Laser illumination for cinema

Frequently Asked Questions (FAQ)

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1. What is laser and why is the industry moving towards it for cinema projection?

Lasers are collimated, monochromatic optoelectronic sources that emit concentrated light over distance from diodes. On a component level, lasers are robust, solid-state devices that have much longer lifetimes, operate on less power, and generate less heat compared to Xenon lamps of a similar brightness class. This has led display manufacturers to engineer laser illuminated projectors that take advantage of the lower TCO, longer life, higher brightness, and improved performance.

2. What are the differences between laser phosphor and RGB pure laser projectors?

Laser phosphor projectors use only blue lasers as the illumination source. Blue light from these lasers are directed to a yellow phosphor element which when excited with the blue lasers, emits green and yellow light. The needed red color is derived from filtering the yellow light. The blue light from the lasers is then mixed with the green and red light from the phosphor element to create white light. The white is further filtered and color corrected to properly render the colors within DCI-P3 specification. RGB pure laser projectors use banks of laser diodes in individual color primaries – red, green, and blue. These discrete emitting banks of lasers are color-mixed to produce a nearly infinite amount of pure, rich colors in the visible spectrum, including pure white light.

Lasers also have a tightly focused emission angle, known as the etendue. The smaller the etendue, the higher the achievable contrast. It is this property that allows RGB pure laser projectors to achieve high contrast and high dynamic range. With laser phosphor projectors, the high contrast benefits of a narrow angle are lost since the laser light gets dispersed and diffused through yellow phosphor.

3. Why do these two laser illumination platforms share a place in the market?

The market place demands low cost, long life, low maintenance, and high performance projectors. Laser illumination has the potential to satisfy these demands. However, just because laser phosphor and RGB pure laser projectors share a similar illumination source, that does not mean these platforms are interchangeable in terms of performance and applications.

For rental staging, corporate and education markets, laser phosphor makes economic sense since the demands for a wider color gamut and contrast are less stringent when compared to cinema. Therefore, laser phosphor can deliver on the cost, lifetime and reliability requirements demanded by these market places.

In cinema, the industry requirements are more stringent in terms of color, contrast, and brightness – performance areas which are best served by RGB pure laser. Initially, uptake of RGB pure laser in mainstream cinema has been slow – mainly due to the high cost of first generation systems. This allowed the laser phosphor platform to be introduced to meet the mainstream cinema market needs in terms of cost and maintenance, but there are deficiencies in performance and sacrifices in lifetime that need to be considered. As second generation RGB laser projectors are introduced, the cost disadvantage will no longer be an issue, making way for this high performing platform to become the standard for all cinema applications.

4. Why was RGB pure laser first introduced for cinema?

The performance levels which RGB laser projection is capable make it the ideal platform to take cinema into the future. The priority of the cinema industry is to have projectors achieve higher brightness levels to illuminate larger screens and show brighter 3D motion pictures beyond the limits of Xenon lamps. And RGB pure laser is the platform that will achieve this.

The performance benefits of RGB laser are clear and proven but until now, cost, has kept them reserved primarily for the premium large format auditoriums. As development continues and costs come down, RGB illuminated projectors will become the choice for *all* cinemas.

5. What were the reasons laser phosphor projectors entered the market when there were still uncertainties about the technology's potential for cinema?

Laser phosphor projectors for cinema still satisfy two requirements from the market: lower maintenance and longer life. They entered the market to fill a void in cost brackets between Xenon and RGB laser. When examining the total cost of ownership of a laser phosphor projector from initial purchase price to cost of maintenance and replacement of light modules/engines, it makes more economic sense to stay with a Xenon lamp projector.

6. Are both illumination technologies feasible for cinema?

In terms of providing the best visual presentation possible, RGB pure laser is by far the best option for cinema.

Because of their long operational life and low cost, laser phosphor does have a fit in cinema where auditoriums are in remote locations or projectors are hard to access for maintenance. However, it is important to consider the *useful* life of laser phosphor, not just the operational life. Laser phosphor projectors use phosphor wheels and laser diodes which degrade, dropping onscreen brightness below the DCI-spec long before their 50% brightness mark. Alternatively, an exhibitor could purchase a high-brightness laser phosphor projector and run it in a low-power mode, extending the usable life of the system but at a considerable cost increase.

Unlike Xenon projectors, which are restorable to full brightness with every lamp change, or RGB laser projectors which have an illumination lifetime (30,000hrs to 80% brightness) that stays within DCI specification, laser phosphor projectors require potentially costly maintenance of critical internal components to restore brightness to an acceptable range.

7. Can audiences see the differences between laser phosphor and RGB pure laser on screen?

There is a clear difference in image quality on screen between laser phosphor and RGB laser. Laser phosphor requires a yellow notch filter extreme color correction/ balancing to meet the DCI-P3 color specification for cinema whereas RGB pure laser inherently delivers a much wider color gamut that exceeds this specification. RGB laser based illumination offers greater contrast, is brighter, more saturated, and is more vibrant.

Laser phosphor also lacks the sharpness that RGB lasers are able to produce by maintaining the small etendue throughout the optical system. By design, light passing through a laser phosphor optical system goes through a phosphor wheel to be converted into white light. In this process, the light has already been diffused and subjected to light loss.

8. Why is Christie placing more value in RGB laser than other illumination technologies?

Christie believes that each innovation introduced needs to provide a clear benefit to the market. Xenon has been the workhorse for cinema for decades and will continue to be one for quite some time, however the performance limitations in Xenon are well known, and laser phosphor doesn't address them all.

RGB pure laser is the natural progression forward to achieve improved brightness, color, and contrast to meet demands of studios and exhibitors. As cost has been the barrier to entry for the mainstream cinema, Christie has invested in the research and development of next-generation RGB laser projectors that carry all its benefits while hitting a favorable price point for exhibitors. Our commitment has always been to serve the economics of cinema while continuing to improve performance.

9. What innovations have occurred in the development of next-generation RGB pure laser illumination systems?

Working with our strategic and collaborative partners at Ushio, a leading provider of illumination technologies, we have been able to optimize the optical designs for the lasers, utilize and integrate the next-generation of laser components, and simplify the active cooling for the projection system. This has helped with the reduction in overall system costs and improves optical and thermal efficiency, which yields increased longevity and stable color and light output.

10. Will RGB laser illumination make economic sense for mainstream cinemas?

This is what Christie has envisioned for the cinema market and is working towards. Taking the knowledge gained from building the first generation fiber-coupled RGB laser projection systems and working with our technology partners, Christie's focus is manufacturing the next generation RGB laser systems that use highly efficient direct-coupled lasers with a self-contained, simple liquid cooling system. Complexities in external chillers for cooling add costs and burden installations with their oversized bulk. By removing them, the savings in a simplified system are passed on to the exhibitor. These next generation RGB pure laser projectors will have all the benefits of their fiber-coupled predecessor with the exception of scalable brightness, but come in at a much lower price point. With Christie's next generation RGB laser projectors, cinemas will finally be able to offer audiences an improved experience in addition to simplifying their operations and optimizing costs.