# UV LED Lens Technology


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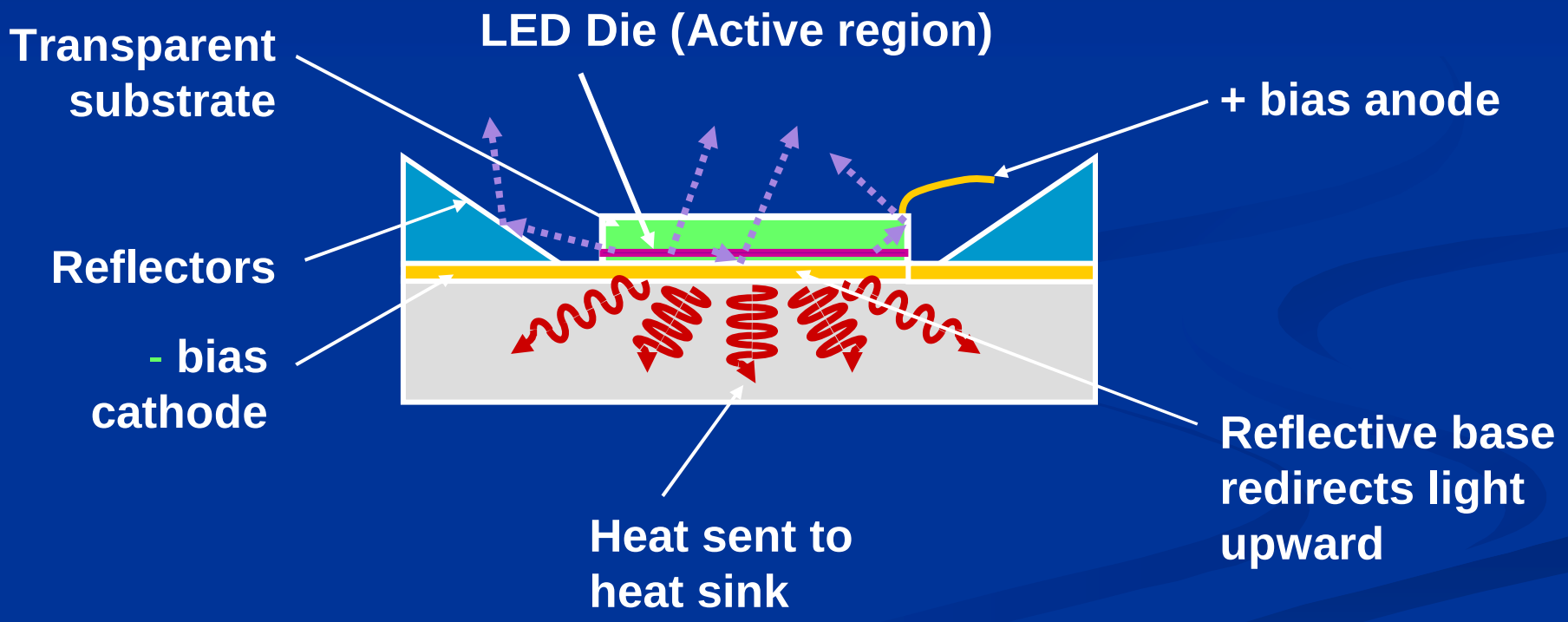
# Features of UV LED

- LEDs are solid state devices
  - Narrow optical spectrum
  - Energy efficient, Instant on/off
  - Rugged, Reliable, Long Life
- Environmentally Friendly, Safe
  - Mercury free, Lead free
  - RoHS compliant
  - Low voltage
- Application
  - Adhesive, ink and coating curing
  - Inspection
- Output power
  - Low-Moderate
  - Growth following Moore's Law

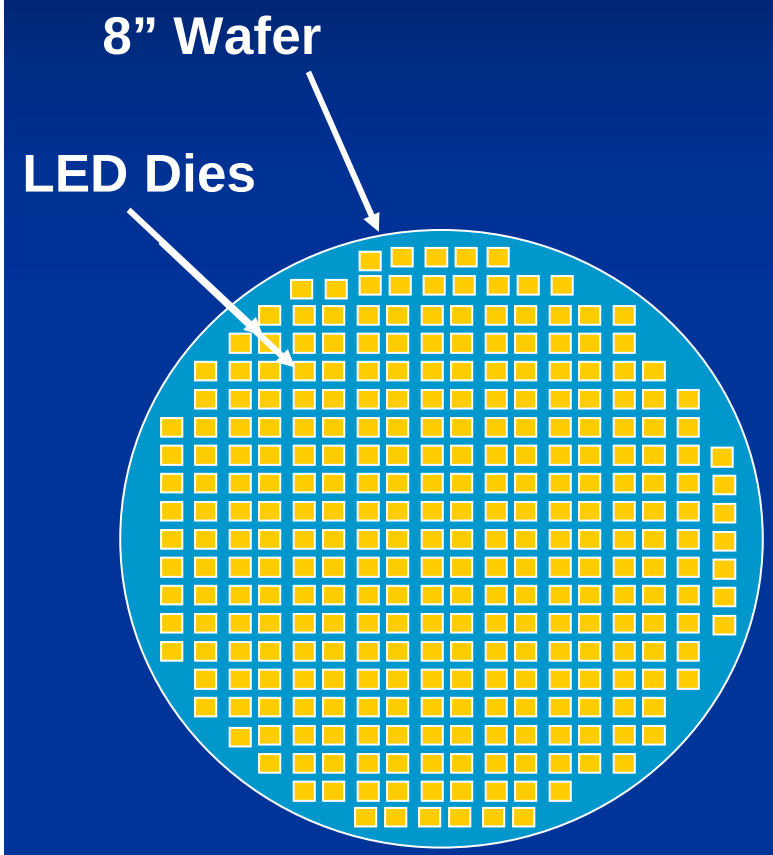
# Outline

- Physical characteristics that affect optical design
- Optical lens for array of LEDs
- Control of radiation from one LED + lens
- Different beam types
- Measured data
- Summary

# Lambertian Emission Pattern Affects Optics



# Small Die Results in Low Power Per Die




Typical LED Die Size: 1 mm x 1 mm

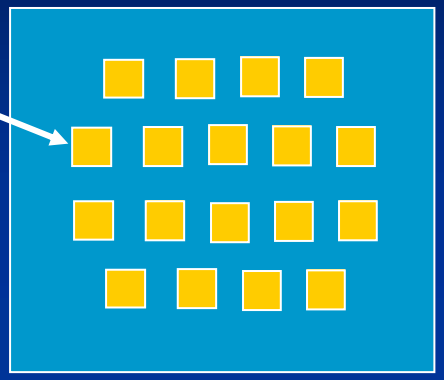
Advantage of Small Die Size
- Discard just defective die
- Distribute waste heat to heat sink
- Less expansion mismatch of die and heat sink

Disadvantage of Small Die Size
- Low power per die

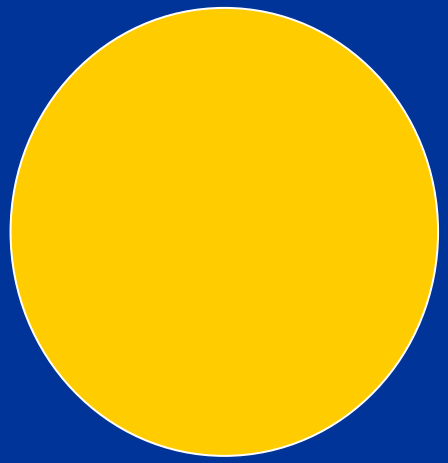
Solution
- LED Arrays
- Optical Lens

# One Lens vs. Array of Lens

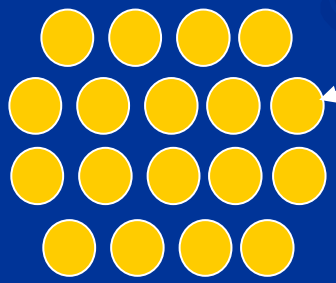
LED



Array of LEDs



One Lens



Array of Lens

Lens could be
- Aspherical
- Fresnel
- Half sphere
- Rod
- Others

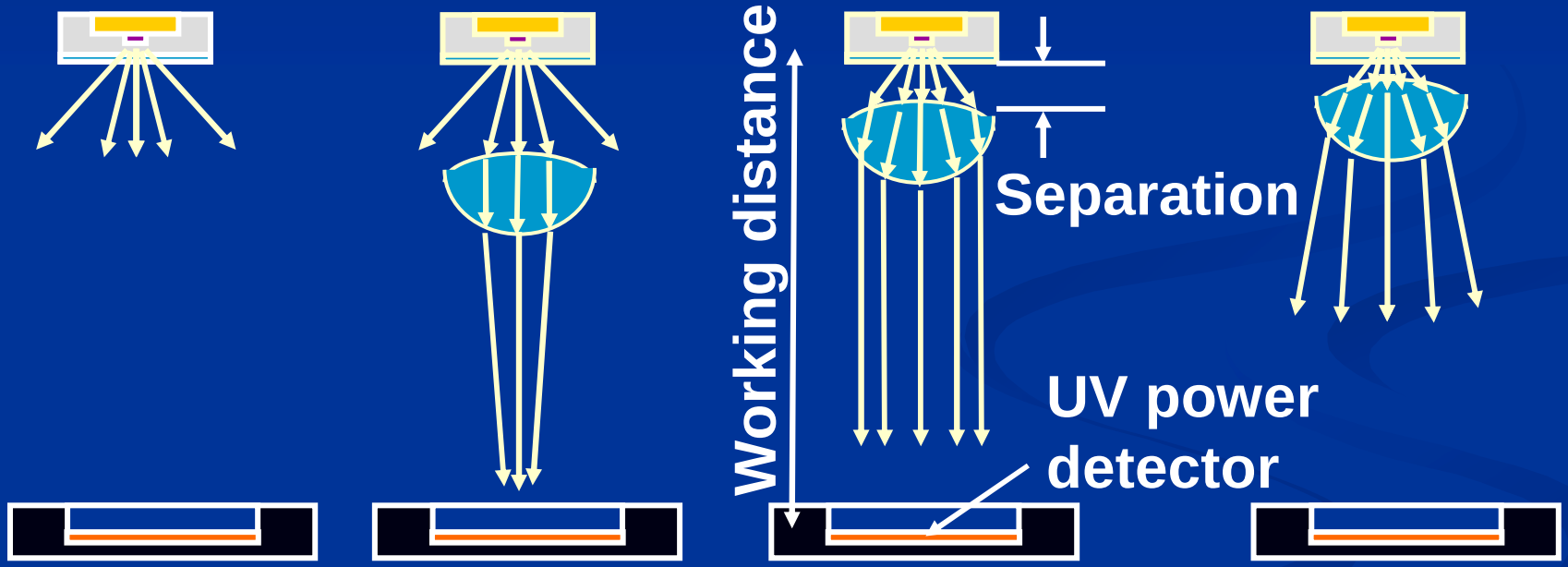
# Lens Size and Separation

**No lens**

**Lens far from chip**

**Lens near LED chip**

**Lens very close to chip**




**Power is spread widely**

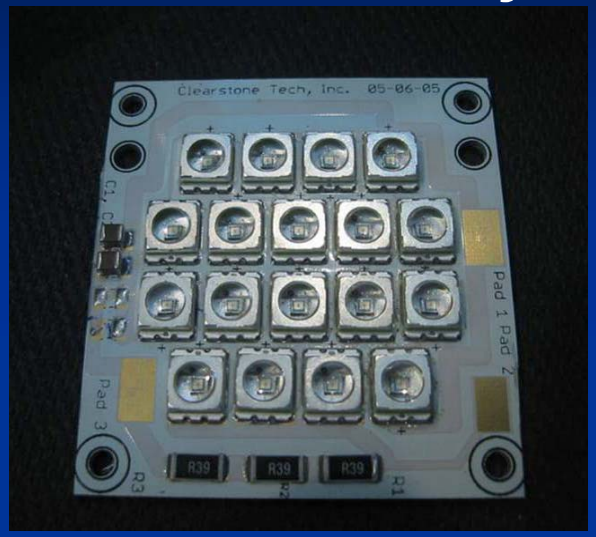
**Not all power capture by lens**

**Beam collimates**

**Beam will not collimate**

# Lens Array on LED Head

## 18 LED Array

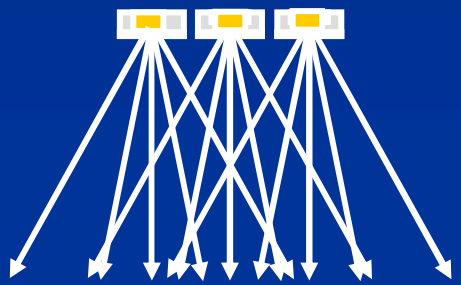


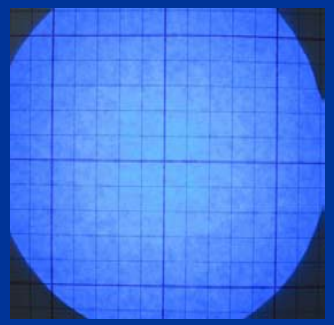

## 18 Lens Array

## LED Head with Lens Array

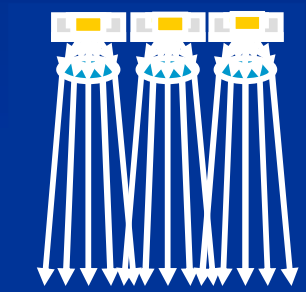
# Lateral Offset Focuses the Beams

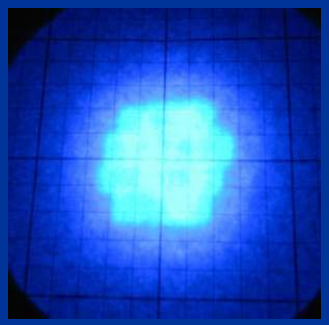
**No Lens**
**24 mW/cm2**



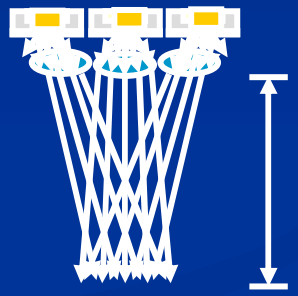


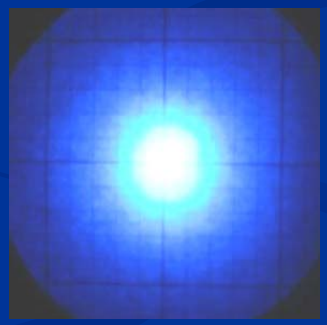
**Parallel Beam**
**168 mW/cm2**



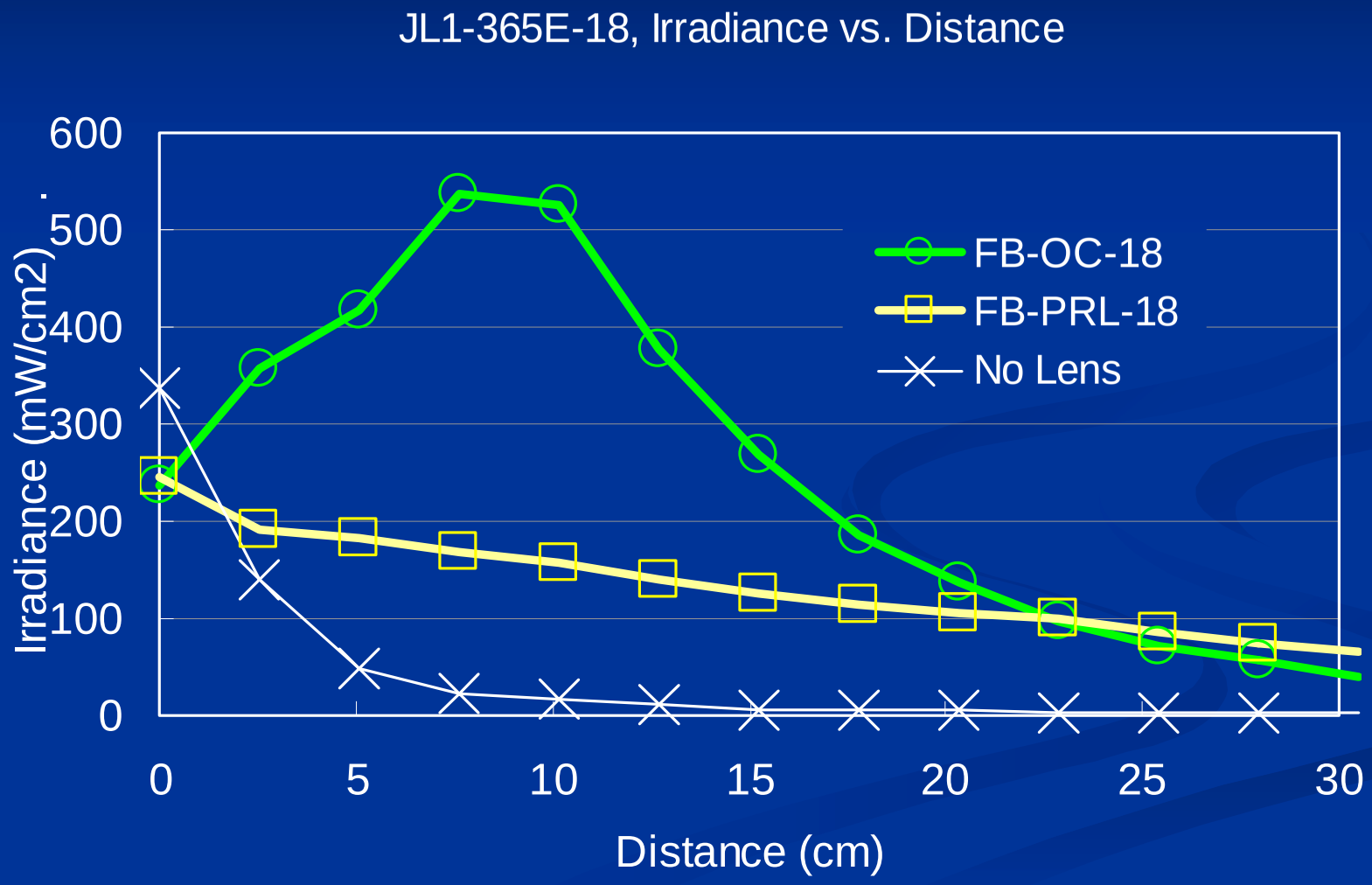


**Focused Beams**
**538 mW/cm2**

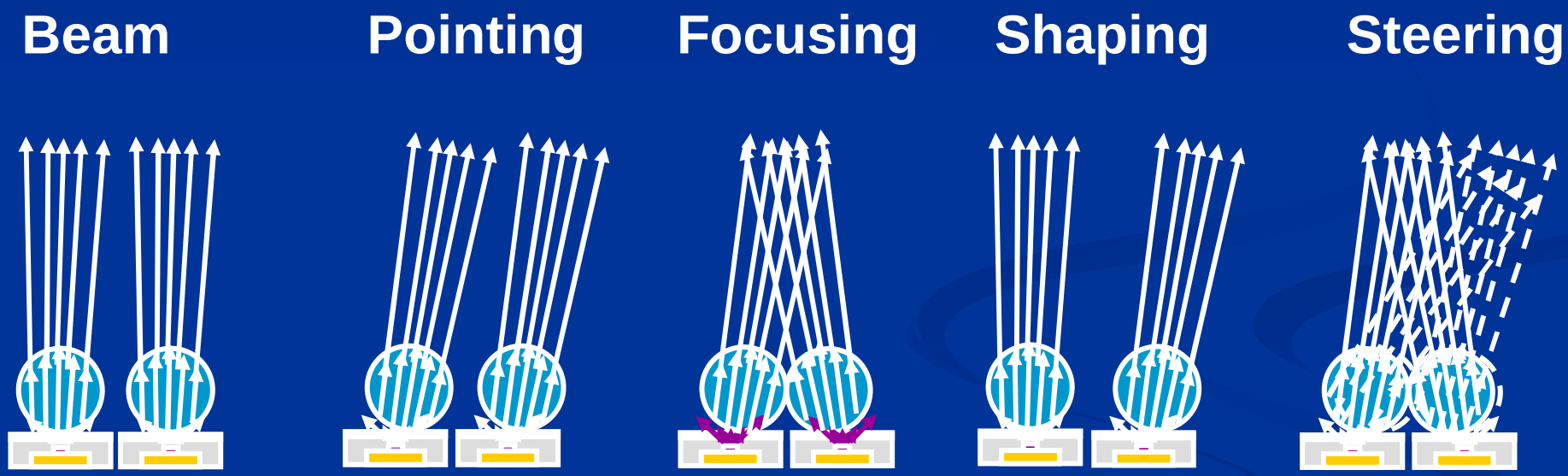


# Optical Power Density Comparison
## 18 LED Array w/wo Lens Array



# Lens Array Forms Different Kinds of Beams



# Summary

Power from individual LED is relatively weak. Solution is
- Array of LEDs
- Array of lens

Lens size and separation controls radiation from one lens.

Lateral offset forms different kinds of beams from array.

LED Array + Array of Lens increases capability of LEDs.

Benefit of attractive features of LED can be realized.