

ATST Thermal Design Challenges

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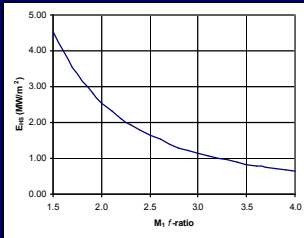
Project Phase



- We are now ~1 year from CoDR
- Tasks:
 - Concept exploration
 - Requirements definition
 - Straw man design



Straw Man Optical Design



Thermal concerns: M₁, M₂, and the Heat Stop (HS)



M₂: Q = 0.3 kW, E = 340 W/m²

HS: Q = 11 kW
E = 2.5 MW/m²

M₁: Q = 13 kW, E = E_s = 1010 W/m²

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Heat Stop Functions

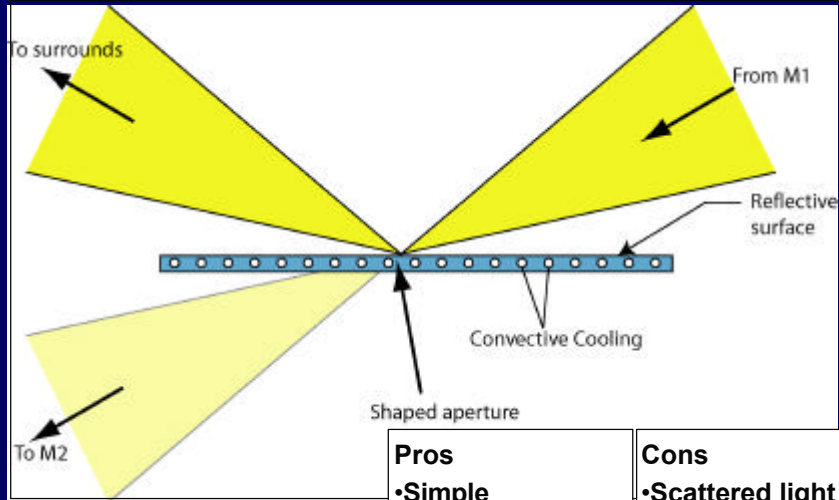


- Separate field of view (FOV) from the undesired portions of the image (UPI)
- Remove UPI from telescope optical path *without degrading image quality*
 - DT = thermal plumes = seeing
 - Stringent requirement on surface temperature: ambient +/- 2°C
 - or sheath suction (seeing at prime focus may not allow this)

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Heat Stop Concept A: Reflective Plate



The ATST Team

Pros

- Simple
- Robust
- Low temperature

Cons

- Scattered light
- Unwanted beam

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Heat Stop Concept B: Radiative Diffuser

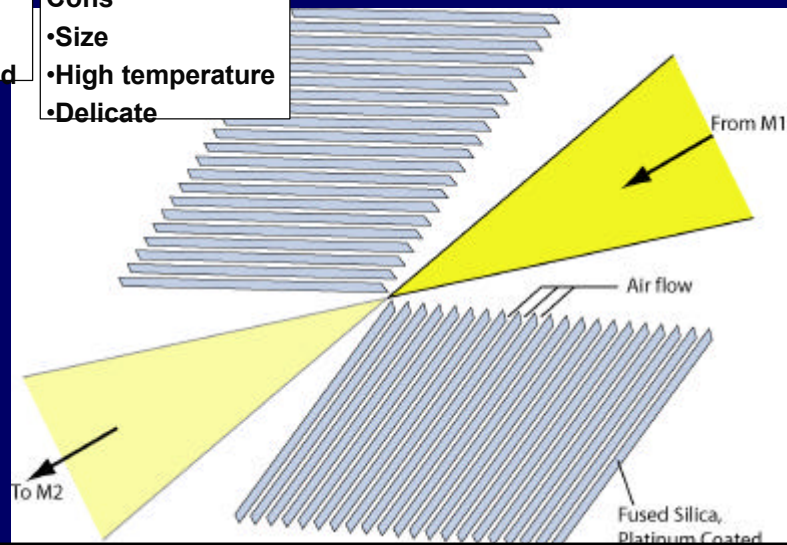


Pros

- Elegant
- Air cooled

Cons

- Size
- High temperature
- Delicate

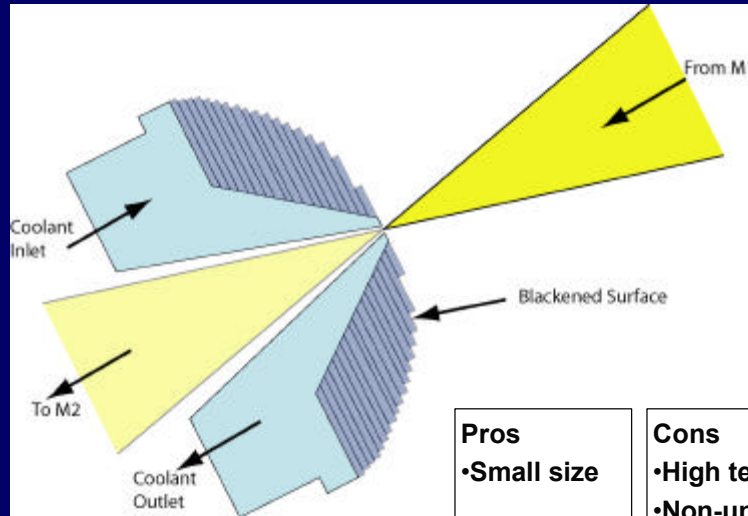


W. Siegmund

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Heat Stop Concept C: Absorbing Stack



Pros
• Small size

Cons
• High temperature
• Non-uniform T_s

LEST-style

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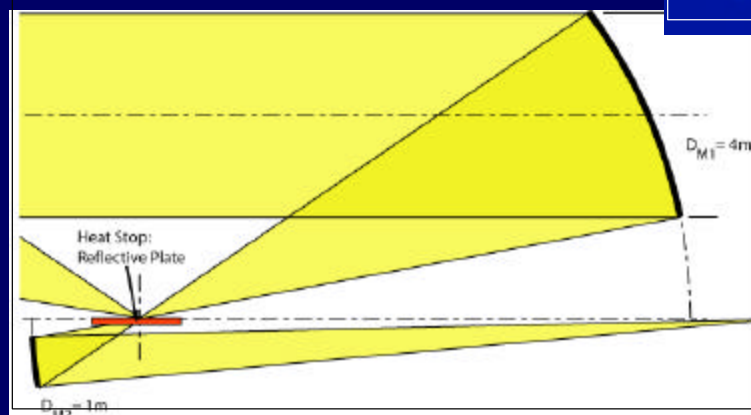
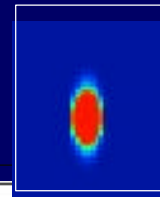


Straw Man Heat Stop: Concept A



- Reflective plate with hole
- $Q = 12 \text{ kW}$, $E = 2.5 \text{ MW/m}^2$,
 $\dot{q}'' = 180 \text{ kW/m}^2$ absorbed

Heat flux
distribution



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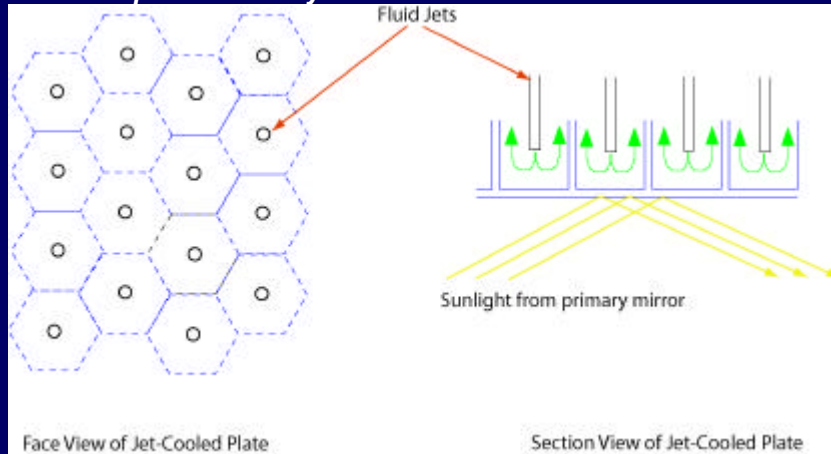
Single-Phase Jet- Impingement Cooling



- Large heat transfer coefficient
- DT kept low (2 – 4K)
- Simple, fluid temperature near ambient:
no complex control system

$$\dot{q}_{conv}'' = h(T_s - T_f)$$

$$\dot{q}_{cond}'' = -k\nabla T$$



Future Work



- Explore Concepts
 - Define Requirements
 - Select Concept
 - Design, Develop and Test
- } Parallel efforts