RGB laser projection for premium cinema screens

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CinemaCon review

- First showing of Barco DP4K-60L projector
- Cinemark XD auditorium (45ft white 1.8 gain screen)
- Screening of Hobbit 2 trailer, 14fL 3D with 6P Laser3D with a single projector
- Commercial sales announcements
  - Cinemark (5x), Santikos(1x) (US)
  - Kinepolis(4x) (Europe)
  - JinYi (2x), Sichuan Pacific, Henan Oscar (China)
- Installations Q2 through Q4 2014

Barco track record in laser projection

April 2010
Photonics Europe
Barco's first laser demonstrator (300lm LCOS)

January 2011
RED Studios
"TestBed 1" (3000 lm de-speckled 2K laser projection)

Summer 2011
Further work on despeckling with VUB Brussels

April 2012 – CinemaCon
"TestBed2" 4K laser projector with Hollywood content featuring 4K resolution, 48 fps HFR, and the industry's brightest 3D on a 70' x 30' screen.

March 2014 – CinemaCon
Barco announces **DP4K-60L**, the 60kLumen RGB-laser illuminated cinema projector with **6P, Laser3D** capabilities

2010 2011 2012 2013 2014

February 2010
Paper : 'Speckle suppression in Laser Projectors' on EOS Topical Meeting on Diffractive Optics

January 2012 – Moody Gardens
"TestBed 2" 4K integrated laser-illuminated projector presentation on 78' wide screen at 56K Lumens. Side-by-side comparisons of 4K digital vs. 15/70 mm.

March-April 2012
Pixar demo
"TestBed 1"

April 2013 – Barco offices
Private showing of latest technologies to selected European cinema and post-production professionals

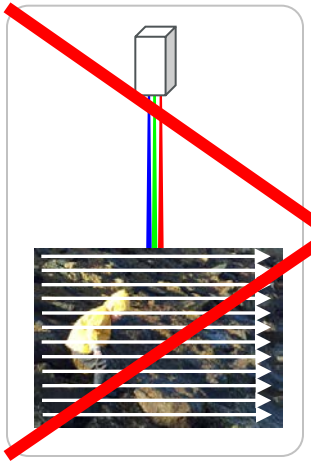
Q4 2013- Burbank, CA
Barco presents **"TestBed 3"** (3000 lm de-speckled 2K laser projector) side by side with Xenon to Hollywood audience (Studios, colorists, ASC members, etc)

- Private Product Demos
- Industry Conferences
- Papers/ Academic work

Concepts of laser projection

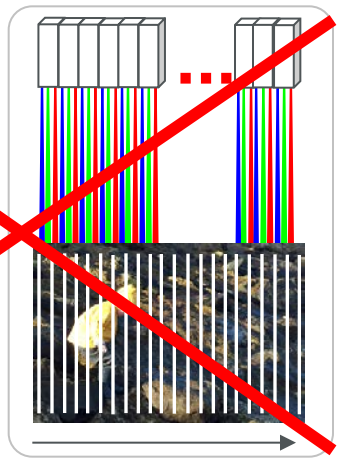
Direct Scanned laser Projection

One laser beam



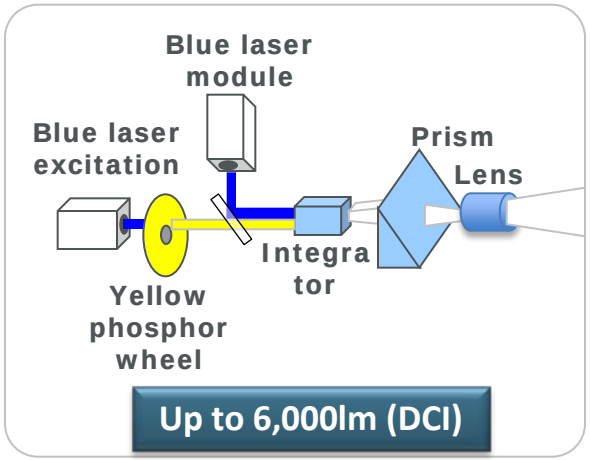
Direct laser light projected on the screen
Eye-Safety hazards
Image quality challenges
Not used in front projection applications

Array of laser beams



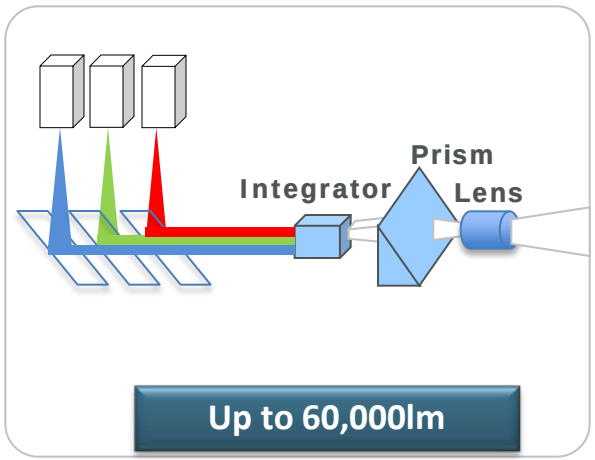
Laser Illuminated Projection

Laser Phosphor Illumination



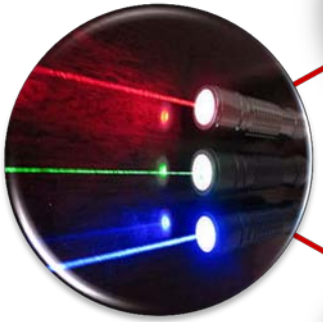
Direct laser light + laser pumped phosphor
Diffuse laser light
Limited brightness

RGB Laser Illumination



Direct laser light for R, G, B
High Brightness

Benefits of laser technology for cinema



Audience experience

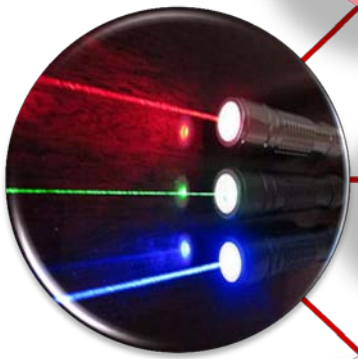
Lower operational costs

RGB laser only

- Premium experience
  - Brighter 3D (DCI HFR 3D: 7fL)
  - Better contrast, gamut, uniformity, sharpness.
- Consistent experience
  - Constant brightness
  - No lamp flicker
  - No lamp failures/lost shows

- No lamp costs
  - no purchase, stocking, replacement, disposal
- No sudden lamp failures
  - No lost shows
  - No warranty claims for lamp explosions
- Better efficiency
  - Better lumen/Watt performance vs. Xenon

Challenges of laser technology



Regulatory

- Old regulations coming from laser light shows
- LIPA actively working on changing this
- Barco LIP FDA variance in the approval process

Image quality

- Speckle

Cost

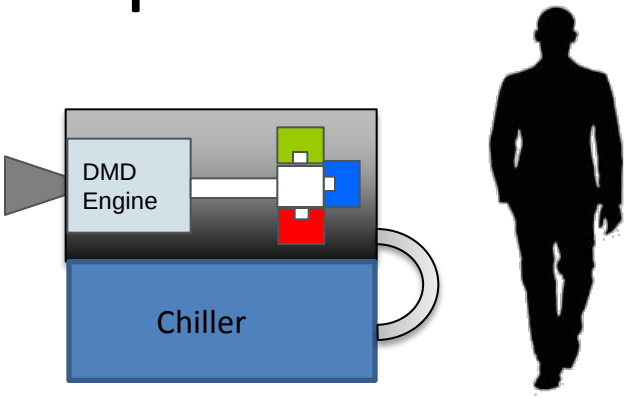
- High purchase price
- (but: operational cost benefitial vs. Xenon)

Barco approach

- <u>"Same or better than Xenon"</u>
  - Focus on high brightness
  - Focus on speckle removal
  - Sharpness and uniformity improvement
  - Improving Color3D efficiency with the 6P concept.
- <u>Minimize OPEX</u>
  - Conditioning of laser working temperature for longer lifetime
  - Minimize losses in optical components (e.g. no fibers)

Barco product concept

- ***Integrated*** laser light source
  - "Direct coupling", no fibers and fiber losses
  - Increasing Lm/W projector efficiency
- Active ***cooling***
  - Prolonging lifetime of DMDs and laser diodes.
- ***6P*** in a ***single projector***
  - Avoid dual projector installation, maintenance and service
- Proprietary ***despeckling***
  - Using diversity of wavelengths, angles, polarizations to reach very low speckle contrast ratios on screen

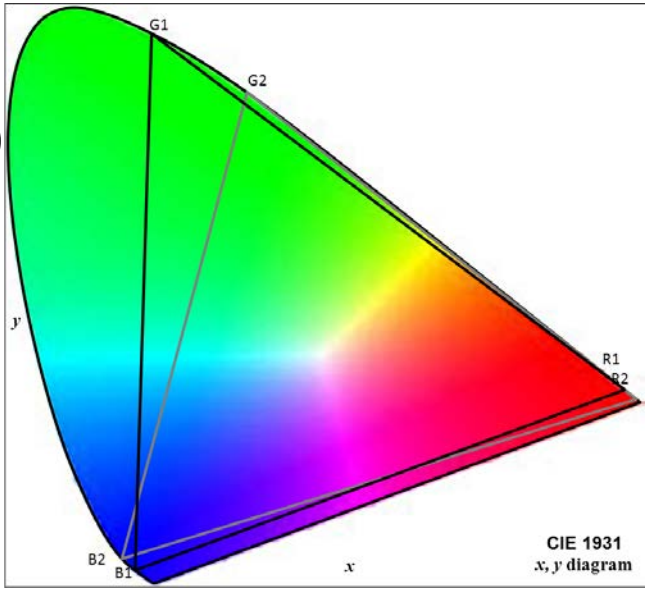


DP4K-60L – product performance

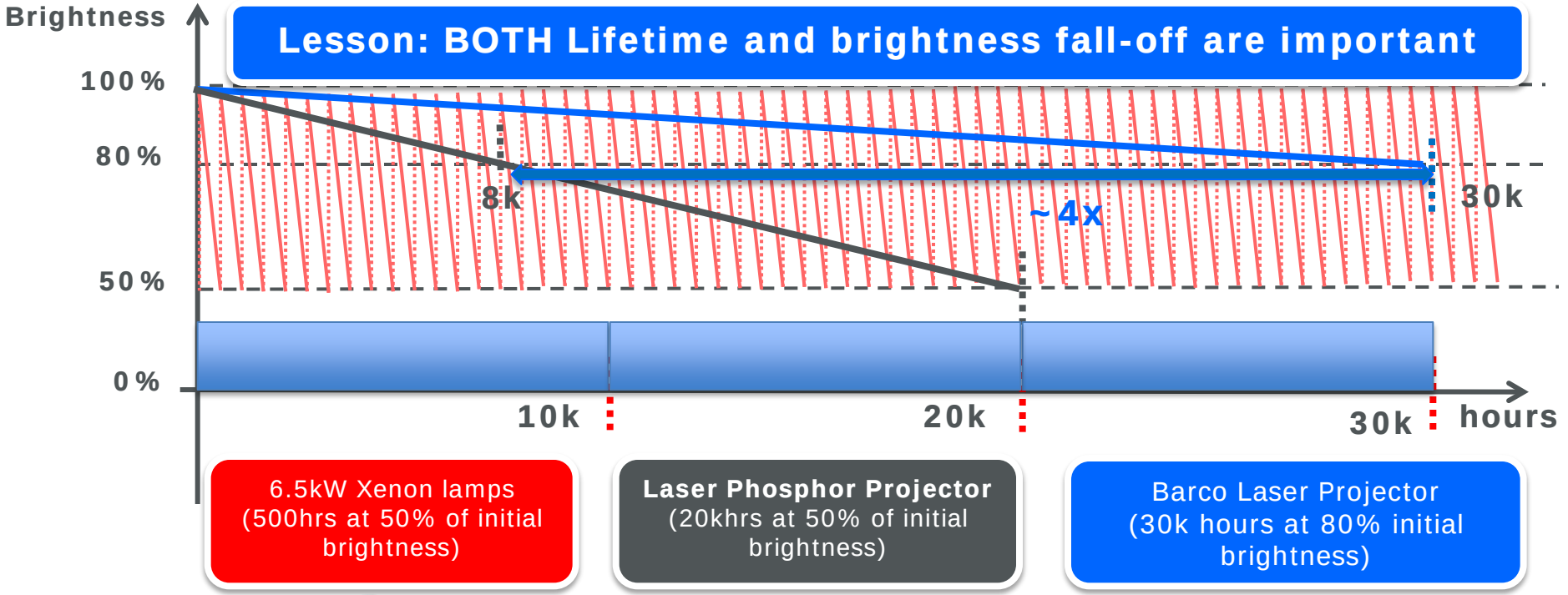
- 60.000 DCI lumens
- 30.000 hrs light source lifetime
  - With 80% remaining light
- Active 6P, “Barco Laser3D”
  - >22% efficiency
- 4K-60fps and 4K-3D capable
  - Barco Alchemy media processor

What is 6P (six primaries)?

- "6P": Laser projection with two sets of R, G and B primaries ($R_1G_1B_1$ for left eye, $R_2G_2B_2$ for right eye)
- Special glasses (e.g. coating tuned for laser wavelengths)
- No Dolby Wheel or additional hardware needed
- Result:
  - Clear 3D with no cross-talk (very high extinction ratio)
  - 2x higher efficiency than Dolby3D (with a single projector)
  - Similar efficiency as RealD XL
  - No silver screens needed

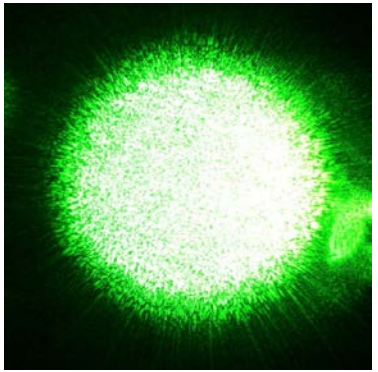


Focus on lifetime and TCO



Speckle

- Barco has long history in speckle research and despeckling techniques
- 2010-11: Milestone papers on speckle metrology which are used as a reference now
- Speckle contrast improvement:
  - Osiris: 16%
  - Testbed1: 4%
  - Testbed2: 6%
  - Testbed3: 3%
  - ***DP4K-60L: 2%***



Lumen/watt comparison

- Single Xenon (e.g. Barco DP4K-32B)
  - With new lamp: 33.000 lumens/7.5kW = 4.4 lm/W
  - On average (75% brightness): =24750/7.5kW= 3.3 lm/W
- Single Barco DP4K-60L
  - Out of the box: 60.000 lumens/10kW = 6.0 lm/W (36% better)
  - Average (90% brightness) = 54.000/10kW = 5.4lm/W (63% better)

Application examples

- A ***single*** DP4K-60kL projector can do:
  - Up to 24m screens in 7fL 3D with 1.8 gain and Barco Laser3D.
  - Up to 17m screens in 14fL 3D with 1.8 gain and Barco Laser3D.

- *A single 60kL projector can provide 7fL 3D to almost all premium screens!*

Please be invited to our Laser projection demo:

- Cinemark Century 16 South Point, XD theatre
- Sunday April 6th (technical) and Monday April 7th (general) at 18:30

www.barco.com/laser