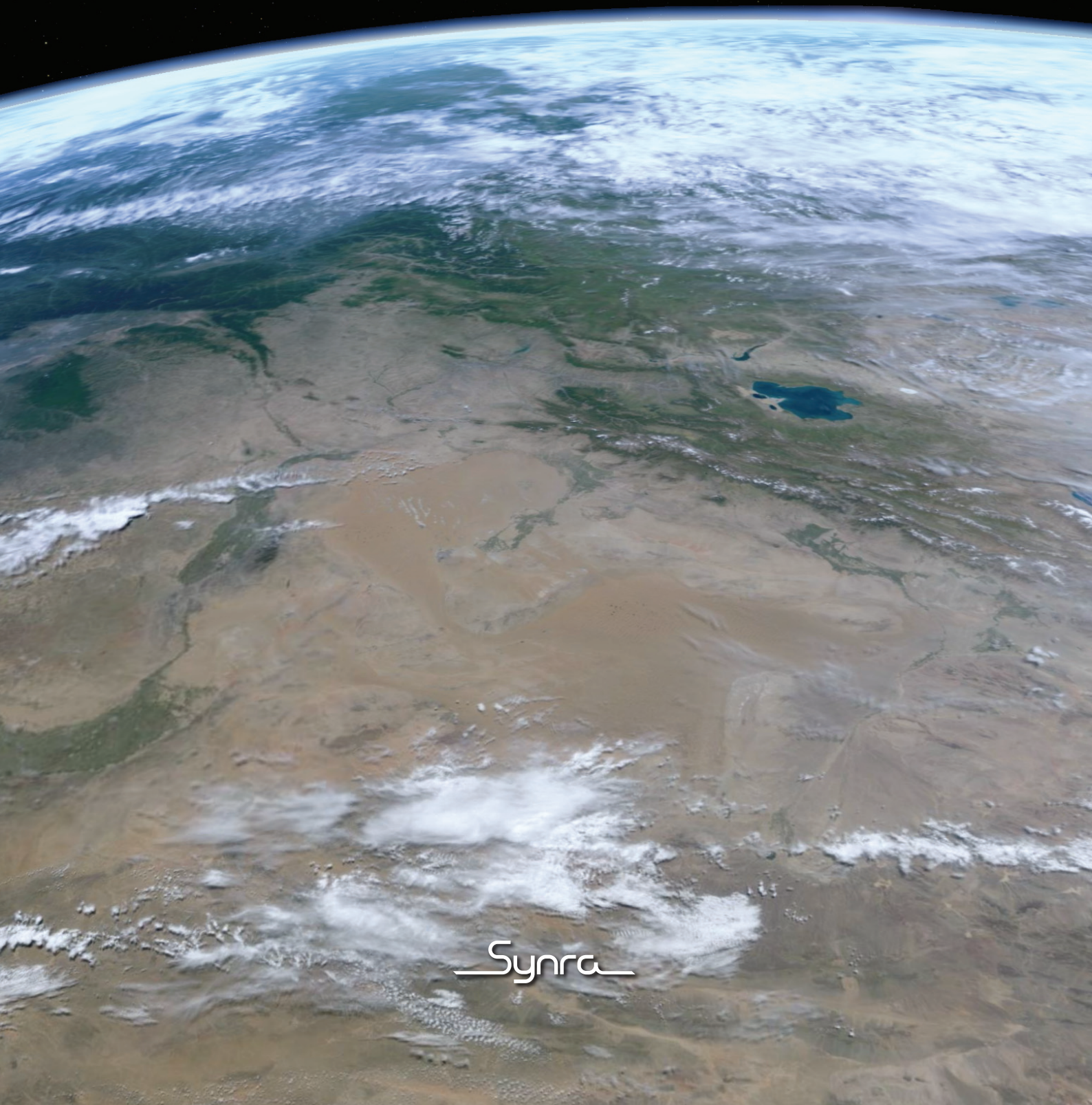


# SYNRA DOME

SCIENCE MUSEUM, TOKYO



Synra





# The Place where you will Encounter the

Japan' s First,

Stereoscopic full-dome theater "Synra Dome" is here!

Experience the powerful images covering all horizons.





# Entire Universe

## Welcome to Synra Dome

One of the vital missions science museums and other museums have is to disseminate the findings from research undertaken by universities and research organizations to the general public in a way that is easy to understand.

The recently opened “Synra Dome” is not only a theater where, thanks to state-of-the-art imaging systems, you can view amazing image contents, it is also a place for experimentation and development, where researchers can collaborate with technicians and artists.

It is our intention to work in concert with more and more research organizations, industry bodies, as well as science museums and other museums in future to popularize and further develop this ground-breaking initiative referred to as “Synra Dome”. We ask for your support and cooperation in bringing this to fruition.

**Akito Arima**  
Director of Science Museum

## A Mirror Reflecting the “Entire Universe”

The “Synra Dome” stereoscopic full-dome theater was opened on the fourth floor of the Science Museum, in Kitanomaru Park, in Tokyo, in August 2008. It was named “Synra” after the Japanese term “Shinra Banshou” (meaning everything in the universe) to encompass all phenomena that occur in space.

Three dimensional images of the whole sky, including the planets in the solar system and the Milky Way galaxy, the world of intracellular DNA and proteins, as well as the deep seas of the globe and the world of insects, are projected on the screen to create an amazing sense of being right there. The Synra Dome is a mirror in which the entire universe is reflected, it is a creative space where science, technology, and art meet.



# Cosmic Discoveries

So how far have we reached in space and how much have we been able to find out about it?

Why don't you experience for yourself the latest views of what space looks like from the information mankind has discovered as you travel from the earth to the farthest reaches of the vast cosmos.

## [ Highlights ]

Based on the American Museum of Natural History's three-dimensional space database "Digital Universe", the world's best real-time space image generation software "Uniview" was used to create Cosmic Discoveries, the latest images of the cosmos.

Cosmic Discoveries is an original work, which is also significant as a new generation of dome content creation using real-time visualization technology.

## [ Basic Information ]

Running time: Approximately 15 minutes

Program format: Stereoscopic full-dome movie

Authoring and Production: Orihalcon Technologies

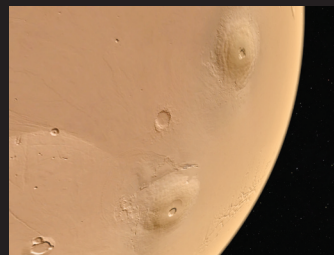
Narration: Hideyuki Tanaka



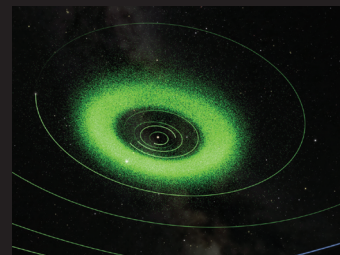
View of dawn from space



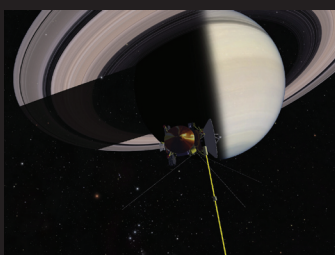
The International Space Station



The surface of Mars



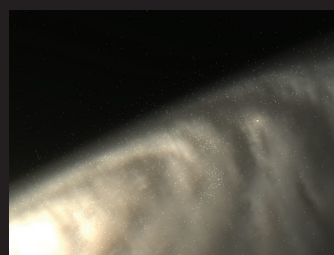
Distribution of asteroids



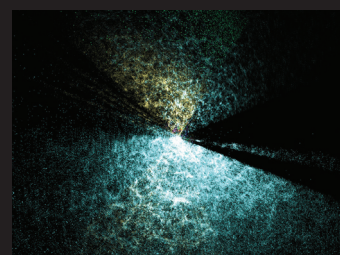
Saturn and Cassini



Interstellar flight



The Milky Way Galaxy



Large-scale structure of the cosmos



Joint performance played out within life forms by molecule machines

# The Central Dogma

Making protein from DNA –  
Dynamically experience for yourself the flow of information  
that is the basis of all life activities.

## [ Highlights ]

The Central Dogma is an original work by RIKEN Omics Science Center based on the latest research findings. It introduces life's most fundamental mechanism, the "Central Dogma" of assembling protein based on the design information written in genomes (DNA).

## [ Basic Information ]

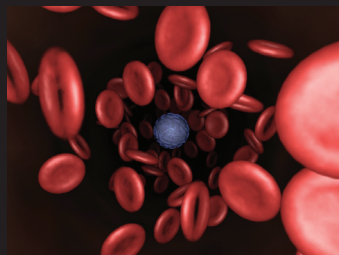
Running time: Approximately 15 minutes

Program format: Stereoscopic full-dome movie

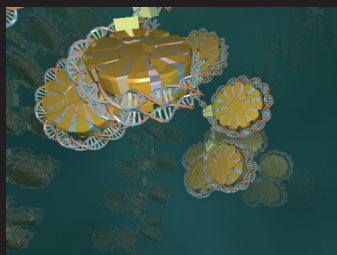
Authoring and Production: RIKEN Omics Science Center

Production Assistance: Orihalcon Technologies, Japan Science Foundation

Narration: Hideyuki Tanaka



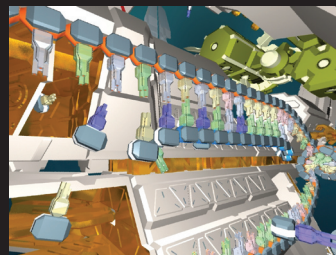
Inside a blood vessel



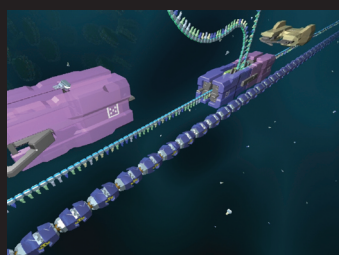
Chromatin and DNA



RNA polymerase and transcription factor



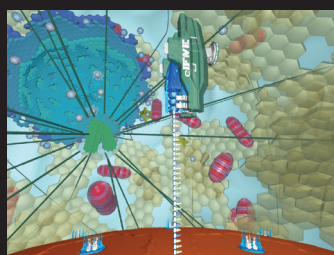
Transcription process to RNA



Splicing



mRNA heading for nuclear membrane pore



mRNA that has exited the nucleus



Production of protein by ribosomes



# National Astronomical Observatory of Japan's 4D2U Project

Various scientific visualizations of the cosmos have been produced by combining the latest astronomical research by the researchers of the National Astronomical Observatory of Japan with supercomputer technology.

## [ Highlights ]

4D2U content is a work that was made using large-scale simulation visualization technology developed by the 4D2U project.

This is the first stereoscopic full-dome screening of "the formation of the moon", "the formation of a spiral galaxy", "large-scale space structures", etc. outside the National Astronomical Observatory of Japan's facilities.

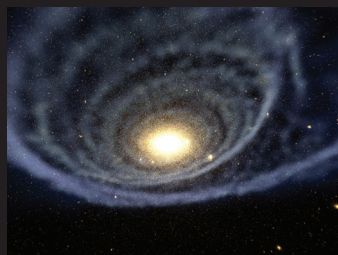
## [ Basic Information ]

Running time: Approximately 15 minutes

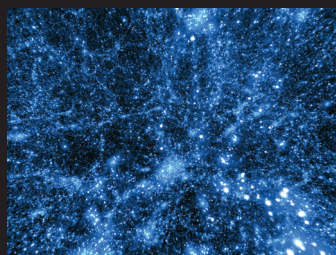
Program format: Stereoscopic full-dome movie

Authoring and Production: Orihalcon Technologies

Narration: Hideyuki Tanaka



Simulation of the formation of a spiral galaxy



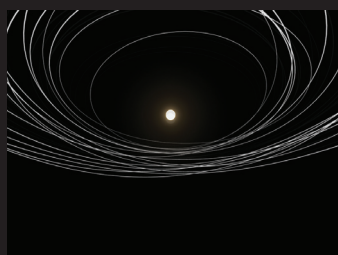
Simulation of the formation of large-scale structures



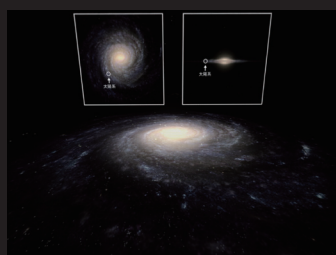
Simulation of the moon's formation



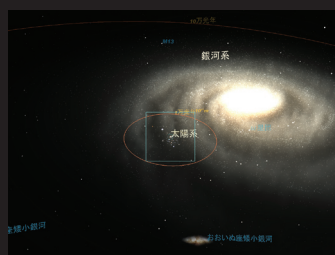
From "The Birth of the Earth and Moon"



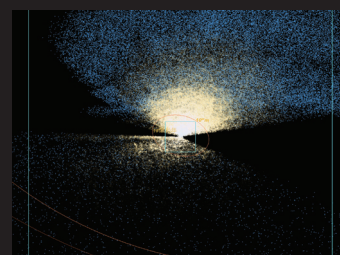
From "The Birth of the Earth and Moon"



From "The Milky Way Galaxy"



From "Cosmic Views"



From "Cosmic Views"





# Synra

## Variety of Activities Going on at Synra Dome

At the Science Museum, in addition to the normal program screenings at Synra Dome, the vast array of possibilities the stereoscopic full-dome environment provides are also being pursued, through activities such as the live science show put on by researchers called “Universe”, and the holding of numerous events.

### ■ Live science show “Universe”

“Universe” is a live science show that presents the latest science topics, including astronomy, using real-time computer simulations and networks. The show is hosted by “Facilitators” who are front-line researchers. They are assisted in operating the computers and a variety of other tasks by “Assistants” from the student volunteer group “Chimonzu”. The first live show was held in the hall “Universe” of the fourth floor of the Science Museum (in Chiyoda Ward, Tokyo) on April 21, 1996, and since then has continued as a regular show performed twice every Saturday afternoon. From August 2008, it has been updated to become a live stereoscopic full-dome show performed in the “Synra Dome”.

### ■ Synra Dome Tech Demo

Synra Dome Tech Demo is a regular event at which all of the contents and software Synra Dome has are demonstrated and where the demonstrators and participants talk about the possibilities of media, such as Synra Dome and stereoscopic domes. The aim is to explore new initiatives and collaborations with as many scientists and creators as possible in an ‘open dome theater’.

### ■ Bella Gaia - Private Preview -

The “Bella Gaia” project is a fusion of beautiful Uniview images of the earth and emotional music by musician and New York resident, Kenji Williams. This work has been performed to rave reviews at a museum venues around the world, starting off with dome concerts at the Denver Museum of Nature & Science (formerly the Denver Museum of Natural History), followed by the NASA Ames Research Center. At Synra Dome, which is the launch pad in Japan for Uniview, a private preview of the Bella Gaia dome concert was performed for the first time in Japan, in December 2008, and Synra Dome proactively contributed to the image production. (Planning and production: Bella Gaia Japan)

### ■ Digital Planetarium Workshop

A digital planetarium workshop gathering together over 100 people involved with planetariums across Japan, was held in September 2008. The Synra Dome’s state-of-the-art set up and variety of image contents were presented at the workshop, showcasing the new possibilities stereoscopic domes and interactive science visualization hold for the planetarium community. The opening of the Synra Dome, with its flexible systems, made it possible to easily project various contents and software brought into the workshop, which also became a forum for lively discussion on the future of planetariums. (Organizers: JPA Digital Planetarium Workshop Group)

### ■ Three-dimensional VJ Event “Overlapping Spiral”

“Overlapping Spiral”, the world’s first stereoscopic VJ concert was held at the end of 2008, with the images of VJ (Visual Jockey) image creator VJ REEL, which dominate the senses with the live performance feel of stereoscopic surround images, moving to the progressive sounds of artist Saitone using an 8-bit sound generator. This event came into fruition from an idea from technical demo participants. At the Synra Dome, we continue to explore the possibilities of the stereoscopic dome as a media through pro-active collaborations with creators and artists. (Planning and production: VORC Records)



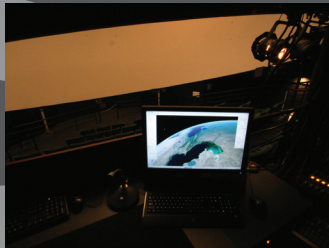
# The Hardware that Supports Synra Dome

In the Synra Dome, twelve projectors are used to project stereoscopic images onto a full-dome screen that is 10 meters in diameter. A variety of technologies have been installed to create this totally new visual environment that is different to that of conventional dome theaters.

## Synra Dome Specs



Panorama view of the theater



Operating console

**Location** : 4th Floor, Science Museum, Kitanomaru Park

**Projectors** : 12 x BARCO SIM5R

**PC Cluster** : 12 for image generation, 1 for operating  
+ MDGRAPE-2 (dedicated supercomputer)

**Screen** : Skylight Screen (completely seamless screen)  
10 meters in diameter, 18 degree incline

**No. of seats** : 62 seats (tiered seating)

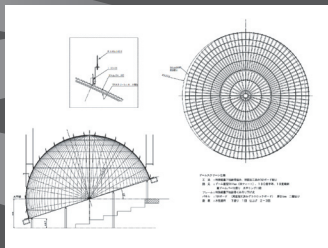


財団法人 日本科学技術振興財団  
Japan Science Foundation

## Skylight Screen

### Completely Seamless Dome Screen

The screen of the Synra Dome is semi spherical in shape and 10 meters in diameter with an 18 degree gradient. Dome screens are already in use in planetariums, so such shape of the screen is not unique. However, with screens made using the conventional overlapping aluminium punching plate construction method, the joints are inevitably noticeable. In particular with stereoscopic viewing the seams terribly reduce the stereoscopic vision effect, so having no seams is the ideal. Also, the 20% larger aperture ratio with the numerous punching holes also causes image quality degradation.



Screen blueprints



Framework of dome under construction

A “Skylight Screen”, developed by the Tenmado Kobo company, was installed in the Synra Dome in order to achieve the maximum projection effect of the stereoscopic images. Moreover, taking into account the dimming function of the Infitec filters, the screen was coated with paint that has the characteristics of being pure white, highly reflective, close to a perfectly diffusing surface. This totally seamless screen is the first of its kind installed in Japan and demonstrates sophisticated visual effects.

### Optimum Speakers for the Dome

A dome space is the worst environment for normal speakers due to the large degree of echoing. However, “TIMEDOMAIN Yoshii9-Skylight Pro” from the Tenmado Kobo company is used in the Synra Dome. Clear 360 degree omni-directional sound is emitted from the speaker units, which are mounted in the top of cylinders. These speakers cancel out unnecessary acoustic pressure to produce only pure sound with virtually no echo.



Omni-directional speakers



有限会社天窓工房  
TENMADO KOBÔ



# Infitec

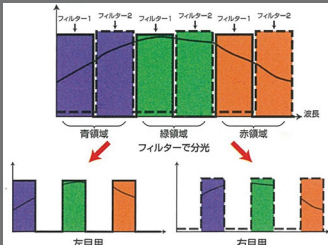
## Stereoscopic method for Full-dome Environment

The most popular method currently used for stereoscopic viewing of images is the polarization of light, in which a polarization filter is used to separate left and right images. However, in this polarization method the screen needs to be converted to a special dedicated three-dimensional one, which would be an obstacle to the multi-purpose use of stereoscopic dome theaters and for use in existing facilities. Also, the brightness is uneven on curved surfaces and there is the problem of the stereoscopic effect being easily degraded depending on the position and tilt of the audience member's head. Thus, a new stereoscopic method, which is not impacted by the shape of the screen or the materials used in it, called "Infitec" was adopted in the Synra Dome. Infitec is a system in which light is separated according to wavelength using a special spectral filter with good separation of the left and right images that allows for the projection of high-image quality stereoscopic images.

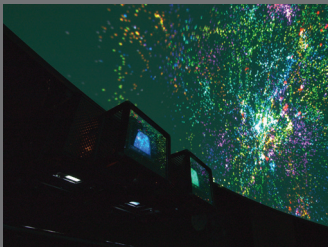
Twelve SIM5R projectors made by the BARCO company employing this Infitec solution are used to project stereoscopic images onto the full-dome screen, and stereoscopic viewing is achieved by viewing the images through glasses fitted with the same filter. The filter on these projectors can be turned on and off remotely, making it also possible to screen normal dome images as well. Further more, two sets of projectors realize very bright projection and highly redundant long-term stable operation possible.



Infitec 3D glasses



Principles of Infitec stereoscopic system



Projector set for stereoscopic projection

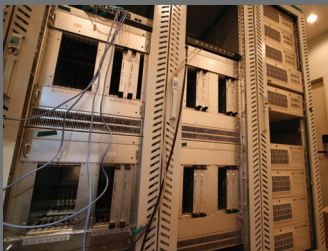


# MDGRAPE-2

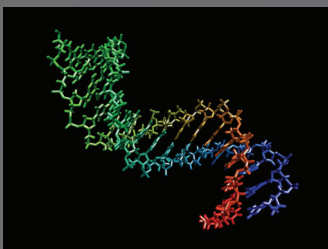
## Directly Connected to a Supercomputer

A working "MDGRAPE-2" research-purpose supercomputer is on display in Synra Dome's entrance hall. In the year 2000, this supercomputer won the Gordon Bell Prize, which is one of the most prestigious awards in the world of high-performance computing, and, up until the year before it was moved to the Synra Dome, it was actually in use for research at RIKEN.

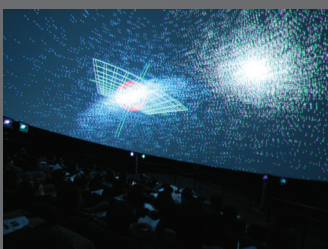
This supercomputer is directly connected to the dome projection system and is used for interactive real-time simulations of galaxy collisions and the dynamics of molecules, etc. in the live science show "Universe". A dome theater equipped with its own supercomputer is of course a world first. Bringing in the actual tools used by researchers makes it possible to gain an authentic shared experience of what real science is all about.



MDGRAPE-2 cluster



MD DNA simulation



Galaxy collision simulation





# The Software that Supports Synra Dome

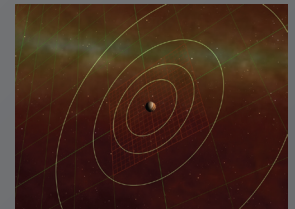
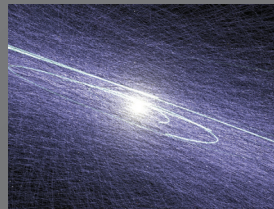
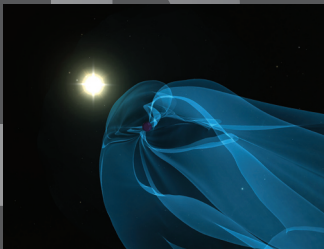
A range of world-leading, state-of-the-art software is used at the Synra Dome in order to create a theater environment that allows for the latest science visualization and dome contents to be freely displayed. Close collaboration with these software developers allows Synra Dome to be continuously evolving.

## Uniview

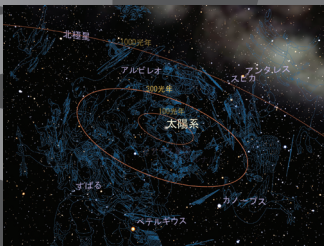


Uniview is a cutting edge real-time space engine that was first developed at the Hayden Planetarium in the American Museum of Natural History. The characteristic features of Uniview are the quality of the unparalleled images of space, which are said to be the most beautiful in the world, and the first-rate operability is designed for real-time production and live performances. With the Digital Universe, the world's foremost space database, and through the on-going incorporation of the latest research findings thanks to the cooperation of organizations, such as NASA, the system's functionality continues to expand.

Synra Dome is the first installation site of Uniview in Japan and Synra Dome is also the only theater in the world where you can see stereoscopic full-dome projection using Uniview in a dome.



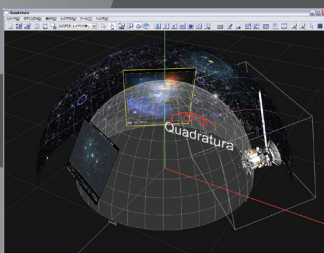
## Mitaka Pro



Mitaka Pro is an interactive space engine created by a major functional upgrading of the famous real-time space viewer Mitaka, which was developed by the National Astronomical Observatory of Japan's 4D2U Project. Mitaka Pro is used in the live science show "Universe" to explain the latest astronomical events and space structures. As Mitaka Pro is compatible with Mitaka, which is publicly available freeware, the synergistic effect is contributing to the popularization of astronomical education.

Synra Dome is the first installation site of Mitaka Pro in a dome theater in Japan.

## Quadratura



Quadratura is groundbreaking presentation software for use in domes and it allows Synra Dome to be used as a multi-purpose theater. In addition to assisting with the staging of live shows and events, Quadratura can also be utilized in program production for dome spaces.

Quadratura is designed to be highly scalable and not only does it allow for image and sound control, this tool was used as a framework to bring real-time simulations using supercomputers, such as galaxy collision simulations, to the screen.

## Synra Theater System



Synra Theater System is an integrated theater system that manages the sound, light control, and automatic program screening, etc, in the Synra Dome. The characteristic features of this system are that not only is it highly stable as well as wonderfully flexible, it is also highly scalable and can be used in conjunction with a variety of other software.



# How to Get To Synra Dome (the Science Museum)

## Science Museum

2-1 Kitanomaru Park, Chiyoda Ward,  
Tokyo 102-0091 JAPAN



## By Train

### Tokyo Metro Tozai Line

7 minutes walk from Exit 1b of Takebashi Station  
7 minutes walk from Exit 2 of Kudanshita Station

### Tokyo Metro Hanzomon Line

7 minutes walk from Exit 2 of Kudanshita Station

### Toei Subway Shinjuku Line

7 minutes walk from Exit 2 of Kudanshita Station

## Access to the Science Museum

### Opening Hours

Museum Opens at 9:30am  
Museum Closes at 4:50pm  
Last admission is at 4:00pm.

### Museum Holidays

Closed over New Year (29 December ~ 3 January)  
\* The museum closes at 3:00pm on 28 December  
and 4 January (last admission is at 2:00pm)



- From Exit 1b of Takebashi Station, cross at the Takebashi intersection in front of the Mainichi Newspapers, cross Takebashi bridge, walk past the National Museum of Modern Art, just before the pedestrian bridge turn right and go up the slope. The Science Museum is on your right.
- From Exit 2 of Kudanshita Station, proceed in the direction of the Nippon Budokan and once you have walked past the Nippon Budokan walk along the path in the Kitanomaru Park until you come to the Science Museum on your left.

Alternatively, from Exit 4 of Kudanshita Station, from in front of the Kudan Police Box proceed in the direction of Kudan Kaikan and once you see the moat turn right and pass through the Shimizu-mon gate and climb up the stone steps. Please be aware that the Shimizu-mon gate route involves climbing a long set of stairs.

## Museum Admission

(Entrance to Synra Dome is free once museum admission has been paid)

	Adults	Junior/Senior High School Students	Children (4 years and above)
Individual	600yen	400yen	250yen
Group	500yen	300yen	200yen
Disabled person's discount	300yen	200yen	150yen

\* Consumption tax included.

\* Groups are of 20 people or more.

\* We have a discount system for disabled persons. The discount applies to the person and one carer accompanying them. Please inquire regarding group rates.

Please check the website (<http://www.synra.jp/>) for the latest program screening schedule.

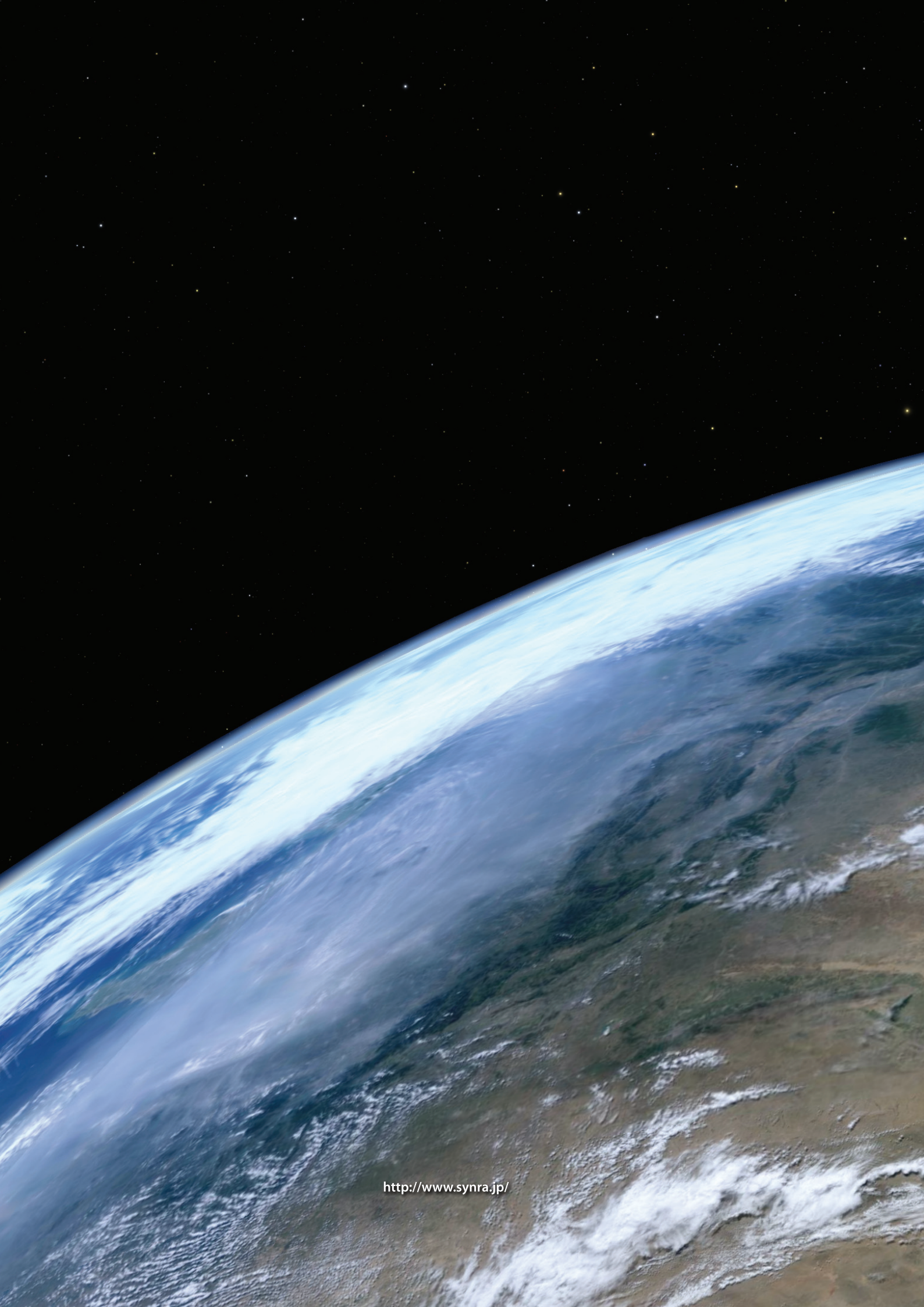
# Inquiries about Synra Dome to:

Science Museum Operation Department  
Japan Science Foundation

2-1 Kitanomaru Park, Chiyoda Ward, Tokyo 102-0091 JAPAN

Tel. No.: 03-3212-8544 Fax. No.: 03-3212-8443  
Japan Science Foundation website: <http://www2.jsf.or.jp>





<http://www.synra.jp/>