LUXIM®

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Increased collection efficiency of LIFI™ high intensity electrodeless light source

SPIE08, San Jose convention Center
Abdeslam Hafidi, PhD, Sr. Staff Scientist

Outline

- Introduction to LIFI™ technology
- LIFI™ light source performance
  - Reliability data
  - Power efficiency
- Applications and target markets
- Summary

LUXIM Corporation: LIFI™ Lighting

- LUXIM Corporation
  - Lighting Company
    - 34 people
    - Founded in 2000
    - Based in Silicon Valley
  - Diverse markets
  - Investors:

SEQUOIA CAPITAL®

CROSSLINK CAPITAL

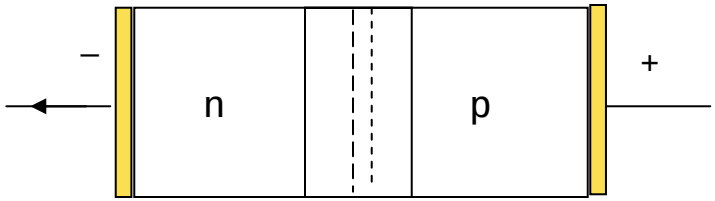
WORLDVIEW TECHNOLOGY PARTNERS

LUXIM Headquarters

LUXIM Launches LIFI™ at CES 2007

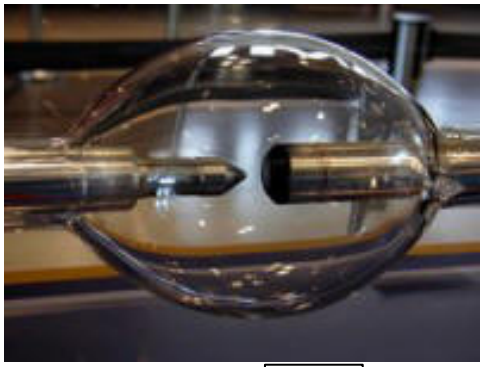
Light Generation: Start with Basics

Semiconductor technology



Apply voltage across PN junction

High Intensity Discharge (HID) technology



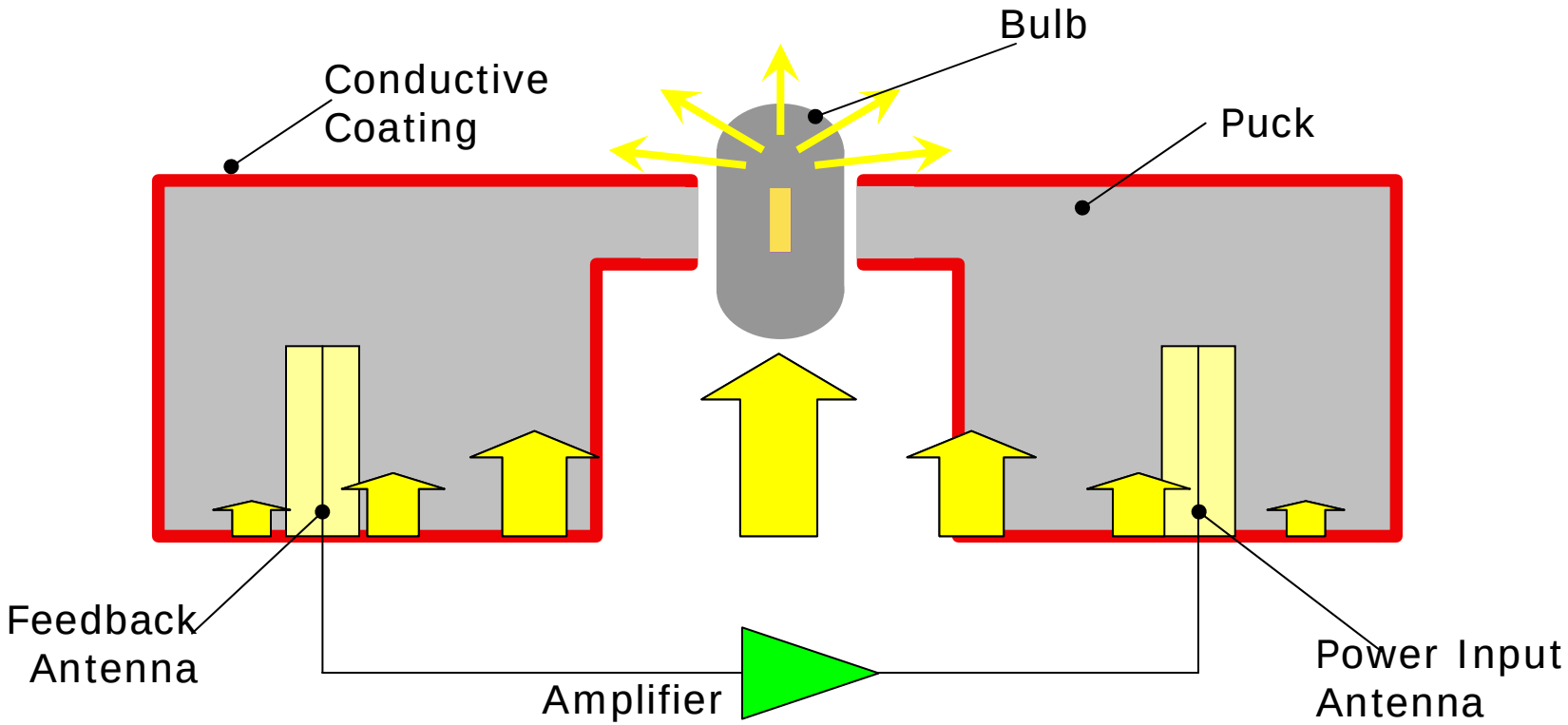
Apply voltage across electrodes

Semiconductor technology to generate power

HID approach but without electrodes

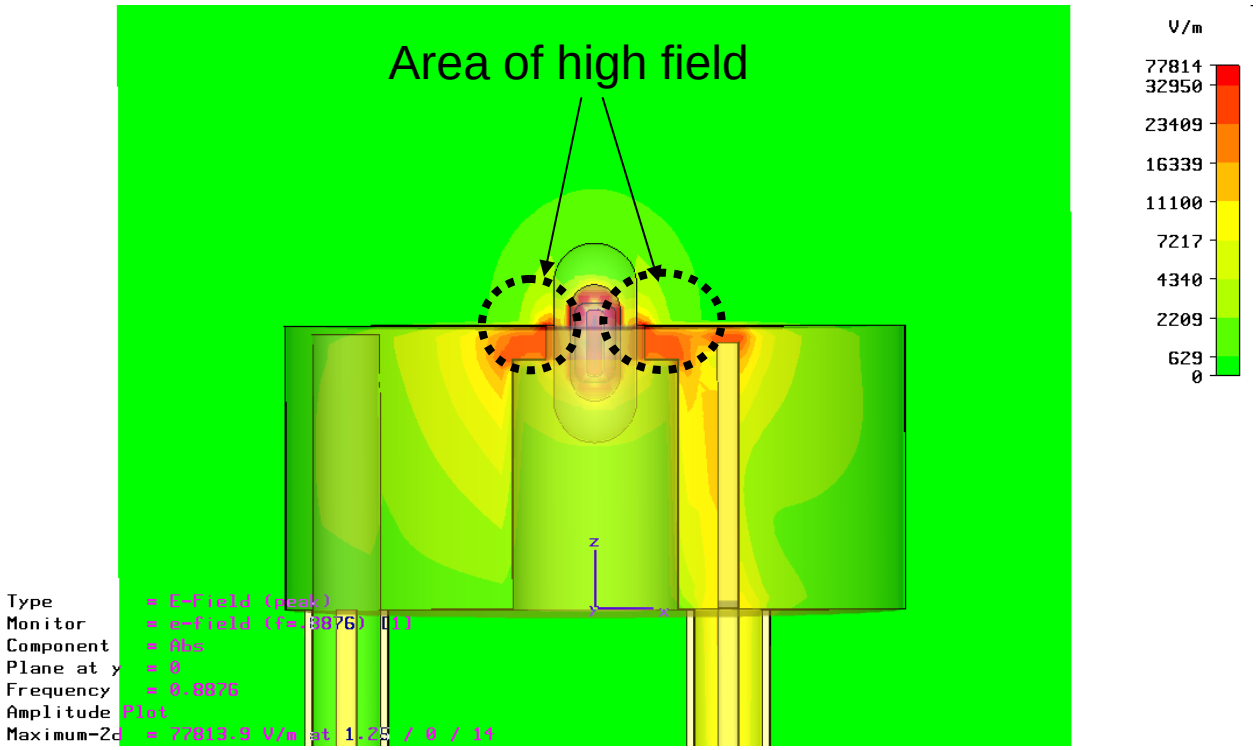
LIFI™ Hybrid light source

How Luxim's LIFI Technology Works



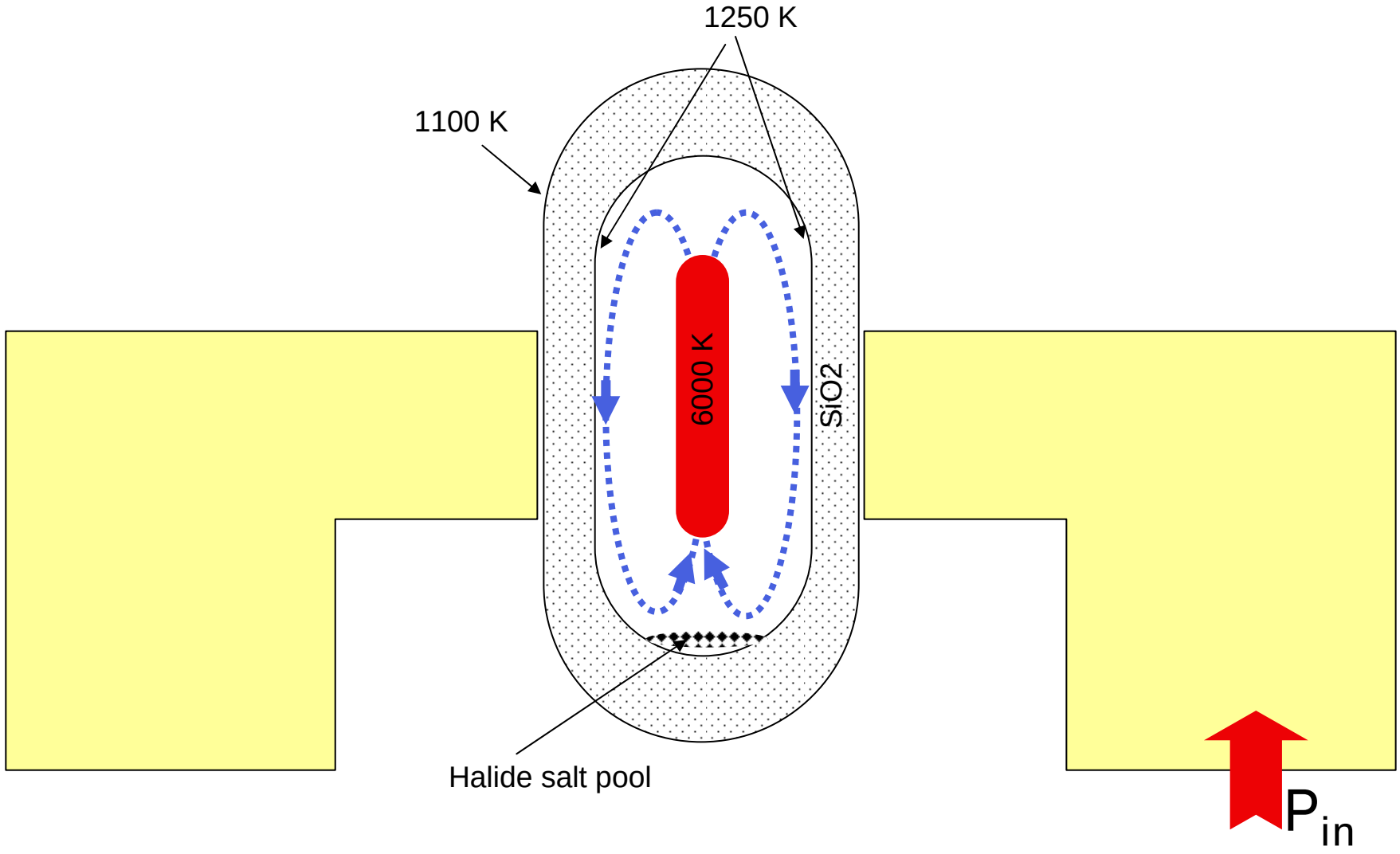
1) Amplifier feedback circuit establishes electric field
2) Field ionizes gas and creates plasma ⇒ Purple glow emission
3) Plasma vaporizes the salts ⇒ Blue light emission
4) Salts join the plasma ⇒ Powerful white light emission

Field Strength Simulation

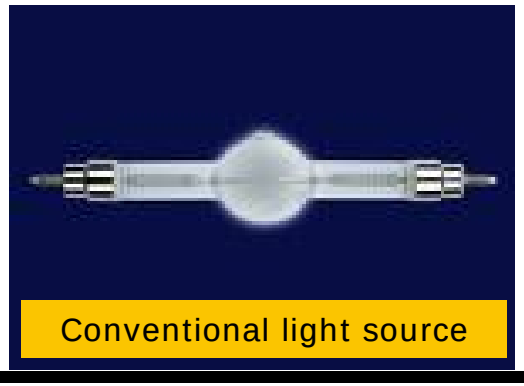


Simulation with bulb/puck shows the strong E-field at the vicinity of the bulb

Thermodynamics Inside the Bulb



Power Balance Improvement



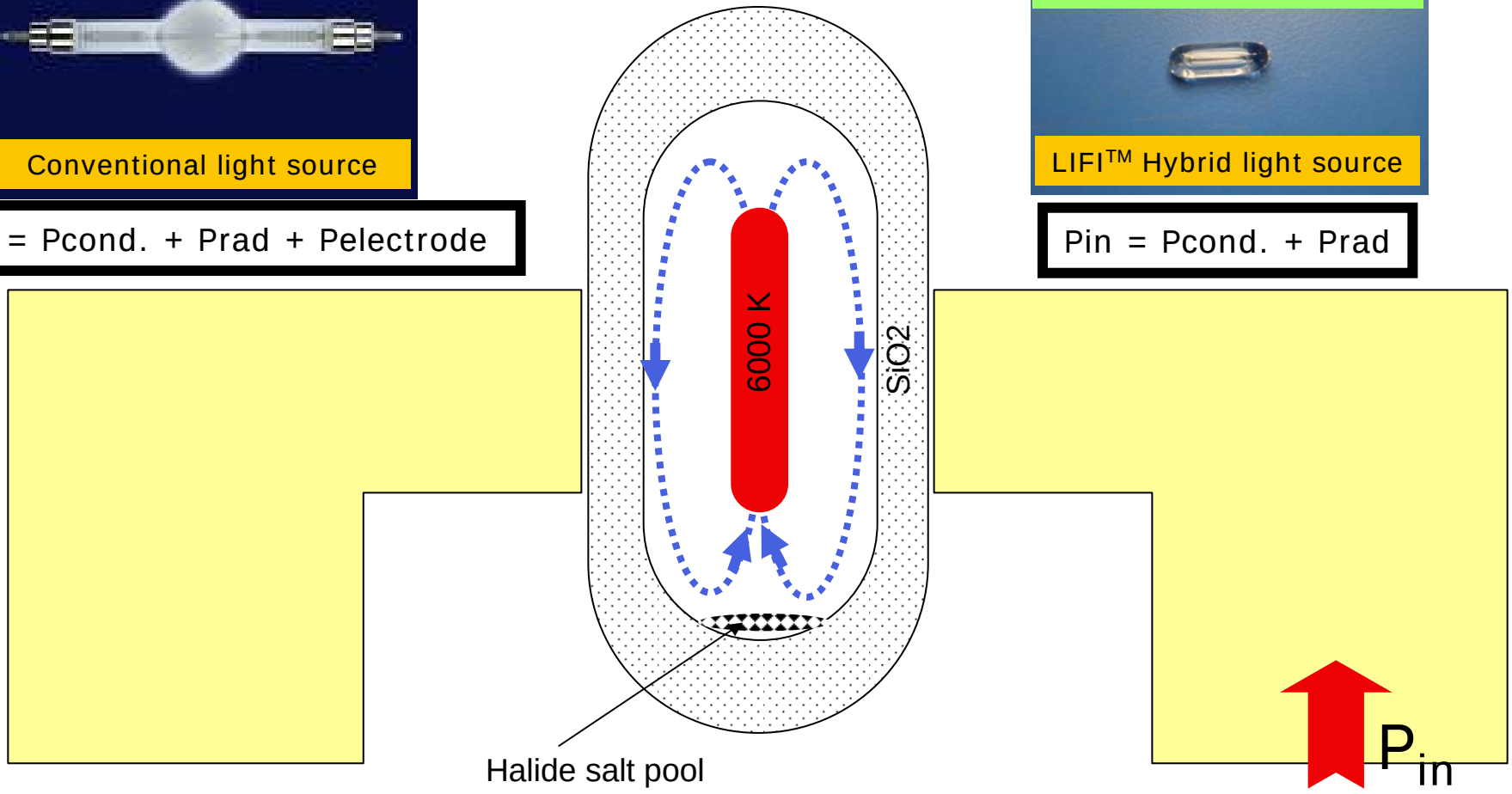
Conventional light source

Pin = Pcond. + Prad + Pelectrode

20% improvement in efficacy by eliminating electrodes

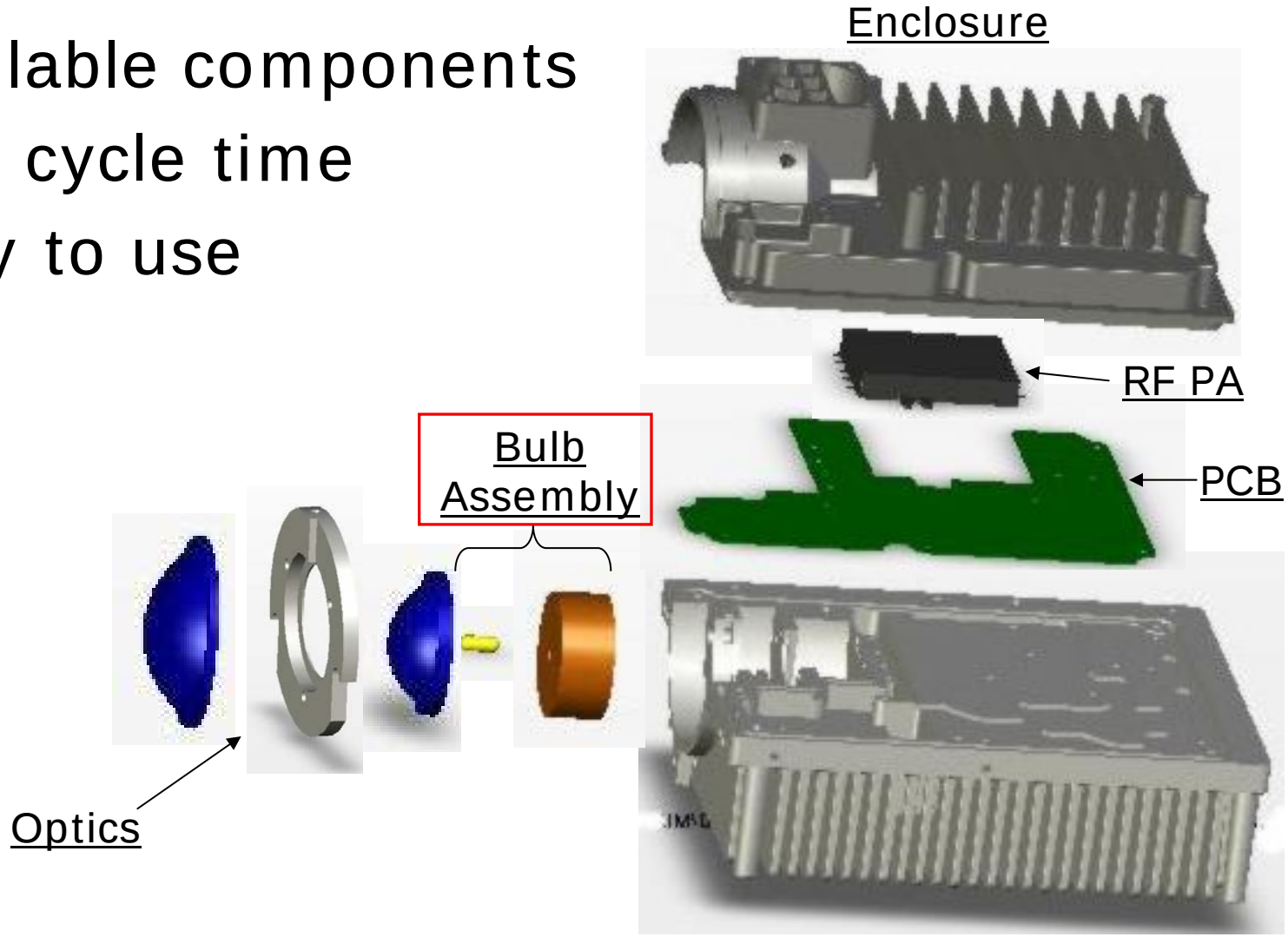
LIFI™ Hybrid light source

Pin = Pcond. + Prad

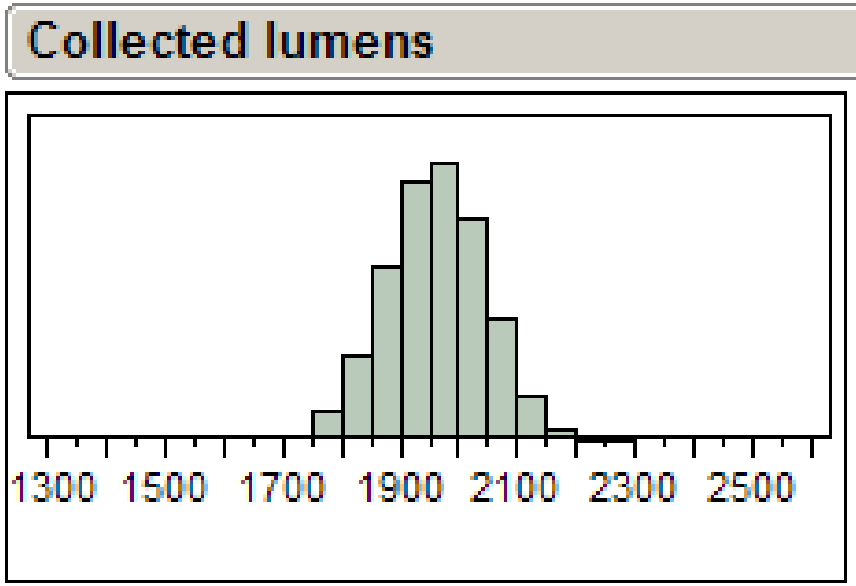


LIFI™ Design Simplicity

- Available components
- Fast cycle time
- Easy to use



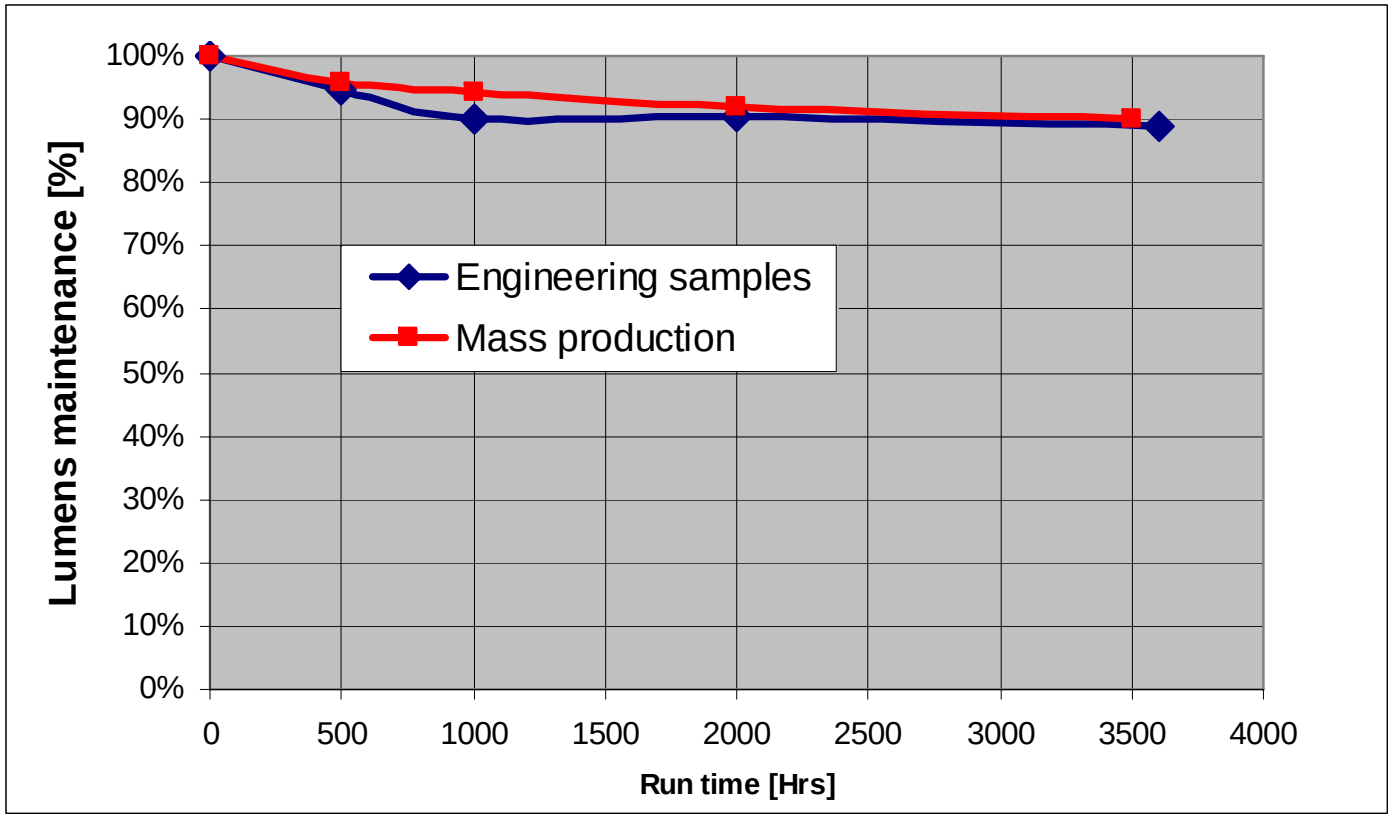
LIFI™ Hybrid Light Source: Mass Production Data (9/07 to 10/07)



Moments

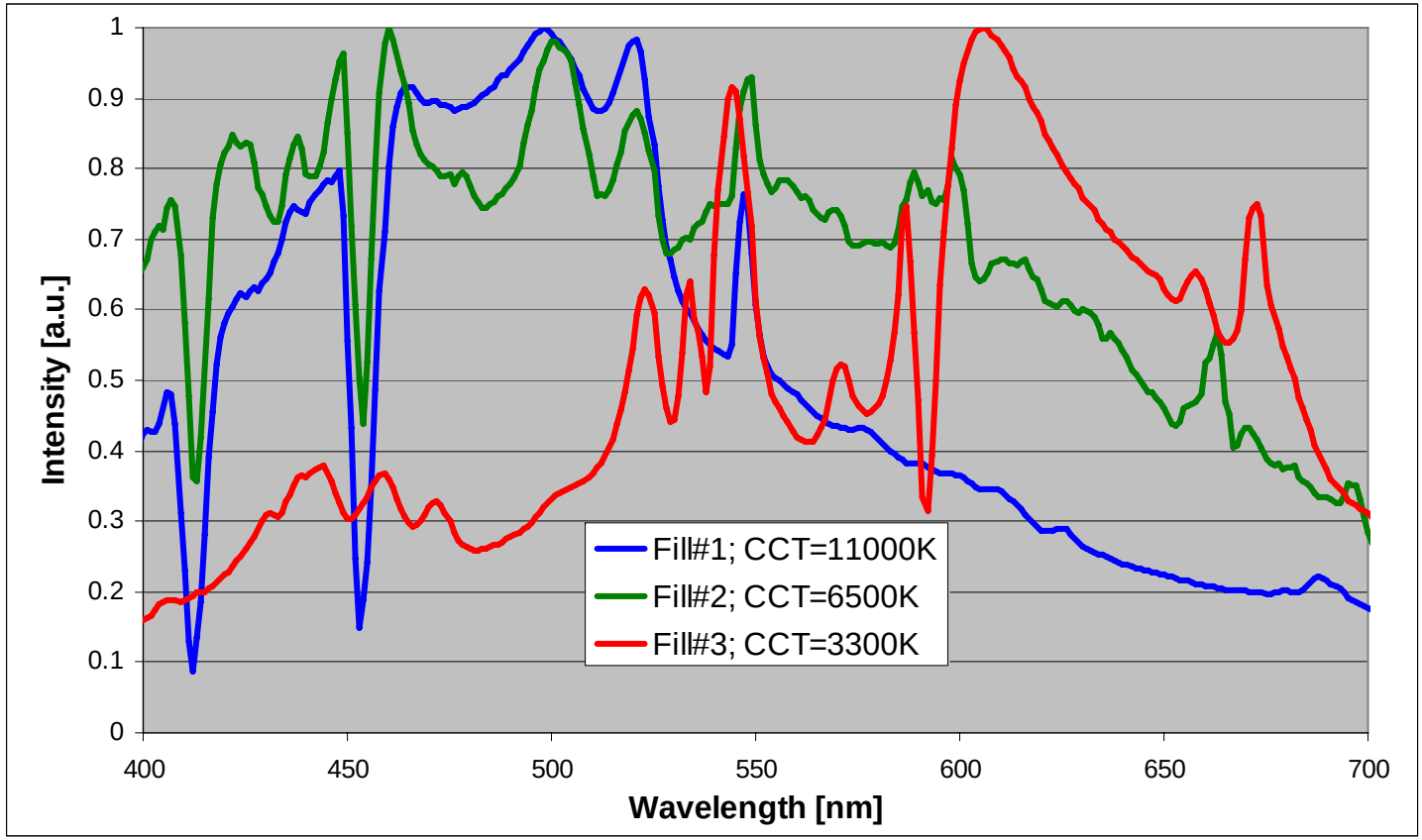
Mean	1961.2159
Std Dev	83.627767
Std Err Mean	0.4872053
upper 95% Mean	1962.1708
lower 95% Mean	1960.2609
N	29463

LIFI™ Hybrid Light Source: Reliability Data



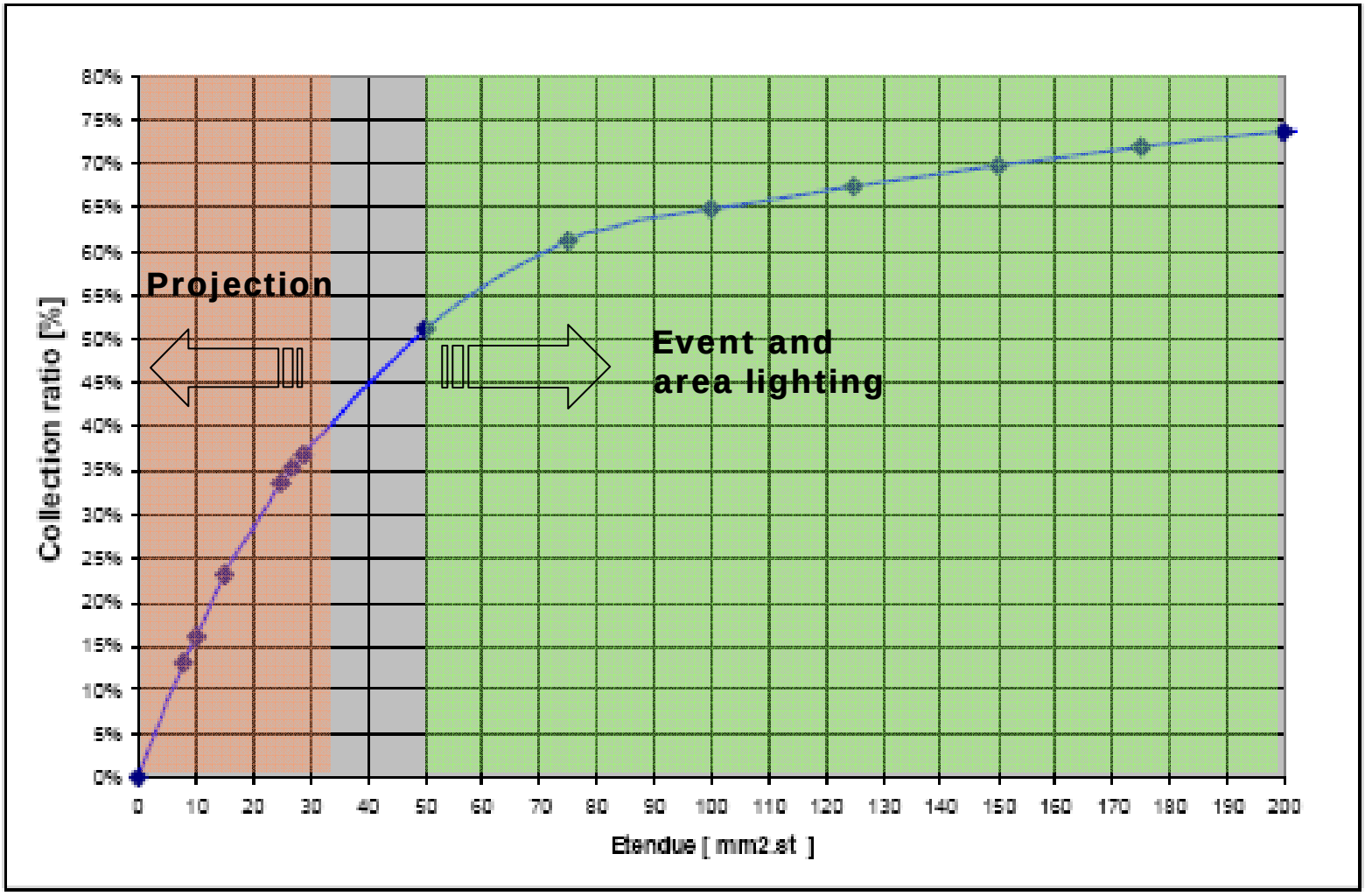
1min ON/1min OFF	84 000 cycles

Spectrum Variation Versus Bulb Fill

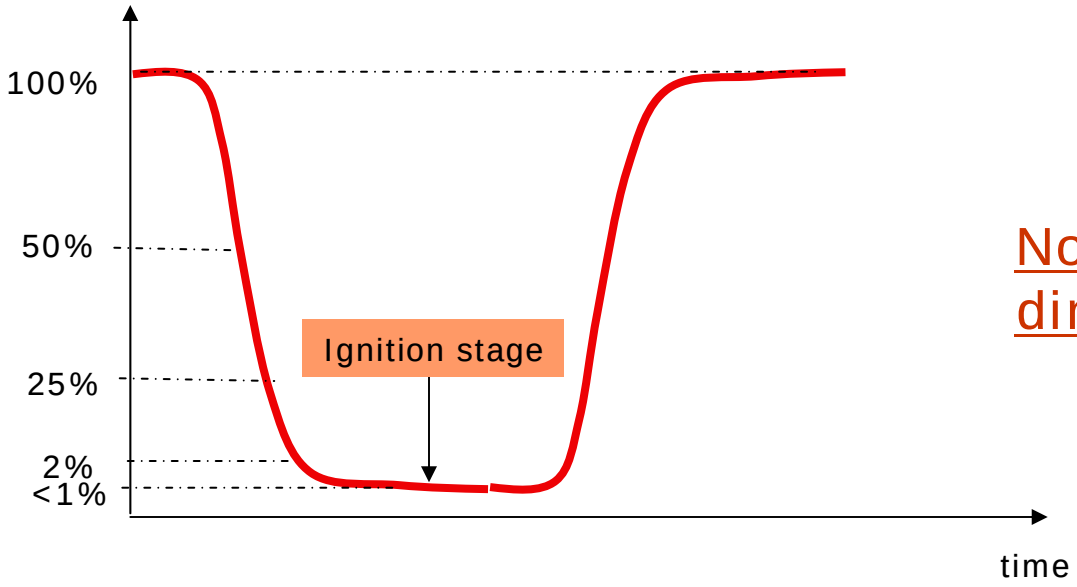


- **Color Rendering Index (CRI) > 90**
- **White point on black body curve**

Lumens – Etendue Curve



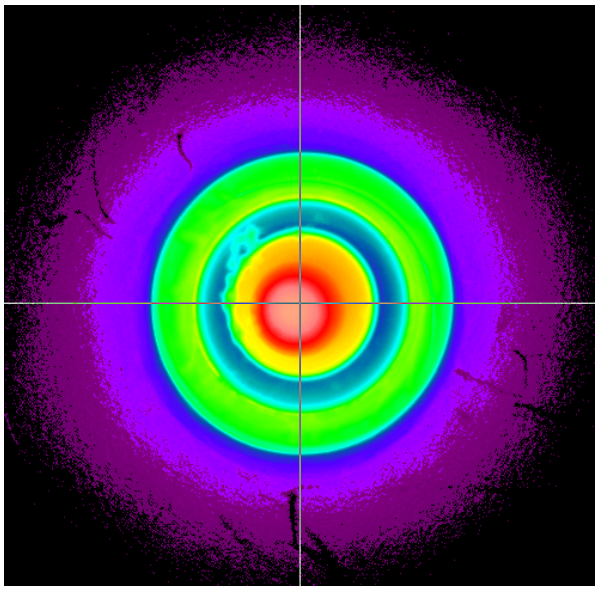
LIFI™ Hybrid light source: Dimming Characteristics



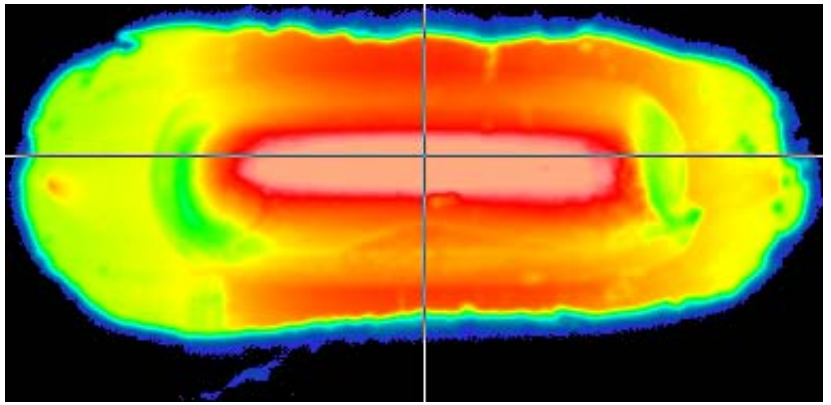
No flickering during dimming

This future is designed in to improve the light source power efficiency

Next Generation Product: Key Innovation

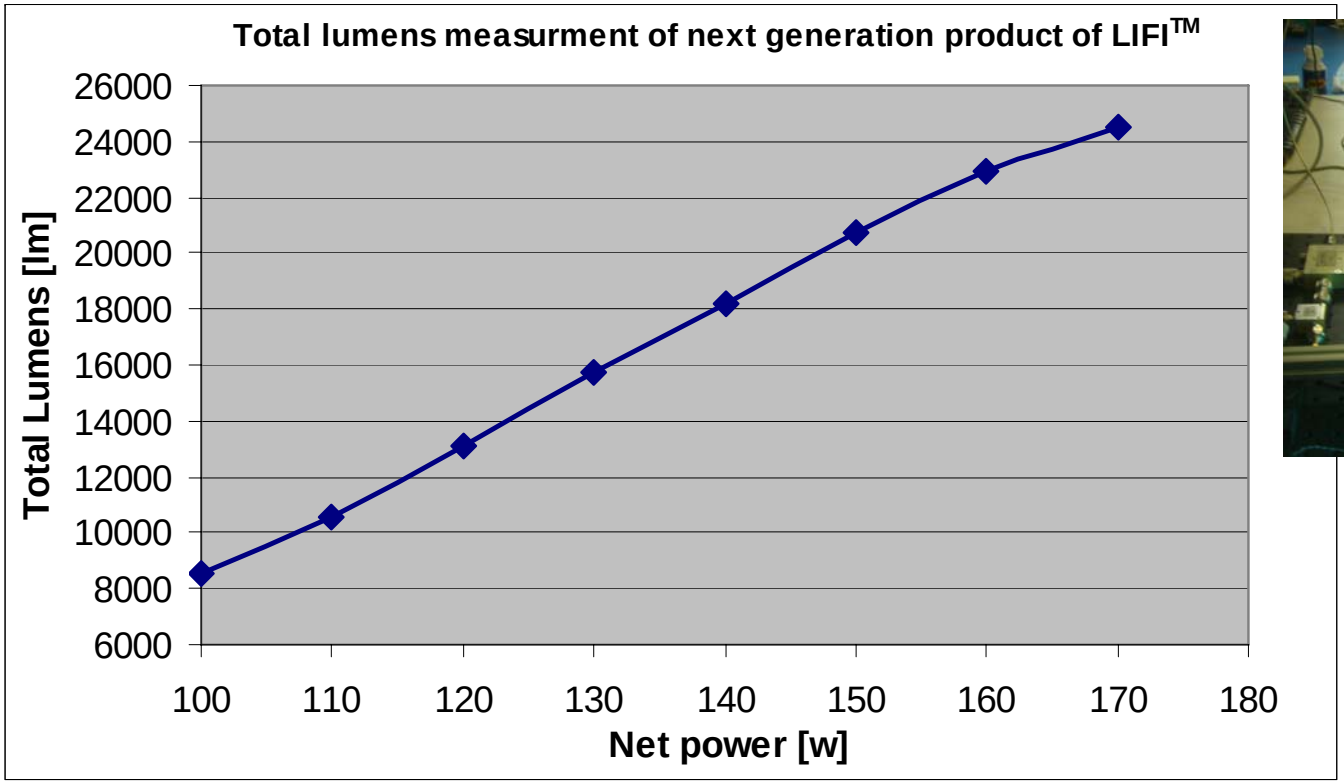


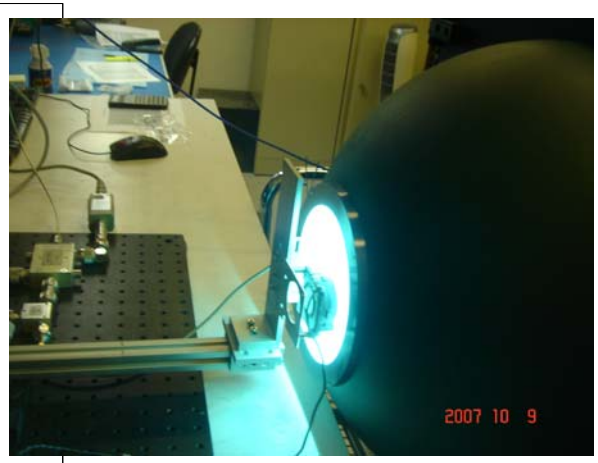
LIFI™4000 technology



Next generation product

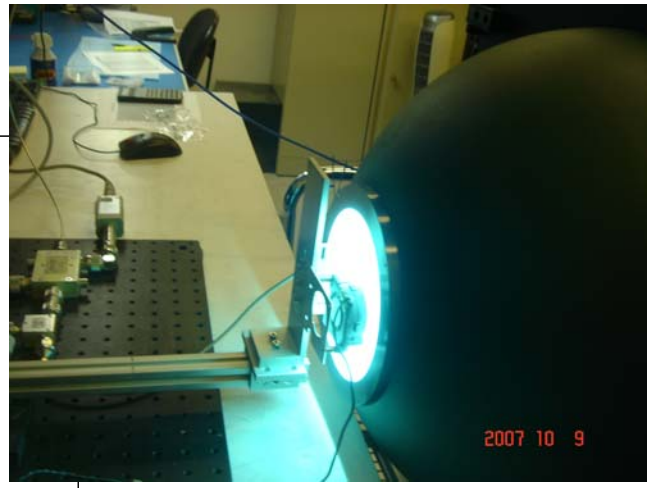
Total Lumens Measurement

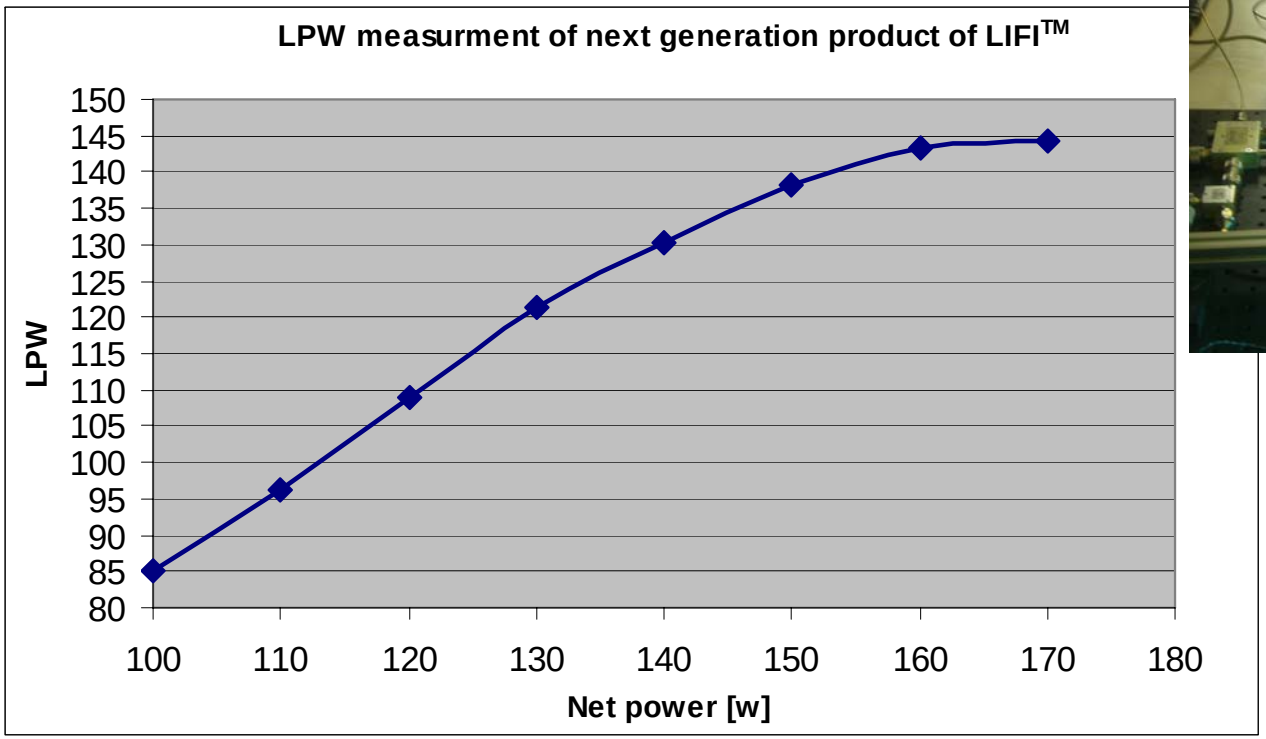




- Maximum Total Lumens = **24537 lm @ 170W**

LPW Measurement



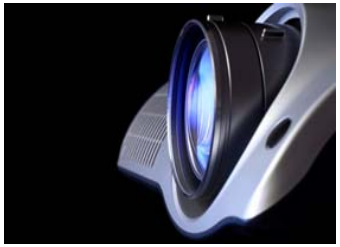


- **Maximum LPW = 144 with the first prototype**

LIFI™ Product Portfolio

Platform	Variants	Application
LIFI 4000 (HxWxL=90x130x173mm) 	4000	•Projection display (in production)
	4000T	•Microscopy (product launch 11/07)
	4000P	•Endoscopy, Inspection •Projection Display
	4000U	•UV curing, fluorescence imaging
LIFI 8000 (HxWxL=70x105x105mm) 	8000	•Projection Display
	8000L	•Entertainment and event lighting

Target Markets for LIFI™

	Projection Display	Instrument & Medical	Stage & Event	Roadway and Area
				
Benefits	•Long life •Full spectrum •High contrast •Fast start	•Low Maintenance •Stable output •Full spectrum	•Energy efficient •Low Maintenance •High CRI •Small source	•Energy efficient •Low Maintenance •High CRI •Small source

Summary

- The first product introduction in rear projection application showed that LIFI™4000 platform light source is reliable product with:
  - long-life
  - Stable color overtime
  - Dimming capabilities to <0.1%
- LIFI™ offers design flexibility to achieve better tradeoffs between light efficiency, long life and high color rendering
- LIFI™ has demonstrated high power efficacy that will allow us to address the needs of general lighting application

Thank you

- Team and Co-authors (M. DeVincentis, M. Duelli, R. Gilliard)

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