Thermodynamic Understanding of Segmented CPC
Bennett Widyolar, Lun Jiang, Roland Winston

**Methods for Approximating CPC Profile**

1) Simple segment approximation, where endpoints of segment lie along ideal profile.
2) Projection of segment based on edge-ray principle which can be taken from the start, mid, or endpoint of the segment.

**Performance Metrics**
Geometric optical efficiency does not have a direct correlation with flux and therefore the geometric concentration can be larger than the theoretical limit of \( C_{\text{lim}} = \frac{1}{\sin(\theta_d)} \) by having optical efficiencies less than one. We therefore propose the following Figure of Merit (FOM), where \( C \) is the geometric concentration ratio and \( \theta_d \) is the modified IAM (mIAM), a function of \( \sin \theta \) instead of \( \theta \). The entire rightmost term contains the integrals is the modified optical efficiency. The mIAM graph correctly reflects the energy density for different angles according to the cosine effect which weighs optical efficiencies at small incident angles more importantly than those at larger incident angles. The FOM multiplied by the radiation flux at the source is the maximum surface flux achievable at the absorber.

**Incidence Angle Modifiers**

- **Segment Approximation**
  - 45 Degree - Segment Approximation
  - 45 Degree - Start Point Projection

- **Start Point Projection**
  - 45 Degree - Start Point Projection
  - Midpoint Projection

- **End Point Projection**
  - 45 Degree - End Point Projection

- **Guaranteed Optical Transmission**
  - Guarantees Acceptance Angle
  - Guarantees Ideal Flux!

**Reflector Length**
Start point projection is impractical for small #s of segments due to huge reflector length.

**Figure of Merit vs # of segments**

The ideal CPC guarantees both optical transmission and maximum flux. By segmenting the profile, however, we have guaranteed them separately.