Beyond 4K: Providing a High-definition Immersive Video Experience

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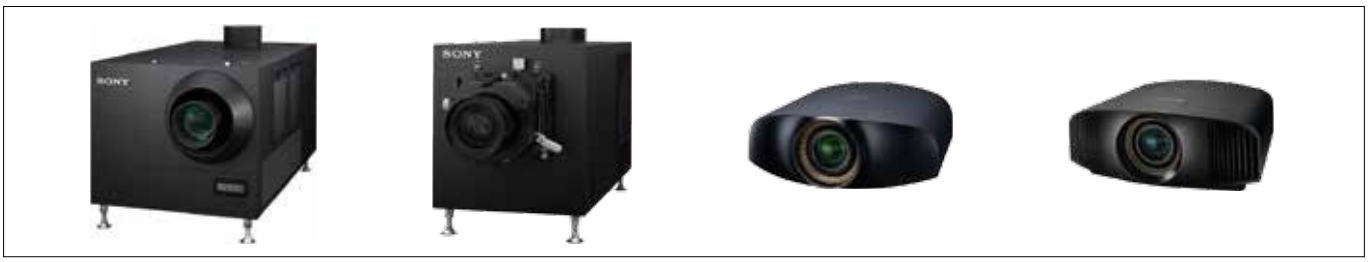
Figure 1: Sony current line-up of 4K projectors: (From left) SRX-T423, SRX-T615, VPL-GT100, VPL-VW520ES/VW320ES



1. Introduction

There are various different enterprises that aim to provide an immersive video experience, including theaters, museums, theme parks and planetariums. Here I would like to focus on planetariums — which are increasingly switching from optical to digital systems — and on the projectors they use.

This article discusses the attributes that an ideal planetarium projector should possess in order to inspire people, and introduces Sony's efforts to develop a high-quality display that has the ability to provide people with a truly moving experience.

2. Projectors suitable for planetariums

The projector in a planetarium needs to provide people with an immersive and captivating experience by showing them the vast multitude of stars that exist in the world of astronomy. The most important requirements in this regard are high resolution and high contrast (allowing it to display glittering stars against a pitch black sky). It hardly needs to be said that planetarium operators prefer a product that is not only simple to install according to the ideal layout, but also achieves low maintenance and running costs by constantly adjusting its picture quality. To respond to the needs of planetarium applications, Sony is working on the development of projectors using leading-edge technology. The efforts we are making in each field are introduced below.

3. Sony's efforts

• High image quality

The highest resolution currently available from a commercial projector is 4K, which has over four times the resolution of full HD video. Reflection-type devices are advantageous for the design of high-resolution systems. At Sony, we have developed a reflection-type high-resolution display device called SXRD™ (Silicon X-tal Reflective Display) that combines the advantages of both higher resolution and higher contrast. Since 2005, we have been introducing 4K projectors into the movie theater, consumer and special industry markets. We have also introduced many products in planetariums around the world, and their picture quality has been highly acclaimed. (Figure 1)

Our 1.55-inch panel that was first mounted in large-scale equipment has now been reduced to a quarter of the size (0.74-inch diagonal) with the pixel pitch reduced from 8.5 µm to 4 µm, enabling us to pack in approximately 8.85 megapixels in an area of about 1.5 cm². This miniaturized 4K projector has been put to use in an even wider range of applications.

Also, by optimizing the fabrication process for this panel, we have arrived at a native contrast level of 20,000:1 without resorting to optical aperture control. (Figure 2,3,4)

Figure 2: SXRD panel

Figure 3: Reducing the pixel pitch

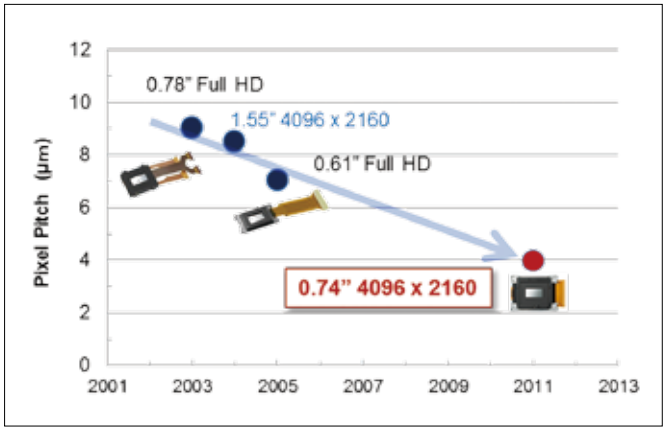


Figure 4: Improving the panel fabrication process

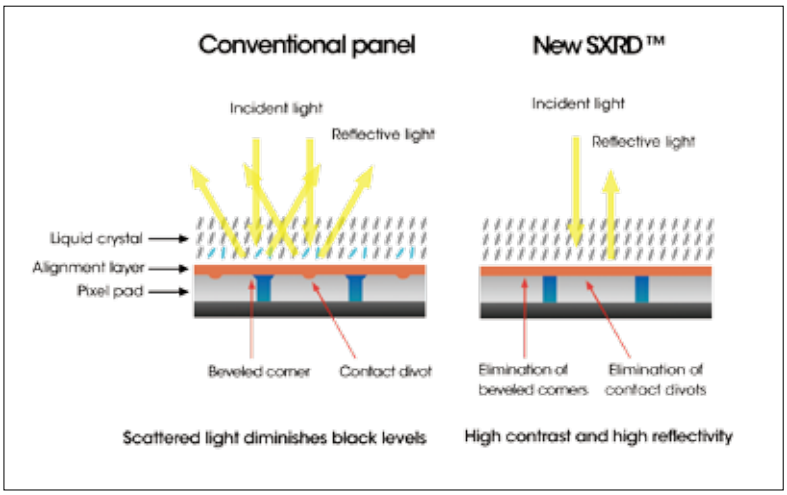


Figure 5: Laser light source (image)

We have achieved roughly 80% coverage of the BT.2020 color range by incorporating a blue laser light source that has two different wavelengths for excitation and blue reproduction, and expanding the display gamut with phosphors that provide a wider range of colors. This contributes to the reproduction of subtle color differences in each star, which will not only improve the projector's ability to display variations of light and dark regions but also enables it to reproduce higher density video by plotting a subtle gamma curve.

It is hoped that this will increase the options for providing a more impressive immersive experience by leading to the development of better planetarium operations including, for example, the creation of content that takes advantage of this wide color gamut. (Figure 5,6)

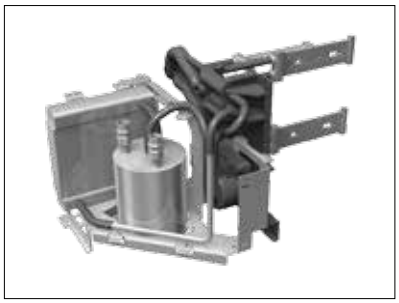
• Ease of installation

Depending on the dome size, a single projector may be sufficient in some cases, while in others it may be necessary to produce a single image with multiple projectors oriented in different directions. The shape of a planetarium domes can be "horizontal" or "tilted", and since these require the projectors to be installed at different angles, it is important that projectors are able to be installed at various different angles. The design of the light source and cooling system has a strong bearing on this capability, and products that are not optimally designed are liable to have a severely impaired lifetime and require frequent maintenance.

In some cases it may be necessary to project onto a large screen from a short distance or to operate quietly because it is installed behind the viewers.

To resolve these issues, we focused on using a laser light source instead of a lamp light source that is strongly affected by the angle of inclination, and we made it possible to orient the projector at any angle horizontally or vertically. We have also developed a system with a lens that can be shifted up/down and left/right to faithfully reproduce 4K high-definition images despite having a short focal length with a throw ratio of 0.8 to 1.0, and a hybrid cooling system that combines air-based and coolant-based techniques to provide optimal cooling in each internal area. This resulted in equipment that is easier to install, provides more stable cooling of the light source, and produces less noise.

Figure 7: Liquid cooling system

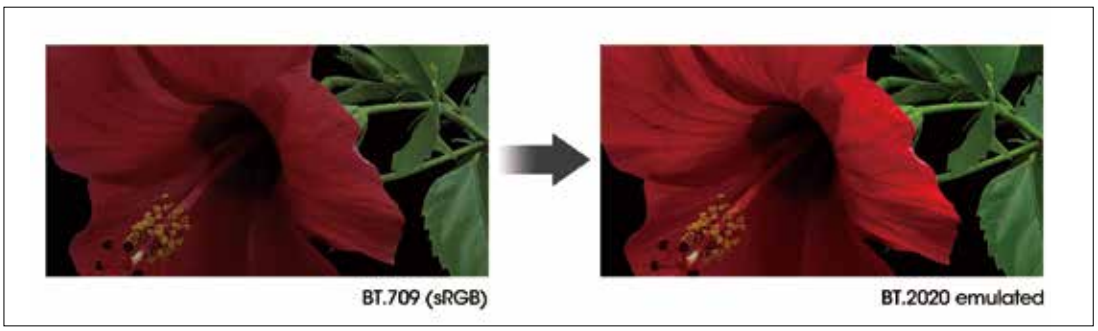


• Reduction of maintenance

When a projector is operated in a public place, routine maintenance is generally required due to the following factors:

(1) Dimming over time: Routine replacement of the lamp after it has been operating for a few hundred or a few thousand hours

Figure 6: Wide color gamut



(2) Variation of brightness/picture quality over time: Combined readjustment of multiple projectors

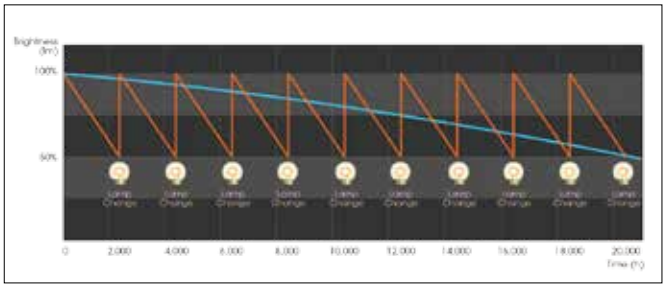
(3) Routine cleaning of optical components: In an environment where there are lots of people coming and going, dust can enter through the cooling vents, causing reduced light intensity.

Sony has devised features that alleviate the burden of these maintenance tasks.

(1) A laser light source with a lifetime of at least 20,000 hours (depending on operation mode)

This lifetime is over ten times that of a conventional lamp light source, thereby reducing the cost and effort of replacing the light source.

Figure 8: Comparison of lifetime with an ordinary lamp light source (laser light source: blue line)



(2) Uniform intensity mode aimed at avoiding intensity fluctuations until the light source lifetime has been exceeded Sensor with a built-in auto-calibration mode to restore the color gamut and color temperature of the original settings

Figure 9: Constant brightness mode

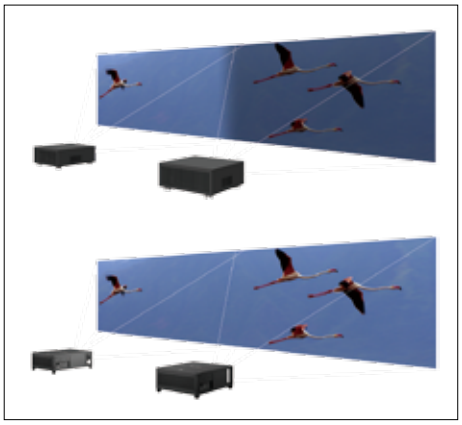
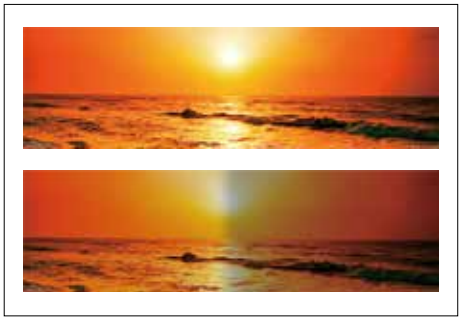


Figure 10: Auto-calibration



(3) Preventing the infiltration of dust by adopting a sealed optical unit with the panel cooled by liquid coolant.

Figure 11: Sealed optical unit

In spring 2016, we plan to launch a new projector incorporating Sony's unique technology for planetariums as introduced above.

	VPL-GTZ270 4K SXRD Laser Projector
Light output	5,000 lm
Resolution	4K (4096×2160×3)
Native contrast ratio	Up to 20,000:1
Maximum color gamut	BT.2020 (80% equivalent)
Light source	Laser diode
Installation angle	360° free angle
Input/output terminals	HDMI (HDCP 2.2)×2, display port (HDCP 1.3)×1, display port (HDCP 1.3 for Vsplit)×1
Operating noise level	≥35 dB (depending on operation mode)
Cooling system	Hybrid (liquid cooling + air cooling)
Maintainability	Light source lifetime of ≥20,000 hours, constant brightness mode, auto-calibration, sealed optical unit

Figure 12: VPL-GTZ270 4K SXRD Laser Projector

Conclusion

Planetariums are widely supported as a type of edutainment that stimulates people's intellect and curiosity. There is no doubt that planetariums will continue to fascinate audiences with an overwhelmingly immersive experience. At Sony, we intend to devote even greater efforts to the creation of industries that provide people with a moving experience and stimulate their curiosity.