

Laser Light sources in Cinema Projection

Consequences for cinematographers

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Kommer Kleijn SBC www.kommer.com

- VFX cinematographer, stereographer, film school teacher, retired
- Early retirement due to unfortunate health accident
- Initiated Additional Frame Rates standardization for DCP in 2004
- SMPTE 27C P-member, chairing frame rate subgroups 2006-2020
- Former chairman of the IMAGO technical committee
- Audiovisual perception researcher (both Image and Sound)
- Participates in development of a new type of loudspeakers
- IMAGO honorary member 2019
- SMPTE Fellow member 2020

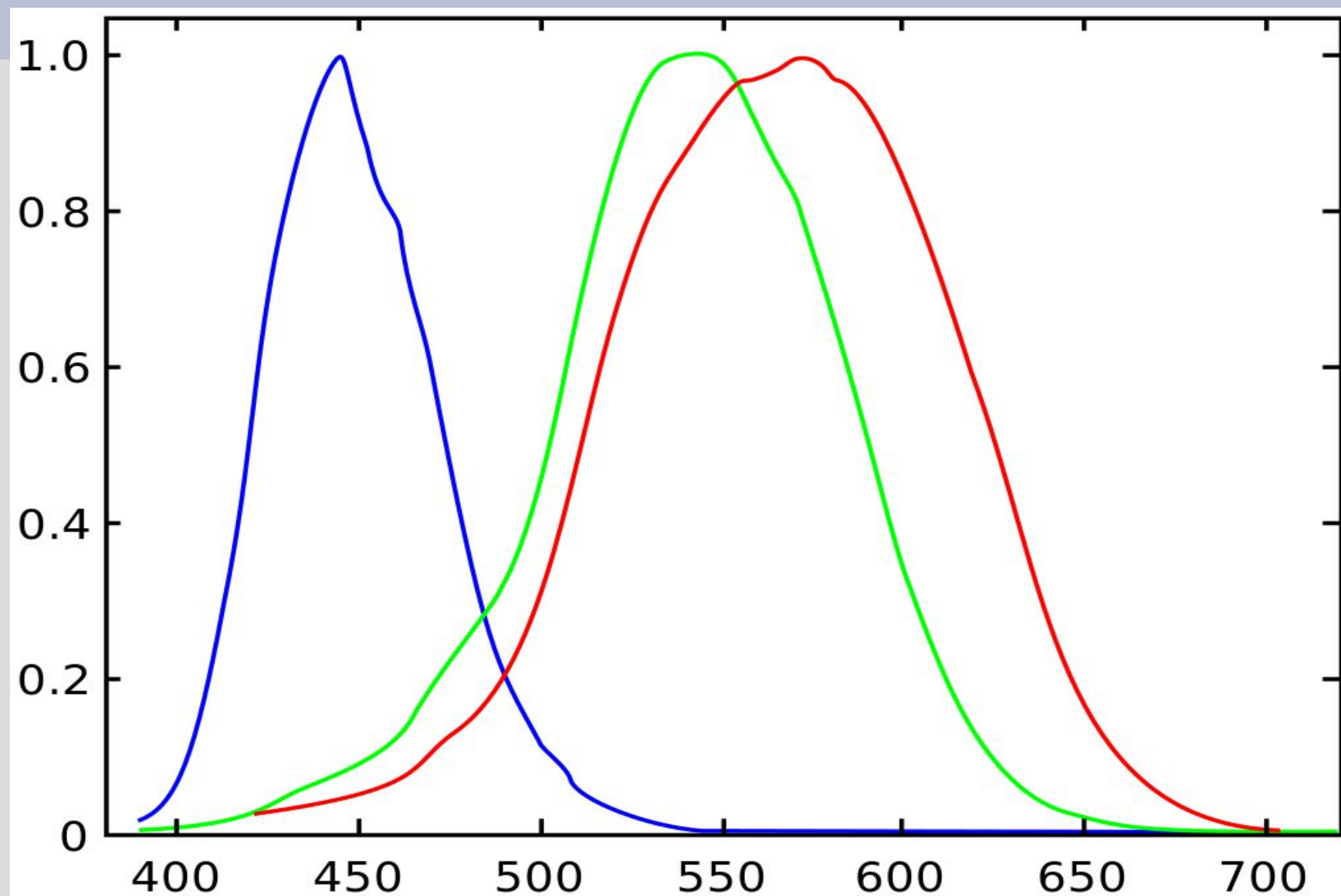
Advent of Laser projection light sources

- Prototypes were shown around 2010/12 – Commercially available 2014
- Only the light source changes, same modulation techniques as Xenon
- End of lamp changes, laser source good for 20 - 40.000 hours
- More output power possible, wider color gamut, less power consumption
- Commercial introduction was after the Digital conversion was complete →
Not that many projectors in the field today, mainly big rooms or new rooms
- Xenon projectors are hardly made any more
- RGB / Phosphor types:
 - RGB laser has three narrow bandwidth primaries
 - Phosphor-laser source has one (sometimes 2) narrow bandwidth primary (blue) and two that are similar to Xenon light (G and R)(sometimes only G)
- Phosphor Laser is used for medium screens, RGB is used for BIG screens
- Grading rooms still equipped with Xenon, as are the majority of theatres

RGB Laser source projection challenges

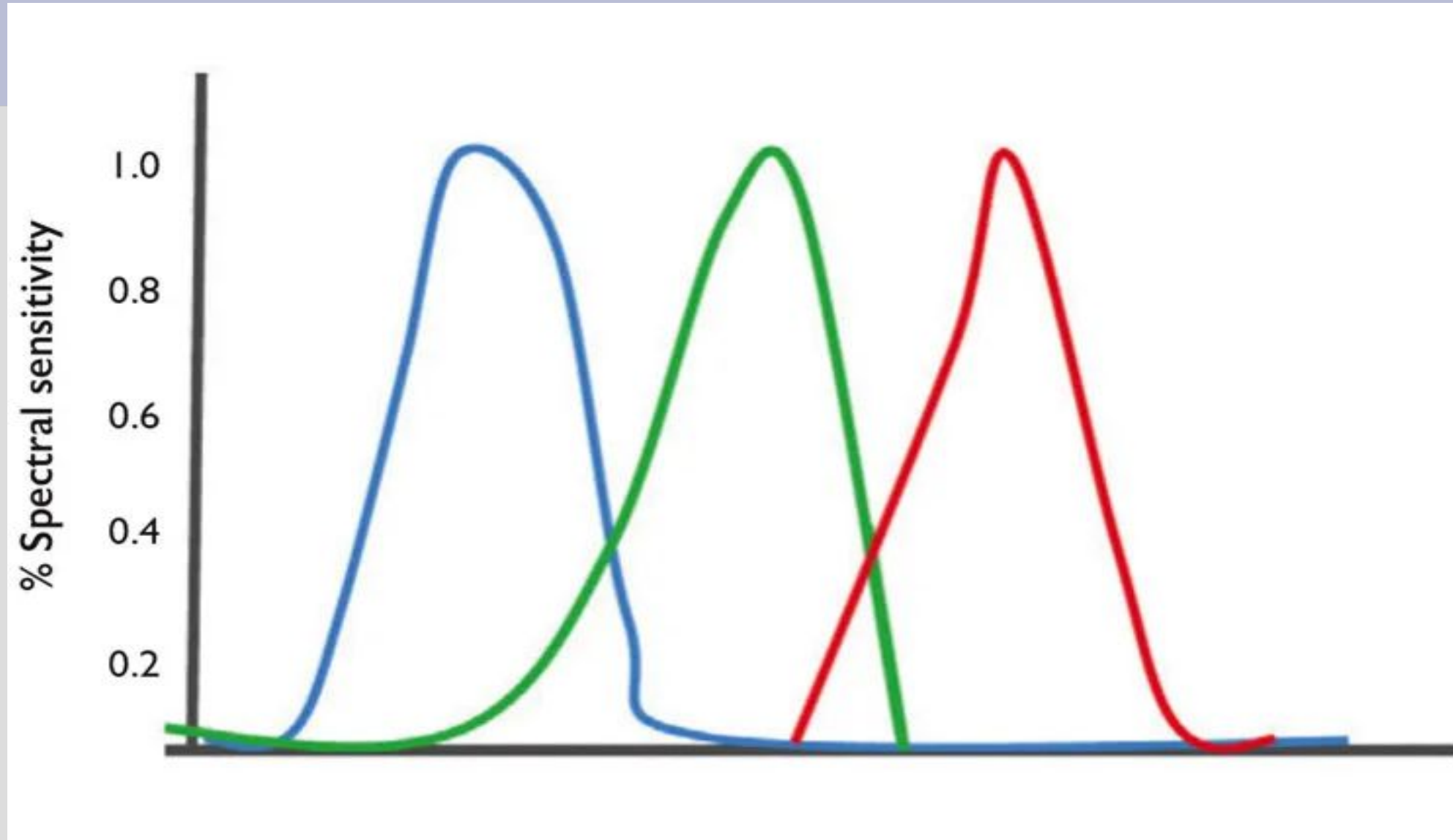
- **Metamerism (perceived color differences)**
 - Pictures graded on a Xenon projector may look different when shown on an RGB laser projector. Cinematographers need to verify in a laser theatre
 - These differences may also vary from person to person (!)
 - With Phosphor-laser projectors this problem is not seen (or much less)
- **Color Fringing (perceived colored borders at sharp, high contrast image borders & subtitles)**
 - This is also due to an interaction between the small bandwidth primaries and the human visual system. The colored lines are not actually there!
 - Stronger effect when far from the screen (no effect when very close)
 - Stronger effect for viewers wearing prescription glasses / contact lenses

Human Retina Average Spectral Sensivity is quite different from ...



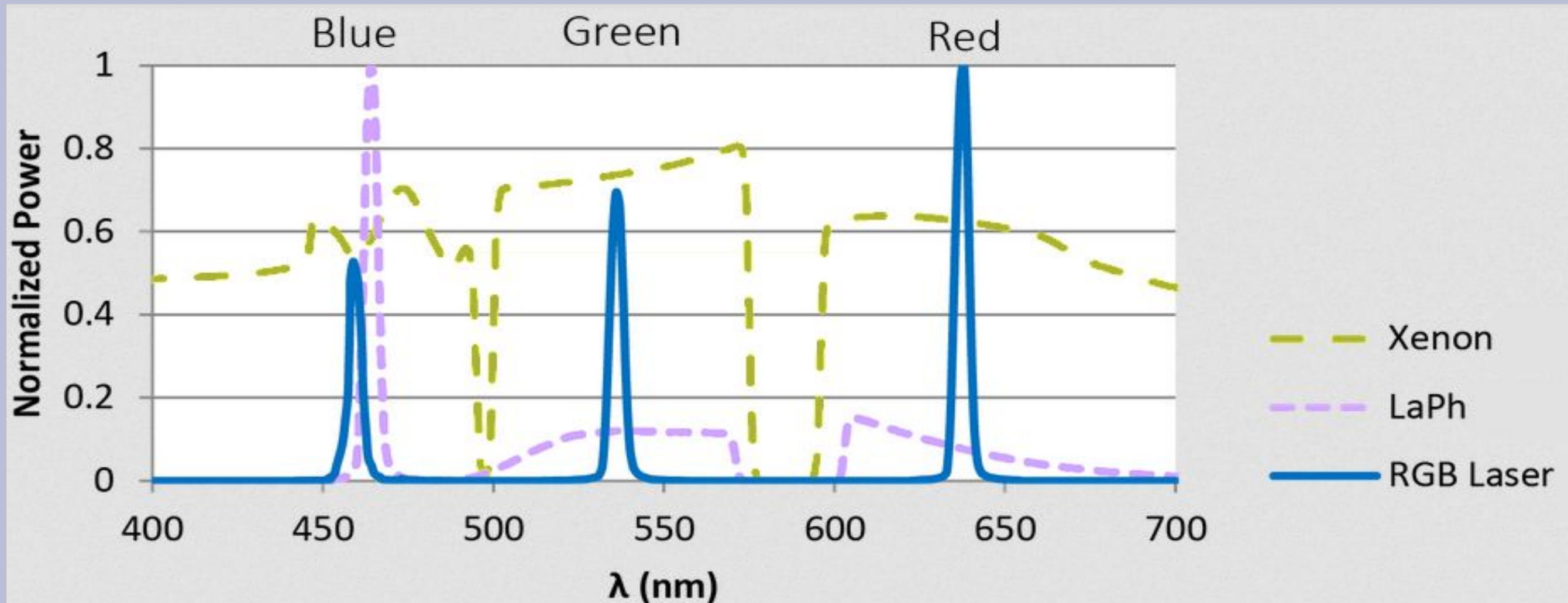
Picture source: https://en.wikipedia.org/wiki/Spectral_sensitivity

f.e. a Digital Camera Average Spectral Sensivity



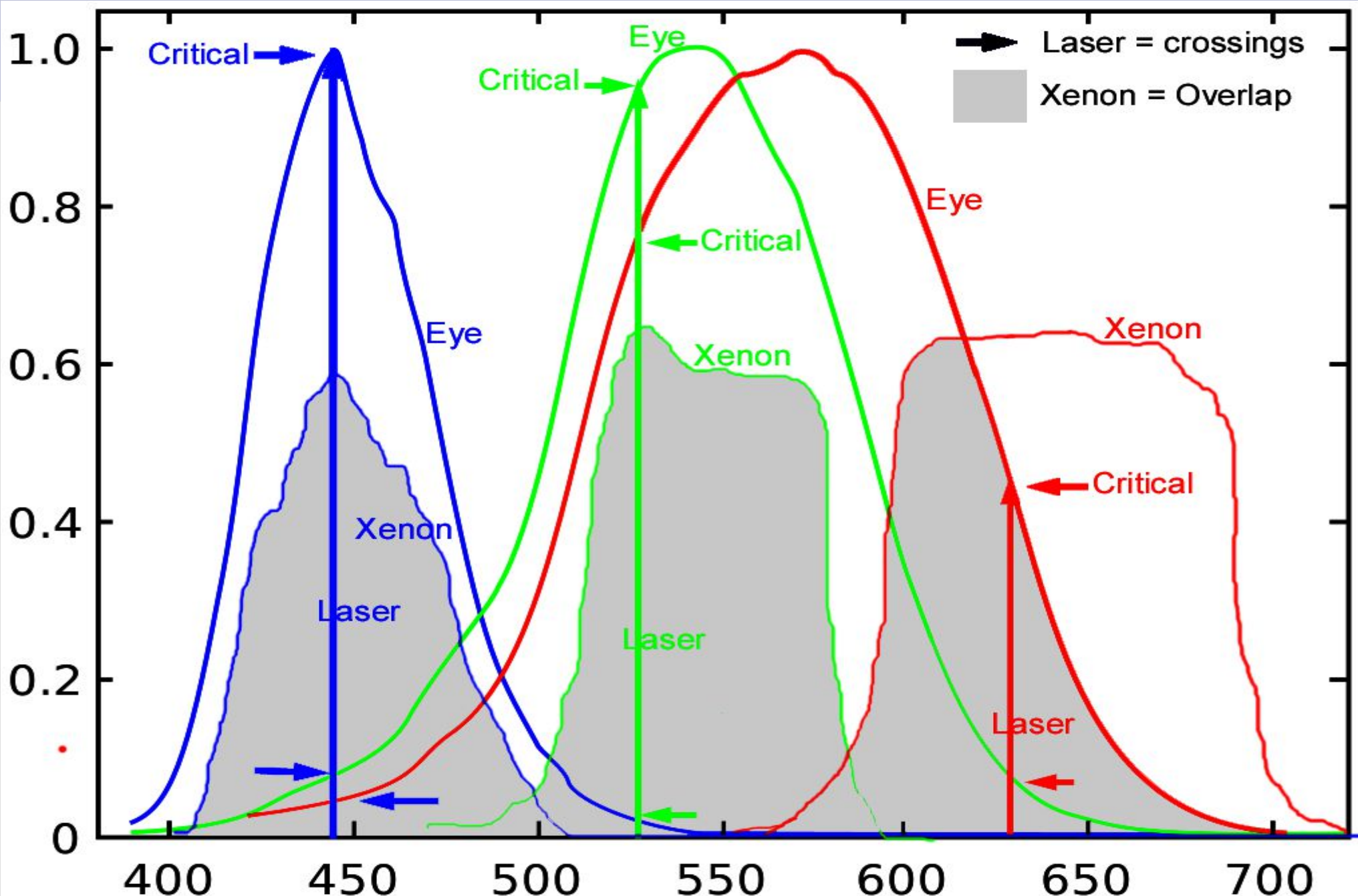
Picture source: <https://www.techbriefs.com/component/content/article/tb/supplements/pit/features/technology-leaders/36142>

Appr. Color Primaries of Digital Projector Types



Picture source: <https://spie.org/news/spie-professional-magazine-archive/2018-july/the-days-of-the-xenon-lamp-are-numbered>

RGB Laser Projector Stimuli on a Human Retina



RGB Laser source projection challenges

- After grading their work on a Xenon projector, cinematographers (and directors) may want to check the result in an RGB-laser equipped theatre
 - Please report to ITC if important differences are perceived
- More research is needed to quantify the problem
 - Please let us know if you can participate :-)
- A solution is needed to assure again that movies always look the same on all presentation systems
 - This was a primary goal and promise for D-cinema and the DCP standard

**An upcoming special application of laser light
sources:**

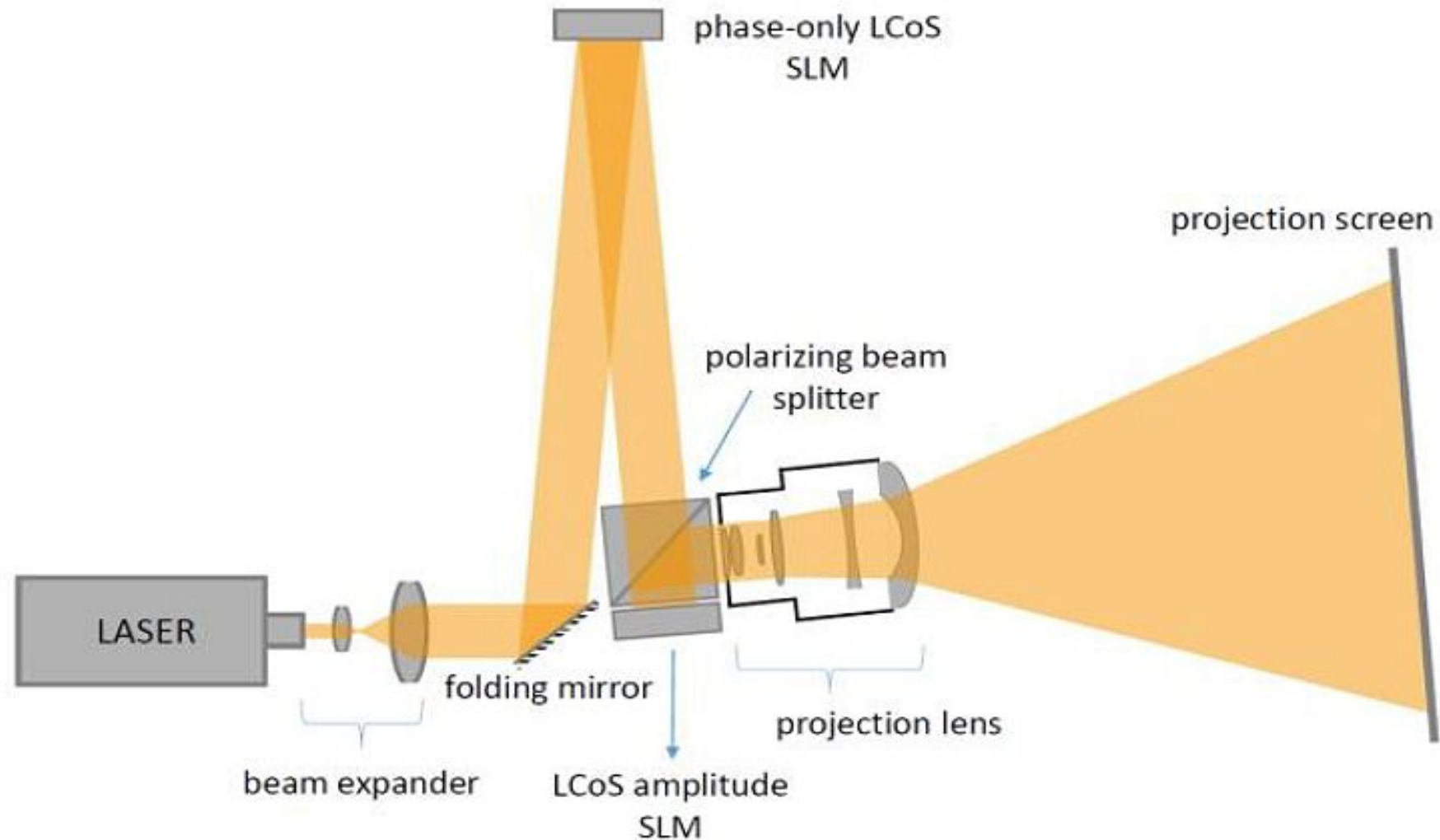
The Light Steering Projector

An upcoming special application of laser light: The Light Steering Projector

- Light not needed in dark areas of the image can be used for highlights
- HDR highlights possible several stops above general max white, with limited screen area but without the need for a stronger light source
- Deeper blacks possible by steering light away from darker areas, when steered towards brighter areas or a waist provision

- Created by MTT Innovation Inc., Vancouver, Canada
- MTT Innovation Inc. was acquired by BARCO in June 2016
- Prototype of a practical projector has been developed
- Early public prototype demonstration: CinemaCon May 2018
- Recent demonstrations at the Cannes festival May 2023 and other demonstrations between these events.

Light Steering Projector Diagram



- Picture source: <https://vccimaging.org/Publications/Damberg2017LightSteering/Damberg2017LightSteering.pdf>

Light Steering Projection Challenges

- Requires RGB laser light source (not possible with Xenon or Ph-laser)
- HDR Highlights only possible for limited screen areas, not for a big surface like a sky that fills half of the image. This may not be a problem but will need to be managed, also by the content creators (we!)
- New standards will be required
- May need more time to become accepted and if so, mass produced
- Theatre owners may be tempted to wait for direct view (LED) screens rather than investing in an intermediate technology

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Thank you for your attention

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