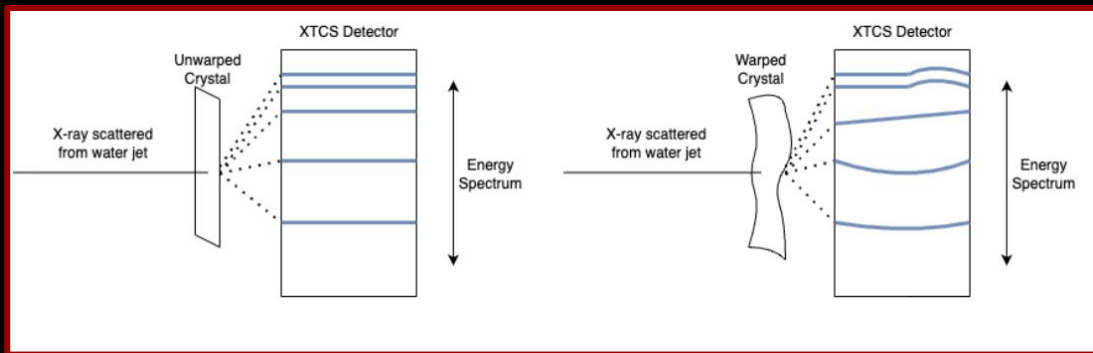


Ultra-thin water jet used as target of high-energy, short-pulse laser. Rapid laser firing replicated necessary irradiation conditions for an effective fusion reaction.

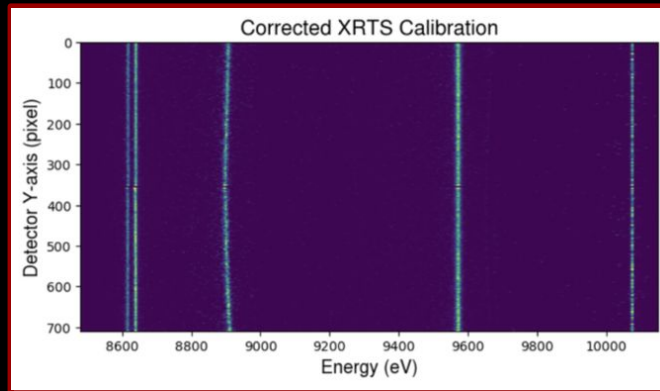
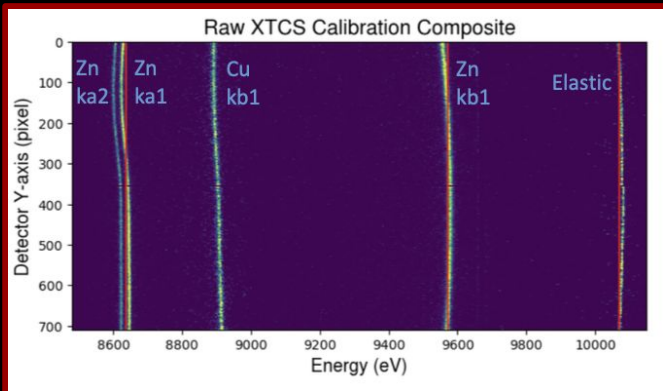


Linac Coherent Light Source data collection center

Inertial Fusion Energy (IFE) Research Intern



Detectors gave significantly distorted results. I worked with experiment subteam to determine this was due to diffraction crystals



I created a python-based distortion correction function to help dewarp detector images and analyze experimental data

Inertial Fusion Energy (IFE) Research Intern

Presented results at the IFE-STAR Summer Symposium: a national forum for undergraduate nuclear fusion research



SLAC NATIONAL ACCELERATOR LABORATORY

High-Repetition Rate Inelastic X-Ray Scattering from Laser-Irradiated Water

Asher Goodman¹, MEC 1008603 Collaboration, Arianna Gleason¹, Siegfried Glensner¹, Nicholas Hartley¹
¹IFE-STAR Summer Intern, SLAC National Accelerator Laboratory, ²HEDS Division, SLAC National Accelerator Laboratory

RISE

U.S. DEPARTMENT OF ENERGY

IFE-STAR

ABSTRACT

Achieving electrically efficient inertial confinement (ICF) fusion demands laser irradiation of a fusion target at a minimum rate of 10 pulses per second. Hartley's high-repetition-rate laser irradiation experiment aimed to demonstrate the effective heating of a water sample via high-repetition-rate laser pulses. X-ray Thomson Scattering (XRTS) was used to track the evolution of the water's electronic structure during and after its irradiation. However, calibrating the XRTS detectors unveiled a distortion pattern attributed to an unforeseen curvature in the Bragg diffraction crystal. In this work, we will discuss my analytic code for reversing the distortion of the XRTS detector crystal.

MOTIVATION

Demonstrating successful high repetition rate laser heating and high repetition rate target analysis is a critical step toward a viable ICF setup design.

RESULTS

XRTS crystal distortion produces warped spectral lines. To effectively analyze XRTS, a distortion-correction function is necessary

EXPERIMENT

X-ray Thomson Scattering (XRTS) detectors measure the electronic properties of plasmas, providing temperature, density, and ion structure diagnostics.

- Forward XRTS (XTCS) accesses information about the collective plasma oscillation
- Backward XRTS (B-XRTS) displays Compton scattering for individual electrons

This marks the first experimental implementation of the MEC thin film water jet

- Forms a liquid sheet target capable of 250nm thickness

RESULTS

Find the centroids of 3 emission lines from the calibration composite (centroids in red). For a given row, subtracting the x-value of each emission line from that of its centroid yields the horizontal distortion at each of the 3 centroids.

Fitting a quadratic through the 3 distortion values gives an estimate for the distortion across the entire row. Subtracting each pixel's distortion from its x-value corrects the warpage.

Repeating this process for every row produces a fully corrected image.

Horizontal Distortion (eV)

Distortion of Centroid (Quadratic Fit)

Distortion of Centroid (Quadratic Fit)

Corrected XTCS Calibration

XTCS

B-XRTS

This correction function will be used to reduce noise in XRTS data from laser-heated shots, enabling more precise extraction of water jet temperature

ACKNOWLEDGMENTS

This work is supported by the U.S. Department of Energy (DOE) Office of Fusion Energy Sciences funding FWP100182 and FWP 10086 and the IFE-STAR Summer Undergraduate Research Experience

References:
 B. Barber et al., "Collective x-ray scattering measurements of plasmas in solid-density plasmas," *Nat. Commun.* **9**, 1-7 (2018). <https://doi.org/10.1038/s41467-018-03696-w>
 M. J. MacDonald et al., "The Matter in Extreme Conditions (MIEC) instrument at the Linac Coherent Light Source," *J. Synchrotron Radiat.* **22**, 776-783 (2015). <https://doi.org/10.1107/S1600577515004865>

SUMMARY

This experiment posed unexpected challenges with the XTCS crystal and water jet, exacerbating experiment timeline and data analysis. A few things we have gathered:

- Crystal warpage is not quadratic, making distortion correction difficult without 3D crystal analysis
- Test for crystal flatness and implement topographic distortion reversal
- Plasma-state water exhibits higher reflectivity than desired, which reduces the effectiveness of laser-driven heating
- Investigating liquids with low plasma-state reflectivity and low viscosity would increase laser energy absorption while remaining water jet compatible

New Projects Soon!

Updates posted at <https://acgoodman24.github.io/>