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# Efficient high-power planar-waveguide lasers

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**The key attributes that determine the usefulness of a laser are:**

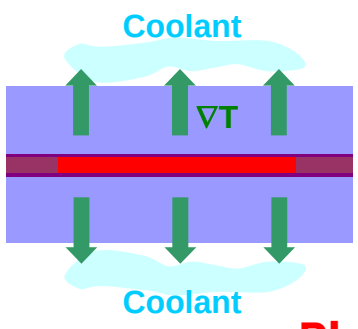
- **brightness** power per unit solid angle ($Wsr^{-1}$)
- **spectrum** of the emitted radiation
- **temporal characteristics** pulsed or continuous wave (CW)

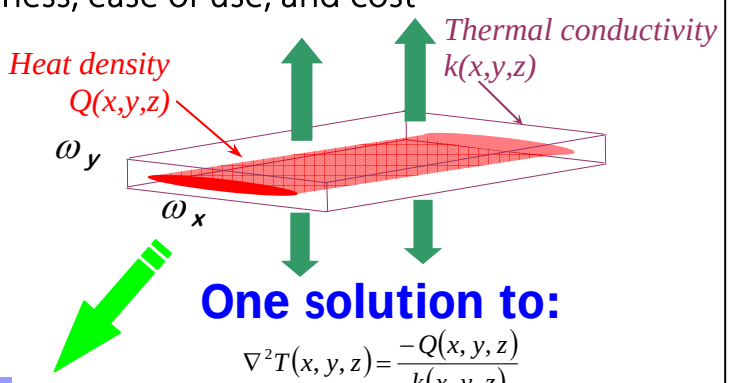

## Motivation for higher laser powers

- general interest in expanding the laser's operational parameter space
- new applications emerging that push state-of-the-art
- primary drivers: efficiency, size, robustness, ease of use, and cost

## Primary challenge

- efficiency ⇒ paramount for high-brightness lasers
- deficit in power absorbed to power extracted ⇒ **HEAT**
  - ➢ temperature rises, gain medium distorts
  - ➢ brightness limited
  - ➢ potential for critical failure




## One solution to:

$$\nabla^2 T(x,y,z) = \frac{-Q(x,y,z)}{k(x,y,z)}$$

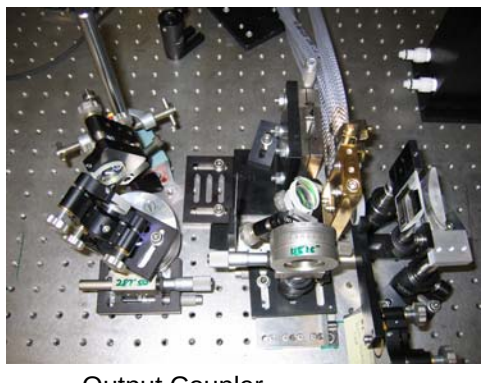
- planar geometry
- ~2D heat deposition $\omega_x >> \omega_y$
- ∇T in one axis only

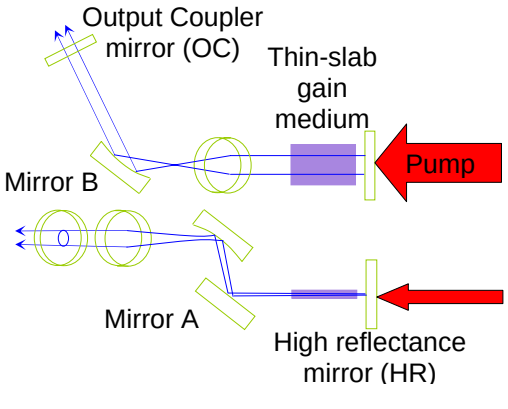
## Planar waveguide advantages

- ✓ High gain ⇒ excellent efficiency
- ✓ Compatible with high-power diode lasers
- ✓ Index guiding stronger than thermal effects

## Planar waveguide challenges

- ✖ Highly elliptical and astigmatic beam
- ✖ Unguided axis ⇒ standard cavity design
- ✖ Extreme $Q$ at very high powers



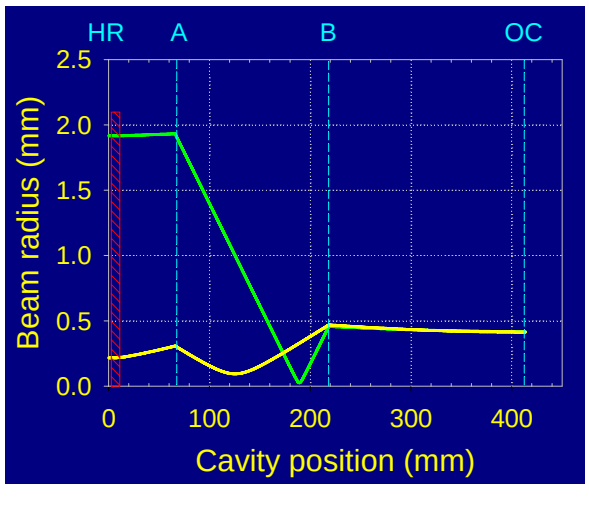



## Progress:

- ✓ Demonstration of a resonator answering first two challenges
  - ⇒ Highly elliptical beam in thin-slab gain medium
  - ⇒ Circular anastigmatic output

## Future work:

- ➢ high pulse energy thin-slab
- ➢ Combine resonator and waveguide structure for high-power CW
- ➢ Planar waveguides for very high powers and specific applications

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