Mirror Holder 3D Print Test Grid

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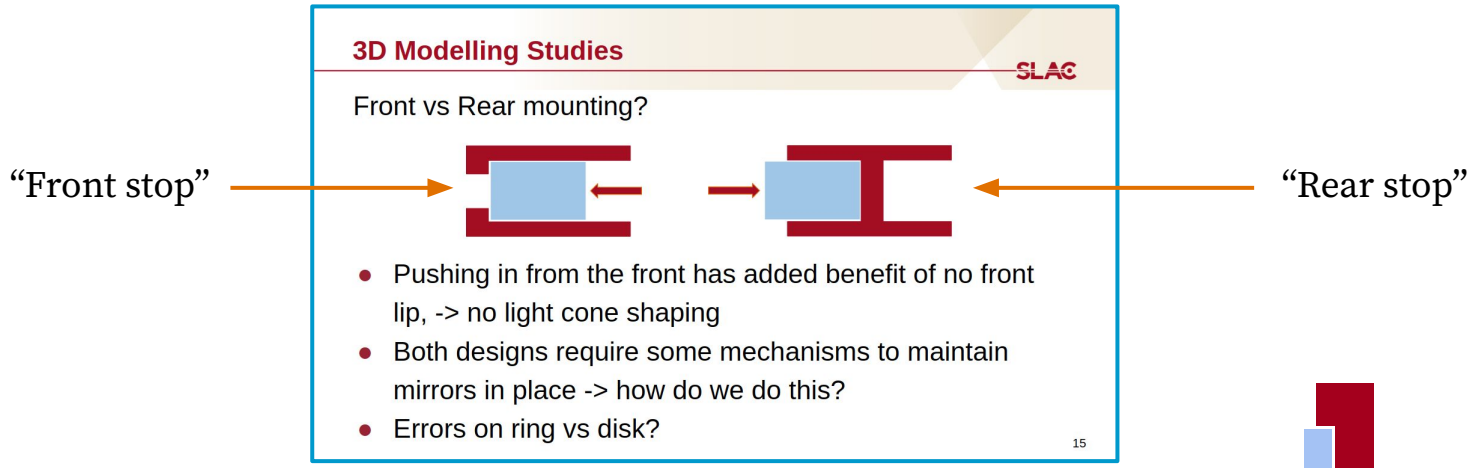
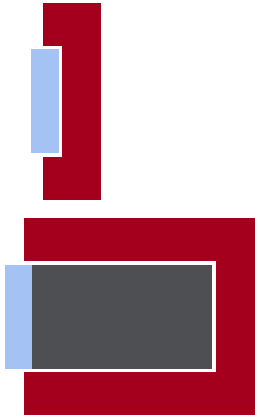
U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

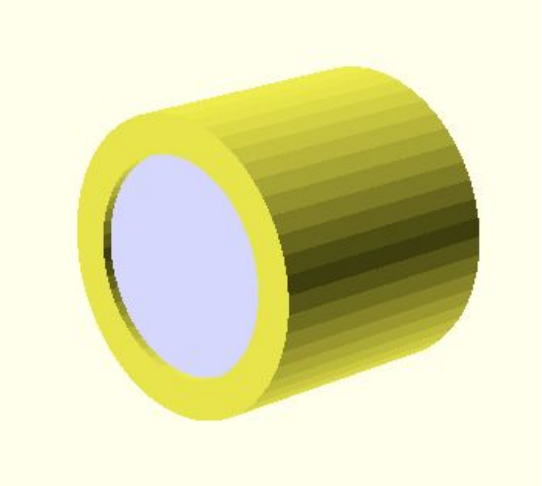
How to hold the mirrors in place



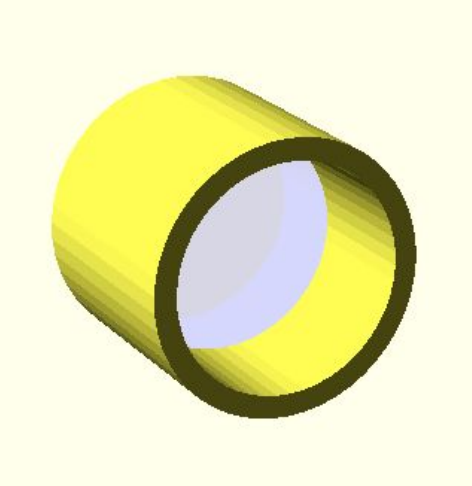
- Mirror thickness of O(mm)
  - Rear-stop: not much room to “click in” precisely or grab & control
    - Could use a long screw/glass rod or something
  - Glue isn’t really an option (I don’t want to…)
- Will focus on **front stop design** for now
  - More parameters to test & study



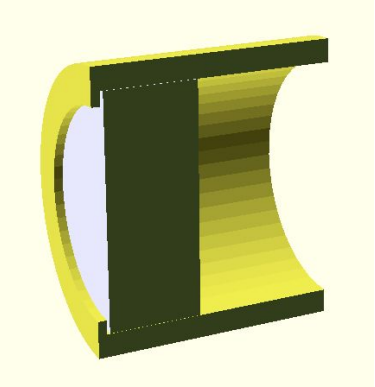
Mirror Holder Design: Overview



Front (angled)



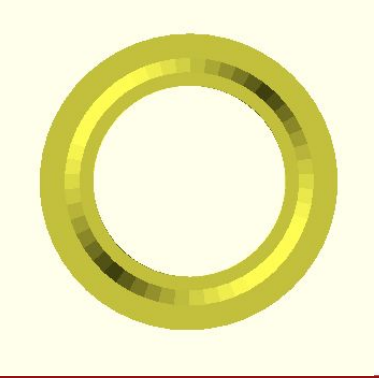
Back (angled)



Cross-section (side)

Example parameters:

- Mirror thickness: 2mm
- Mirror radius: 2.5mm
- Aperture radius: 2.2mm



Back (no mirror)

Mirror Holder Design: Main Parameters

Front-stop depth

- If too thick,
  blocks/carves lightcone
  - No thicker than 1mm?
- If too thin,
  too weak mechanically

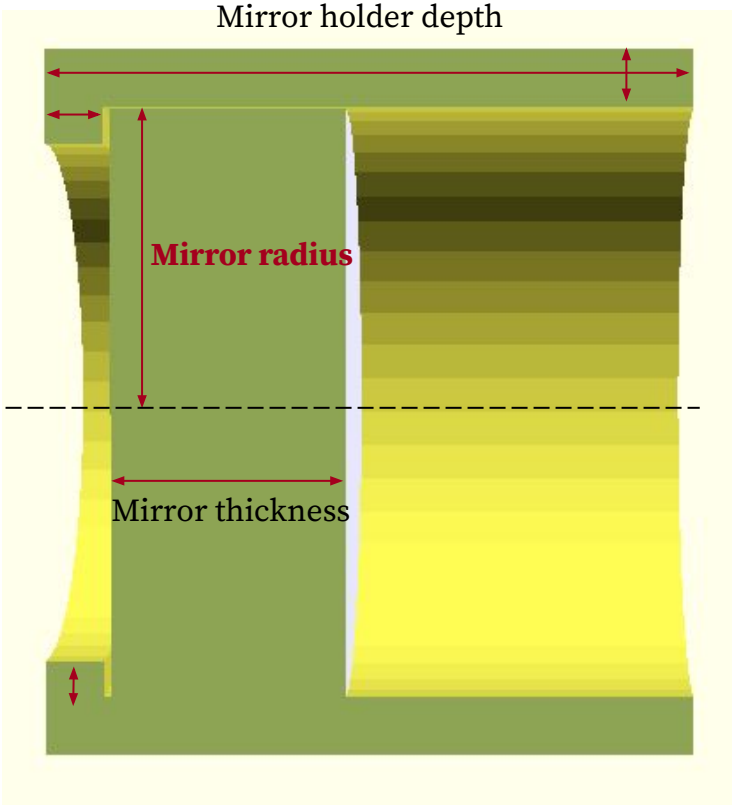
Front-stop / Aperture shape

- Doesn't have to be circular?
  (see later slides)

Front-stop overlap

- Mechanical stability
- Determines:

$$R_{\text{mirror}} = R_{\text{aperture}} + R_{\text{overlap}}$$



Outer thickness

- Limits packing efficiency

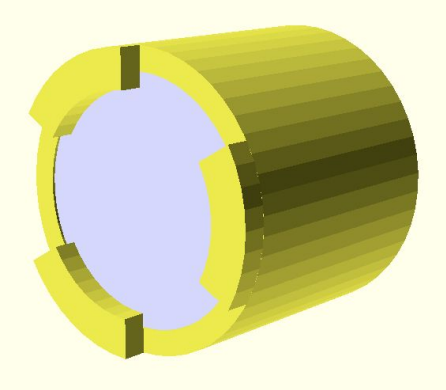
Inner radius (regular *n*-gon)

- Impacts how the mirror clicks in
  - Strength, alignment, etc.
- Radius ~ mirror R
- Optimal size for friction holding?

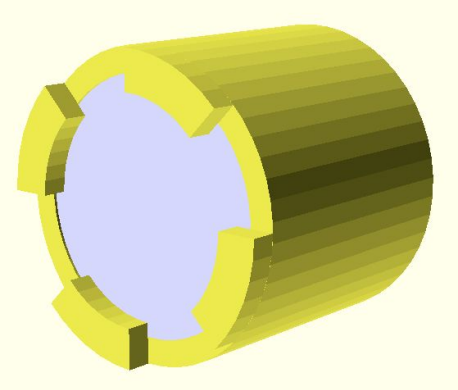
Mirror Holder Design: Front-stop Shape

Front-stop

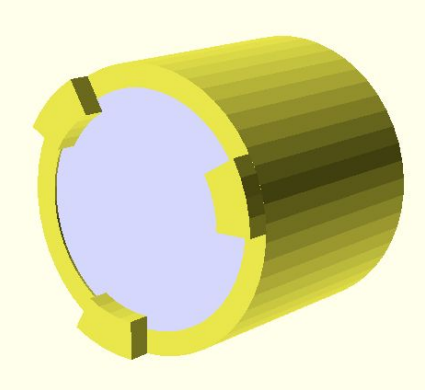
- Size limits aperture
- Smoothness impacts angular alignment
- Doesn't have to be a full "ring"---worth exploring different designs



$n = 3$



$n = 4$



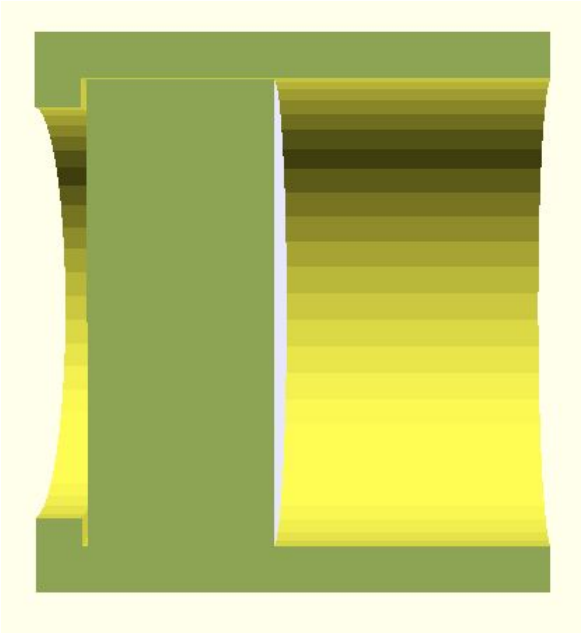
$n = 3$

smaller span

Parameter Relevant for Mechanical Testing

Main goal: friction holding mechanism & overall stability

- Mirror
  - Thickness: 2mm
  - Radius: 2.5mm
- Hole
  - Inner radius: {2.3, 2.4, 2.5, 2.6, 2.7} mm
- Front-stop
  - Depth: 0.5mm
    (not too thick, not too thin)
  - Overlap: {0.2, 0.4, 0.6, 0.8, 1.0} mm
  - Shape: n = {1, 3, 4}

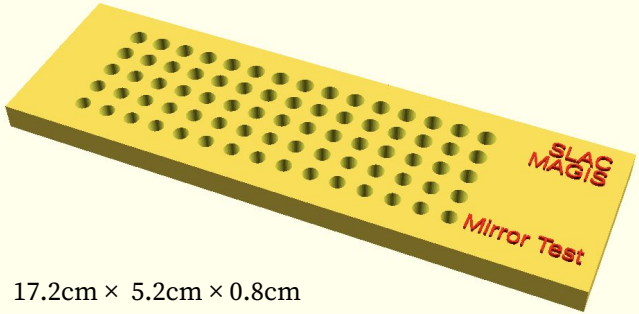


$$R_{\text{mirror}} = R_{\text{aperture}} + R_{\text{overlap}}$$

3D Print Test Grid

3D-print a grid for mirror holder, mainly testing:

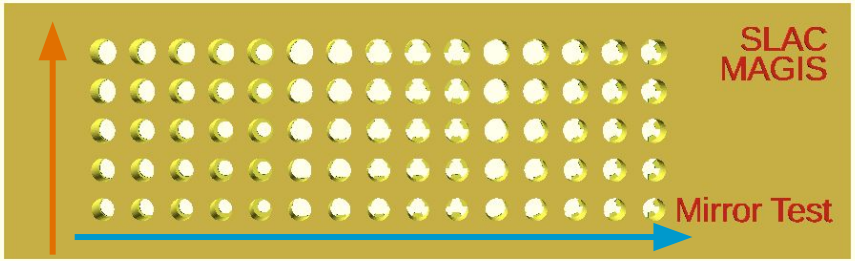
- Friction holding
- Angular alignment
- Overall mechanical stability



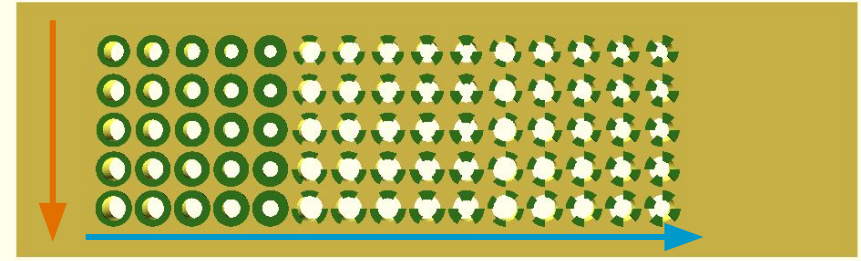
17.2cm × 5.2cm × 0.8cm

Inner Radius

R +/- 0.2mm



Front-stop design (size & shape)

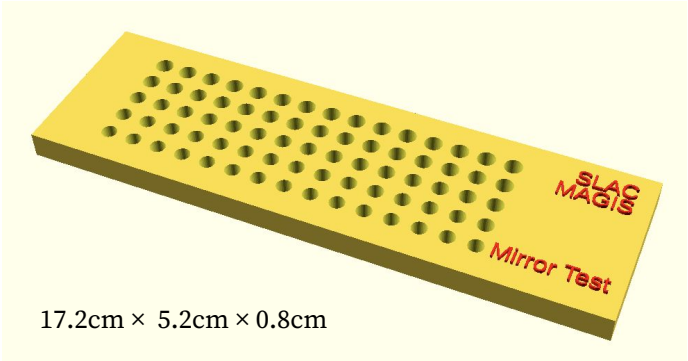


n = {1, 3, 4} × Overlap [0.2, 1.0] mm

Conclusion

My questions

- Precision, min. feature size, etc. depends on **specific printing technology**
  - Overview of printing tech. & tolerances
  - Which one should we go with? Is cost a factor too?
- Do the parameters seem reasonable?
- If so, which companies shall we consider?



Plans going forward

- Finalize the test grid
- Order the test grid + ~10 mirrors for testing
- Study the mechanical properties & angular alignment