

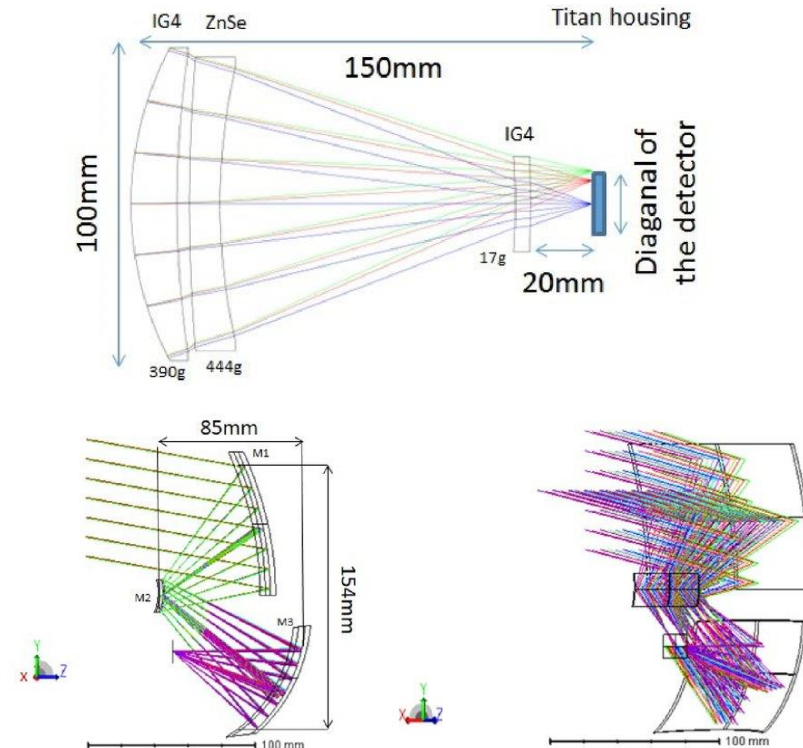


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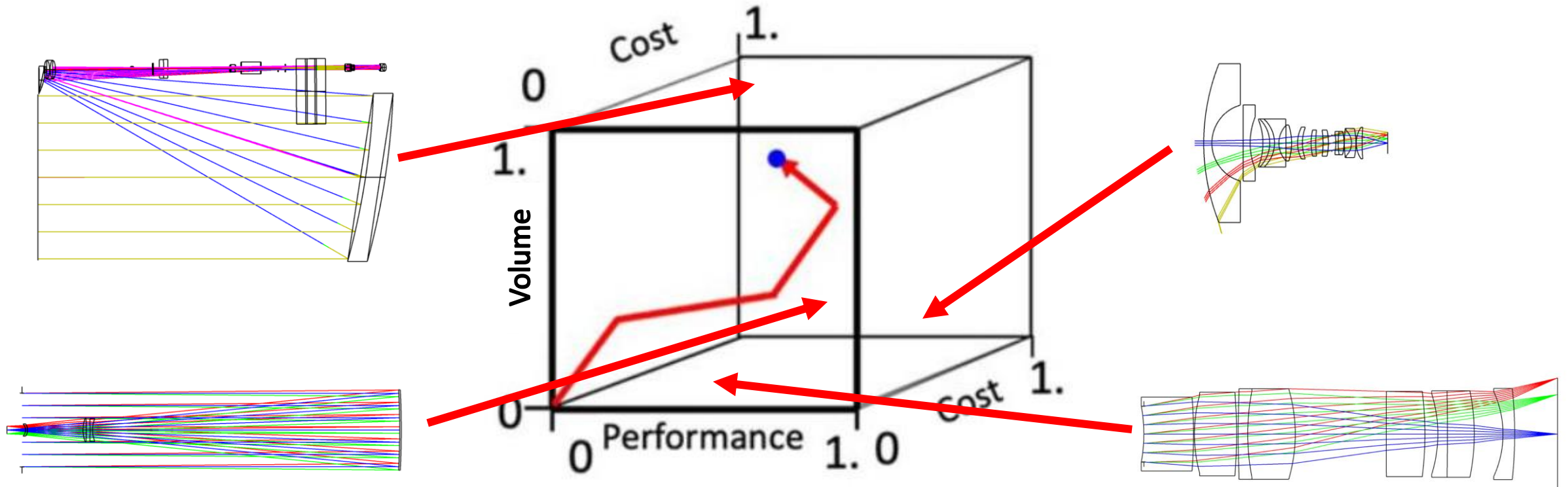
## PODS Project Proposals

- What UV/Optical/IR objectives are optimal?
  - Refractive
    - Standard Spheres
    - Anomalous Dispersion / Aspheres
    - GRIN & Voxel GRIN
  - Reflective
    - Axial Spheres
    - Unobscured / Aspheres
    - Freeform
  - Catadioptric
  - Diffractive / MODE



[1] Druart et. al. (2018)

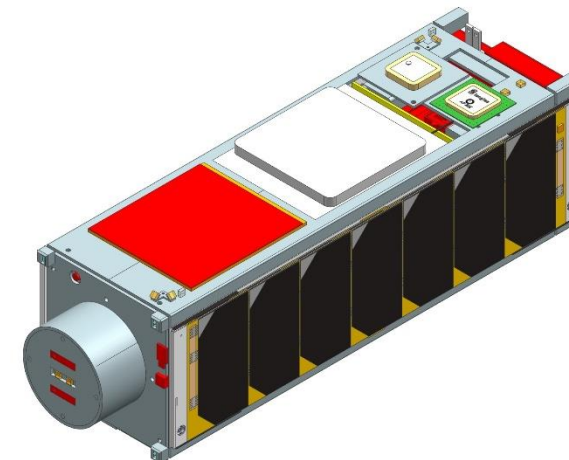
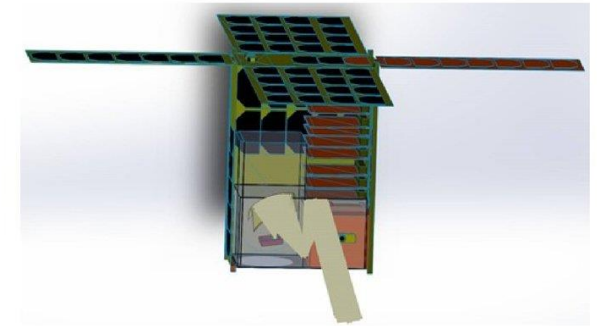
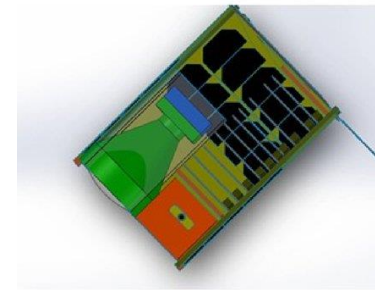
- End goal – a design space!
- Evaluate all designs w/ a tolerance analysis to determine cost



[2] Breckinridge et. al. (2019)

- Collective Approach
  - Start w/simple designs, decide on “best by group” each week to add to design space
  - Spend several weeks on more complex designs
- Competitive Approach
  - Team Reflective v.s. Team Refractive (etc.)
  - Two teams develop a single design
  - We would need 4 on each team tho for things to be fair

What Payload Size? 2U/3U/3U+







# CubeSat Objective Optic Trade Study - Jaren



## References

- 1) Guillaume Druart, Renaud Allieux, Philippe Perrault, Vincent Lefranc, Nathan Cariou, Laurent Rousset-Rouvière, "Study of infrared optical payloads to be integrated in a nanosat," Proc. SPIE 10690, Optical Design and Engineering VII, 106900N (5 June 2018); <https://doi.org/10.1117/12.2309789>
- 2) J. B. Breckinridge, J. E. Harvey, R. Irvin, R. Chipman, M. Kupinski, J. Davis, D-W. Kim, E. Douglas, C. F. Lillie, T. Hull, "ExoPlanet Optics: conceptual design processes for stealth telescopes," Proc. SPIE 11115, UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts IX, 111150H (9 September 2019); <https://doi.org/10.1117/12.2528825>
- 3) Plus avengers stuff



# Idea 1: Adjustable Aperture Add-on for Smart Phone Camera

- Many companies have been designing smart phone lens add-ons that enhance smart phone camera capabilities
- Not many allow adjustable aperture stop
- Could we design a compact lens add-on with an adjustable aperture stop?
  - Edmund Optics has imaging lenses for cameras with adjustable aperture stop



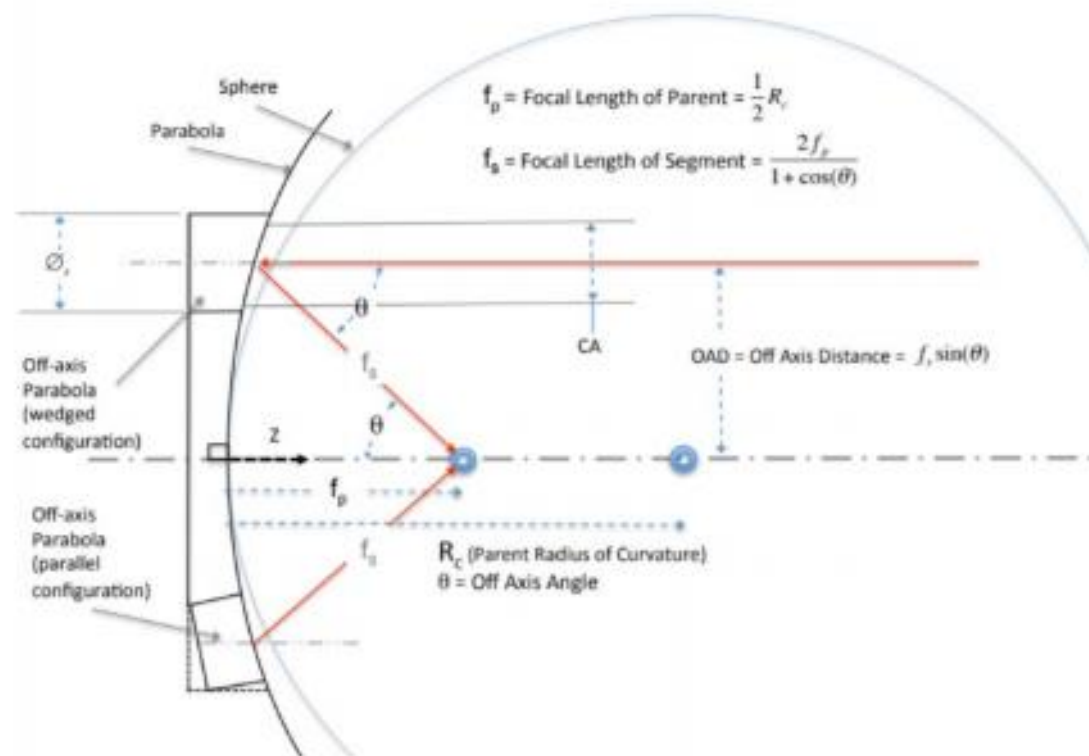
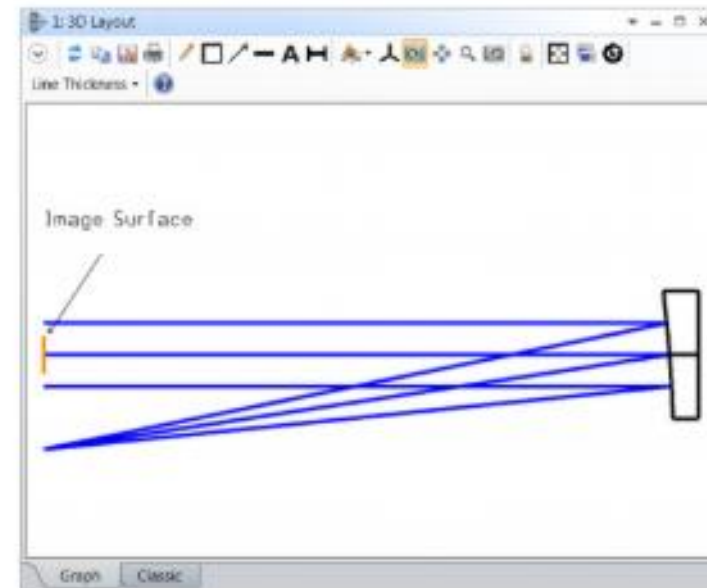
Smart phone “Telephoto” lens add-on



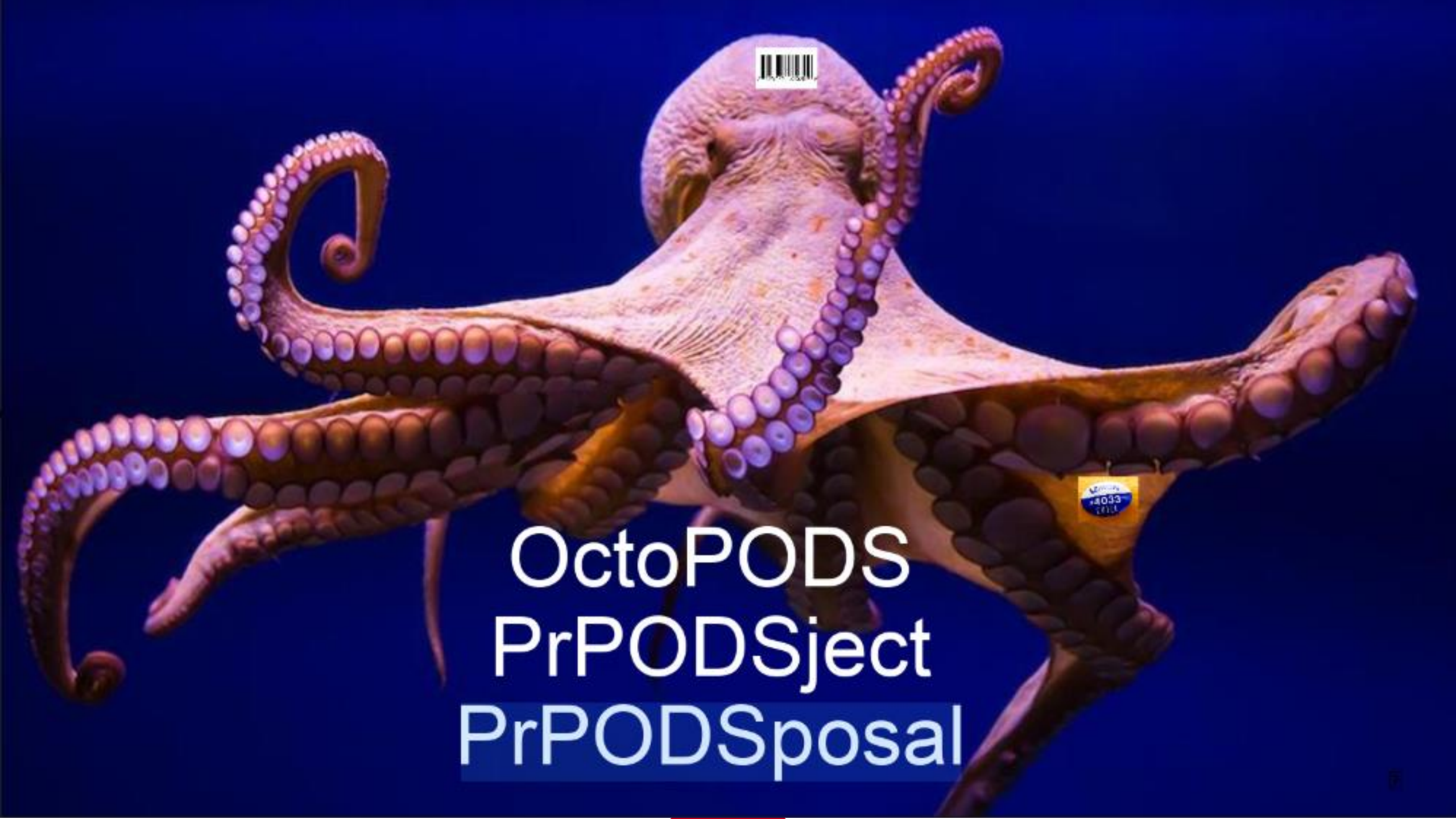
Edmund Optics imaging lens for cameras (f/2.2 – f/22)

## Idea 2: Zemax Macro for creating an Off-Axis Parabola

- Creating an OAP in Zemax can be tricky
- What if there was a Zemax macro or Python/MATLAB function that allowed you to input OAP parameters and create an OAP in Zemax?
- This could make life easier for people
- This idea could be extended to another complicated optic







OctoPODS  
PrPODSject  
PrPODSposal

# Project

Macro: Grocery store scanner that can scan all items at once!

Micro: Design a lens system that can image the barcodes of foods on a grocery store conveyor belt.



# Project

Novelty: Speed up checkout process. Can also be applied to taking inventory or any situation where multiple objects with barcodes must be processed.





# Project

Anticipated difficulty: imaging different sized barcodes (high spatial frequency) in a wide field of view.



# Project

Considerations:

Where would something like this be mounted?

What are possible object orientations?



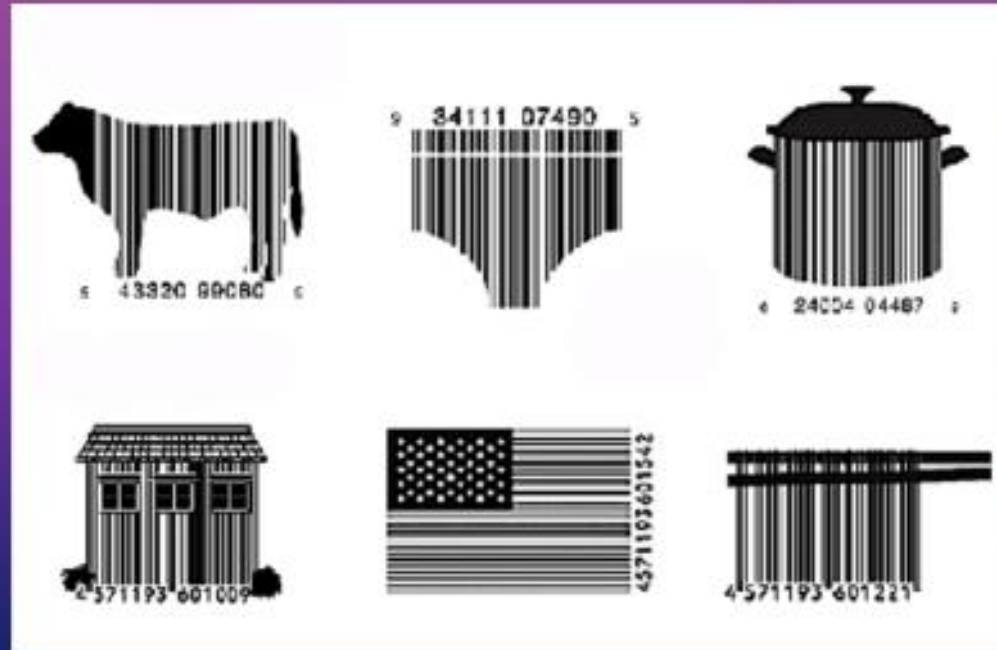
# Project

Considerations:

Where would something like this be mounted?

What are possible object orientations?

Possible barcode shapes...?





# OSC Optics

Optical system in the shape of the OSC Logo

Based on IODC 2017

Lens Design and Illumination Design Problems

- The Centennial Lens -> The OSC Lens
- The Centennial Illuminator -> The OSC Illuminator



# EXTREME SOLAR IMAGER

EXTREME



VERY EXTREME



## EXTREME SOLAR IMAGER

Solar space telescope for direct observation of the Sun

- Clever optical design may eliminate the need for restrictive occulter, sun shield, baffles
- Improve on the ESA Solar Orbiter optical design
- No idea how to get started with this one (Koshel has thoughts)



# Freeform Index Optics

- 3D Printed Optics are starting to become real (ish?!)
- Allows for insertion of different materials within a bulk optical element, non-circular apertures, minimal post processing
- Potential for 1 or 2 elements to replace multi component systems
- Many designs possible (achromat, telephoto, beam expanders, Aberration correction, AR/VR...?)
  - >>8 possible to go around 😊
- Some methods could be modelled Sequentially
  - Likely need non-sequential ultimately
- Interesting Stray-Light analysis
- See papers in [GitHub](#)

# Design Constraints

- We wanna design stuff that's not crazy right?

- SiO<sub>2</sub> doped with wt % off...

- GeO<sub>2</sub>
- TiO<sub>2</sub>
- Other stuff that's possible? (I'll ask)

- Feature size

- 100um now. 10um future.

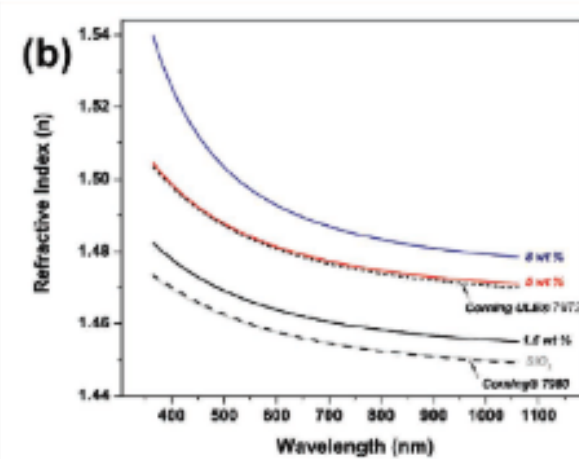
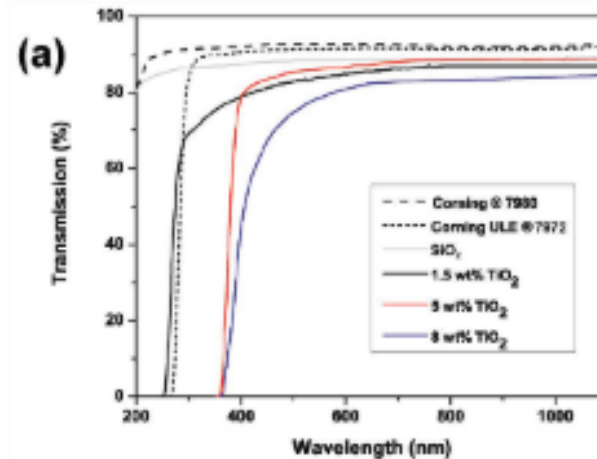
- Element size

- 1in now, 2-3in future

- Maybe not suitable for PODS, but still cool!

$$n^2(\lambda) - 1 = \sum_{i=1}^3 \frac{[SA_i + X(GA_i - SA_i)]\lambda^2}{\lambda^2 - [SL_i + X(GL_i - SL_i)]^2}$$

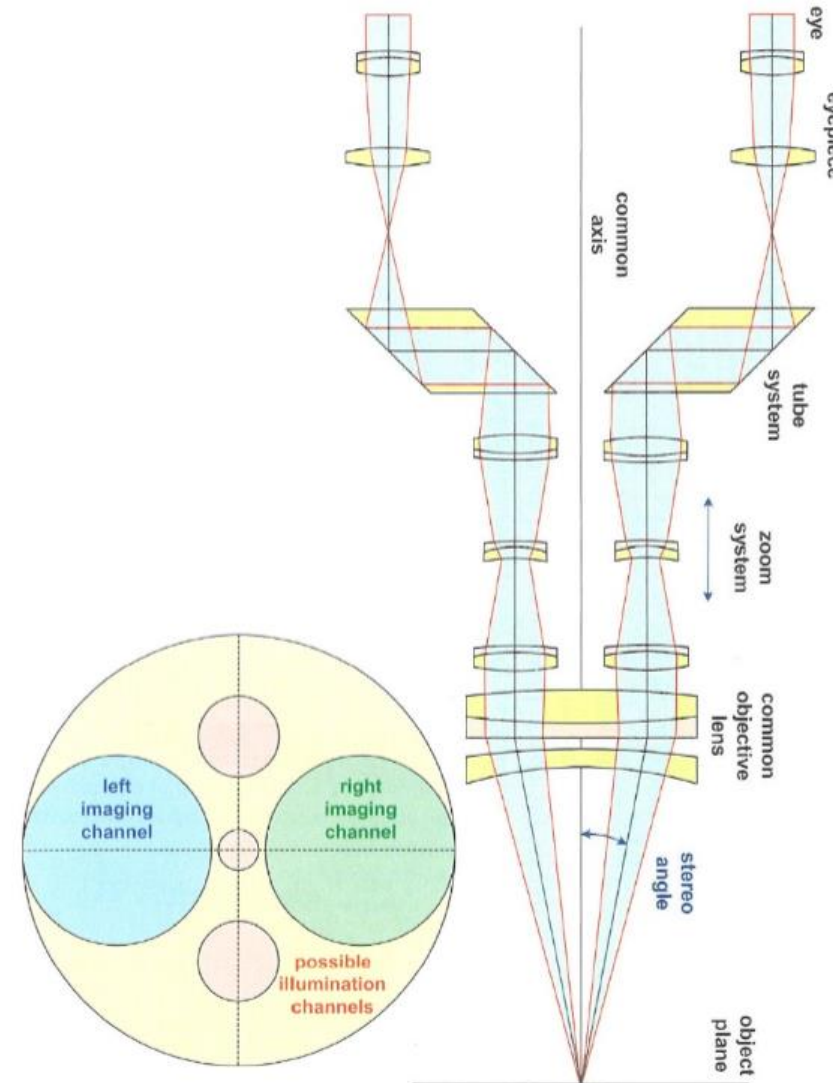
Sellmeier coefficients	SiO <sub>2</sub>	GeO <sub>2</sub>
$A_1$	0.6961683	0.6068842
$L_1$	0.0684043	0.06872006
$A_2$	0.4078426	0.71815848
$L_2$	0.1162414	0.15398806
$A_3$	0.8974794	0.85418831
$L_3$	9.896161	11.841831



# Telescope Setup



- Two binocular channels are aligned and parallel to each other.
- A commonly used objective lens focuses the ray bundles into the object point.
- The main objective lens is used by both channels off-axis, which may cause some problems in non-symmetrical residual aberrations.
  - Special requirements are distortion, lateral chromatic aberration, and flatness of the field.







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Any Others?



- VOTING ROUND 1 (in-person)
  - Vote for top 2 projects!
- VOTING ROUND 2 (on slack!)
  - Vote for top project of those remaining
- Voting w/ Yanqi^