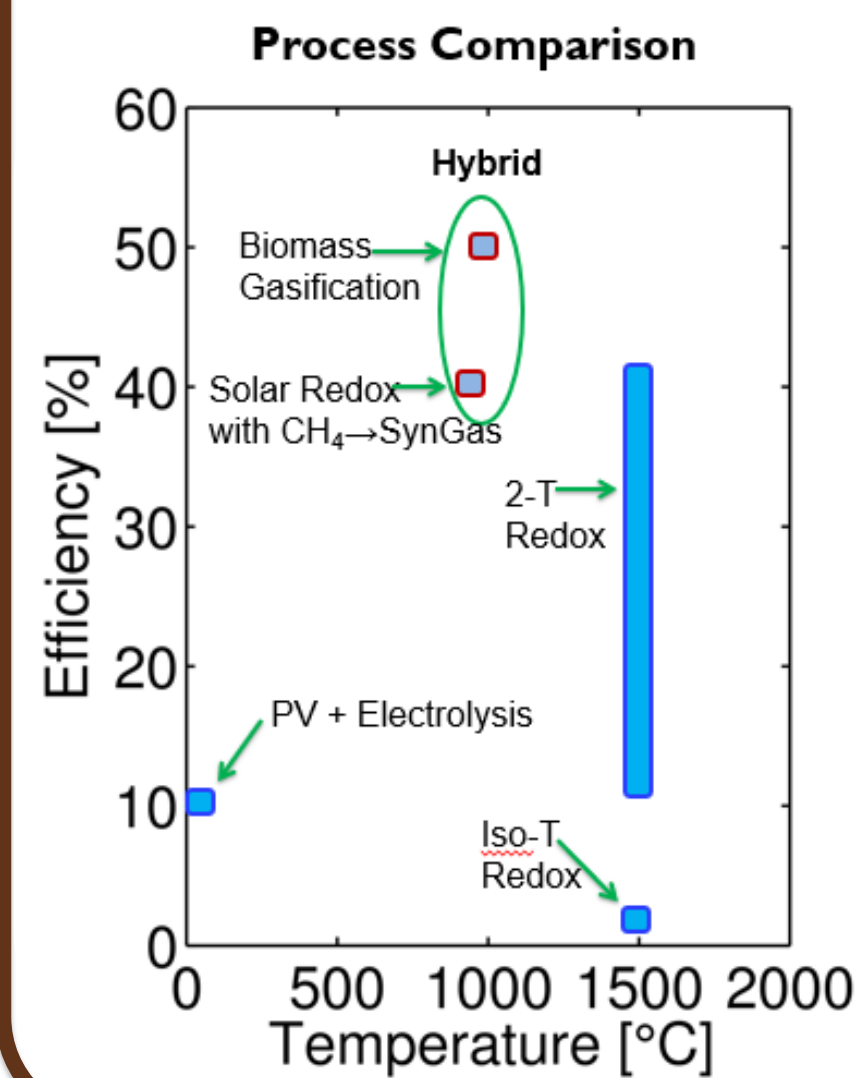


Impact of Secondary Concentrator on Concentration of Sunlight in Solar Furnace

Nate DeGoede and Dr. Peter Krenzke

Concentrated Solar Background



Concentrated Solar is an alternative to photovoltaics (solar panels) for harnessing the sun's energy.

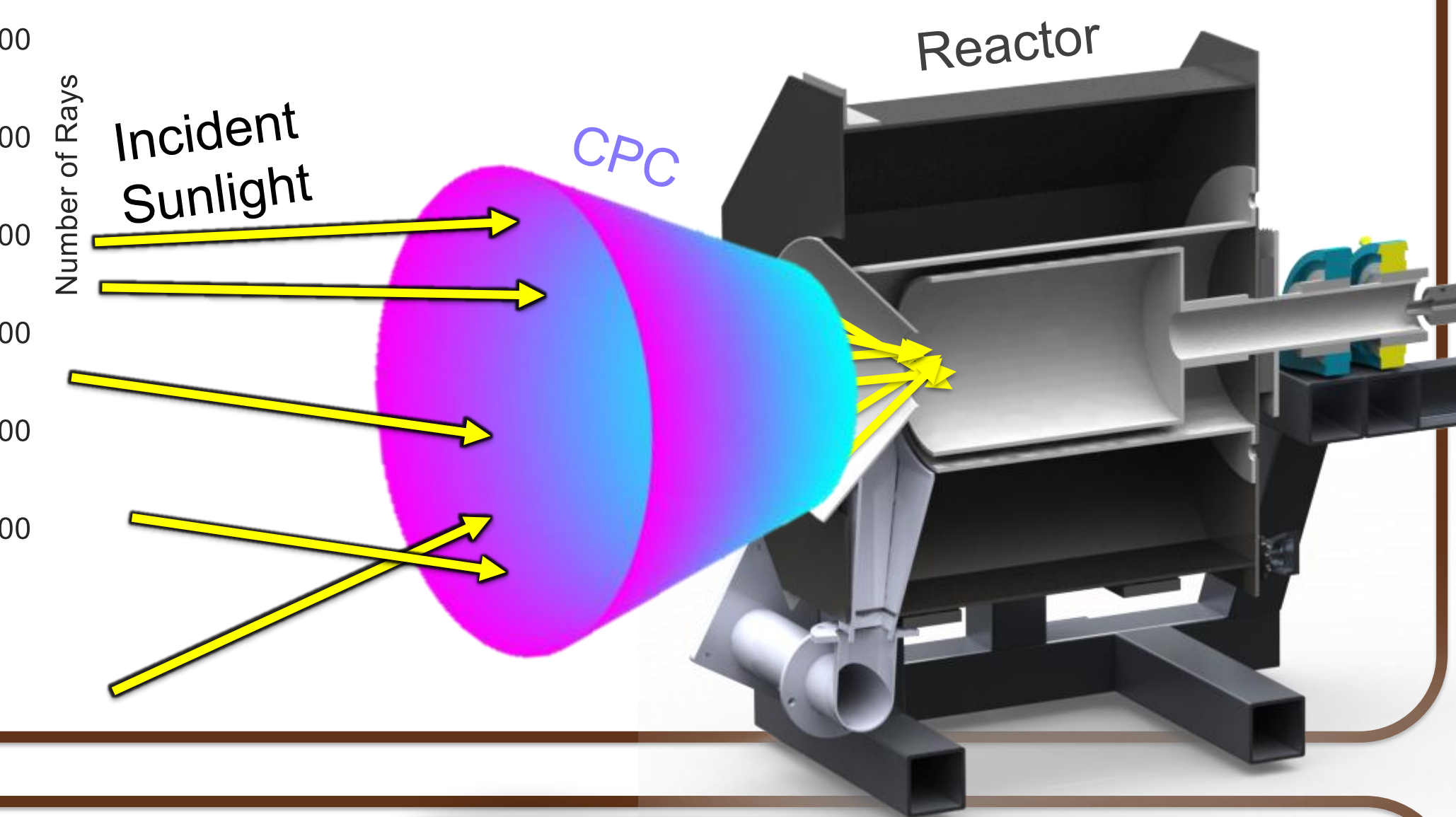
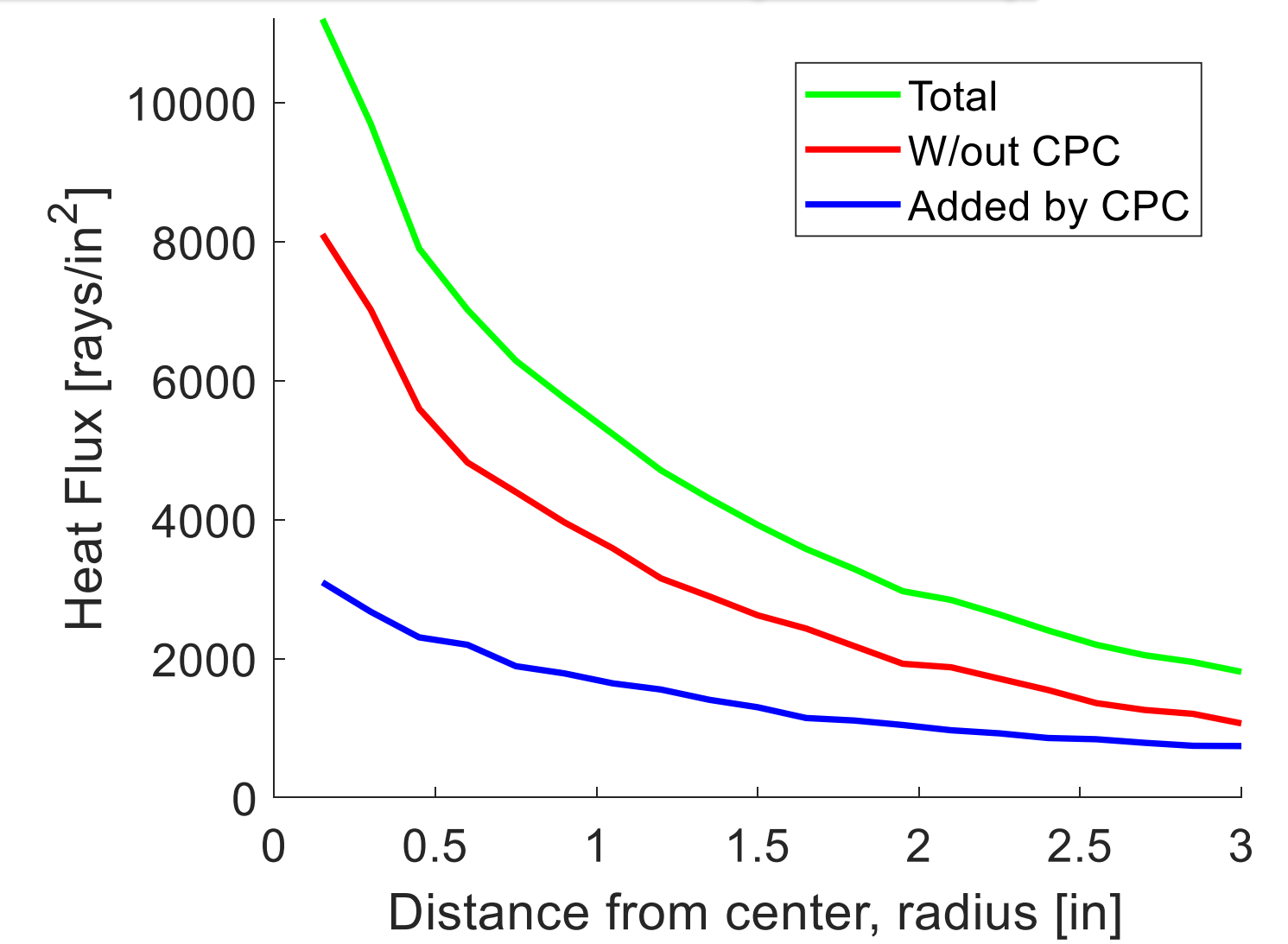
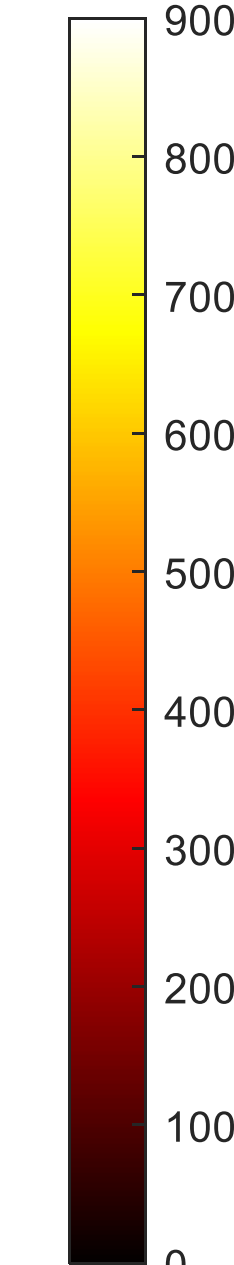
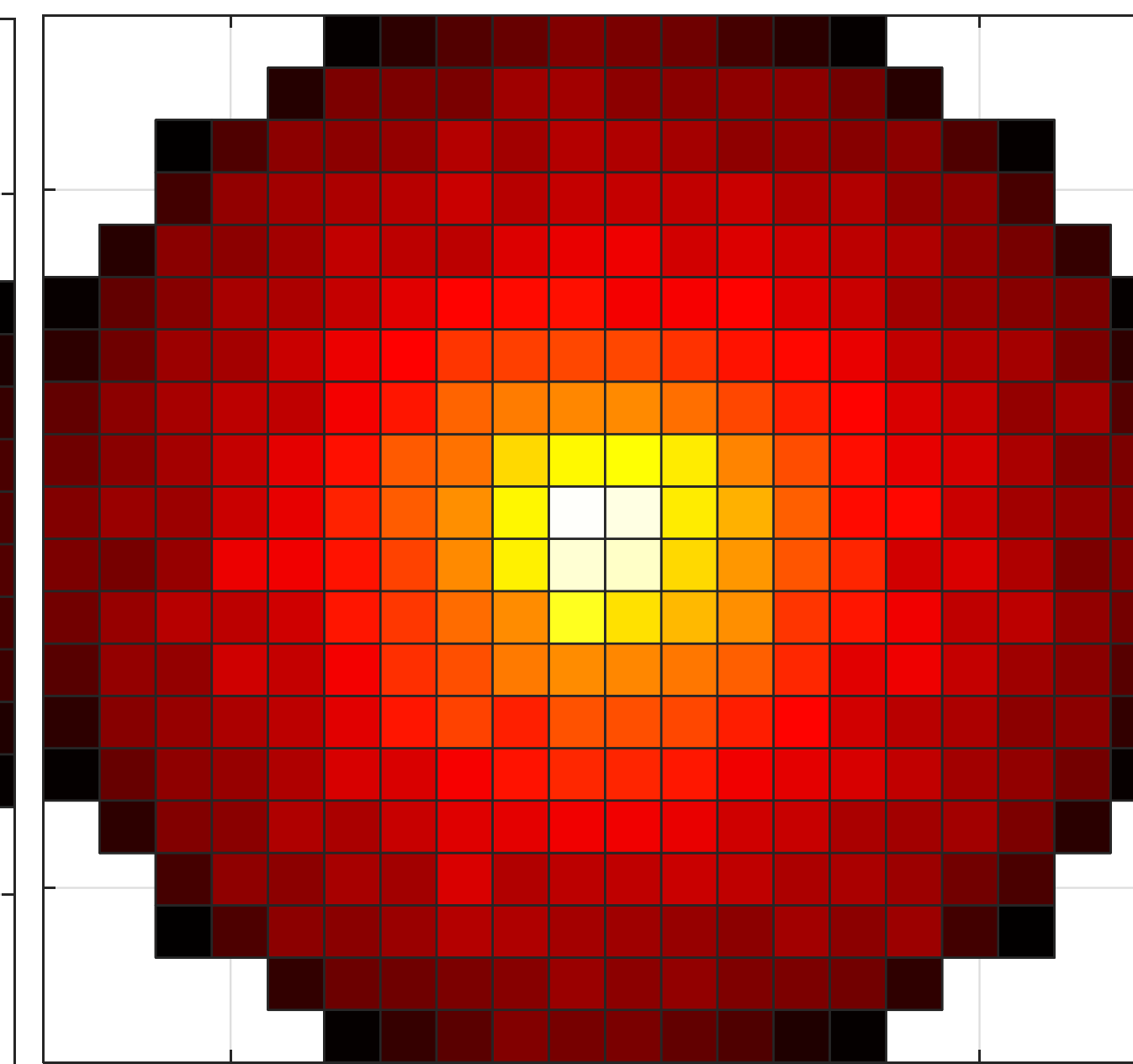
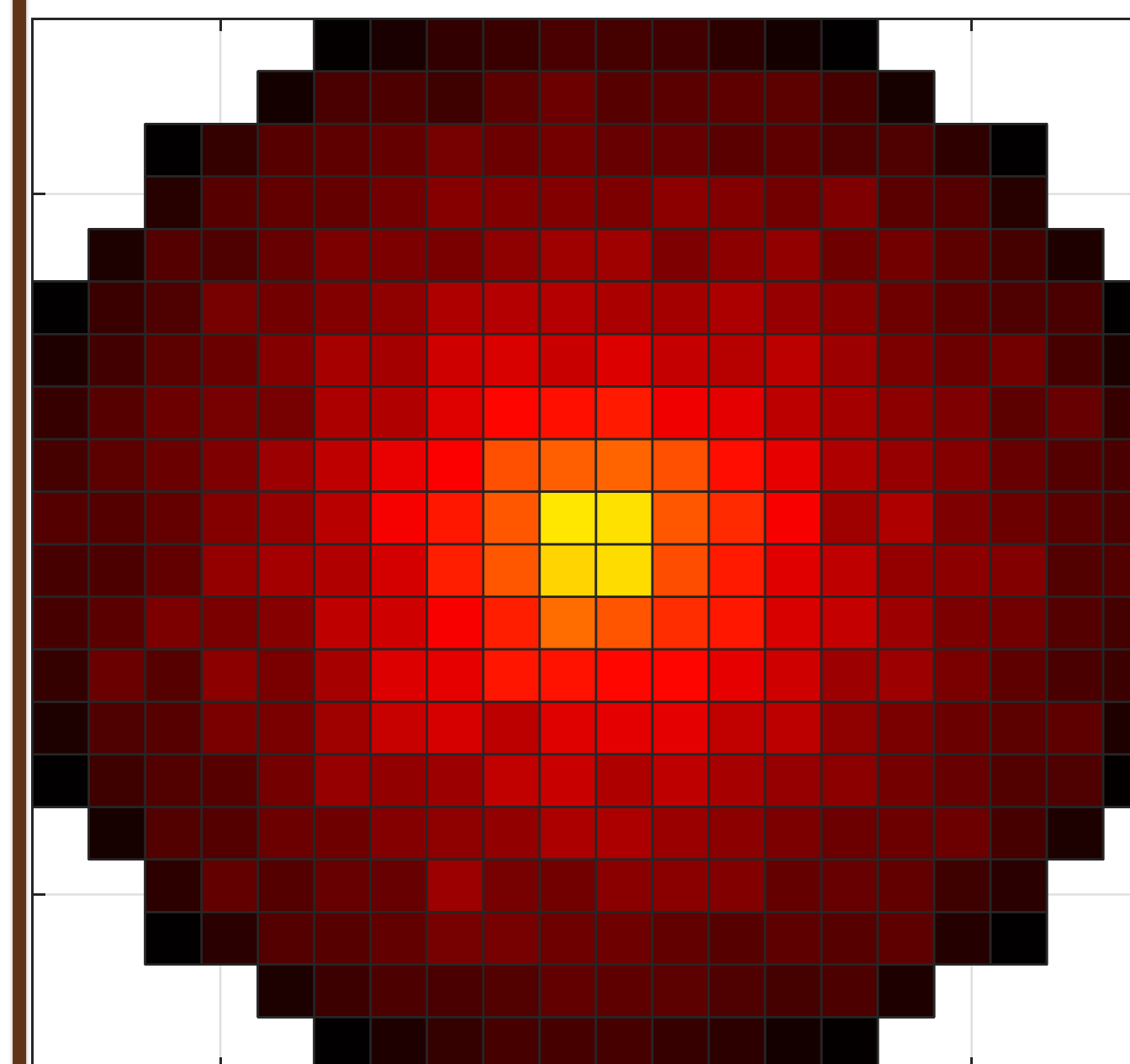


Can we capture this wasted sunlight?

Secondary Concentrator – Compound Parabolic Concentrator (CPC)

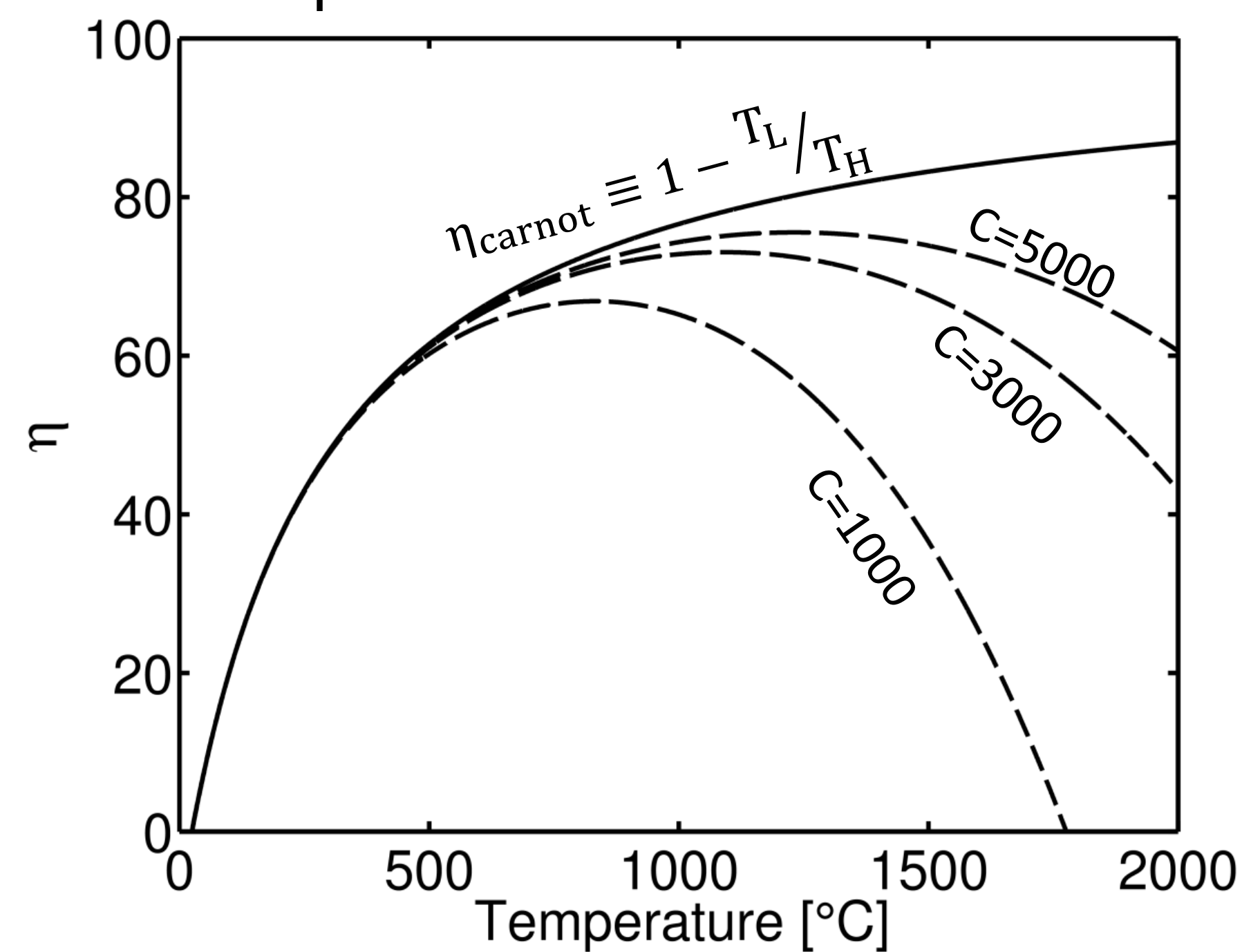
Using a CPC as a secondary concentrator we are able to capture some of the sunlight that originally would miss the opening to our reactor.

The CPC increases the concentration ratio by 52%.

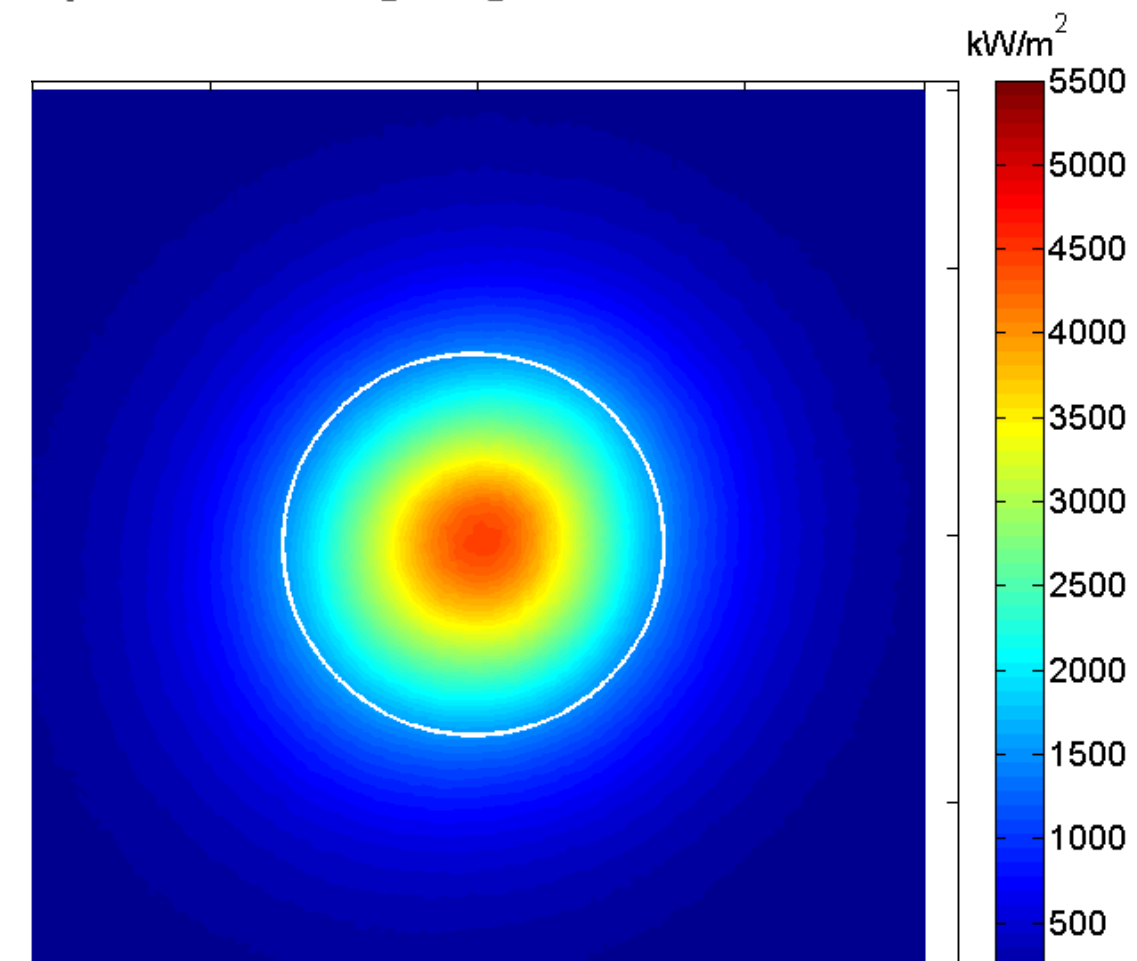


The Goal – Increase Intensity

Higher concentration ratios allow for higher temperatures and efficiencies.

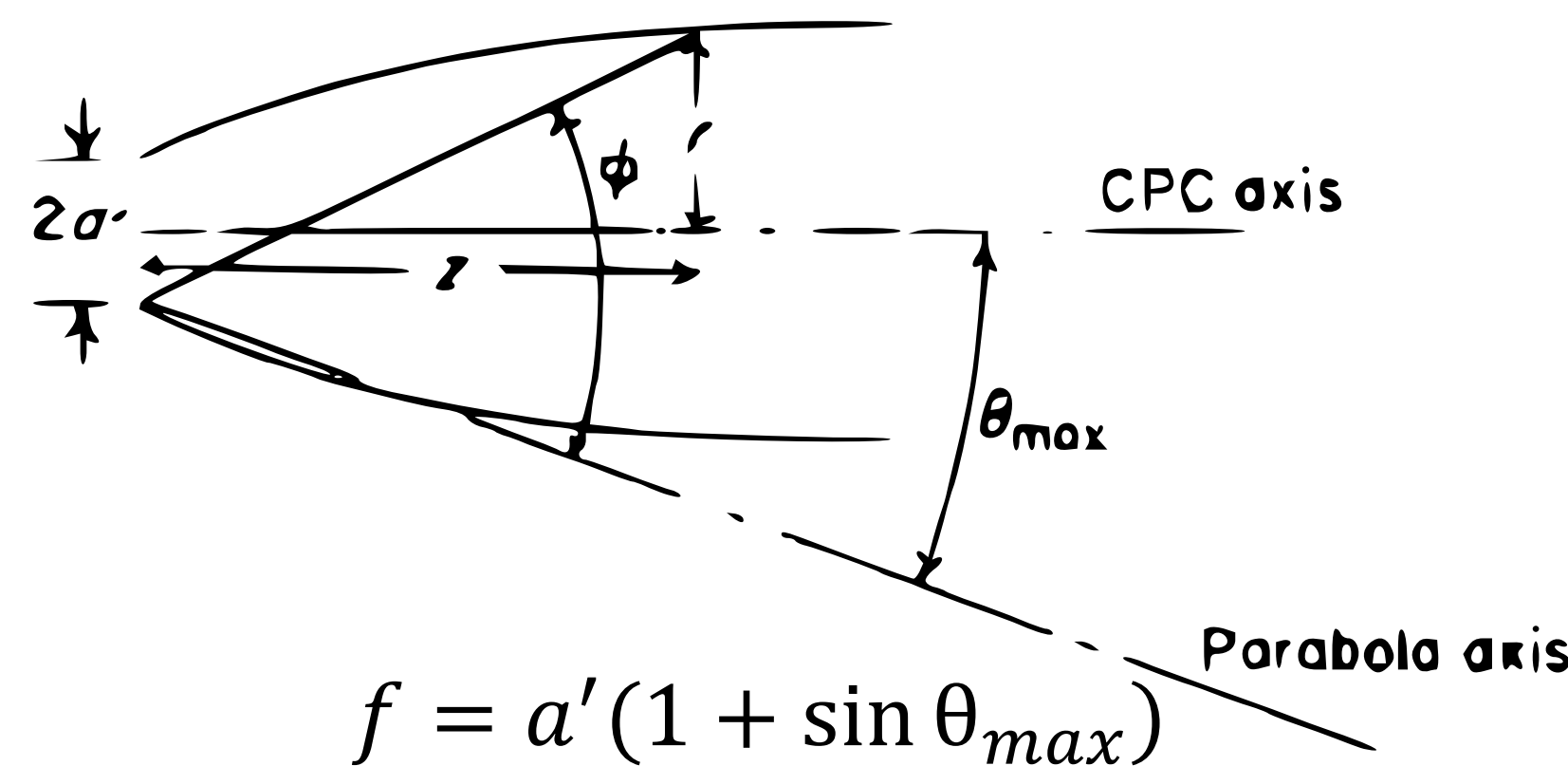


Some sunlight misses the opening to the reactor. If we capture this, we can increase the concentration of sunlight.



CPC Geometry [1]

a' = radius of reactor aperture
 θ_{max} = maximum angle of light



$$f = a'(1 + \sin \theta_{max})$$

$$x = \frac{2f \sin \psi \sin(\varphi - \theta_{max})}{1 - \cos \varphi} - a' \sin \psi$$

$$y = \frac{2f \cos \psi \sin(\varphi - \theta_{max})}{1 - \cos \varphi} - a' \cos \psi$$

$$z = \frac{2f \cos(\varphi - \theta_{max})}{1 - \cos \varphi}$$

$$0 < \psi < 2\pi$$

φ bounds determined by a' & θ_{max} as well as any truncation desired

Monte Carlo Ray Tracing

