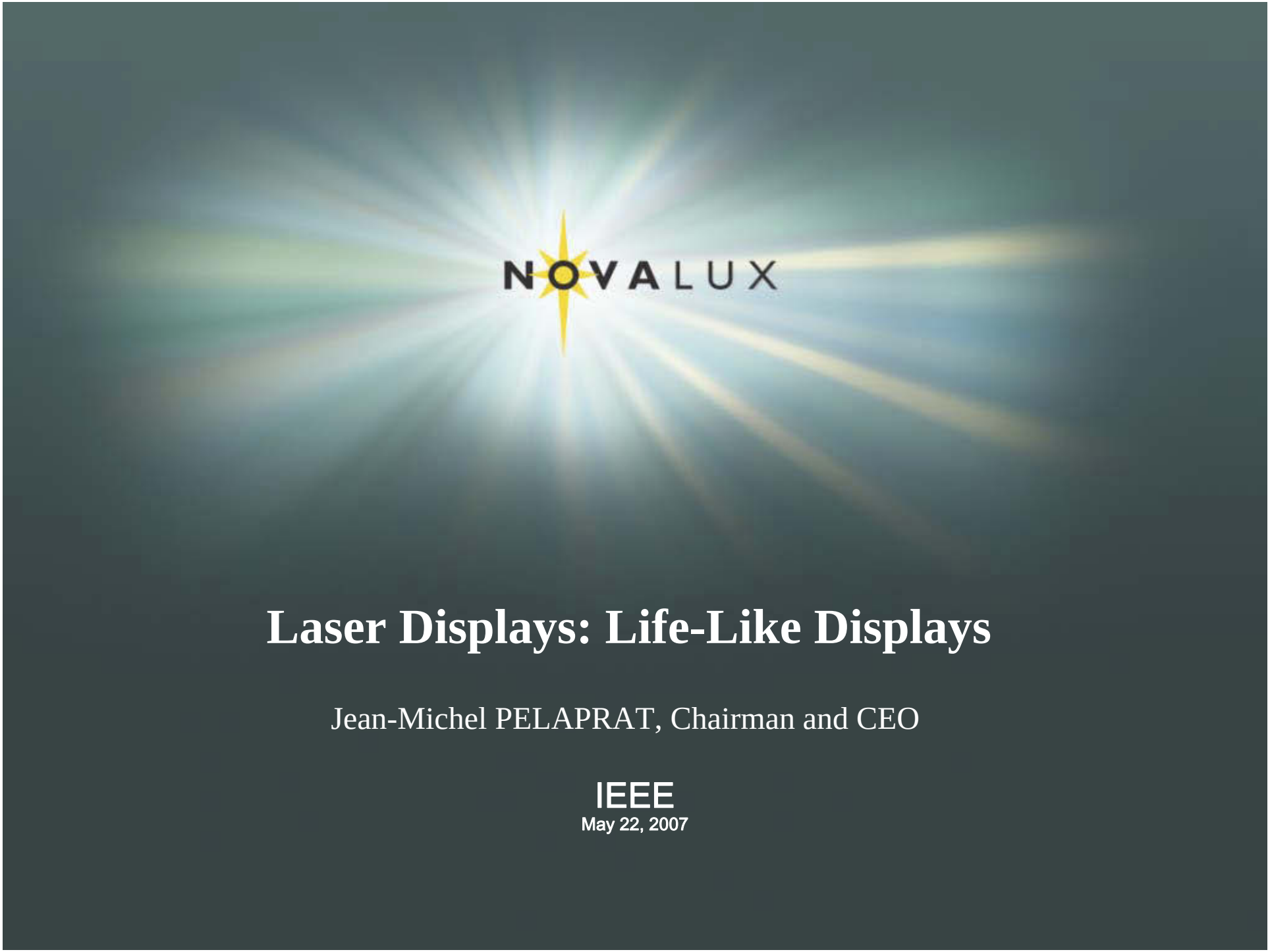


Laser Displays: Life-Like Displays

Jean-Michel PELAPRAT, Chairman and CEO

IEEE

May 22, 2007

Introduction

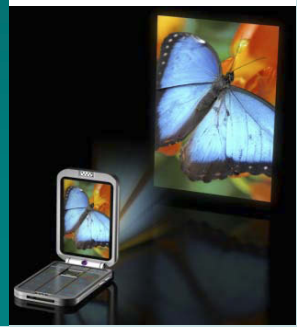
Lasers (solid state lighting) are enabling projection display from cell phones … to TV … to digital cinema

For the consumer, laser-lighting offers a unique viewing experience

- Life-like images - a "**True Color Display**" (>90% of what the eye can see)
- Identical images from all laser-based displays

For consumer electronics manufacturers

- A highly competitive display solution (low-cost with a long life time)
- A novel and long-term solution



Contents

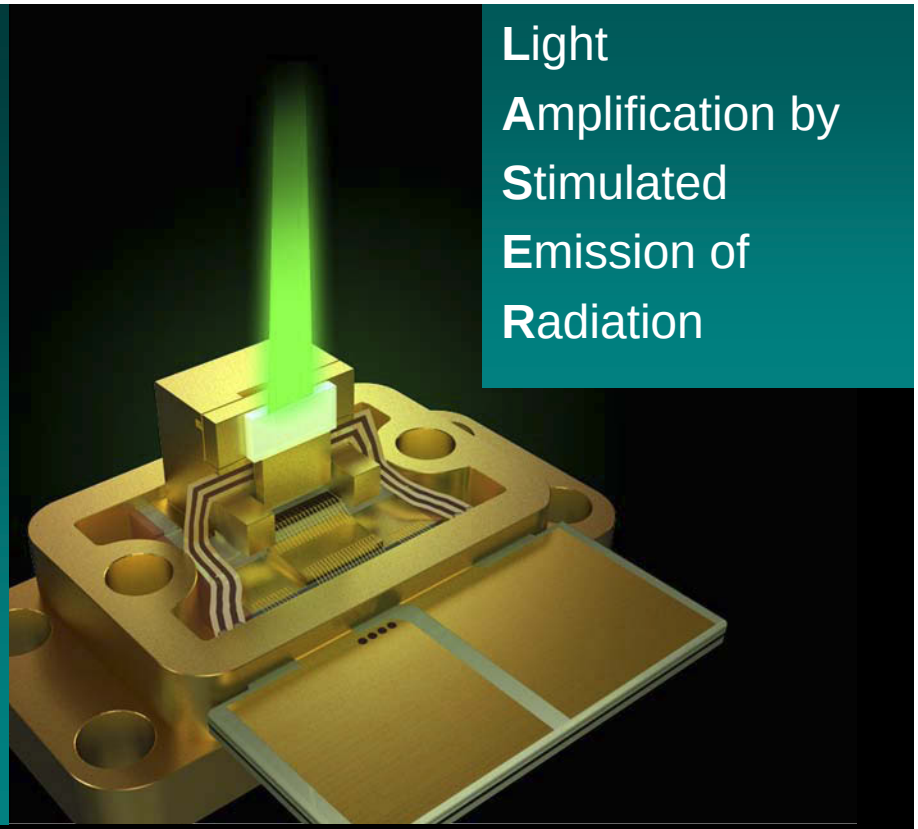
This talk answers the following key questions:

- What is a laser?
- Why NECSEL™?
- Why do I want lasers in my Projection TV?
- What are the target markets for lasers?
- Why do I want lasers in my LCD backlight unit?
- How do lasers maximize the HDTV experience?
- How do lasers penetrate PTV and enable all projection display applications?

What is a Laser?

Lasers are a unique light source

Lasers are an extremely bright, reliable, efficient, small, and cost effective source of light

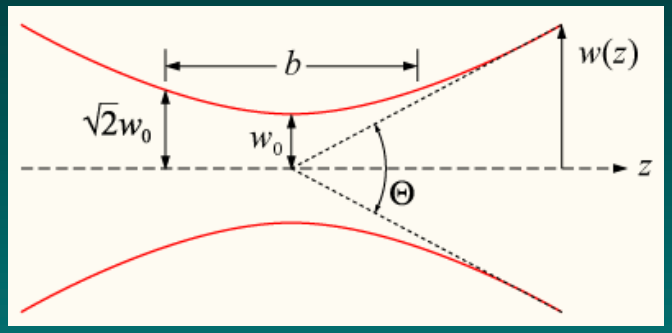


Light
Amplification by
Stimulated
Emission of
Radiation

Displays companies have wanted lasers for a long, long time …

LASER DESIGN CONSIDERATIONS

Gaussian beams

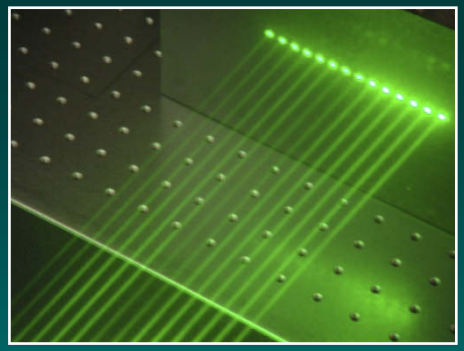


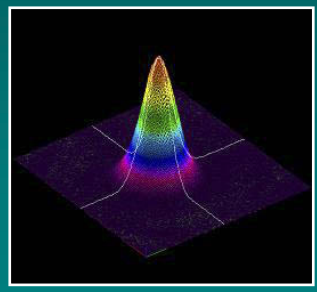
Geometry and behavior defined by a few key parameters:

1.) beam waist (w_o)

2.) beam divergence (θ)

3.) waist location (z)





"Lasers", A.E. Siegman Chapters 16 & 17

Completely different than lamps or LEDs … Well know beam propagation characteristics

LASER DESIGN CONSIDERATIONS

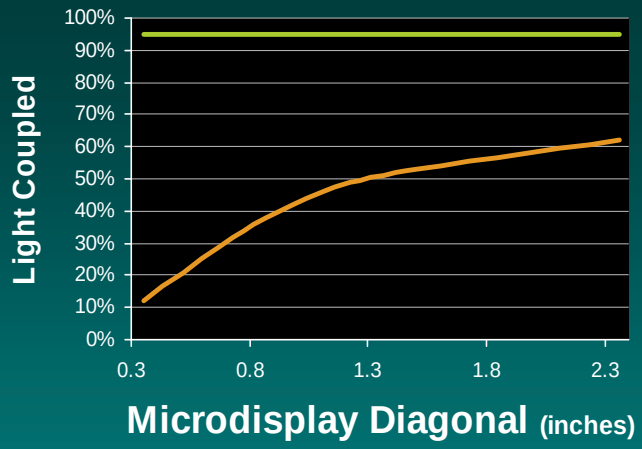
Narrow spectral width (< 1 nm)
- Predictable aberrations, use digital correction with cheap spherical optics
- Enables thin designs (10:1 screen to thickness ratio)

Extremely bright (> 10^5 W/mm²str)
- LED and Lamp < 1 W/mm²str

High quality beam (M^2 < 1.5)
- Small spots, efficient fiber-coupling

Instant-On & Direct Modulation

Highly Polarized



Laser always > 95%

UHP lamp (and LED) drops dramatically with smaller panels

Completely different than lamps or LEDs …

LASER DESIGN CONSIDERATIONS

Displays companies have wanted lasers for a long, long time …

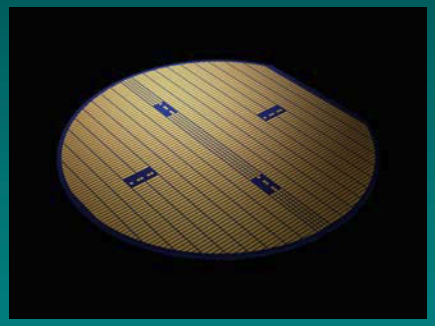
Any technology so far was:

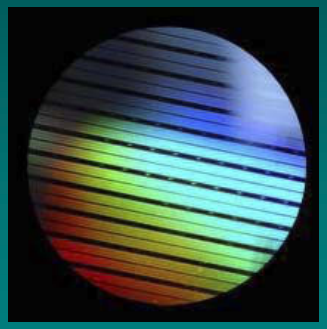
- Too expensive!
  - (DPSS….)
- Lacking power or wavelength!
  - (Semiconductor lasers….)

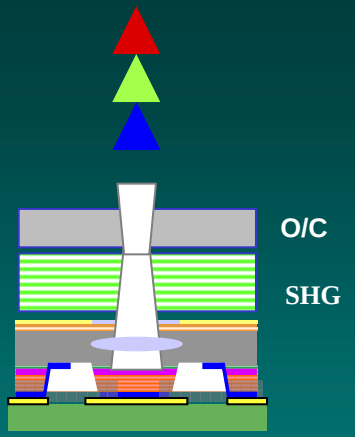
Why Necsel Lasers?

LASER DESIGN CONSIDERATIONS

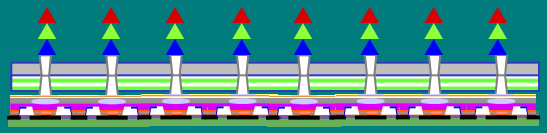
Wafer scale manufacturing and testing enables low cost & high volume







NECSEL™ *

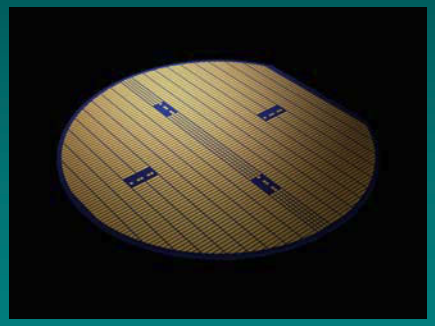


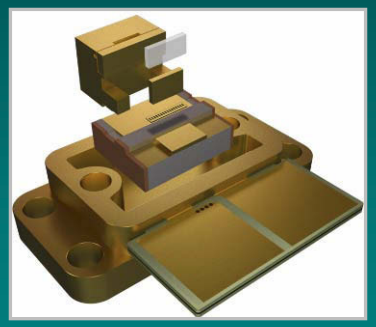
* **N**ovalux **E**xtended **C**avity **S**urface **E**mitting **L**aser

Very unique laser low-cost technology - high volume

Why Necsel Lasers?

Wafer scale manufacturing and testing enables low cost & high volume





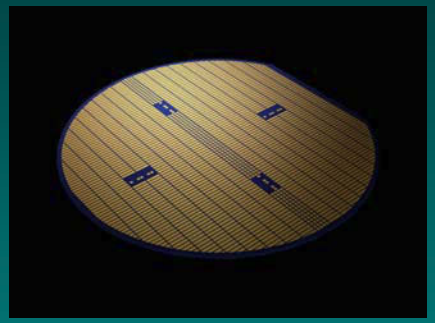
Mass Volume - Low Cost

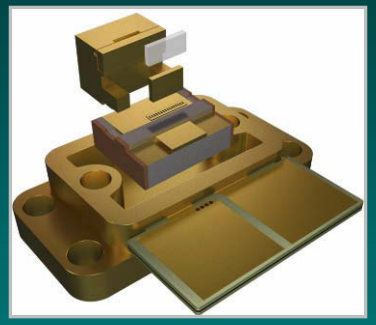
- All components wafer produced
- Fully tested at wafer level (high yields)
- Automated line assembly
- Cost similar to UHP lamp at 1 million/year with higher cost compressibility
- Cost model validated by several CE companies

***** **N**ovalux **E**xtended **C**avity **S**urface **E**mitting **L**aser

Very unique laser low-cost technology - high volume

Why Lasers for Projection Display?





NECSEL LASER COLOR

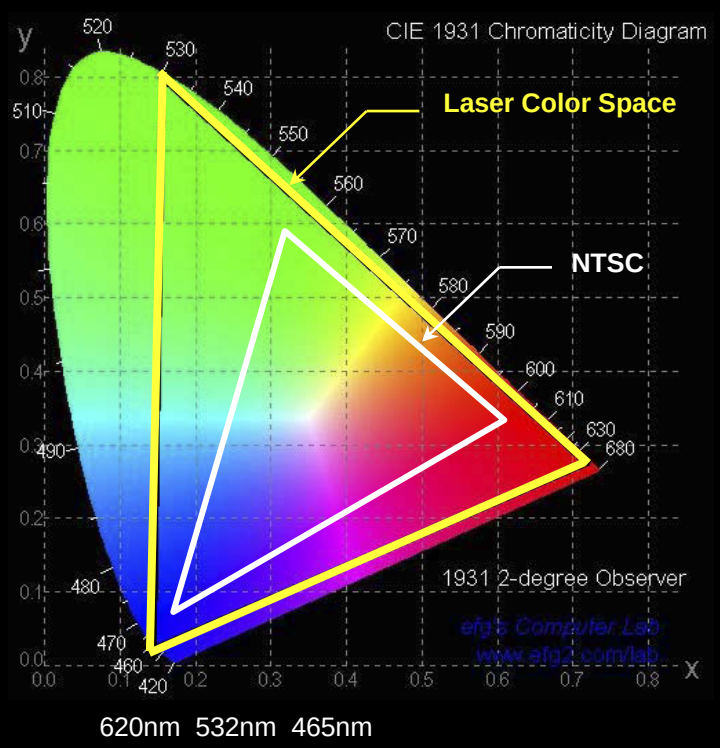
Why Lasers for Projection Display?

TRUE COLOR DISPLAY

Lasers are the ONLY light source that produce saturated primary colors that reach over 90% of what your eye can see

Lamp-based ~ 40 – 45%
LEDs ~ 55 – 60%
LCD and Plasma TVs ~ 40 – 45%

Color stability and consistency



Very unique laser low-cost technology - high volume

RELIABILITY

Reliability has a “life time” aspect:

- **Lamps** – get replaced twice a year and fade in power
- **Lasers** – “life time” is >30,000 hours at 100% power

Reliability has an “endurance” aspect

- Lasers have constant power and constant wavelength over time & temperature
- For the first time ever, your D-Cinema picture will never change!

Life-like images … Forever!!

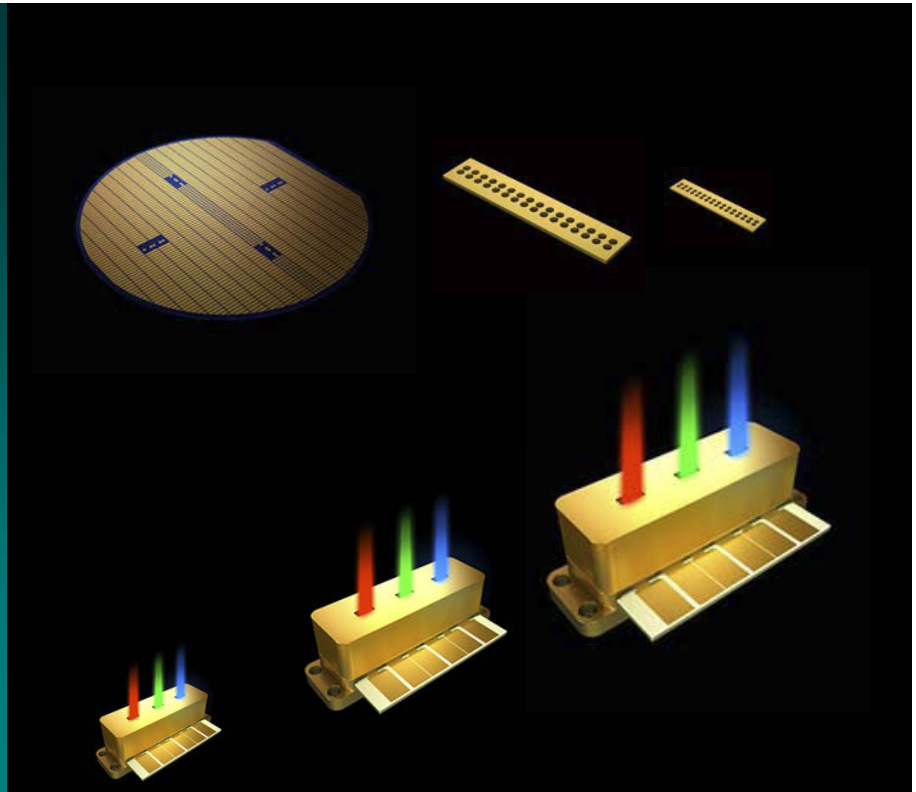
POWER SCALABILITY FOR ALL SIZES

Necsel™ * Lasers are scalable in power

- Same design
- Same package
- Same colors
- Low cost volume manufacturing

Viewers will see true color images of the highest quality ever seen – even on the largest screens.

*** Necsel: Novalux extended cavity surface emitting laser**



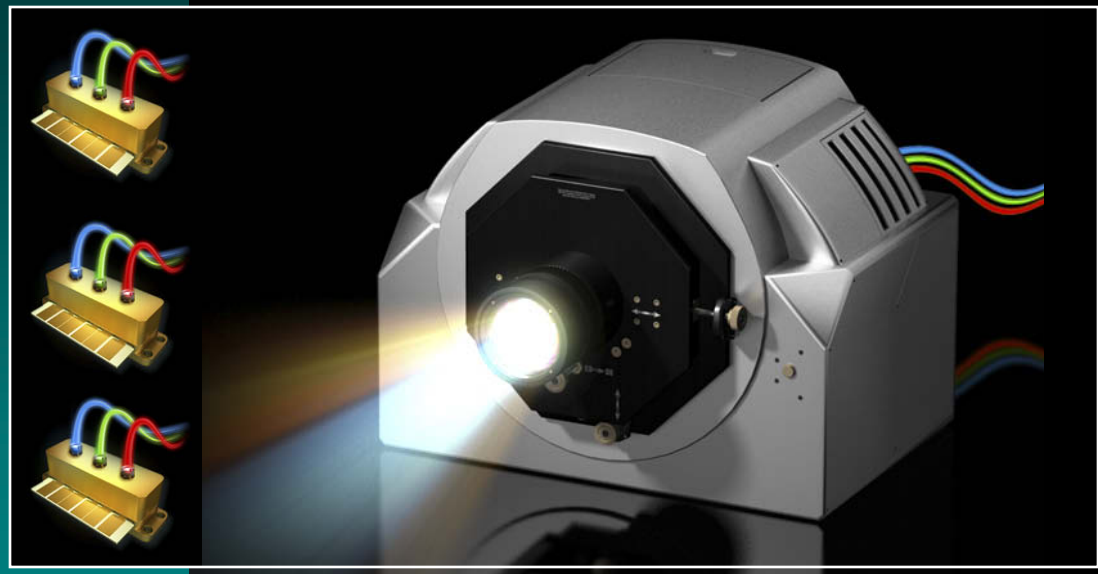
Same RGB Laser Packages for All Size Projectors

MODULARITY

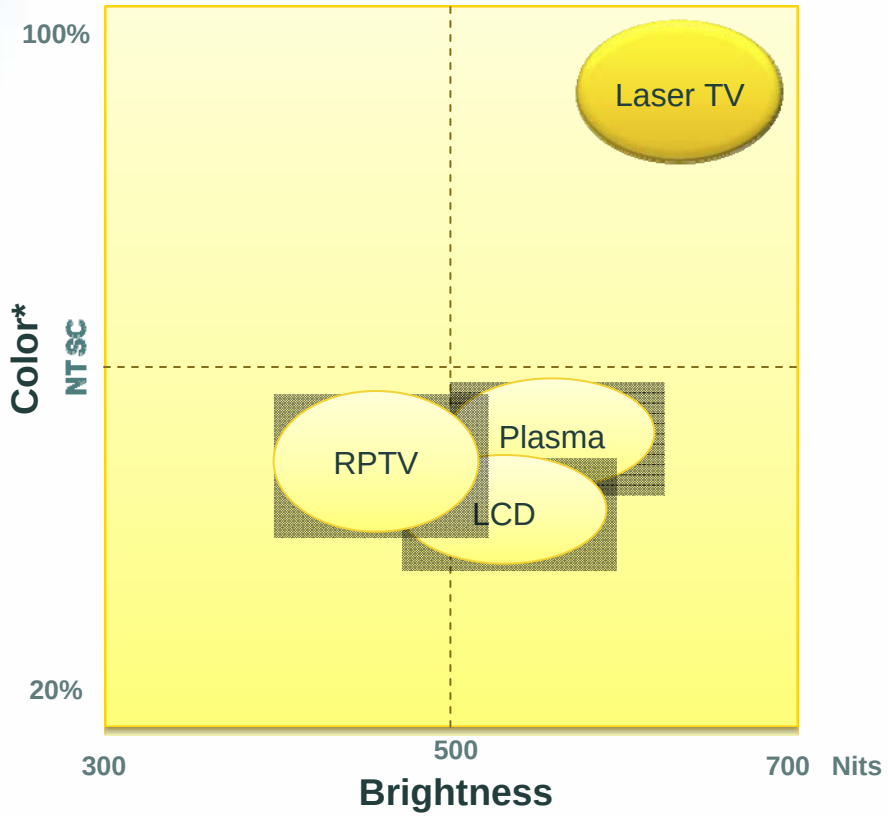
Lasers are compact modules

Group lasers to get to
20,000 lumens

Easily integrated and serviced



Fiber-coupling can only be done with laser light sources

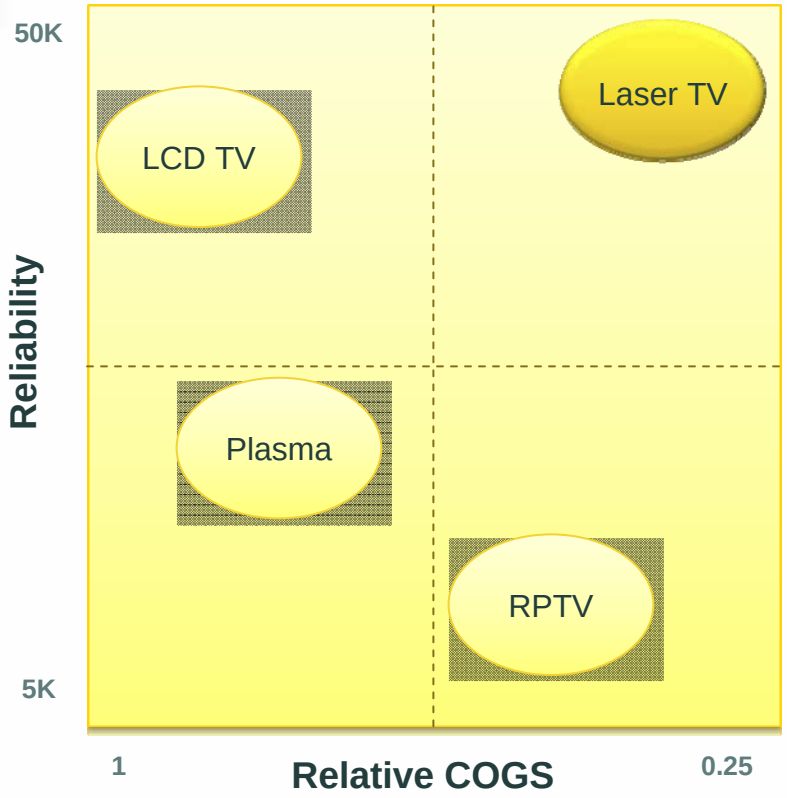


* Color in % of what human eye can see

Laser TV –

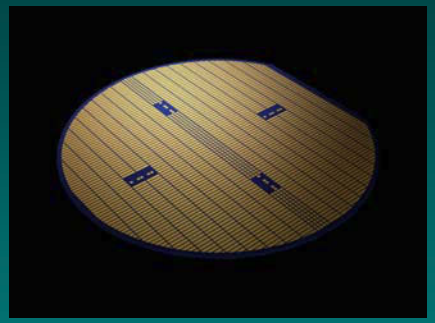
The Ultimate Big Screen Experience

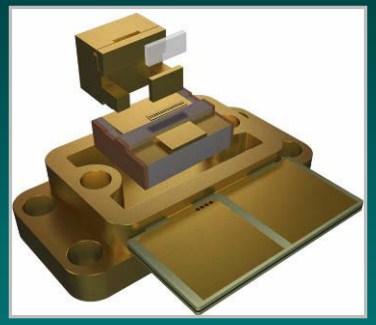
- **Life-like true-color images**
- **No screen size limits**
- **¼ power consumption of plasma**
- **½ weight plasma & LCD TVs**
- **As thin as plasma & LCD TVs**
- **Highest resolution**



A Disruptive Light Source

- 50K hours full power with no color shift
- 30% cost reduction from existing RPTV
- ½ cost of plasma and LCD for > 50”





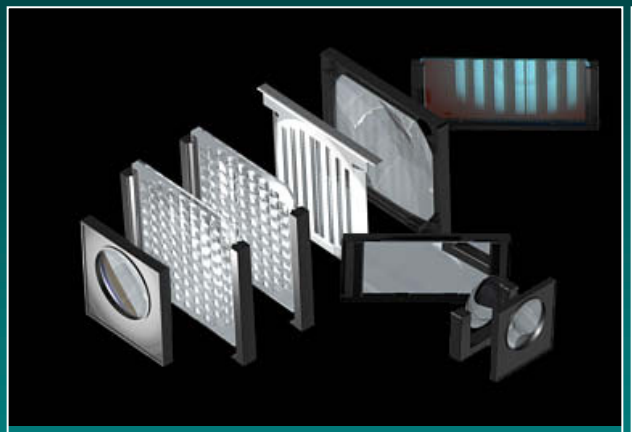
Why Lasers for TV?

NECSEL LASER COLOR

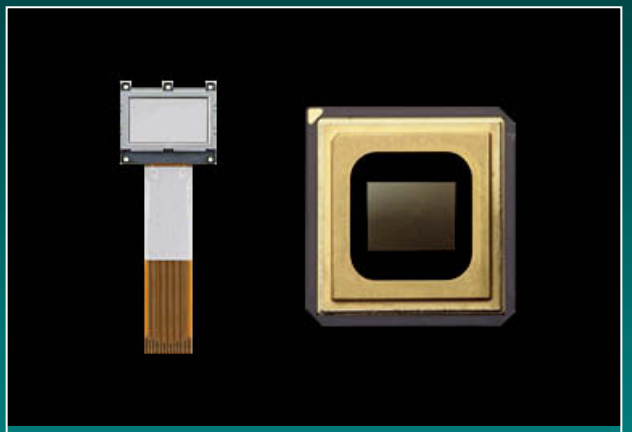
COST

What are the real **cost** problems in Microdisplay?

Lamp Replacement



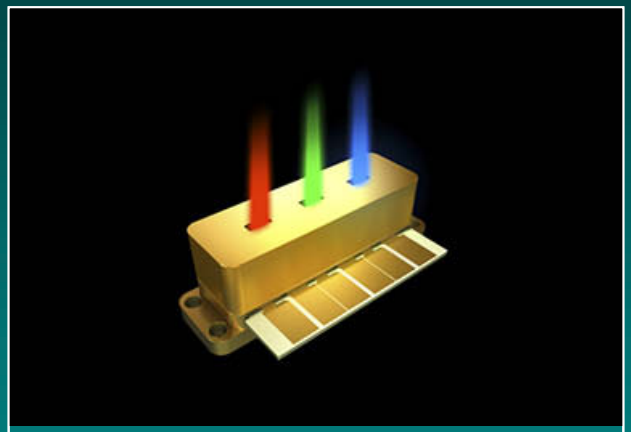
Optics



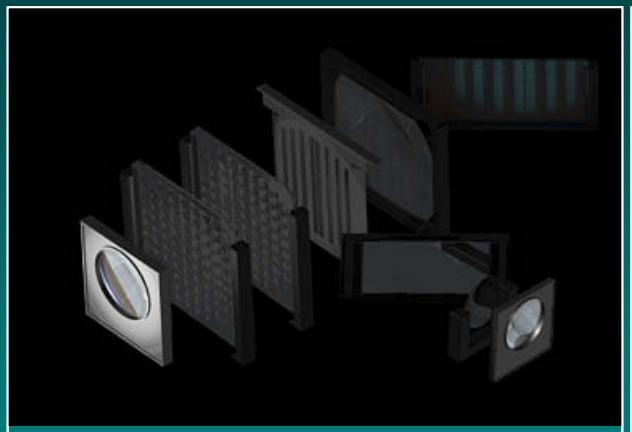
Microdisplays

COST

Lasers Provide Solutions



Never Needs Replacement



Fewer Optics

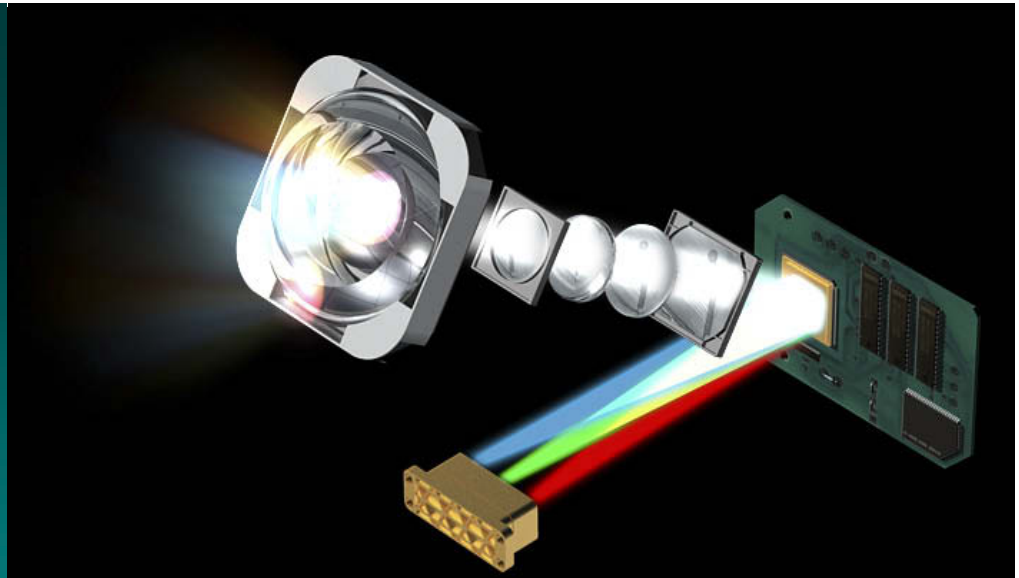
DLP – LCD - LCOS

Smaller Microdisplays

LOWER-COST PROJECTORS

Fewer Optics Makes Simpler Light Engines Possible

Cost Decrease potential
> 30%
DLP, 3LCD, and LCOS



Reduces illumination optics, microdisplay, projection optics, & light source costs

BRIGHTNESS

Who wants a big screen with only **300 nits** and a **gain 5** screen??

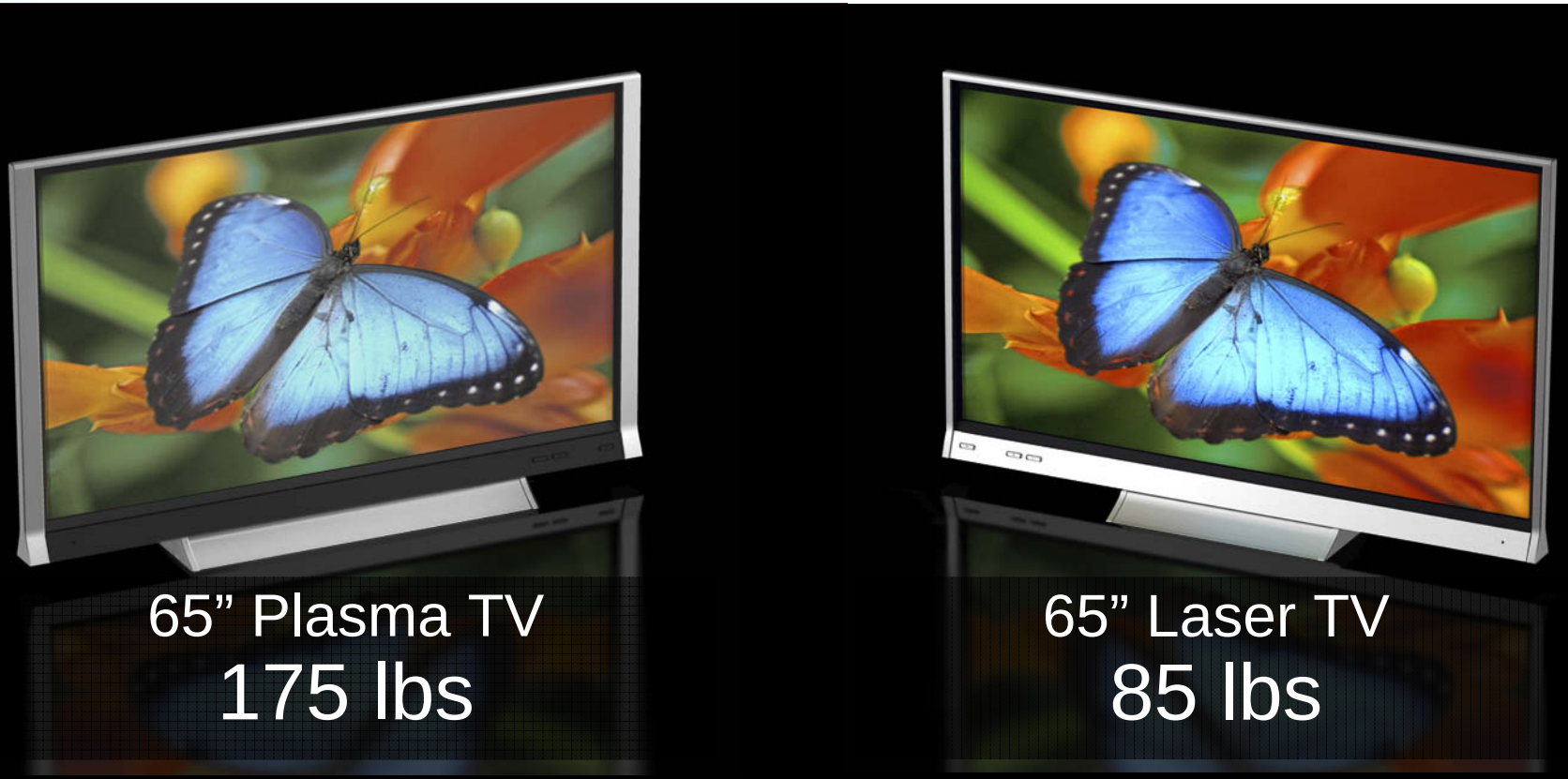
Lasers provide unlimited lumens

- In particular, Novalux lasers are scalable arrays
- … if you need more power, either add more lasers or use a bigger array

Any screen size can have high brightness and low gain

Major Opportunity: Wider viewing angles with 1000 nits will allow penetration of signage market (airports, train stations, etc.)

WEIGHT



Lasers offer substantial weight savings

ELECTRICITY

65” Plasma TV
850W

65” Laser TV
200W

Get your Laser TV for free!! Save $300/year of electricity

CONSUMER COST

65” Plasma TV
$9995*

65” Laser TV
< $2500

Laser TV has lowest cost for big screen & high resolution

* Panasonic 65” 1080p at BestBuy on Mach 12, 2007

THIN

Hang it on a wall

65” Laser TV
< 8” depth

No more bulky rear projection architectures

Revolutionary New Performance and Viewing Experience Requires New Branding

Laser TV

Big Screen | Immersive | True High Definition | Thin Modern Look

Unrivaled Picture Quality

STARTING 2008 SEASON

Laser TV

50” and above (Home Theater)

1080p

xvYCC (>200% NTSC color capable)

½ weight of Plasma

¼ power consumption of Plasma

6” thin

Several Key CE Brands

Roadmap to Market

CES 2006 (Jan 2006)
- Novalux demonstrate 3LCD and DLP Laser TV
- Large Brand Laser Demonstration in Private Suite

CES 2007 (Jan 2007)
- SONY: Laser TV on the Floor (xvColour)
- InFocus: Laser Home Theater on the Floor
- Several brands : TV in Private suites

Christmas 2007
- One TV brand launching Laser TV

Season 2008
- Mass-volume market with top 5 key brands

Laser Adoption in Consumer Display

Projection Microdisplay


Laser TV


Home/Data FP


Pocket


D-Cinema

Direct Scan


Cell Phones


Camcorder


PDA's

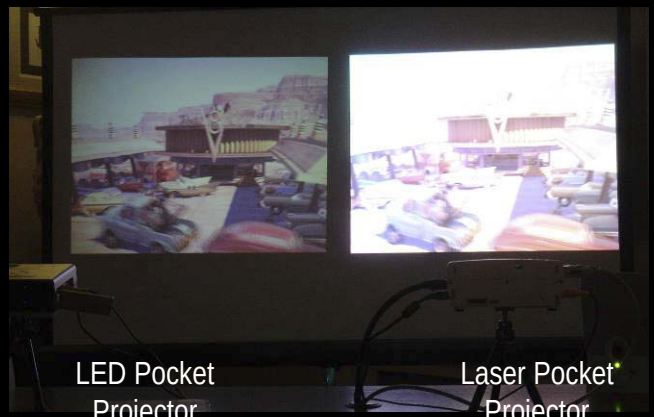
General & Specialty Lighting


LCD Back Lighting

Lasers enable usable pocket projectors

Pocket Projection

Affordable: smaller and cheaper MD
Brighter: up to 300 lumens



LED Pocket Projector (20 lumens)

Laser Pocket Projector (150 lumens)

NOVALUX

Pocket Projection

Convenient – Versatile – Fun - Affordable - Small

Launch 2008

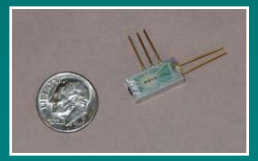
Through your gadgets …

Project from your PDA …

… or camcorder … or phone

Mobile Projection

On-the-go 2D MEMS scanning projection enables ubiquitous laser products



Mobile Projection

Project Anywhere – Battery Friendly – Share Instantly – All-in-One - Impromptu

Launch - Late 2008 / Early 2009

Head-up Display

Existing solution is backlit LCD panel

Expensive, hard to see, doesn't shape to curved windshields, difficult to install

NECSEL currently being tested by major auto companies

Much brighter (for daylight driving)

Higher contrast (no ghosting at night)

Much easier to install (2D MEMS scanner)

HUD is made practical by lasers

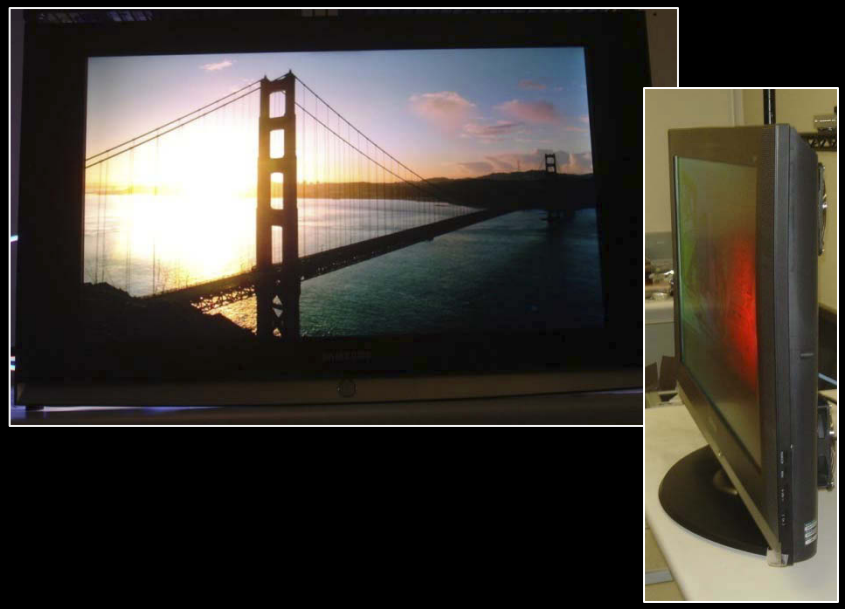
Launch - Late 2009 / Early 2010

LCD and Monitor Back Lighting

Lasers can easily be used to backlight LCD panels

LCD BLU

Lasers lower cost and improve performance



Samsung 32” LCD TV modified with Necsel laser backlight unit

LCD does not have to miss out on the Laser TV wave!

LCD and Monitor Back Lighting

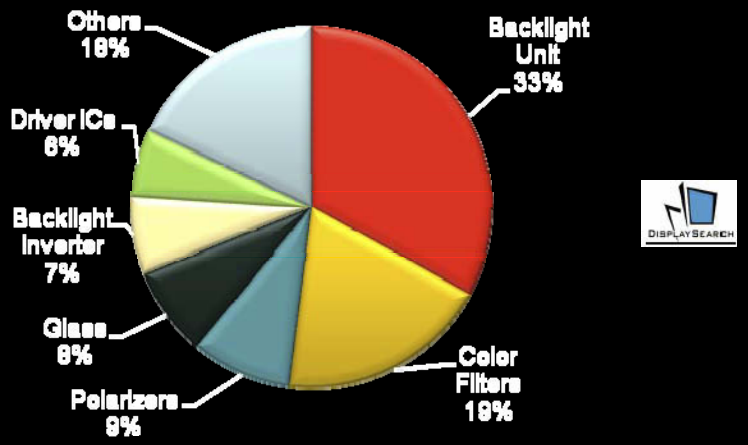
Lasers highly disruptive

LCD - BLU

Cost decrease > 30%

Color >200% of NTSC (vs. 80% for CCFL and 110% for LED)

BOM for 32” LCD TV



Eliminates color filter (using sequential laser colors)

Eliminates polarizer (laser is polarized)

Laser is lower cost than CCFL

Currently seeding the market – Target launch 2009

Novalux

Solid state lighting company targeting >$4B market

RGB semiconductor laser technology: **Necsel™ ***

Feature a **"True Color Display"** (>90% what the eye can see)

Partnering for mass production of RGB lasers

Seiko Epson, Oerlikon, Young Optics (Coretronics)

Converted several CE companies to use NECSEL in their next generation TVs

Novalux is recognized as the DISPLAY LIGHTING high value enabler by the vast majority of display companies worldwide

Several CE brands have introduced their NECSEL Laser TV at CES 2007 and going to market in 2008

NECSEL LASER COLOR

*** Necsel: Novalux extended cavity surface emitting laser**

Summary

Lasers enable projection business technically and economically

Lasers offer a unique viewing experience with lifelike colors for the first time

Laser brings consistent color displays through all display forms

Companies are positioning to launch Necsel-based products

www.novalux.com

Lasers are a platform for all types of displays

Thank you for your attention

In your phone…

In the cinema…

In your pocket…

In your home…

In your car…

www.novalux.com jpelaprat@novalux.com www.necsel.com

