GxL

Laser Dream Theater at the Aichi Expo

Impact of high-definition screen of more than 6M pixels – 50 meters wide and 10 meters high (equivalent to 2005-inch TV)

A view such has never been seen before.
Visitors to Global House,
the central pavilion of Expo 2005 Aichi, Japan,
will be overwhelmed
by the frozen remains of an intact mammoth,
and by the 2005-inch ultra-wide high-definition
screen of the Laser Dream Theater.
As though gazing from a giant window,
visitors will see the earth
and the current state of human living.
This is a new world of the screen image,
made possible by GxL ("G-by-L"),
the latest imaging technology
under development by Sony.

The hushed still green of the forest. The embracing blue of the sky. The awe-inspiring white of the glacier. The brilliant reds of the people of the grasslands. In scenes shot from the air, one gets an incredible feeling of being suspended in space. Images of nature and civilization appear brilliant and detailed, together with animation and environmental statistics in a twenty-minute production that allows us to contemplate our relation to the earth, now and in the future. The 11.1-channel surround sound adds extra impact.

Laser Dream Theater

Location of presentation:	Nagakute site, inside Global House
Projection:	GxL ("G-by-L") system (laser projection)
Screen:	2005-inch (10 m high by 50 m wide)
Seating capacity:	Approx. 900
Theater area:	Approx. 2300 square meters

More technical details of GLV appear in CX-NEWS Vol. 31 "Featuring."
Also available on the Sony Semiconductor website: http://www.sony.net/Products/SC-HP/

This is not just an enormous screen.
The high resolution, high contrast,
and wide color reproduction range
results in a detailed image
with an unparalleled realism and depth.
The first world expo in Japan for 35 years
invites you to experience
an entirely new world of imagery.

GxL("G-by-L") – the latest imaging technology brings out the world of today in vivid detail

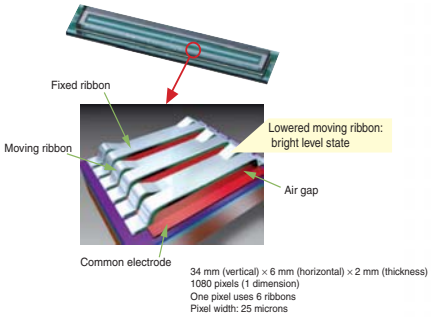
"GxL" uses optical diffraction.
What is "diffraction phenomenon"? ...

When light impinges on a surface with grooves and ridges in a regular pattern (a diffraction grating), the direction of the light is deflected. This is the same phenomenon that causes CDs to reflect the colors of the rainbow.

Tiny ribbon reflectors are used to control the intensity of the diffracted light, generating the light and dark of the image.

A total of six ribbons are arranged to alternate between movable ribbons and fixed ribbons, forming an optical diffraction grating. The movable ribbons move vertically to produce a tiny difference in height, thus causing the optical diffraction. Using special filters, the diffracted light only is projected onto the screen (reflected light is shut off). When the six ribbons are at the same height, the image is dark, and when the movable ribbons are lowered the image is light.

■ GxL element construction

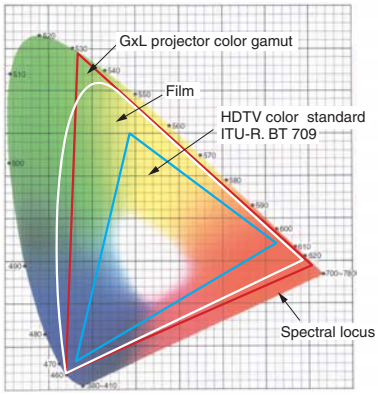


The micro-ribbon reflector is raised and lowered by an electrical imaging signal, to control the amount of optical diffraction. This combination of an electrical circuit and mechanical action is known as a micro electro mechanical system (or MEMS device).

Light source consists of single-frequency lasers. Great improvement in color reproduction

By using RGB lasers, with outstanding color purity, as the light source, saturated colors can be produced in a way impossible with conventional image display systems.

■ Projector color gamut



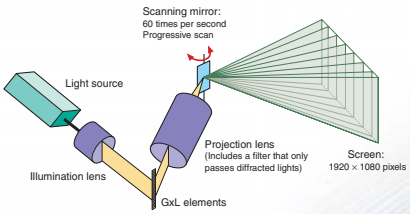
CIE 1931 chromaticity diagram (xy chromaticity diagram)

The range of color reproduction realized exceeds that even of film.

Scanning with a one-dimensional vertical image creates the full high-definition image (two-dimensional screen)

The vertical resolution is the same 1080 pixels as an HDTV image, realized by a linear array of GxL elements. A scanning mirror converts this vertical linear image by horizontal scanning to a two-dimensional full high-definition progressive image, 1920 pixels (horizontally) by 1080 pixels (vertically).

■ Operating principle of the GxL system

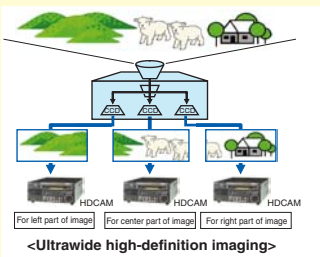


The projector forms a 2-dimensional image by scanning a 1-dimensional image.

The number of pixels in the horizontal direction is determined by the angle and the pitch, but this is variable. Since the ribbons are aligned continuously in the vertical direction, even closely approaching the screen it is not possible to make out individual pixels. This far surpasses the conventional concept of pixels, and unlike existing projector imaging systems, approaches the quality of silver-based photographic film.

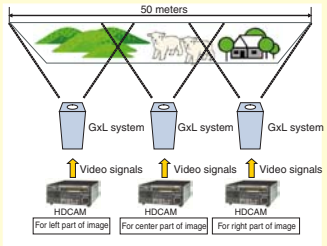
Combining three HDTV images — Shooting and projection system —

A special-purpose camera system is used, in which the image created by a single lens is split and simultaneously captured by three cameras, assigned to the left, center, and right portions of the image. The resulting video material is then recorded on three HDCAM HDTV video systems.



<Ultrawide high-definition imaging>

The recorded images are projected by three GxL systems, assigned to the left, center, and right portions of the screen. These three images are combined seamlessly on the screen, to form a single wide image (each projector produces approximately two million pixels, for a total of six million pixels).



<Laser Dream Theater>

The Expo is a time machine
– an event where visitors get a foretaste of
the delights and surprises
in the radically changing life of the near future.
This Expo reveals dream display technology.
It will without fail will have enhanced
the potential of all those who worked
on the development and production.

ANOTHER EXPO

1970 OSAKA

The 1970 Osaka Expo had a total attendance of 64,220,000 people, amounting to half of the population of Japan at the time (110 million).

1985 TSUKUBA

In 1985, Tsukuba ("Science City") in Ibaraki Prefecture hosted a Science Expo, featuring imaging, robots, future transportation systems...
A revelation to the science kid of twenty years ago – Sony exhibited its Jumbotron large-screen display system.

Amazing images — even though I was involved in the development myself

Naoya Eguchi
General Manager
Laser and Optics Development Department
Photonics Development Division
Core Technology Development Group
Micro Systems Network Company
Sony Corporation

A 2005-inch display in 2005

The first time I heard talk of a demonstration at the Expo was in the summer of 2002. This was shortly after the press conference in June on "GLV" (Grating Light Valve: optical diffraction grating). At that point, the only thing decided was that for an Expo in 2005, it would have to be a 2005-inch model. At first, I was thinking of something like the Jumbotron at the Tsukuba Science Expo. But as we moved into 2003, the plan firmed up to convert an existing skating rink to a theater. The skating rink was an wide shape, and this led was the trigger to practical discussion, based on the entirely new idea of setting three HDTV images alongside each other using the GxL system.

No reason why we can't

In 2002, the GxL system was in prototype, and had reached a 200-inch version. This left a factor of over ten to our target 2005 inches – a huge gap. However, this didn't give us reason to say it was impossible. Basically we took on the job, because we could not see a reason for failing. Of course, we didn't actually know a reason why it would be possible, either. Once we started the actual development, we had quite a tough time.
The Expo made this a very special demonstration, and we want it to have historic significance. Moreover, the laser display would attract public attention as the realization of a dream. We would be making history with our own hands, creating our own dream, and so we decided we would also go for the development of our own blue and green lasers.
In fact, we had quite some struggle with the laser development, and there were times when I thought, "Let's just buy them in." "What are you talking about?" demanded my enraged superior. "If we buy them, there will be no value in the Expo demonstration. Just grit your teeth, and then it will really be worth doing." The Expo became our driving force.

In the name of the Expo

The Expo really closed the distance between the companies within Sony.
The two technology arms of the GxL system are the laser light sources and MEMS. The project could not have succeeded if either of these had failed.
The lasers were developed from zero by the Micro Systems Network Company (MSNC), with technological collaboration from related departments.
The MEMS devices had already ended their development phase at the time, but in making the MEMS devices while still in the pre-quantity production phase gave us considerable problems in the mounting. The Semiconductor Solutions Network Company (SSNC) came to full potential, just for the Expo, making an all-out effort to raise the technology level.
This project was truly a job of vertical integration. The Expo was a target transcending the strategies of the individual companies. The Expo was a keyword that brought everyone working together in a technological effort for Sony. It was like getting back to the basis of creativity.

Amazing experience: "a window everywhere"

The cells in the human retina respond to the primary colors of red, green, and blue. By using single-frequency red, green, and blue lasers, with no extraneous light, the eye's visual system can really react 100%. That is, the nerves in the eye can be stimulated directly.
Even for example with a red of the same brightness, with a laser light source, the color can look twice as bright as on a television screen, and thus twice as vivid. When we watch television normally, we adjust, and do not even notice the difference from the original colors. So we perceive the colors we expect to see. But then when we view a GxL system image, since the colors really are the

2005 AICHI

Every ten minutes, 152 babies are born in the world.
Tears and smiles, an overflow of emotions, and it is the green earth that sustains this life. The breathtaking beauty of nature. And all of these, made real by the very latest in imaging technology, are the very face of our earth.
The technology bringing us new sensations will surely, as it has from previous Expos, soon reach our homes.

originals, we perceive them as “more real than real.” For someone who wears glasses, it is like the feeling of putting the glasses on. Nobuyuki Idei, Sony’s chairman & Group CEO likes to use the term “window”.
“That window there, beyond that window is the real world,” he will say.
At the Expo, the Laser Dream Theater further adds the effect of an ultrawide large screen. At 50 meters wide and 10 meters high, it is one giant window. The fantasy character Doraemon has “Go anywhere” doors, and surely this is a “See anywhere” window. Once an image is projected, while sitting in the theater, one can be traveling the world, or through space, in a never-before experience. At the sharp end of Sony’s imaging technology, you will surely get this experience. At any rate, even though I was involved personally in the development, when I saw the presentation I was totally swept away.

Reversal – an evening in Tohoku

This felt quite different from a normal product development project. I suppose it is rather like a civil engineering project, when you can say “See that bridge? I helped build that.” I think everyone involved in the development and production had the same feeling. Hard work brings its rewards.
We wondered if it was going to be possible to produce the lasers. At one stage this became serious – members of the development team were heard muttering of leaving the company or committing hara-kiri. The Executive Deputy President, Ryoji Chubachi, was heard to say “If you lot slit your bellies, I’ll disappear one night.” So after that we would just say “For the sake of the boss” and press on. That was the melodramatic stage.
When we reached a complete theoretical impasse, and people were talking of trying the unmentionable way, it was hard to make a decision, and we would have to push the engineers in a completely new direction. The laser production was happening in a facility in the Tohoku region, north of Tokyo, and a member of the staff there was an old acquaintance from my days in the Research Center. So I called up from Tokyo and asked, “Is it OK with you if I come up for a drink, on the three o’clock train?” And we sat drinking in a bar near this northern station until the last train back to Tokyo. All the time it was “This is the direction to go in...”
Even when I phoned him, this colleague had been able to guess the drift of the discussion, and in fact had already started on validation tests. “I’ll have the data tomorrow” was his words.
Meetings were always likely to turn into a shouting match, but being able to drop in, as though at the next station, made the atmosphere easier for both of us. Anyway, that was the evening that completely changed the direction of the project.

Bringing the Expo experience into the home

This project required quantity production of the lasers and the new GxL projector to be ready by December 2004, so tests at the production site proceeded step by step with the development, in order to produce the two parts of the system at the same time. It was like a game of catch.
At first we had one problem after another. We set aside a tatami mat recreation room at the assembly plant as a “command center” and weekend evenings, one of the people on the project would be called in so that we could run through problems, and give directions. Of course at some point this became known as the “punishment block”!
In the end we went for the unthinkable kludge. Otherwise, though, I do not think we could have had the lasers in quantity production and the new GxL projectors ready within the time limit. In terms of production quantities, I think Sony in 2004 became one of the world’s top laser producers.
The result of everyone’s sweat and tears was a unique accumulation of know-how, both in theory and in production technology. We are taking great care to ensure that this know-how is exploited successfully; we take the Expo as “Year zero” of the project to bring the GxL system imaging into the home.
I very much hope that all CX-NEWS readers will take the opportunity to come to the Expo and experience the GxL system. You will surely be amazed.
But the Expo is that sort of place - somewhere exciting, somewhere to experience new things. In the end, this is what being alive is all about, I guess. Like the excitement of watching one’s children growing up. But I very much hope that the GxL system will play a useful part in bringing this joy and excitement to all.