When we look up into the starry night sky, we tend to see reflections of ourselves.

— Trevor Paglen

**Trevor Paglen: Orbital Reflector [Main text]**

We may not always realize it, but art helps us change the way we see ourselves. That is why when artist Trevor Paglen imagined launching a reflective, nonfunctional satellite into low Earth orbit, the Nevada Museum of Art understood that his artistic gesture could help to change the way humanity sees our place in the world.

Orbital Reflector is a sculpture constructed of a lightweight polyethylene material that looks like thin plastic. It is housed in a small box-like infrastructure known as a CubeSat that will be launched into space on board a rocket. Once in orbit, about 350 miles from Earth, the CubeSat will open and release the sculpture that will self-inflate like a balloon. Reflective titanium dioxide powder coats the inside of the sculpture, so that sunlight reflects off of it, making it visible from Earth with the naked eye — like a slowly moving artificial star as bright as a star in the Big Dipper.

The Nevada Museum of Art and Trevor Paglen worked with the aerospace engineering firm Global Western to design and manufacture Orbital Reflector. Spaceflight Industries arranged for the launch of Orbital Reflector on board a SpaceX Falcon 9 rocket. As the twenty-first century unfolds and gives rise to unsettled global tensions, Orbital Reflector encourages all of us to look up at the night sky with a renewed sense of wonder, to consider our place in the universe, and to reimagine how we live together on this planet.

*Trevor Paglen: Orbital Reflector, co-produced and presented by the Nevada Museum of Art. The archive materials generated from the Orbital Reflector project will become part of the archive collections of the Museum’s Center for Art + Environment.*

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Exclusive sponsorship for the Orbital Reflector installation, and lead sponsorship for the Museum’s STEAM education programs, is provided by Switch.

Additional support provided by the 557 backers of this project’s [*Kickstarter campaign*](http://bit.ly/OrbitalReflector_KS).

**Process Display Case [Label Rail]**

**Building Orbital Reflector**

Global Western is an aerospace firm that worked with Trevor Paglen and the Nevada Museum of Art to design and manufacture Orbital Reflector. The fabrication and cost of launching *Orbital Reflector* into space was approximately $1.3 million.

1

**Preliminary and Critical Design Review**s

After engaging the aerospace firm Global Western to fabricate Orbital Reflector, Trevor Paglen, the Museum team, and technical advisors met in southern California at Kelly Space Systems and Technologies to review the proposed scope of work and to analyze early designs. During this review, a decision was made to shift from a spherical balloon sculpture to a diamond-shaped object. The new shape would be more reflective and aerodynamic, helping the satellite remain in orbit longer.

The team reconvened at the Nevada Museum of Art to review the proposed CubeSat design, balloon construction, software, and radio systems, as well as the results of initial prototype testing. After the design and prototype were analyzed and approved, the engineers proceeded with satellite fabrication.

2

**Balloon Construction**

Balloon construction took place in a large warehouse facility near Ventura, California. Constructed of a thin plastic material called polyethylene, each section of the balloon was cut to specification and heat-sealed with a continuous band heat sealer. It was then meticulously inspected, inch by inch, to ensure sealing. The final dimensions for the diamond-shaped balloon were 100-feet long by 5 feet wide.

**3**

**CubeSat Fabrication**

A **CubeSat**, considered a U-class spacecraft, is a miniaturized satellite often used for space research. The Orbital Reflector CubeSat is a small, brick shaped steel and aluminum box used to house the balloon sculpture. Materials for the box were custom fabricated using a CNC (Computer Numerical Control) cutting machine to meet the exact dimensions required. The CubeSat was hand-assembled near Denver, Colorado.

4

**Dynamics and Acceptance Testing**

The entire flight unit consists of the balloon housed inside a CubeSat, with all the necessary hardware and software required for communication and inflation. Two complete flight units and a qualification unit were fabricated. A qualification unit underwent a series of vibration and thermal-vacuum tests to prove that the satellite could withstand a launch and the extreme space environment. After each test the balloon was inspected to ensure viability.

5
**CubeSat Integration** **& Launch***Orbital Reflector* is one of 114 planned “payloads” that will ride on the SpaceX Falcon 9 rocket launching in fall 2018. A payload is a satellite or other spacecraft that hitches a ride into space on a rocket. The payloads ride on a structure that will deploy multiple satellites belonging to scientists, researchers, and corporations undertaking various experiments and space missions. *Orbital Reflector* is carried on what Spaceflight Industries calls a Lower Free Flyer, along with fifty-one other CubeSats. The engineering team travelled to Seattle, Washington to integrate our CubeSat into the Lower Free Flyer.

Once the rocket is launched, the Lower Free Flyer will detach from the rocket and eject each of the fifty-two CubeSats in a predetermined order. After the Orbital Reflector CubeSat is ejected, a timer will count down a 10-hour wait period before initiating balloon deployment and inflation. This delay is intended to give the balloon ample space to unfurl, mitigating the potential for collision and snagging with other objects ejected by the Lower Free Flyer.

Inflation occurs when a cartridge releases carbon dioxide (CO2) into the balloon. The sculpture is then filled with titanium dioxide powder so that sunlight will reflect onto it making it visible from Earth.

**A Fascination with Space**

1

Trevor Paglen is fascinated by the idea of space travel and his idea for *Orbital Reflector* is inspired by historical precedent. Russian avant-garde artist Kazimir Malevich (1879-1935) was also intrigued by outer space, the cosmos, and the human destiny to explore. Malevich’s book *34 Drawings* included a manifesto related to space travel and satellites and has long been a touchstone for Paglen.

2

Paglen studied NASA’s satellite program, including the 100-feet-diameter spherical communications satellites—known as ECHO 1 & ECHO 2—developed in the 1960s. These are photos and articles related to the design, fabrication of launch of the ECHO satellites.

3

For decades, the United States military has designed embroidered patches to symbolize and commemorate everything from unit affiliations and significant events, to secret missions and noteworthy programs. Paglen collects military patches, records their symbols and insignia, and asks: "How does one represent that which, by definition, must not be represented?" As a nod to the history of "mission patches," Paglen created a series of custom-designed patches for Orbital Reflector.

**Mini text**

***Prototype Drawings***

Trevor Paglen has long been interested in launching a satellite into outer space as a purely aesthetic gesture. He began prototyping satellite designs many years ago while anticipating a future project. Prototypes are preliminary models from which other forms or ideas are developed or copied. Paglen’s initial prototypes were spherical in shape, alluding to NASA’s Project Echo communications satellites of the 1960s. Other prototypes took the form of rings, kites, and discs.

1 *“The Kite” Concept*, 2012

2 *Antenna-Sat Concept*, 2012

*3 Echo-Type Test Frame Concept*, 2013

4 *Discus Picosat Concept (A)*, 2012

5 *“The Donut” Concept*, 2013

6 *Modified Expansion Concept*, 2013

7 *Echo-Style Canister Deployment and Inflation Sequence*, 2013

8 *Discus Picosat Concept (B)*, 2013

9 *Echo-Type CubeSat Concept*, 2014

10 *Reflective Structure in Orbit*, 2015

11 *Drag Coefficients of Various Shapes*, 2015

12 *OR-Sat Reflection Concept*, 2016

13 *Diamond-Sat Concept*, 2016

14 *Evolved Orbital Reflector Concept*, 2017

15 *Orbital Reflector Component Concept*, 2017

All drawings are graphite on paper and courtesy the artist and Altman Siegel Gallery

**The Other Night Sky**

The Other Night Sky is a project developed by Paglen to track and photograph objects that do not naturally occur in space, such as satellites and orbital debris. Paglen uses data produced by amateur satellite observers to calculate when and where these objects will be visible in the night sky. Paglen uses telescopes, large-format cameras, and other imaging devices to document these anomalies in the night sky.

**Labels:**

*Diamond Reflector,* 2018
*Steel, lacquered*

Courtesy of the artist and Altman Siegel Gallery

This is a small-scale replica of Paglen’s diamond-shaped satellite, *Orbital Reflector*. The actual satellite is made of polyethylene, a material similar to plastic, and measures 100 feet.

*INTRUDER 5A in Cygnus (Ocean Reconnaissance Satellite; USA 160) Note: Other satellites are SCOUT X-4 Rocket Body and Unknown)*, 2017
Dye sublimation print, White Semi-Matte
Courtesy of the artist and Altman Siegel Gallery

*Subsatellite Ferret-D Over the Eastern Sierra (Electronic Intelligence Satellite; USA 3),* 2012
C-print
Courtesy of the artist and Altman Siegel Gallery

*Nine Reconnaissance Satellites over the Sonora Pass*, 2008
C-Print
Courtesy of the artist and Altman Siegel Gallery

*DMSP 5B/F4 from Pyramid Lake Indian Reservation,* 2009
C-Print
Courtesy of the artist and Altman Siegel Gallery

Trevor Paglen
*Dead Satellite with Nuclear Reactor, Eastern Arizona (Cosmos 469),* 2011C-print
Courtesy of the artist and Altman Siegel Gallery

*Auriga
X-37B/OTV-3 in Gemini (Orbital Test Vehicle, “Space Plane”; USA 240)*, 2017
Silver gelatin print

*Prototype for a Nonfunctional Satellite, Installation test at Hangar*, 2017
C-Print

Paglen originally intended his satellite to be spherical in shape. That is why the satellite model that hangs in the Museum’s atrium is a sphere. After working with aerospace engineers, however, it was determined that a diamond shaped form was better suited for orbit.

*Prototype for a Non-functional Satellite (Design 4; Build 6)*, 2014
Mylar, plastic and tape
Courtesy of the artist and Altman Siegel Gallery

Paglen initially thought his satellite could be made from Mylar, a material similar to what was used by NASA for their ECHO 1 & 2 communications satellites. This is a remnant from one of Paglen’s earlier prototype designs.

Join the conversation: [@nevadaart](https://www.instagram.com/NevadaArt/) [@trevorpaglen](https://www.instagram.com/trevorpaglen/) #OrbitalReflector

**Timeline**

**Kazimir Malevich (1879-1935)
Planits, 1923-24**

Russian avant-garde artist Kasimir Malevich was one of the first to imagine art in space. His inhabitable floating structures—referred to as Planits--were experiments in Suprematist architecture. Working during a time of revolution, his notion of “orbital” art was inextricably linked to the pursuit of freedom. In the introduction to the 1920 artist book: Suprematism: 34 Drawings, Malevich dubbed the word “sputnik” to designate the artificial satellites he imagined creating around the earth.

**Soviet Union**

**Sputnik, 1957**

The Soviet Unio*n* sent Sputnik 1—the first artificial earth satellite—into orbit in 1957. It was a 58-inch polished sphere with radio antennae. The success of the launch triggered the Space Race between the Soviet Union and the United States, and is considered part of the Cold War between the two nations.

**Yves Klein (1928-1962)
Pneumatic Rocket, 1958**

French artist Yves Klein was a visionary who imagined a new course for art and a utopian path for society. Klein designed a series of "air architecture" projects, including self-propelled, air-driven projectiles that were intended to launch from Earth and never return. Part of Klein’s research into technology and architectural space resulted from his radical vision of an evolving society.

**NASA, ECHO1 & ECHO 2, 1960s**

These 100-feet-diameter spherical spacecraft, developed by NASA in the 1960s, served as early communications satellites by reflecting radio signals off their mirrored skins. Communication signals were bounced off them from one point on Earth to another.