

G I F T
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S P A C E II

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ESSAYS

Greetings

Takefumi Hayashi

Professor & Leader of Muography Art Project
Faculty of Informatics, Kansai University



Science art could give the viewer the images and interests of the latest science by art works. Furthermore, science art has a function of messages to convey prospects for the future science and solutions for the subjects that science has. In recent years, various forms of science art have been proposed for the latest scientific fields like a project mapping, VR, AR, etc. It is a social trend not only in Japan but also in advanced countries in Europe. We noticed the importance of such science art and launched the Muography Art Project in April 2017 at Kansai University.

Even if it is called science art, the field is very diverse. We took up the latest science which was called Muography promoted by Professor Hiroyuki Tanaka of Tokyo University, also which is proud of worldwide as a latest science. We try to visualize it by three-dimensional (3D) computer graphics, sound visualization and installation of images, and three-dimensional (3D) illusion representation based on human visual cognition research. We will create a new science art and disseminate it to society by using our research results and expression techniques in the field of informatics.

However, science art only in the university has limitations so that many people can understand. Therefore, we decided to promote it with the help of experts from various fields outside the university. I'd like to encourage many people and promote Muography art. As a result of that one, in July 2018, we could have the Chausuyama exhibition of the Muography art entitled the "Gifts from the Universe", which took the intention by Dr. Hiroshi Nakajima and Dr. Kenji Sumiya. I am very pleased about that. In the exhibition, many professional artists participated from various field like oil painting, Japanese painting, digital art, ceramics, Kyo-Kanoko-squeeze dimple art, abstract art, mixed media, delica beads, poetry, art brut(outsider art), calligraphy and cookie. Furthermore students from Kansai University and high school students participated too.

Collaboration with scientists of informatics of Kansai University, professional artists and students under the seed of Muography which is the science and technology of the University of Tokyo is getting fruit and I would like to continue Muography art project in the future.

Describing Muography

Hiroyuki Tankaka

Professor & Director
International Muography Research Organization.
University of Tokyo



Muography utilises the fact that high energy muons can travel through much more matter in a gigantic object such as a volcano than most particles used as probes, such x-rays. While muons do not occupy space as most matter does, they do have an electric charge, therefore electromagnetic interaction with matter occurs. Through interaction with atoms in a volcano, muons will recurrently emit and absorb light (photons). Therefore, the local region near the muon is filled with light. However, this light has much higher energies than visible light so it would be impossible for people to see.

Muons are generated from interactions with galactic cosmic rays (GCRs) and the atmosphere. GCRs are remnants of stellar bodies propelled out at extreme energies (near the speed of light) during the final death throes of stars in supernova explosions. How long does a GCR travel before encountering the Earth's atmosphere? Researchers believe that even GCRs that originate from our galaxy typically spend millions of years traveling at nearly the speed of light before arriving the Earth. Since the diameter of our galaxy is only 100,000 light years wide, how can this be? The reason is that GCRs are frequently deflected from straight pathways by fluctuations in the galactic magnetic field that extend the length of the journey.

Catastrophic events in our Galaxy and the Earth are connected in space and time. A supernova releases the material of a dying star (the galactic cosmic rays; GCRs) into the galaxy, and the GCRs journey extends at a spatiotemporal scale of respectively 10 thousand times longer than 10 trillion miles and 10 million years. By comparing the elemental compositions of primary and secondary GCRs, we can derive when they were accelerated; secondary GCRs have atomic nuclei generated through the interaction between a primary GCR and interstellar materials. Therefore, we can say that the threads that connect the Earth and this supernova event are meandering.

A galactic cosmic ray (GCR) arriving at the Earth today releases energy that was obtained millions of years ago. The acceleration of GCRs takes place everywhere in the galaxy, however, from the temporal point of view, most GCRs (with energies in a GeV region) were accelerated a few million years ago. Once the GCRs arrive at the Earth's atmosphere, they are converted to muons instantly. With their strong penetrative power, these muons propagate the atmosphere, and eventually travel to region within the Earth's interior.

Muons are generated as secondary particles as a result of interactions within the Earth's atmosphere. Since they can penetrate the rock thicker than 1km, muons can be used for taking a picture of the Earth's interior like x-ray imagery. This visualisation technique is called muography, but we need a special camera to capture these invisible muons. The charged particle detector is equivalent to the charge-coupled device (CCD) of a digital photographic camera.

Muons are continuously passing through the subsurface of the Earth. However, unless we can detect these muons, we cannot exploit the information about the structure inside the Earth. A specific component of the charged particle detector, the plastic scintillator, has been successfully applied to various muographic observations. The molecular structure of this plastic scintillator is 1,4-Bis [2-(5-phenyloxazolyl)] benzene (POPOP). POPOP is a key chemical component utilised to convert muons into light (electrons) so that a counter in the

detector can record the number of muons penetrating the material, a key step in the muography data collection process.

Of all the geodynamic elements of the Earth, one of the most dramatic is the volcano since during eruptions we can see underground-originated phenomenon visibly rise out onto the surface of the earth and into the atmosphere. Until recently only lava and processes during and after volcanic eruptions were observed with magma and the cycles of movement within the volcano being invisible and unknown. However, now with muography, the movements of the magma within the volcano can be visualized which helps researchers understand the processes leading to eruptions.

For example, bubbly magma has been imaged with muography in Satsuma Iwojima volcano. As the resolution of muography images improves, as with the 3rd generation and upcoming 4th generation detectors, more magmatic information can be extracted from images; for example, the shape of the magma pathway which influences the eruption style. Ongoing developments in muography are expected to create images with much higher resolution; hence new knowledge of volcano dynamics can be obtained as improvements in the technique continue to increase.

Statistics are essential in order to interpret the number of muon counts in muography data. If the number of muon counts are not sufficient, it is difficult for us to be confident that the number represents the true structure within and is not simply a coincidental fluctuation. The number of counts itself is a fact, but the factor that governs this number becomes probabilistic. Coincidental fluctuations (often errors) tend to be relatively larger as the number of counts decreases. As a metaphor, let's imagine that the muon counts are instead a count of the number of customers visiting a newly refurbished shoe store. If the owner noted an increase of 2 customers per day before the reopening and then 3 customers per day after reopening, it would be difficult to confidently conclude that the increase was due to the refurbishment. However, if it increased from 2,000 customers to 3,000 customers, the confidence level would increase even though in both cases before and after the refurbishment there was the same level of increase: the second day being 1.5 times more than the first day. The confidence level is different between them since the number of customers counted is different. Similarly, in order to visualize the internal structure of a volcano with higher precision, it is necessary for us not only to increase the image resolution but also to increase the number of muon counts recorded in each pixel of the image. To achieve this increased number it is usually necessary to increase the size of the active area, usually by increasing the size of the muography observation system (the muon detector) so more muon events can be collected.

If we imagine a volcano composed of dice, with the individual dice depicting muon counts and their dependence on statistics, it might be a useful metaphor to understand the role of statistics. The number of counts necessary to reveal the mystery of what lies within the volcano interior is equivalent to the number of times one throws a slightly asymmetric (or loaded) dice. If we imagine that we throw a dice that was secretly manufactured with an extra weight so that we are more likely to get 6, we would not be able to realize this with only a few throws of the dice. However, if we were to throw the dice several dozen times, we would be more likely to suspect that the dice was loaded. As we accumulate a larger number of muon counts, the confidence level of the data showing an anomaly (an unexpected low density region, for instance) inside the volcano will increase.

What Is Muography Art To Me?

Hiroshi Nakajima

Ph.D (fine art)

Member of the International Association of Art



I have always thought that art is very important in life, and that it should play an important role for human beings. Some artists think that art only exists for art's sake, but I think that art exists for the sake of human beings. Art gives power to us. There are many good points art has.

Science is also of course very important for human beings and we owe a lot to science. It is no exaggeration to say that our existence depends on science. Without science our modern life would not be possible.

Science and art were thought to be totally different, and it was thought that there was no association between them, but the root is the same. The essence is imagination and creation. I use the Japanese word SOUZOU. From Souzou (想像) meaning imagination to Souzou (創造) meaning creation. What we as the general public come to be interested in by the interaction of both is important for both complex science and beautiful art.

By using science, the expressiveness made possible through art broadens our interest in science and it is desirable to contribute to human activities. muography is science and art, as well.

What is muography? Everybody knows what X-ray is, but fewer people know about muography, though they are both very important.

The word muography is very new and not well known to the general public. In short muography may be said to be a different version of X-ray imaging which is used in order to see the inside of gigantic objects such as volcanoes, pyramids, and kofun (i.e. tumuli or burial mounds). Muography is a new visualisation technique realised by the application of modern physics.

Art has an impressive power to help make the general public understand otherwise incomprehensible phenomena. For example, we the general public have no idea or may not be interested in the subject designated by scientific data and only known to a small group of specialists. However through art such as pictures the general public can understand difficult scientific phenomena well and with interest.

One of the purposes of art is to impress and move us, leading us to the unknown world. This is the point where science and art meet. It is possible that even difficult science subjects may become more popular through art and this is significant.

I still face some big and difficult challenges creating muography paintings. In the first place nobody can really define art precisely.

The definition of art is so vague that it takes time to create the artworks according to some theme, especially very new theme.

Everything concerned with science is very new to me. It is said that nothing comes from nothing, but perhaps they aren't considering the muon or artistic ideas. These things can't be seen with our eyes. But our brains and feelings can sense or analyse both of them. Muography painting forces me to push the limits of my imagination. It is a new challenge. So I am happy now to think what I will create in my next step. I have been excited.

Imagination is very important for both science and art. So in order to arouse the imagination, I dared to choose motifs nobody imagined before.

There are many ways and techniques to create artwork.

Strictly speaking for creating traditional oil paintings, only oil paints must be used, not any other materials.

But for this project which is a frontier art field, anything is possible as far as the art works achieve the goal.

Art is boundless, and for development of art, it must change every minute.

Like a pool of stagnant water, if art stays as it is, it decays.

Especially for this muography art project, we keep moving to find very new ways of creating art like science itself.

So artist should exchange ideas and take new ways from all over the world.

To create the artworks, what is important is that we must know the essence even though the works are abstract.

First of all, we have to recognize what is muography

Then we must create the works for the general public that will interest them in the subject of muography so they know how it is important and useful for our daily life.

What is important is not the art material but how we express on the canvas with their own material.

Our ideas must be fresh and boundless.

Art is very difficult to define. But like every subject, fundamental knowledge is important as well.

On the Birth and Activities of the Muography Art Project

Kenji Sumiya

Visiting Professor of Kansai University &
President of International Art Institute



Science is indispensable for human beings, but contemporary science is becoming too difficult to understand, and young people tend to depart from scientific subjects. This phenomenon is played out not only in Japan but also in Europe. On the other hand, science art based on the latest science and technology has recently attracted attention.

In contemporary society, we aim to introduce a new field—a new genre—where science and art cross over. From the standpoint of science, we believe that collaborating with the field of art will make it possible to expect more information dissemination that is rich in visual communication and is strongly sensory. The act of fusing science, which is so often avoided, with a sensate experience that creates artistry and new value in "expression" is truly attractive. It is a pleasure that many excellent young people are touched by science art, and this cooperation and integration brings a catalyst for focusing on science through a new perspective.

From the perspective described above, we regard muography as a science, and launched a project to express it with art in April 2017. There are three principal reasons for taking up muography as a science: (1) since it is a new scientific field, Japan is leading the world; (2) it allows people to see macroscopic objects such as volcanoes, pyramids, and kofun (megalithic burial mounds); and (3) muography is not generally recognized at all. The Muography Art Project is aimed at having as many participants as possible convey their knowledge, utilize the technology and their relevant skills, express science with art, and obtain a deeper understanding of and greater familiarity with science.

Many artists are not strong in science, but they can deepen their understanding of muography during the process of creating muography art. Artists express esoteric ideals and deep science in art (from science to art), and scientists capture the sensate ideas of artists through science (from art to science). I would like to achieve this type of integration in our project.

A history of the Muography Art Project

In the autumn of 2016, an exchange occurred between Japan and Italy at the Italian consul's official residence in Kyoto. I met Professor Hiroyuki Tanaka from the University of Tokyo. He was concerned about the departure of young people from science and proposed actively incorporating art into youth science education. Consequently, there was a gathering of Professor Tanaka; Professor Paolo Strolin of the University of Naples Federico II in Italy; Takeshi Mukoyama (the chairperson of the Kansai Hungarian Exchange Association and Professor Emeritus at Kyoto University); Dr. Hiroshi Nakajima, an oil and tempera painter; and I at the Nakanoshima Center, Osaka University, and we discussed the importance of science art. After this meeting, I began to coordinate and launch the Muography Art Project.

I gained strong approval from Professor Takefumi Hayashi and Professor Norman D. Cook of Kansai University, as well as from Dr. Takashi Iura, our information engineering expert. This allowed me to position the project under the Faculty of Informatics at Kansai University. In addition, Takashi Fuchida, curator of the Tama Art University Museum, and Sara Steigerwald, a digital painter, joined in the team, and the project was launched.

Activities of the Muography Art Project over the past two years

Kansai University launched the Muography Art Project in April 2017; as of January 2019, nearly two years have elapsed. Though no one had previously attempted to explore this field, we were able to proceed with the participation of the University of Tokyo, the Tama Art University Museum, and many prominent artists like Dr. Hiroshi Nakajima.

When I initially embarked on the project activities, I could not easily attract participating artists. However, Dr. Masaki Yamagata of Kansai University introduced me to young artists. Currently, nine students (eight university students and one high school student) are taking part in this effort. Since their participation, many professional artists specializing in oil painting, watercolor painting, ceramics, calligraphy, Kyo Kanoko squeeze (a Japanese variation on tie-dying textiles), cookie art, dimple art (similar to stained glass), digital art, lumi-art, pottery, abstract painting, art brut(outsider art), etc., have joined us, mainly thanks to Dr. Hiroshi Nakashima. As seen from the above, we have been engaged in numerous activities. In 2018, steady activities gradually took root.

Next activity

Science art not only gives viewers familiarity with and excitement for science, but it also gives a perspective on the future of science. In the future I hope to continue contributing to educating the broader society through the types of activities mentioned herein.

On Muography Art

Kazuko Mukoyama

Inkpainter,
President of International Modern Inkpainting Association



The year 2018 was the 150th anniversary of the foundation of Hyogo Prefecture and many events for celebration were planned. I took this opportunity to take part in the project to celebrate the anniversary. I proposed the plan for Joint Exhibition of International Modern Inkpainting Association and the Muography Art Project of Kansai University.

The International Modern Inkpainting Association held almost every year the exhibition of inkpaintings with traditional techniques and the muography art is based on the recent progress in technology. This kind of joint exhibition is really collaboration between the traditional culture and the most advanced technology as well as between science and art.

For common people, for example members of our association, are not so familiar with an elementary particle “muon” and muography art. I had to explain them patiently what is muon, muography, and muography art.

In 1936, Carl David Anderson and Seth Neddermyer discovered an elementary particle called “muon”. Cosmic rays are traveling more than 10 million years from unknown corners of the Galaxy. When they interact with atmosphere of the Earth, muons are produced. Millions of muons pass through our body constantly every 24 hours, but nobody notices them.

We use Roentgen x-ray photograph to study our body. On the other hand, the penetration power of muons is much stronger than x rays. This makes it possible to use muons to look through the inside of volcanos, huge buildings, pyramids and nuclear reactors. This technique is called “Muography”.

Muography provides us new eyes. The world seen through muons looks different from the ordinary world under light. It is important role of artists to give an image of the latest science to visitors through their artworks and to make them interested for science. This is Muography Art. We artists have to make an effort to generate a new idea between science and art.

My proposal was accepted by Hyogo prefecture and the exhibition was held in the autumn of 2018. During the exhibition, lectures were also given by Prof. H. Tanaka, University of Tokyo, on muography and by Dr. H. Nakajima, a painter, on muography arts. The exhibition was successful beyond our expectation. We had more than 850 visitors in the exhibition and 70 guests for the lectures.

In 1995 my house in Kobe was completely destroyed by the Great Hanshin Earthquake and had to move a temporary residence. Due to the shock of the disaster, the style of my paintings drastically changed and I started to paint mountains with steep ridges. These paintings were my elegy for the victims of natural disasters. After 10 years of the mountain series I was enchanted with “Spirals” and the paintings with spiral series followed.

About ten years ago I became interested in reflection and transmission of light and started a new type of art by the use of artificial light. I named it “Lumi Art”. Lumi Art is a combination of paintings painted with special ink and LED (Light Emission Diode) light. The paintings in the past were prepared to show them only under natural light, such as daylight or white light. When the painting is illuminated with LED lights with different colors and these colors are changed automatically or with a controller, the same painting is looked in

different ways and gives different impression. This is a new type of paintings and combination of "science and art". It is interesting to display them together with music. At my exhibition the music of Scriabin* was played.

In 2015, the World Science Forum (WSF) was held in Budapest, Hungary, in November. WSF is an international meetings, where scientists, government officials, industrial peoples and citizens from all over the world get together to discuss the role of science in society. There were 900 attendees from 100 countries. This year was "International Year of Light" of UNESCO and two artists were invited to exhibit their artworks using new types of light during the meeting. Attila Csáji is a world famous artist using laser beams and hologram and I showed my works with Lumi Art at the meeting hall.

Now I take an active part in Muography Art Project in Kansai University with "Lumi Art of my artwork". I want to express the imaginary world illuminated by new "Light" called "Muon".

*Alexander Scriabin (1872-1915) is a Russian composer and pianist. His symphony No. 5 is called "Prometheus: The Poem of Fire". In Greek mythology, Prometheus stole fire from Zeus and gave it to the mankind. This symphony is the praises of him. There Scriabin tried to change the sound from the keyboard into the color of light by the use of the so-called color organ. This was a new idea in those day. I think that his attempt was a kind of Science-Art. This is a reason why I used the music of Scriabin as BGM of my paintings.

Muography Art-The fundamental and new sensibility-

Takeshi FUCHIDA

Curator

Tama art university museum



"Muography" is the technology to see through huge objects such as volcanoes, buildings, and pyramids. It is an advanced science that observes cosmic rays that reached the earth from a journey of 10 million years as well as muon particles produced in the atmosphere. Muon pours down constantly, and one million pieces pass through the body while we are sleeping in one night. Also muon is high energy and its speed is the speed of light, but it can only exist for two millionths of a second after being born. While living in a very moment, muon penetrates matter and objects.

Muon are invisible. The insides of the volcanoes and pyramids that the muography has observed are also invisible by human eyes. However, the "seeing" experience that was created by the visualization of these by muography came to the world with a fresh surprise unique to the science field. Furthermore, when asking the question "What is muography?" ,we might be allowed to answer -parallel to technology- the vector that leads to the area of sensitivity, which is beginning to shake our perception.,.

Provoked awareness to the hidden existence that is revealed through accepting the unity of the conflict like "Huge / Micro" and "Long time / moment", the desire to visualize something invisible and a sense of touching the unknown phenomenon. Those appear to be an approaches to speculative aspects which may suggest an affinity or development in the humanistic field guided by muography.

In addition, in a broad sense if there is something that "shakes sensitivity" and "motivate creative action" in the root of an attitude toward science, science can hold same reason with art why it has continued to exist to quest the universe, nature and humans from ancient times. Of course we must not forget art symbolizes emotions, sensitivities, ideas and religions. They are all invisible.

It is a remarkable fact that technology and art are recognized as "ART", as a product of "creation" during the Renaissance period, and Einstein's words "my most beautiful thing we can experience is mystery. This is the true source of science", and "the person who quits moving is the same as not living" are very suggestive. Those two stories must tell the fundamental relationship between art and science.

In recent years, a new encounter between art and science has been presented as a muography art, which leads a new invitation for the unknown sense and a horizon of creation. Artists who express the inspiration with the muography cut a figure in North America and European countries, and its movement has begun in Japan. With the "Kansai University Muography Art Project" as a first endeavor the ambitious exhibitions at Osaka Grand Front and the remarkable "Answear from the universe" exhibition at the Tama Art University Museum of Art and an active activity as a full scale exhibition in Japan. Successive activity and exhibition in the Kansai area and the institute of Italian culture shows the concept of Muography Art has energy to capture the heart of Artist. I hope that the new sensibility in Muography Art field can expand and make a fortunate encounter that inspire unknown sense to mankind.

Muography Art Project: Dialogues Between Science and Art

Sara Steigerwald
Digital Painter



Science and art link us to our world in different ways. My own personal viewpoint is that in general scientists seek to observe the outside world and connect these experiences to principles of consciousness and logic whereas artists seek to observe a more interior world connected to the unconscious and emotions. Obviously, there are a lot of variations and overlaps, since every individual performs these activities differently. Also, flawless execution of these goals is impossible, since all humans are both logical and emotional and cannot ever entirely shut down either facet. Having said that, one might reasonably ask why one should mix art and science as members of the Muography Art Project have been doing. If these two goals are so entirely different, what would be the benefit of merging them? Firstly, just as opposite colours on the colour wheel complement each other, I think that art and science complement each other by bringing out the characteristics of each with more clarity. My second viewpoint relates to something that Carl Gustav Jung, the Swiss psychiatrist and psychoanalyst wrote: "Truth that appeals to the testimony of the senses may satisfy reason, but it offers nothing that stirs out feeling and expresses them by giving a meaning to human life." My interpretation of this is that data are all around us and in order to get accurate data, we often must divorce ourselves from our emotions as much as possible; but once the data are available and verified, we must try to emotionally connect to what the data are telling us so we can apply this knowledge to our own lives. I think that science is one of our best methods for acquiring data and art is one of our best methods for digesting data.

In this essay, I would like to discuss the Muography Art Project; the foundation, achievements and also some of the motivations behind this team effort. Muography is a cutting edge, frontier science field which utilizes muon particles as probes to image gigantic structures such as volcanoes, pyramids, and social infrastructure targets. The Muography Art Project, a collaboration between Kansai University, Tokyo University and Tama Art University, aims to gather artists working in diverse mediums and styles to express topics in muography in new ways. The Muography Art Project is part of a larger international Fine-Art Muographers network, a group of artists which has included members of the Tokyo Universal Philharmonic orchestra, Hungarian clarinetist Istvan Kohan, Japanese sculptor Yuji Ichikawa, Japanese painter Keizaburo Okamura, Japanese painter Yoshiyuki Nakano, Italian composer Federico Iacobucci, Japanese painter Hiroshi Nakajima, Hungarian ceramist Agnes Husz, Japanese ink and nihonga painter Kazuko Mukoyama, Japanese photographer Hifumi Miyazawa, Austrian photographer Dr. Michael Hoch from art@CMS based in CERN and many others that have participated in exhibits, lectures, concerts and other events as part of the Muographers community. The common thread is the inspiration of muography and particle physics, with the aim of opening up the possibilities for creating new inspiration in others and outreach opportunities for the communities that we serve. The Muography Art Project continues to seek creative solutions to engage with the public and with members of the art community dedicated to inspiring and shaping our message.

This project was launched as a concept of the founding members, Dr. Hiroshi Nakajima and Dr. Kenji Sumiya, who were the key figures in the creation of the first exhibit In September 2017. Held at the ACTIVE Lab in

Grand Front Osaka, the first exhibit combined art (including paintings, video art, and sculpture), technology (4k and 8k interfaces for art display and interactive science presentations), lectures, and educational opportunities. Since that time there have been over 12 other exhibits organised by the Muography Art Project from September 2017 to June 2019 in Japan with events in Osaka, Tokyo, Kobe, Tama and Okayama. One of the highlights has been an exhibit in 2018 curated by Dr. Takeshi Fuchida at Tama Art University Museum entitled: "Answer from the Universe: Vision Towards the Horizons of Science and Art Through Muography" which exhibited 13 artists from Japan, Europe (Hungary and Austria), and America (USA). It included a special open studio collaboration between music composer Goto Ten and ceramicist Agnes Husz. The Muography Art Project also participated in lectures and presentations at the Muographers 2017 and 2018 General Assemblies. At the Hyogo Prefecture Citizen Hall in Kobe there was a collaborative exhibit featuring Muography Art and Ink Painting in September 2018. Educational opportunities for students have been created with a special program facilitated by Dr. Nakajima and Dr. Sumiya in conjunction with the traditional oil painting program at Kansai University which has mentored painting students with events for interaction with scientists, professional artists, and special exhibits in Osaka and Okayama. Seven students are continuing in this Kansai University program who will be joined by other art students from Osaka City University and Yuhigaoka Gakuen High School in 2019. Returning to the Grand Front Osaka ACTIVE Lab exhibition space in the summer of 2019, the site of the first Muography Art Project exhibit, participation has now expanded to a total of 32 artists presenting artworks inspired by muography. The time is ripe for the next stage of science and art cooperative explorations with the Muography Art Project.

Personally, muography has inspired my paintings because it encompasses many topics that fascinate me: the boundaries of the visible and the invisible, the active and still, the dead and living, along with the past and the future. It thrills me to think that some of the higher energy cosmic rays that generate muons in our atmosphere and traverse the space of our daily experiences (several muons have passed through my body as I write this sentence) were originated from supernova explosions that occurred during the Pleistocene era when woolly mammoths were roaming the plateaus of Eurasia and North America. The cosmic ray's journey which can continue for hundreds of thousands of years ends in an instant upon contact with our atmosphere and after a few transformations becomes a muon which survives for a fraction of a second (approximately 2.2 microseconds). Yet by using the muon particle as a probe we can image, for example, the strata where the woolly mammoth's bones lie buried by the layers of earth that separate us from that time. Humans are a mix of mind and matter and we naturally view our environment subjectively. The sky often seems untouchable and remote and yet we are connected to this vast, unknown region. The Earth is the source of materials, composed of the bones, dust, rock and sweat of the past ages but also teeming with microbial life, the resources required for human sustenance, the roots of plant life, and the internal energy of our planet, both active and dormant which originated from the universe. In many ancient cultures, like the ancient Greek civilisation, this connection between the Earth and the universe took the form of the idea of the sky and Earth gods (Uranus and Gaia) mating, a great metaphor for this connection. The elements of the Earth are interconnected with the universe and are eternal. Therefore, the most beautiful, delicate flower you see on a sunny day in June may later become part of molecular composition of lava exploding from a volcano in November. Muography is one of the keys to unlocking some of the mysteries in the cycles of the Earth that we depend on for survival. Art is one of the keys to help us, with our constantly changing communities and constantly changing possibilities, to understand our roles as individuals and as human cultures so we may shape and react to our social and physical environment with more power and empathy.

Since science fields such as muography are part of human culture, these topics and ideas should be embraced and explored by artists. Like placing the complimentary colours blue and orange in close proximity, we might bring out the best qualities of each method of human observation: science and art. Organisations such as the Muography Art Project help to transform these ideas into new forms that can expand the understanding and participation around the globe of science in general and muography in particular so that as global citizens we can make more informed, wiser decisions about our future.

Muon and Me

Popelier

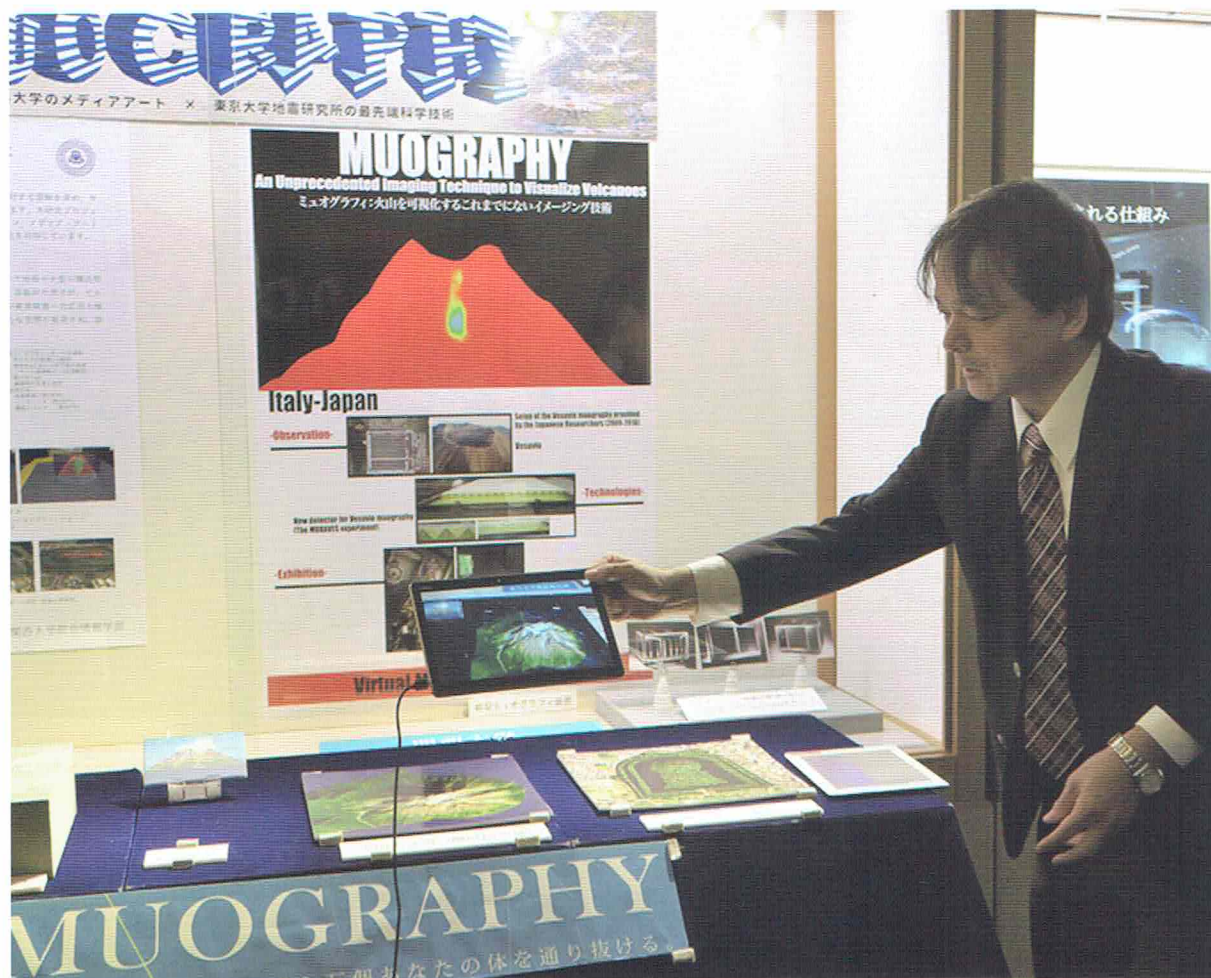
Illustrator, Painter, Animator, Creator



A year ago, I had no idea. No idea what a muon is or does. They say you always remember your first time and in this case it's true. Dr. Nakajima was waiting for me in a gallery in Tennoji, Osaka, as we had arranged a meeting there. A mutual connection had put me in touch with Dr. Nakajima so that I could discuss my project with him, which we did, for about an hour, and just as the talk was winding down, Dr. Nakajima mentioned muography. Did I know it? I didn't. He explained more, and the more I listened, the more ridiculous it sounded. I'm not a physicist, but the very idea of muons was too incredible to believe. I wondered why I had never heard of it before. Was this man crazy? Well, yes, a little bit. He was gripped by 'Muon Madness'. This is not a bad thing. Rather it's an infectious enthusiasm for using art to explain science, something which interested me immediately. I left the meeting with some idea, but little understanding of muography. I contacted an acquaintance who is a nuclear physicist and astronomer and asked her if she had ever heard of muons. A stupid question. Of course, she had, but why am I asking her about it? I explained my meeting with Dr. Nakajima and muography. Without hesitation, she recommended that I get involved.

An invitation arrived to a Muography exhibition at Kansai University and I went along to check it out. I got there just in time, for the speeches were about to begin. After introductions, given by Professor Sumiya, we were given a tour, starting with a section devoted to the science of muons and the use thereof. By now, the idea of muons and muography was starting to click and fall into place. Not quite a "eureka" moment, but more like, "I get it. I think". This was followed by artistic interpretations of muons by artists, some of whom were also there, each one giving a brief presentation of their artwork. Not being fluent in Japanese, I soon became bored and wandered off to look at the rest of the exhibition on my own. What struck me first, was the diversity of the interpretations of muons. There was so much to look at. Painting, sculpture, ceramics and illustration, all used to help people like me understand the concept of muons and this inspired me to think of how I would express this same concept as art. The artwork I created for this exhibition is mostly built around the invisibility of muons, their speed and the subtlety of their existence. As I regularly use the star motif in my own art, it seems like a perfect connection for expressing the origins of muons, cosmic rays from space colliding with our atmosphere. So, there we have it. What we should believe is not always on the surface. Sometimes we need to look deeper within. We should all try it.

ARTWORKS



Informatic Approaching

Takefumi Hayashi

Science art could give the viewer the images and interests of the latest science by artistic technology. Furthermore, science art has a function of messages to convey prospects for the future science and solutions for the subjects that science has. I tried to visualize Muography by AR(Augmented Reality), projection-mapping and motion base simulator.



「Muons and Eyes」
mixed media / M40 / 2019



「Seeing through Kofun, a burial mound」
mixed media / F15 / 2019

Hiroshi Nakajima

"See through" is a keyword for us to understand Muography.

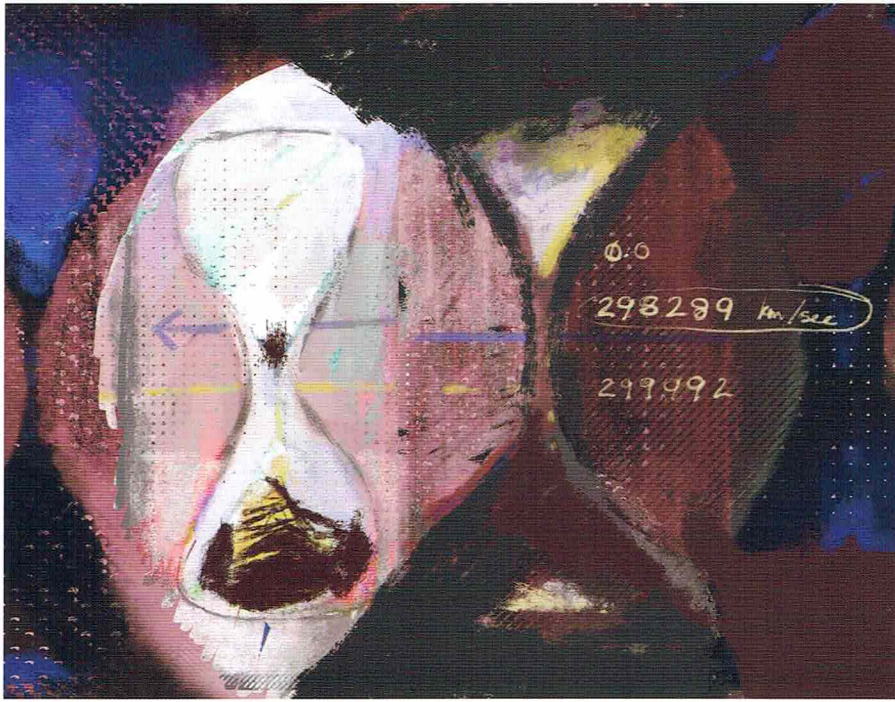
These two works express moving muons which have power to penetrate gigantic objects such as volcanoes and Kofun, burial mounds.



「The Hymn of Life」
Lumi art / H96.4cm x W96.4cm

Kazuko Mukoyama

In the coral reef full of peaceful silence, the healing music flows faintly out of somewhere. There come muons from a corner of the distant cosmos. Muons react in the coral reef and give off bright color of light. They are singing "the hymn of Life". I got this idea in the summer of 2017 when I have been to "The Great Barrier Reef" in Australia.



1. 「Relativistic Muon Time Delay」
Digital art

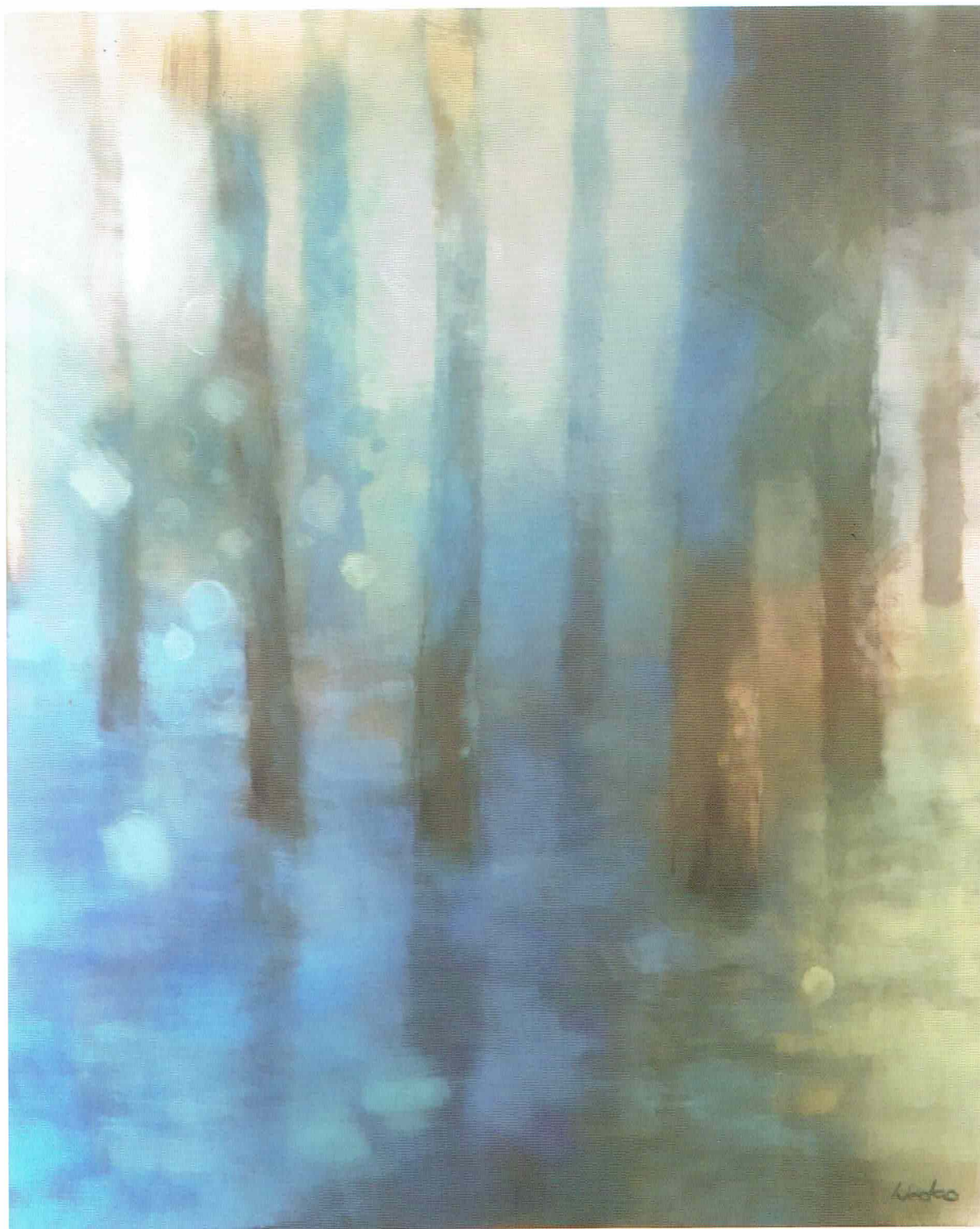


2. 「The Moment When the Particle Experiences the Eruption」
Digital art

Sara Steigerwald

1. In this painting, the left hourglass is at rest and the right hourglass travels near the speed of light, therefore the waist of the right hourglass shape is Lorentz-contracted and the sand-fall is delayed reflecting the relativistic time delay.

2. These muons decay in 2 out of 1 million seconds but are highly penetrative so they can experience the volcano's interior and provide this information to us.



「Water, Grove, and MUON」
Oil painting / F30 / 2019

Hiroko Hashimoto

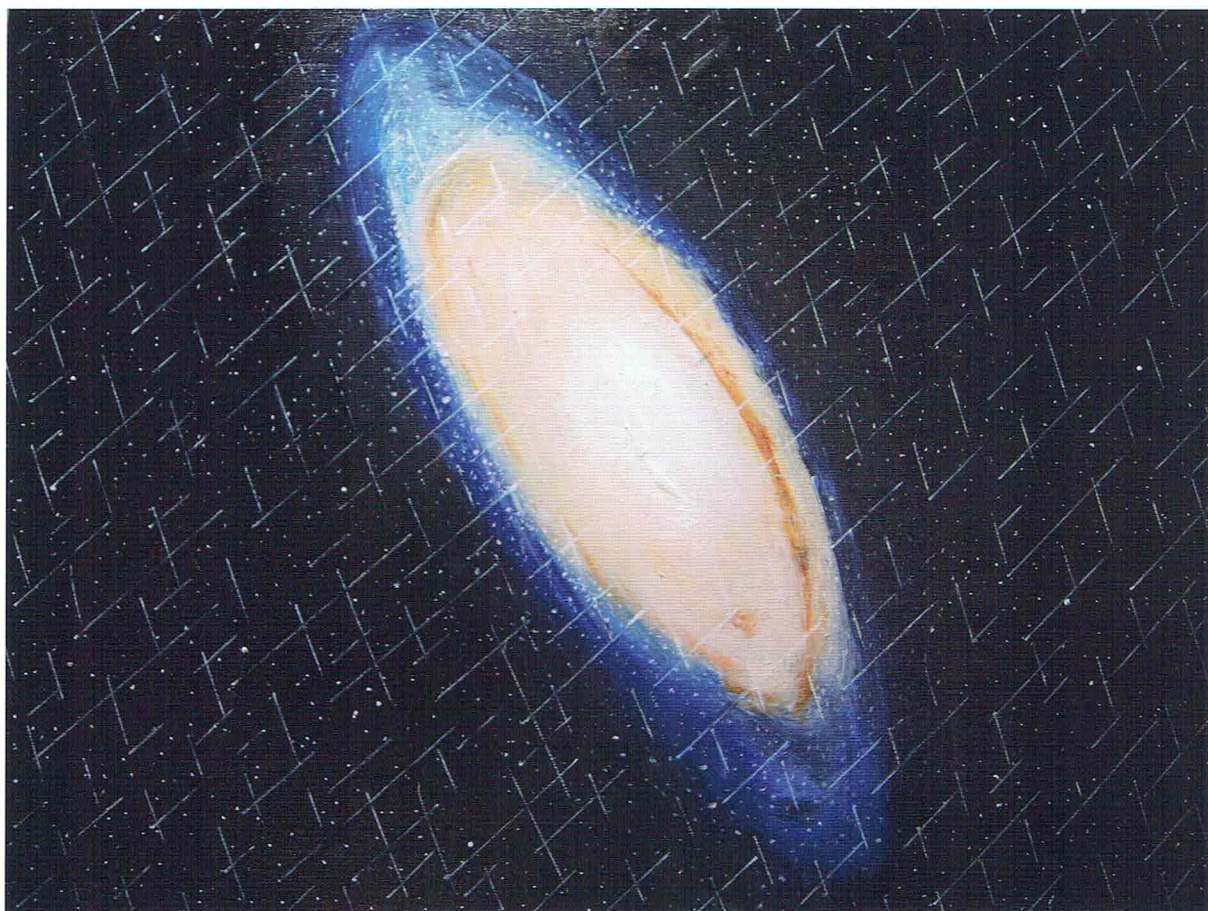
Like a grove nestling in water, MUON waits for time to give vent to life quietly.



「Muon and Me」
Acrylic spray paint, recycled card and paper, gold leaf, acrylic paint on recycled canvas / H60cm x W60cm / 2019

Popelier

My concept is generated from the fact we can't see muons and that they originate from cosmic rays colliding with our atmosphere.
That's why it is all black.

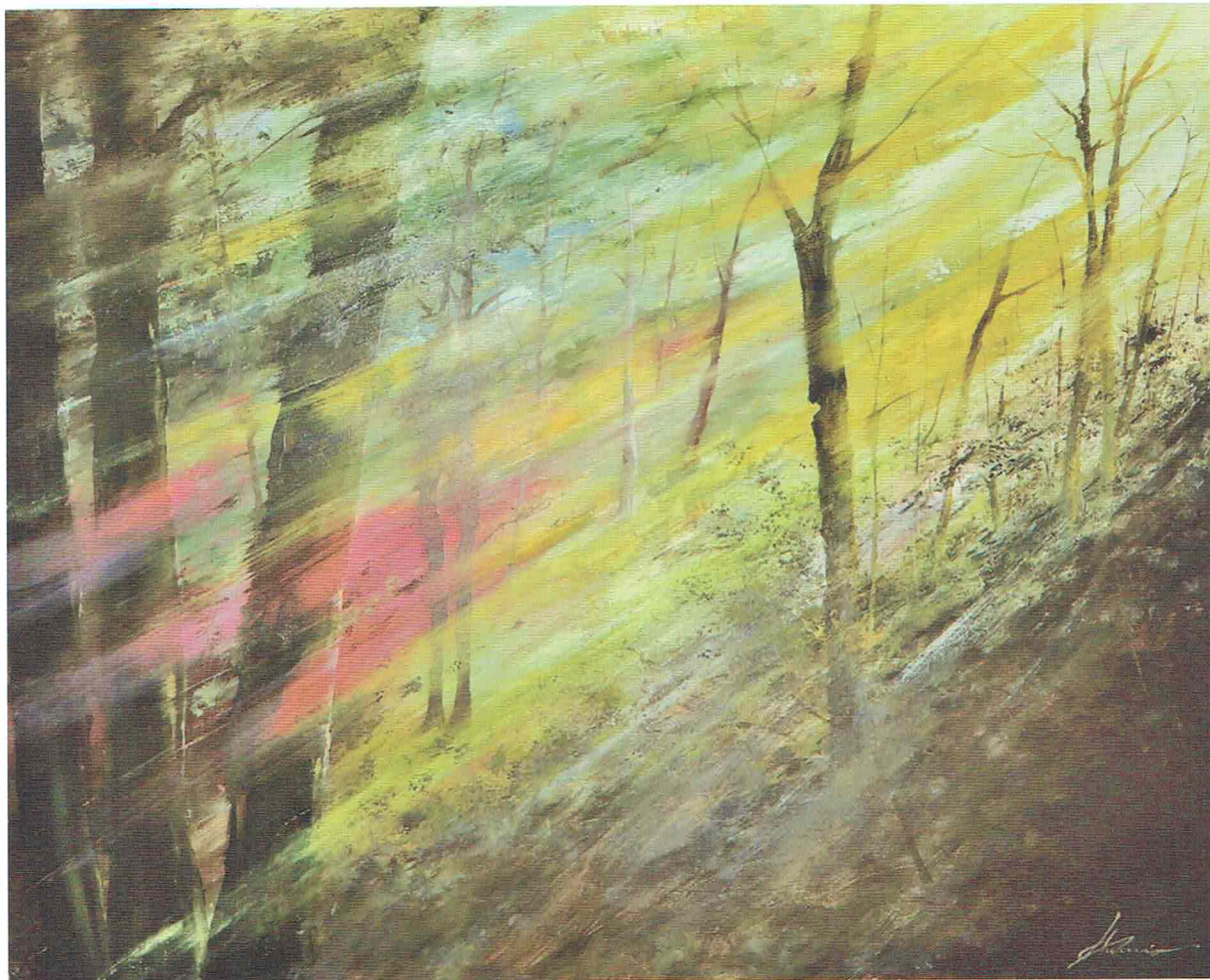


『The Universe and Muons』
Oil painting / P15 / 2019

Kanji Hatamori

Muons falling down as cosmic rays. Though they are invisible, I completed my artwork by using my imagination.

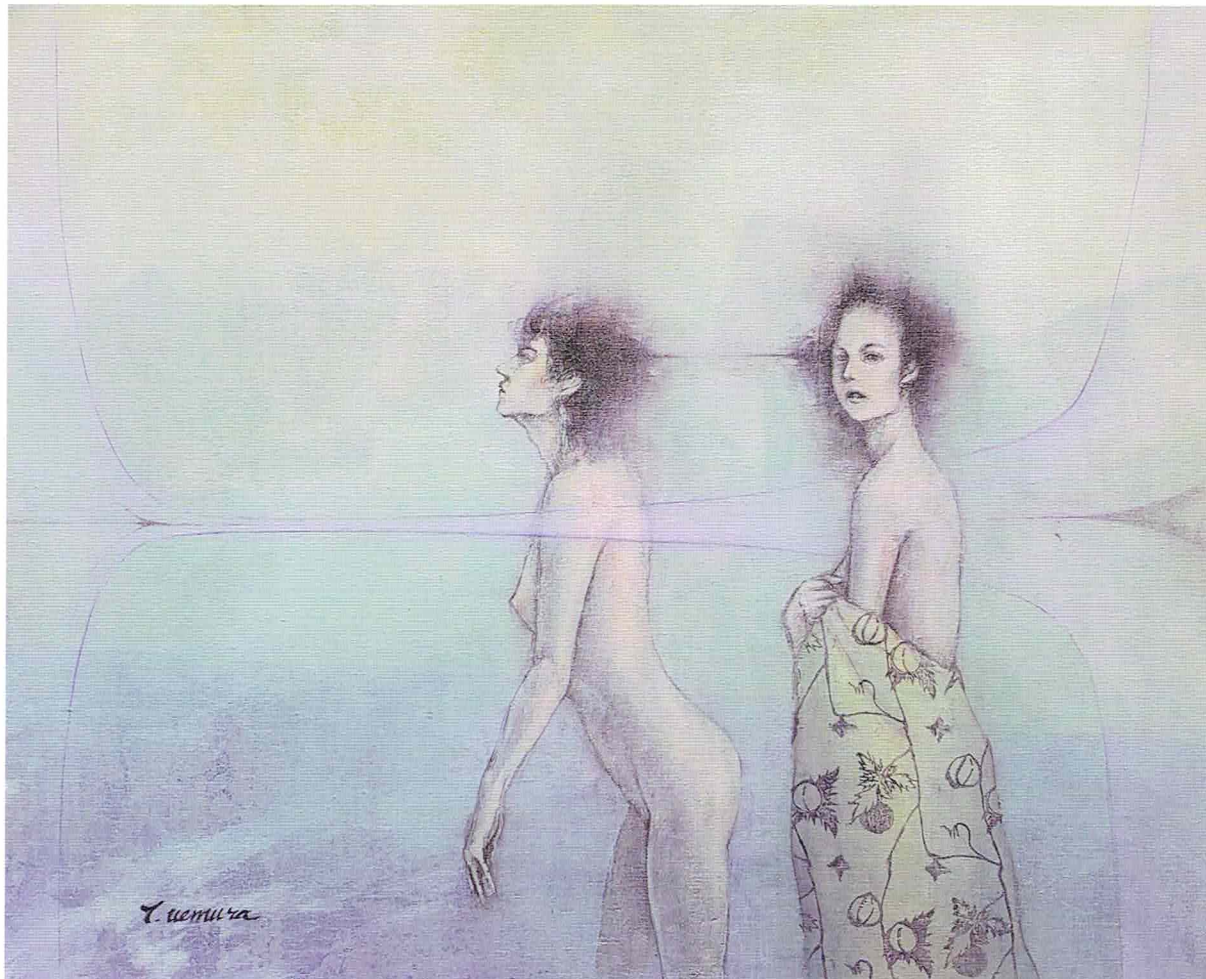
Hopefully the seeing through power of muons will be applied widely in the future.



「Dream Flight of Muons - Part II - / Light and Muon」
Oil painting / F30 H91cm x W72.5cm / 2019

Fumio Horii

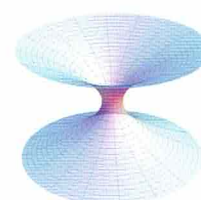
A part of elementary particles born in outer space aims at the earth. Although muons can fly from all directions, in the observation of huge objects, scientific forces capture muons in only one direction. When you reach the ground with muons, if you have muon eyes, will you see this kind of forest on earth?
This work is not science, but is regarded as the world of art.



「Portrait of madams」
Oil painting / Size:F15 / 2019

Tomoya Uemura

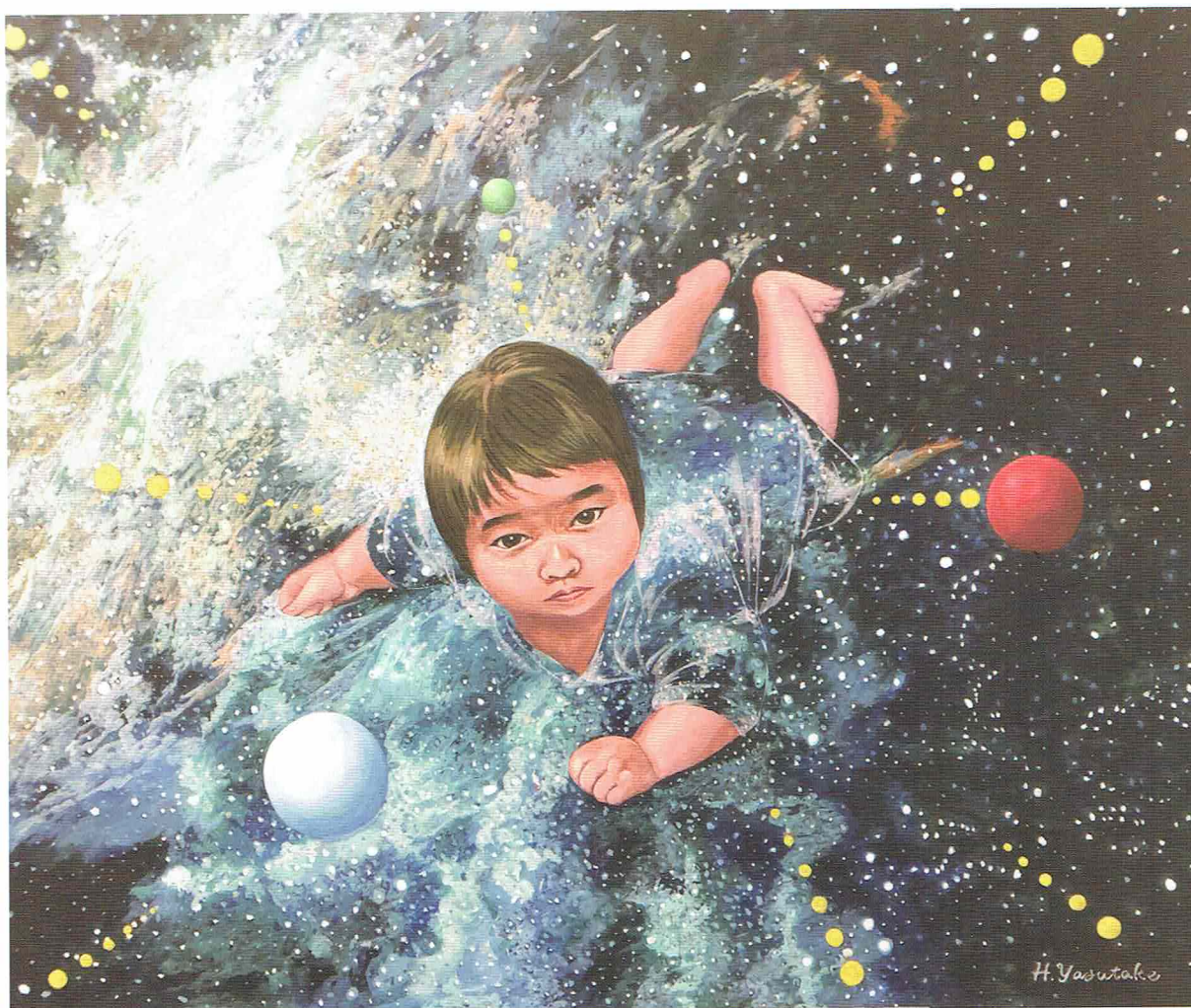
From generating particles to birth of muon.



「Conceptual diagram of wormhole
obtained by wikipedia」

Physicist Dr. Kentarou Mawatari's Comments :

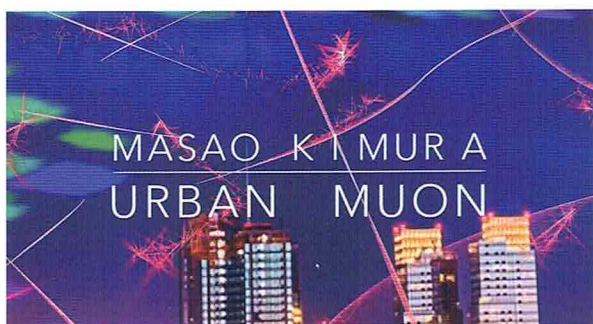
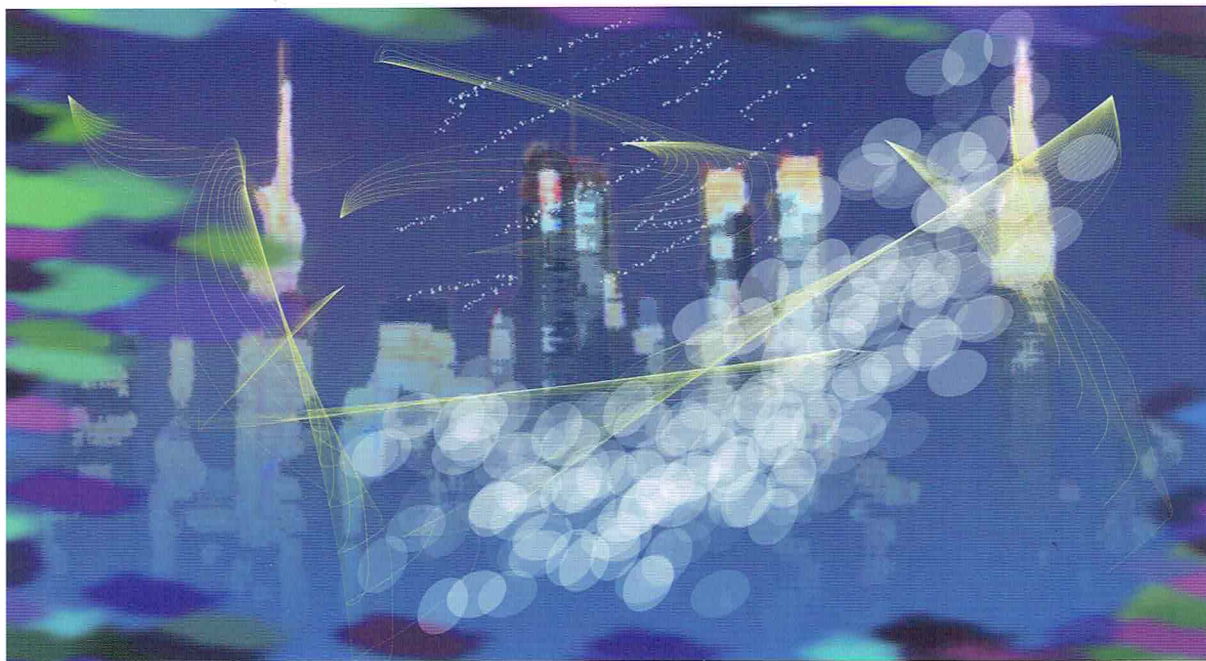
Black holes absorb everything, even lights, which may come out in a different space-time via distortion of space-time. Telepathy ? How do our individual brains connect each other?



「Curiosity to the unknown」
Oil painting / F20 H60.6cm × W72.7cm / 2019

Hideki Yasutake

Various laws are hidden in space and nature.
I think science and art are to simplify and express complex systems of the inside.
Pure eyes of curious children have a power to look at the truth of anything.
We need those eyes to explore science and art.
A child of this work may be looking at something unknown in vast space.



「Urban Muon」
Digital art

Masao Kimura

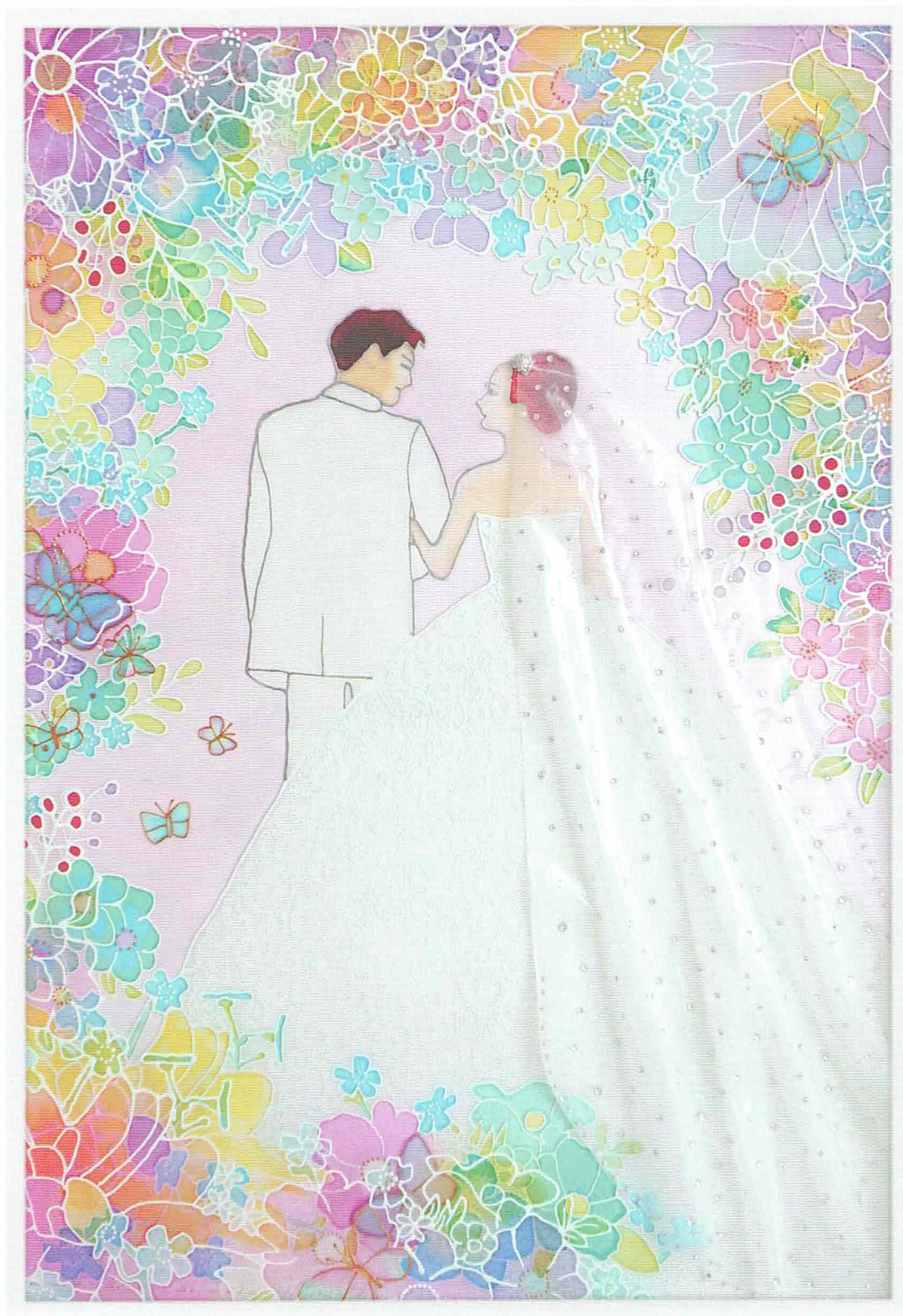
By measuring muon, you can see the structure of buildings and the earth.
Muons penetrate the atmosphere and buildings. I drew an image that was transmitted through all living things.



『In the rain』
Acrylic painting / F15 / 2019

Rie Tomimoto

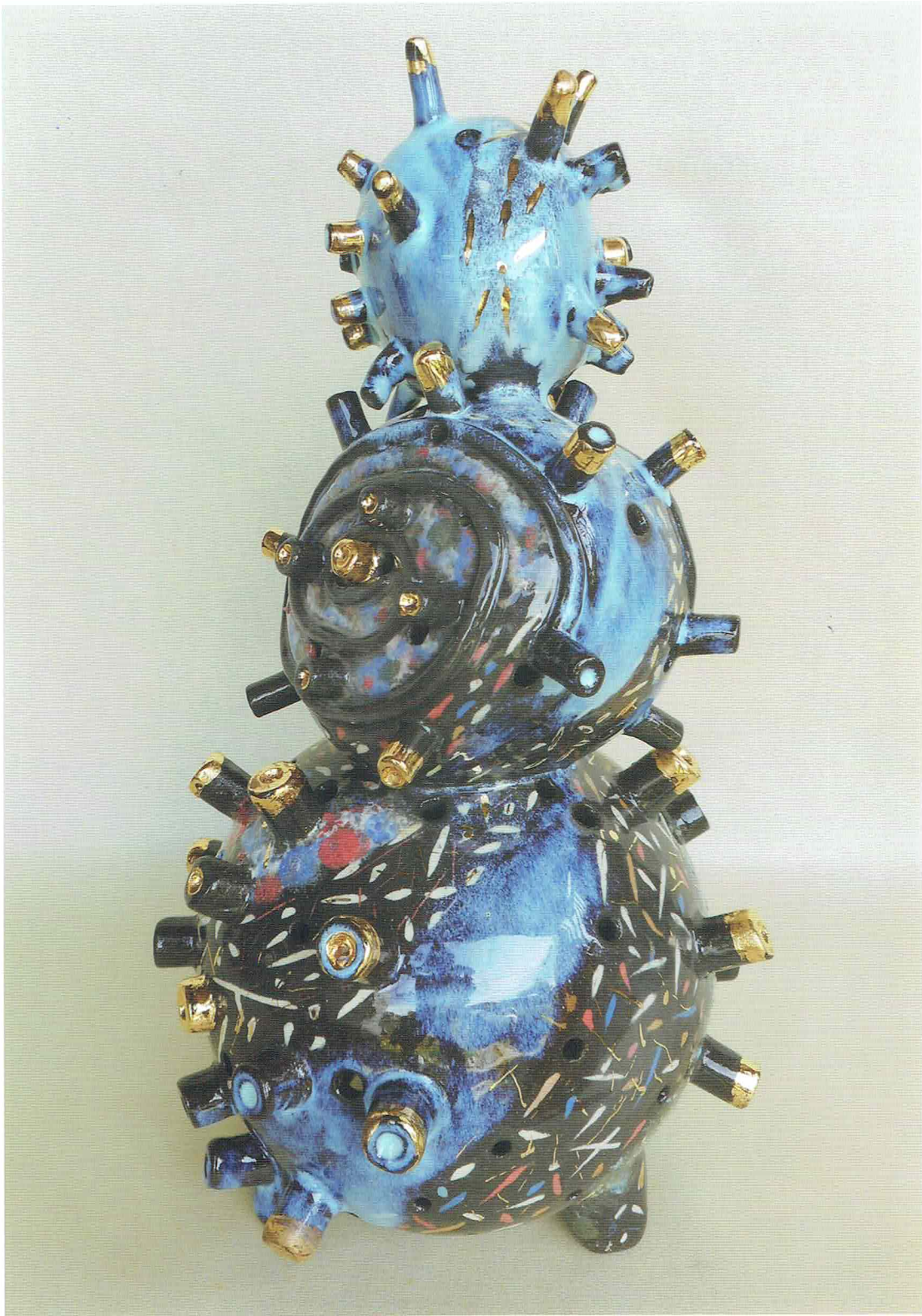
When it's raining, hold an umbrella, but Muon seems to be passing through your body.



「Eternity」
Dimple art / H72cm x W52cm / 2018

HIRO

"Colored Dimple art" is a new transparent art created through color alone, through which light can be transmitted. Like profound love, what is essential is invisible to the eyes. I see the moon as being like profound love coming to us from the universe.



「Galaxy and Muon」
Pottery / H36cm x 18cm x 16cm / 2019

Toshimitsu Sawada

Imagining the universe in the distance of millions of light years and the cosmic rays invisible to human eyes, I created this artwork. After forming the body by handwork, I inlaid colored clay, color makeup clay and gold liquid to express cosmic rays.



「Mankind can not rule the universe」
Pottery / H7.5cm x Φ39.5 cm /

Yoko Kato

Muyon, where have you been and where are you going? I feel your existence within fire from kiln leads to the universe...



「Muons do see it ! Muons do see it !」
Steric / H60cm x W40cm x D50cm / 2019

Nodoka Nakamura

Muography reminds me "eyes". Muons travelling from universe can see the inside of huge objects and have a lot of possibilities !

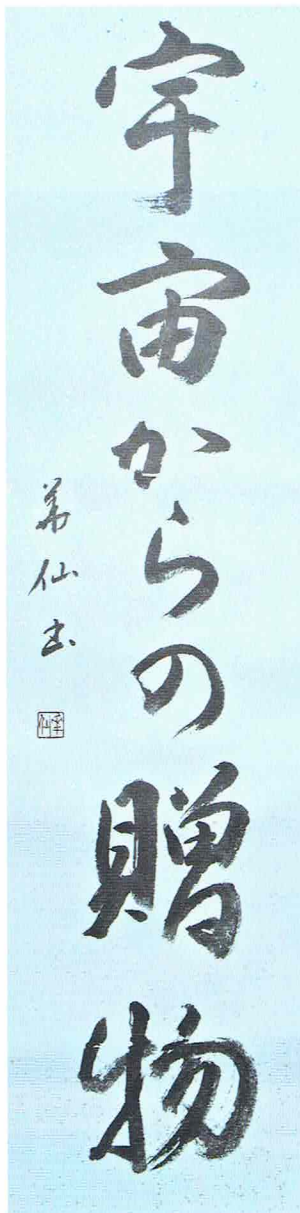
I created this artwork from my imagination that muons can see everything.



「Kofun's Whisper」
 Kyo-kanoko-squeeze (10 kinds of techniques)
 Tapestry / Each size: H155cm x W50cm / Each material: Silk 100% / 2018

Mitsuo Matsuda

I will show you everything before your dreams and romances disappear.
 I am not so wonderful as you imagine !



「Japanese calligraphy "A gift from outer space"」
Calligraphy / H131.5cm x W34.7cm / 2018



「muon」
Calligraphy / H14.8cm x W10cm / 2019



「A gift from outer space」
Calligraphy / H14.8cm x W10cm / 2019

Kasen Sumiya

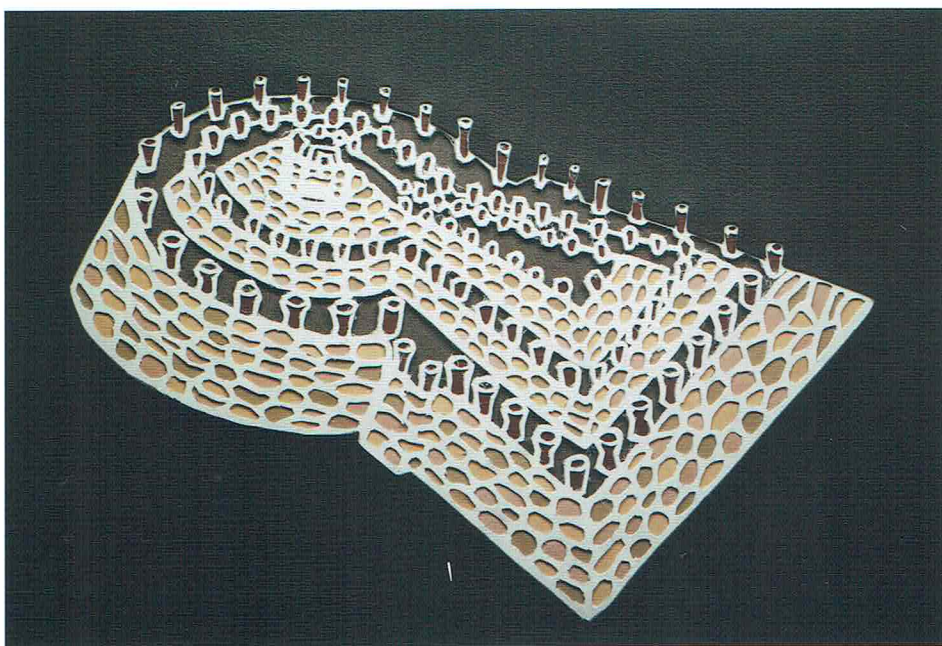
I was very surprised when I knew that about a million muons were passing through the body while sleeping.- Invisible to the eye, but certainly present. Muon is "A gift from outer space", Muon does exist. Muon is a gift to humanity from a huge universe. I hope that the science and technology of muon will continue to evolve. I tried to write the title in an easy-to-understand line style. I used paper like a star scattered in an infinite universe. I drew the character of "Muon" and "Gift" with Japanese chopsticks.



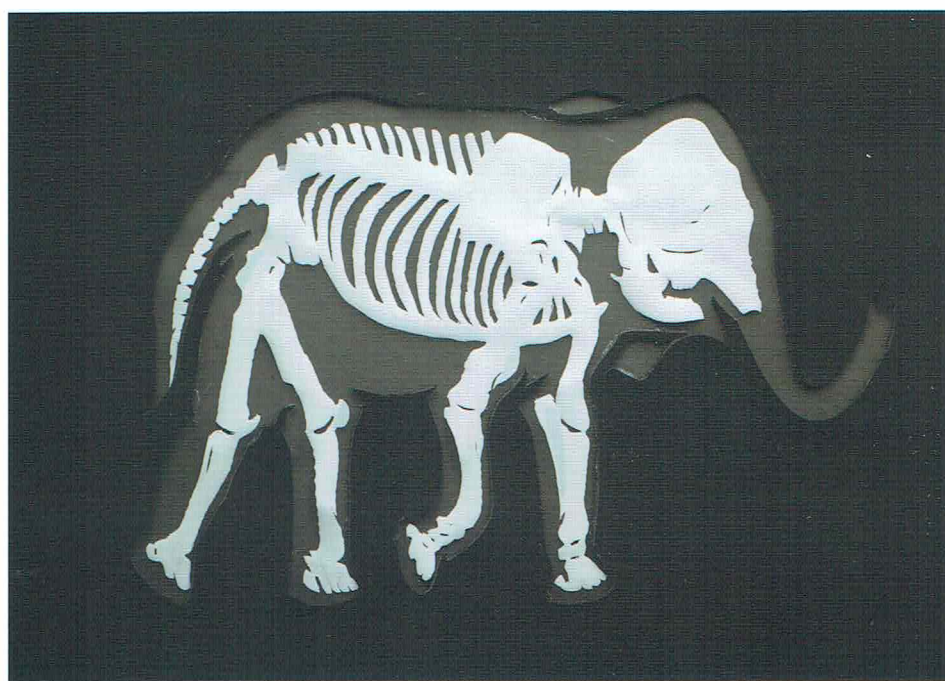
「A spark pageant」
Delica beads / H68cm x W50cm / 2019

Sakanaka Tomiko & Tanimura Eiko

The key words of Muography can be said to be cosmic rays, fundamental particles, explosion, spattering and so on. The glittering beads and long fringes represent muons as well as fireworks.



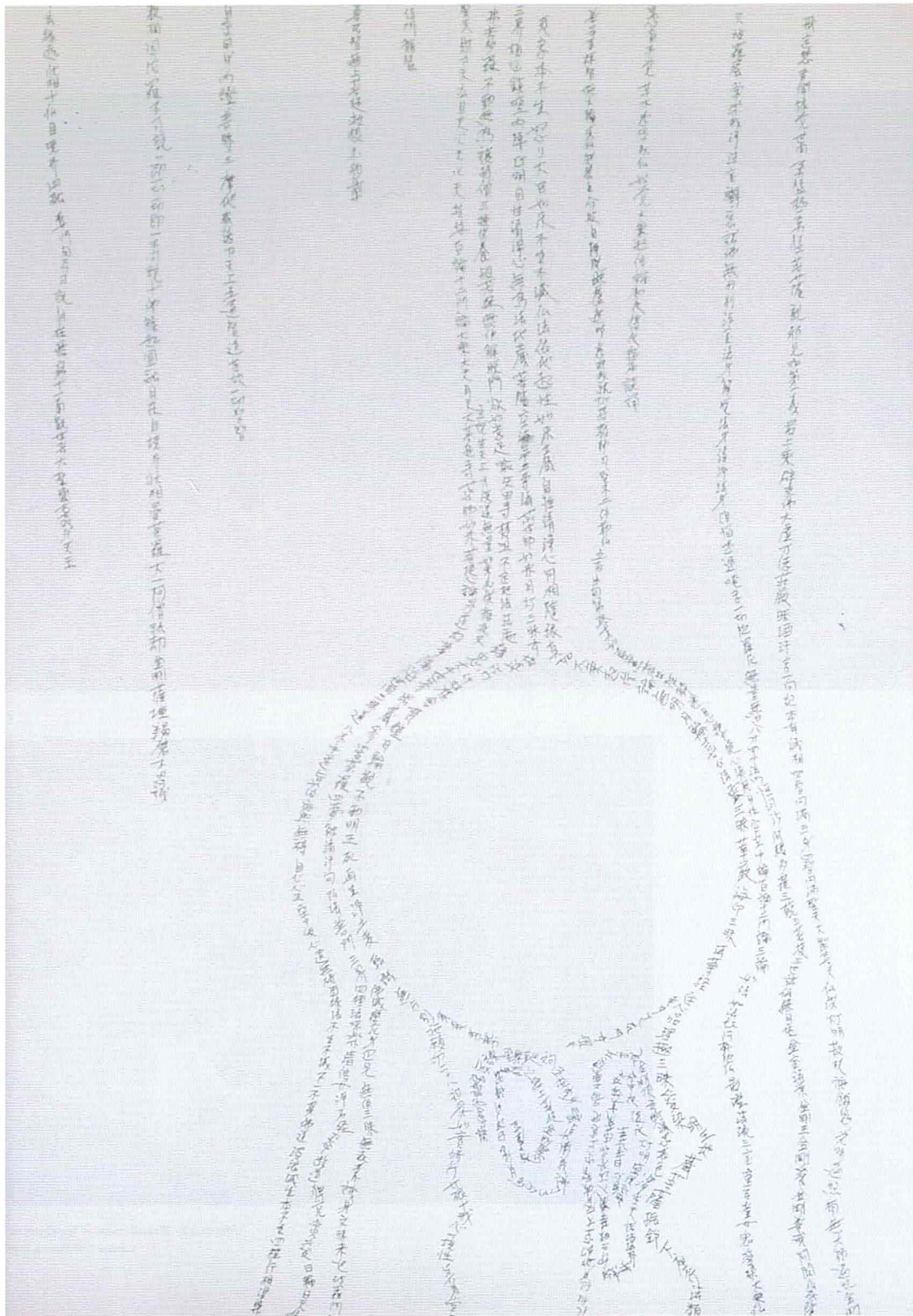
[Fluorographic image of an ancient tomb by muography Vegan leather art, 2019]
H24.8cm x W35.0cm



[Fluorographic image of an elephant by X-rays Vegan leather art, 2019]
H23.8cm x W30.0cm

Maki Hisamoto

I made two works using synthetic leather (vegan leather). It is an image of an elephant seen through with X-rays and an ancient tomb seen through with muon. X-rays, also called roentgens, are used in medical science to diagnose disease. On the other hand, muon can see through huge objects that can not be imaged by X-rays, and is called muography. It is expected to contribute to archeology. Because an ancient tomb can not basically go inside and investigate. However, in muography we can see through the tombs. I want you to feel the difference between x-ray and muon scales.



[Streams of Ideas]
Poem / H54cm x W38cm / 2019

Kiyohito Kitagawa

Images, sounds, memories,
Shadows of eternal Void or Timetable of
KOSAME-Honburi-NochiKaisei

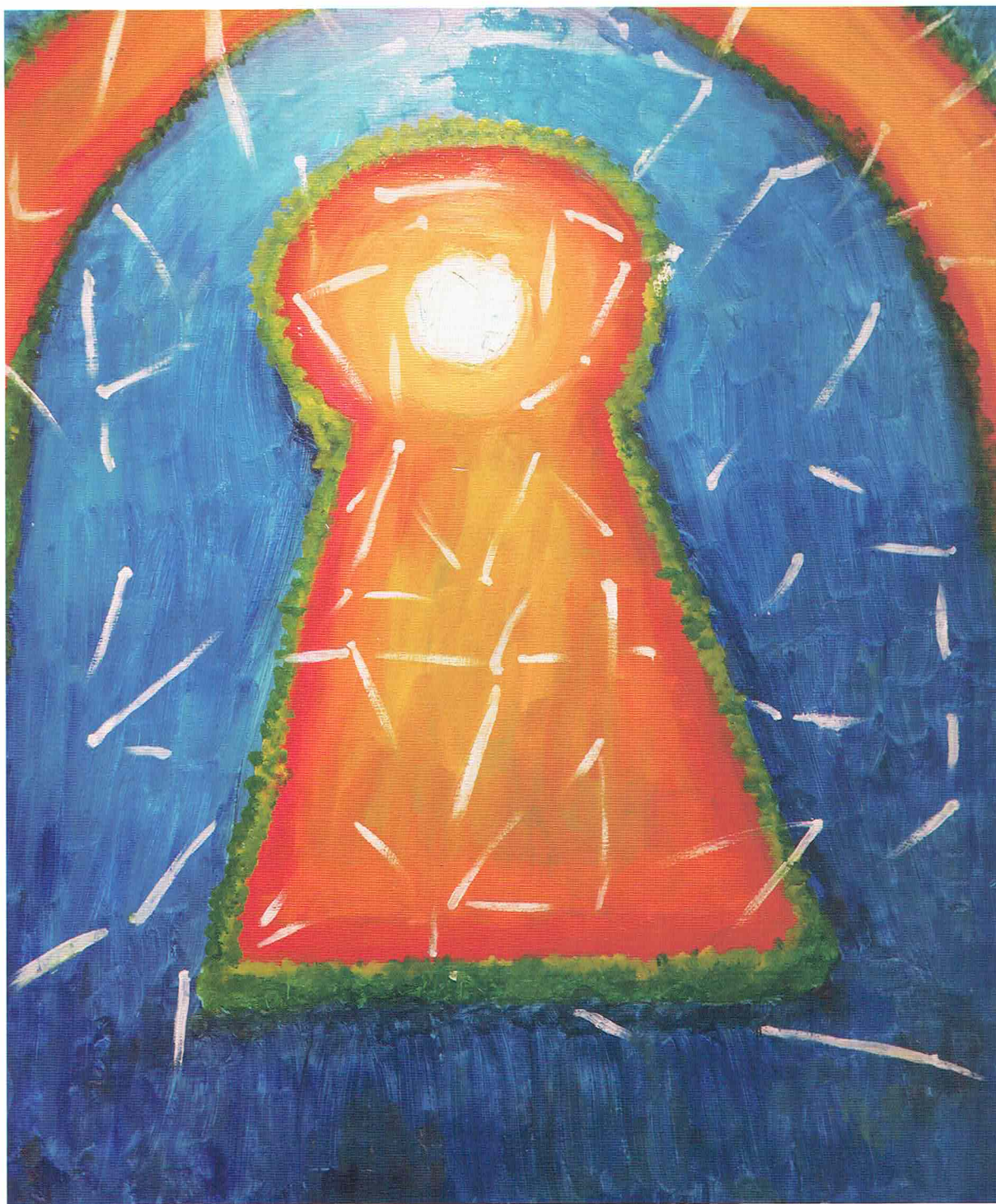


「Muography Measurement of Imashirozuka-Kofun」
Cookie / W30cm x D45cm / 2019

Tomoe Mori & Syono Mori

I hear that a muography equipment is to be installed for seethroughing Imashirozuka- Kofun in Takatsu-ki-city of Japan.

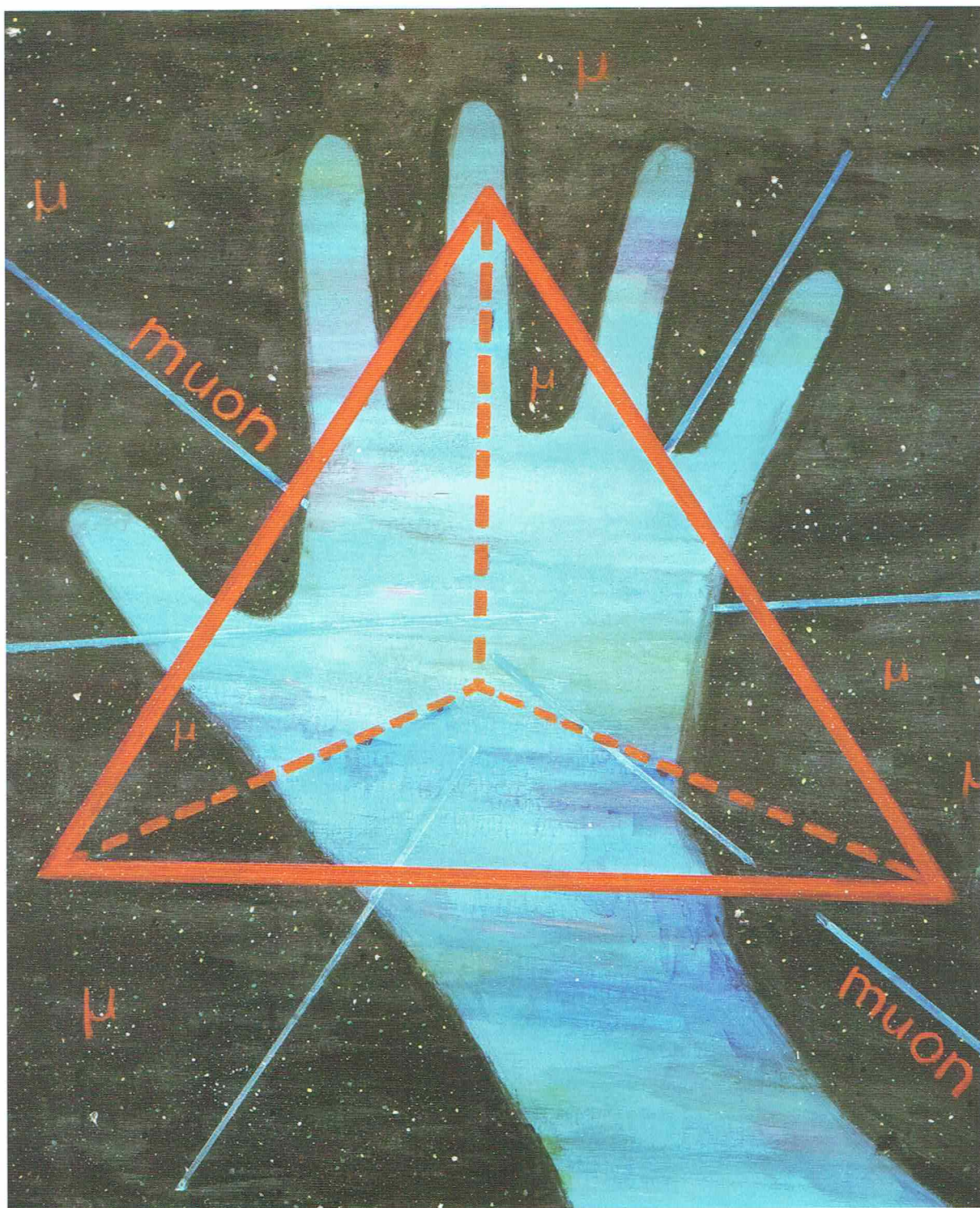
I baked this cookie representing Imashirozuka-Kofun floating in the universe.



[We See What We Couldn't See Before]
Oil painting / F20 / 2018

Hatsue Oso

By using muography technology, we can see what we couldn't see before. We can understand what was hidden from us before.



「Permeability」
Acrylic color / F20 / 2018

Misaki Kosaka

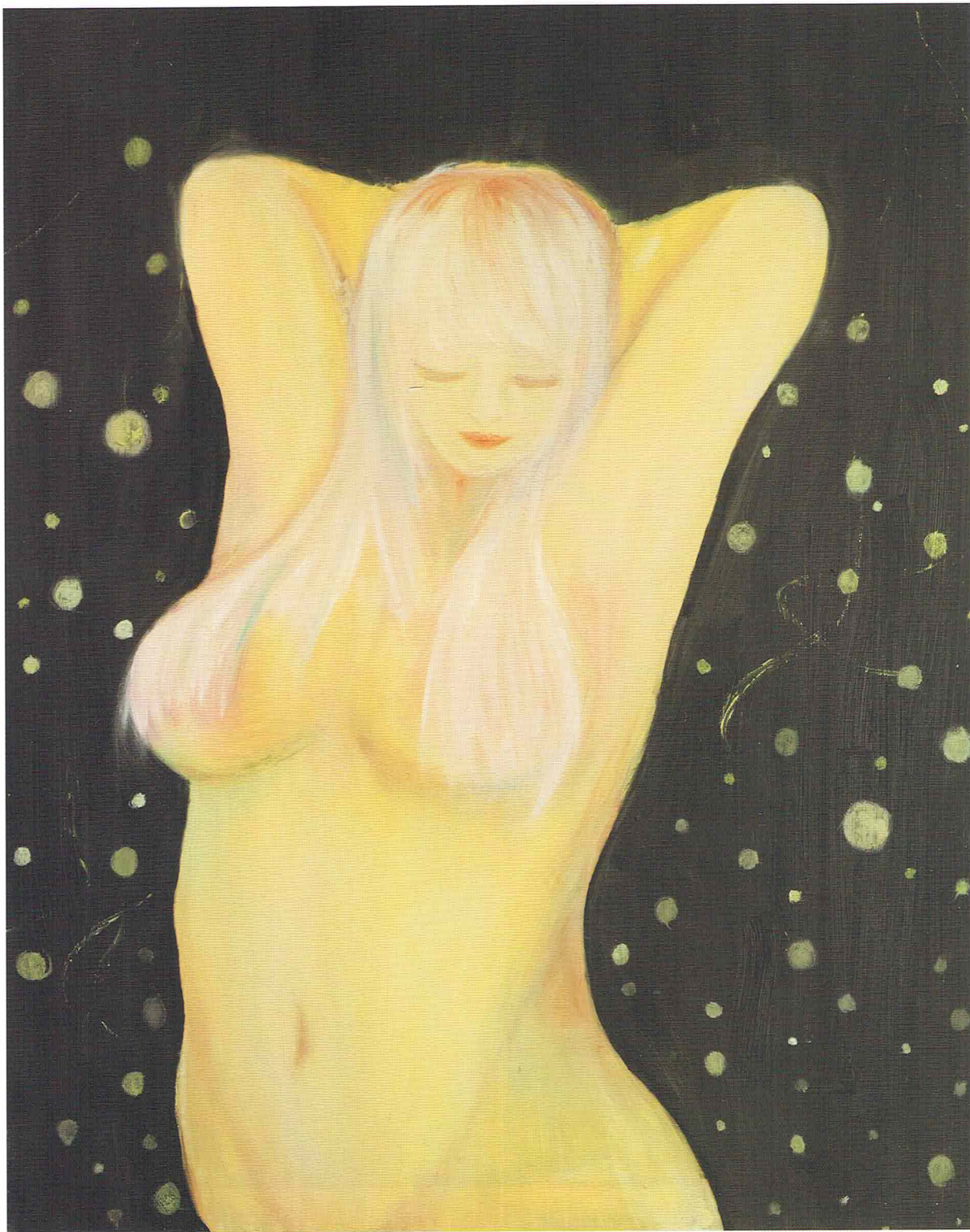
I think the most important characteristic of the muon is its permeability or transparency. The muon is the result of cosmic radiation colliding with the atmosphere of earth. At least one muon reaches the palm of one hand every second. This picture focuses on the nature of these muons.



「Captain」
Acrylic color / F20 / 2018

Tomoka Nishi

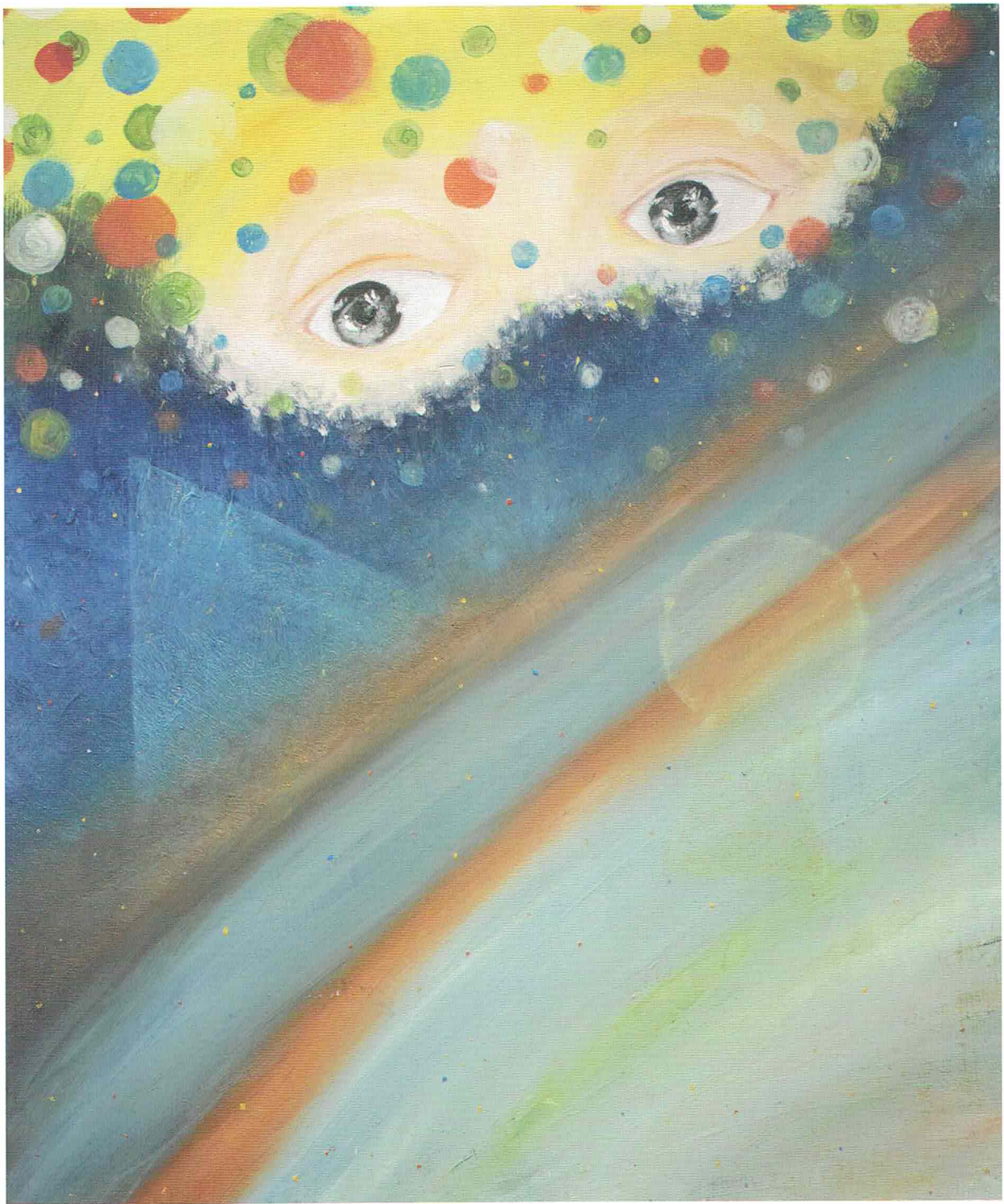
The interior of a visualized volcano is depicted as an upside-down cup.
What came out of the cup was steamy. I represented many possibilities in colorful colors, and think that it is a picture that can be enjoyed from various perspectives.



「Muon at Midnight」
Oil painting / F20 / 2018

Haruno Otsuka

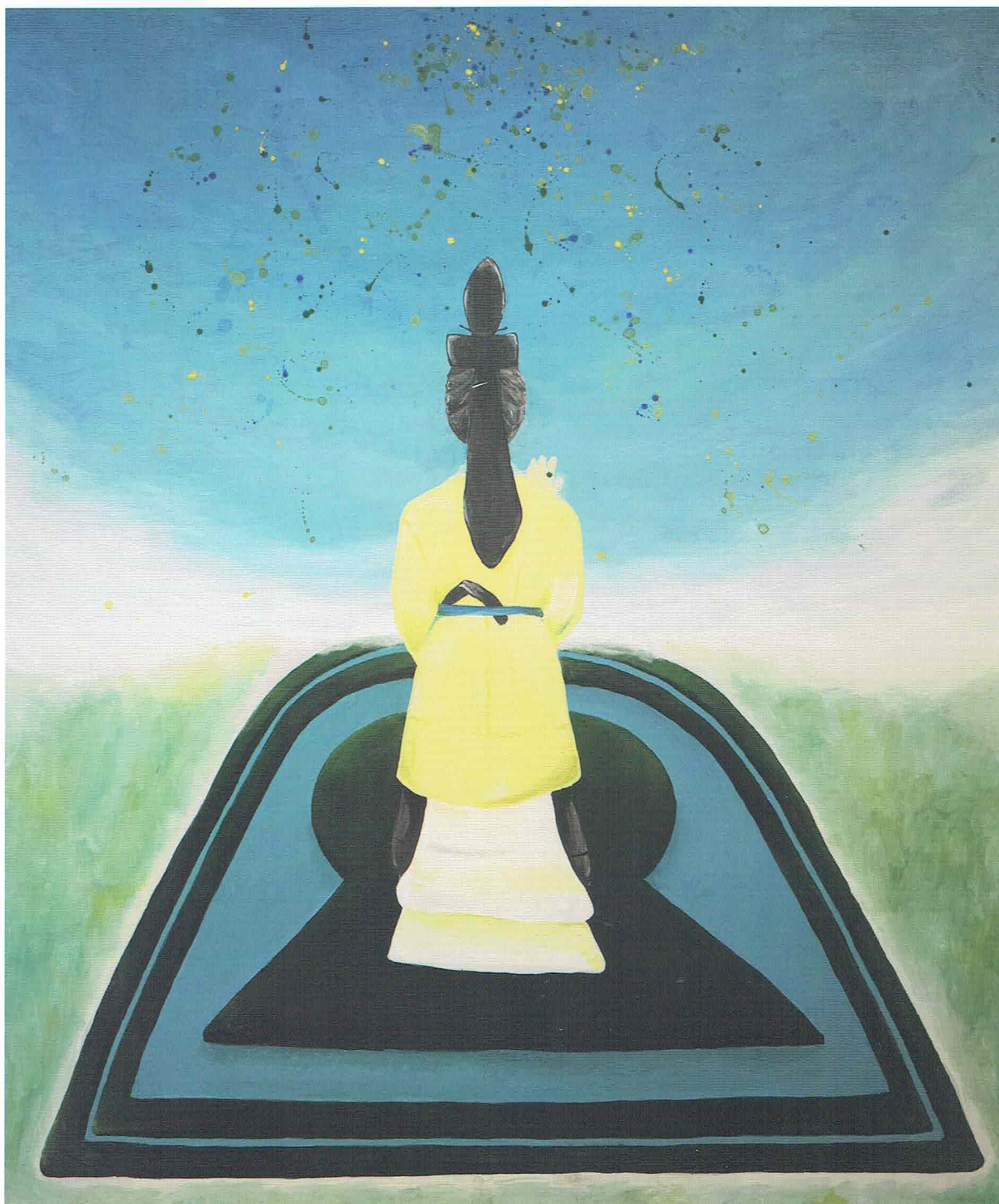
Muons are present in our lives all the time, even on a beautiful summer evenings. This artwork depicts muons symbolized as the light of a firefly.



[Perhaps We See]
Oil painting / F20 / 2018

Azumi Muraoka

Muons penetrate everything from the past to the future ? moving and unmoving objects, human beings, and gigantic objects on the Earth.



「Passing Through」
Acrylic color / F20 / 2018

Misaki Hata

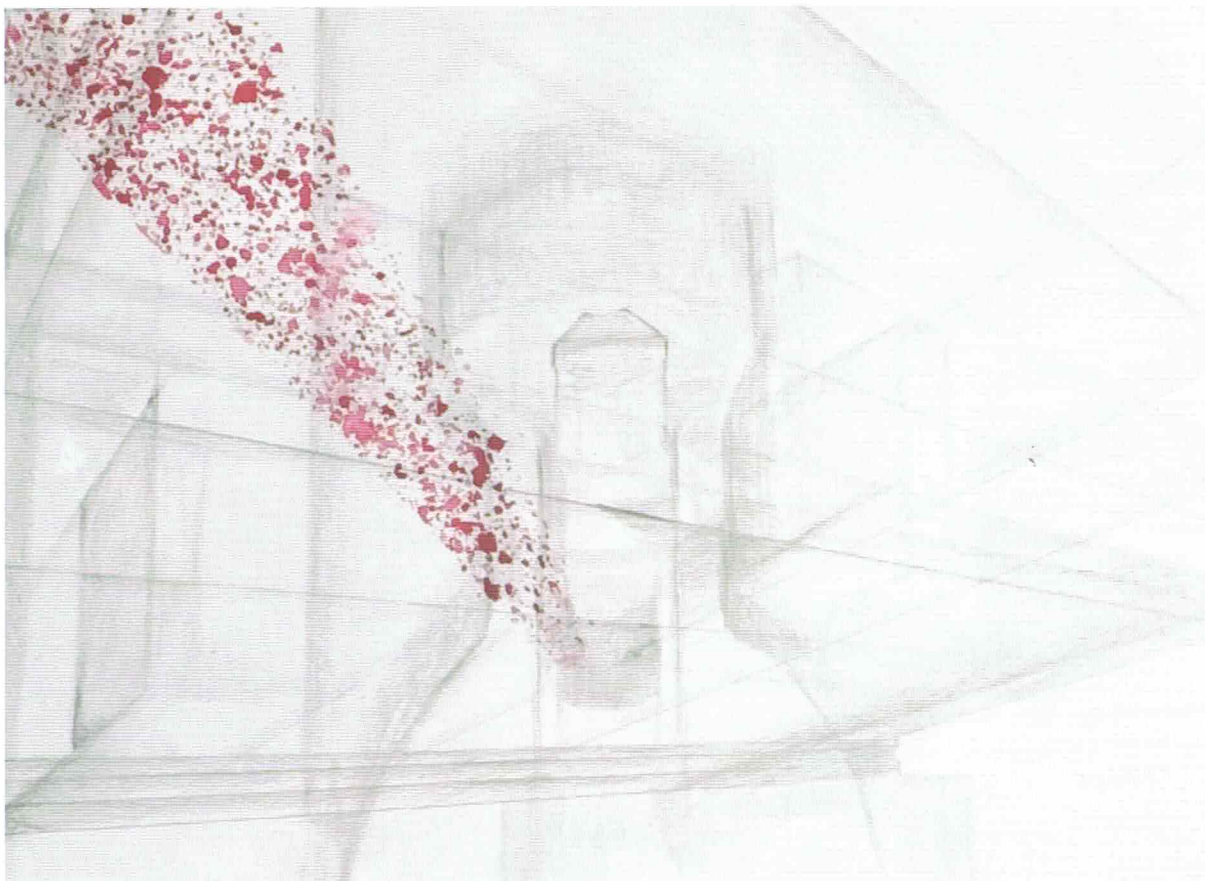
In this painting muons are passing through ancient tombs. Muons have been traveling to the Earth since ancient times.



「Blessed Rain」
Acrylic color / F20 / 2018

Momo Nishiguchi

A shower of muons constantly falls towards the Earth. 1 million muons pass through the body every night. Here the muons that bring new discoveries are expressed as blessed rain.



「REMAINS」
Pencil and Acrylic / F15 H24cm x W30cm / 2019

Kenta Izutani

I was inspired by the inside of the Fukushima No. 1 nuclear power plant seen through muography.
I hope that muography solves the problems of Fukushima nuclear plant in the Reiwa Period.



「A dormant active volcano」
oil painting / F15 / 2019

Yuria Hayase

I saw a lot of twinkling things on the ceiling when I woke up at night in my childhood.
I feel as if they might have been muons. This painting comes from my imagination in my childhood.

Gift from Outer Space II

Date : August 23, 2019

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International Muography Research Organization, University of Tokyo

Tama Art University Museum

Kansai Hungary Society

Honorary Consulate General of Hungary in Osaka

SPACE II
OUTER
FROM
GIFT