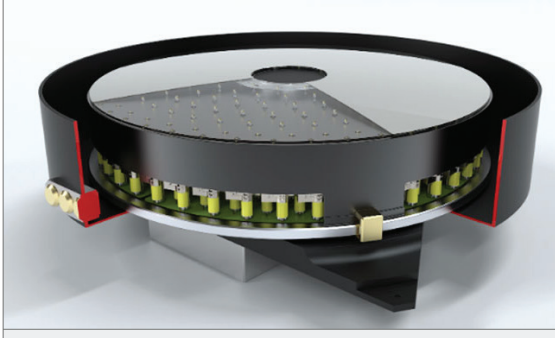
L3HARRIS™
FAST. FORWARD.

ADAPTIVE SECONDARY MIRROR



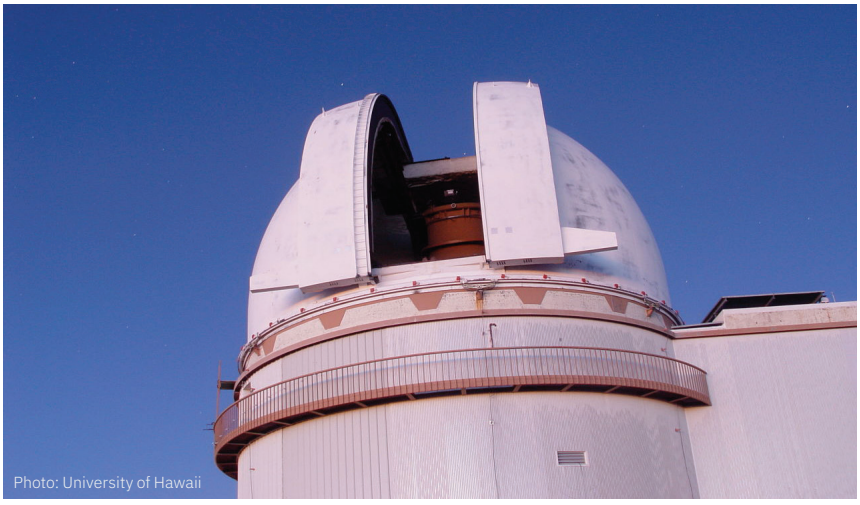
Pushing through Earth's atmosphere for an unaffected view of space has been the foundational challenge for ground telescopes for hundreds of years. Adaptive Secondary Mirrors (ASMs) are an ingenious solution – manipulate the mirror surface to correct the negative atmospheric affects. L3Harris and our partners are taking this technology to a larger size than ever before, aimed at boosting ground-based observatory performance to unprecedented levels.

LARGER ADAPTIVE MIRROR BENEFITS

Most commercially available ASMs, also called deformable secondary mirrors, are smaller than 65 centimeters, or 28 inches, in diameter. That means they are not installed on larger ground-based observatories like the University of Hawaii 2.2-meter telescope, which is also known as the UH 88-inch telescope, or UH88. L3Harris is producing an ASM that will fit the UH 2.2-meter telescope and allow the observatory to operate with corrections for atmospheric turbulence, thermal affects and other factors that degrade the images. This will result in more clarity than is currently achievable in similarly situated ground-based telescopes.

L3HARRIS PARTNERS WITH UNIVERSITY OF HAWAII, DUTCH GROUPS

The ASM UH 2.2-meter telescope project is an international collaboration among L3Harris, UH and three Dutch groups involved in telescope technology. The project lead is the Netherlands Organisation for Applied Scientific Research (TNO), a Dutch independent research organization focused on industrial innovation. Two private Dutch companies round out the project group – VDL and Hyperion Technologies. The U.S. National Science Foundation is providing funding for the effort, along with the government of the Netherlands. The UH 2.2-meter telescope will serve as a testbed for the technology, sharing data with the other stakeholders to refine and perfect the mirror. Ultimately, similar ASM technology will be available for other large ground-based observatories around the world.



UH 2.2-meter telescope

PROJECT DETAILS

- **Sized at 27.6 inches, or 70 centimeters**
- **Controlled by about 200 small actuators that move the mirror surface**
- **Developed by the Netherlands Organisation for Applied Scientific Research in cooperation with the University of Hawaii, L3Harris and two Dutch companies – VDL and Hyperion Technologies**
- **Funded by investments from the Government of the Netherlands and the U.S. National Science Foundation**

HOW ASM TECHNOLOGY WORKS

Adaptable mirrors physically change shape in order to make corrections for atmospheric conditions that degrade performance. Traditional telescope mirrors – especially large ones – have been made from thick pieces of glass polished to an ultra-smooth surface, but are generally passive, or fixed. In contrast, adaptable mirrors are made from thin, pliable glass facesheets that can be manipulated. Controlling actuators are placed below the surface of the mirror, which is a convex facesheet measuring about 3 millimeters in thickness. The actuators are moved by advanced software that transforms measured wavefront errors on the telescope to make real time corrections to improve telescope performance.

PROJECT ROLES

The five partners in the ASM 2.2-meter telescope project each bring an invaluable set of capabilities and expertise that contribute to success.

- **L3Harris –** The long-time telescope mirror manufacturer will provide the convex aspheric facesheet. An advanced engineering process called capture range replication will produce the facesheet, replicating the convex surface using a concave mandrel. L3Harris will smooth the mirror with innovative polishing capabilities, then use ion beam figuring and magneto-rheological finishing the facesheet to the exacting surface-level requirements.
- **The University of Hawaii –** UH will install the ASM in the UH 2.2-meter telescope and integrate and operate the updated telescope as a testbed for the technology. The university will share data with the other stakeholders and the team will make any appropriate enhancements.
- **TNO –** The Dutch business technology incubator is the lead organization on the 2.2-meter telescope. It developed the concept for the mirror and the actuators, carrying out systems and design engineering.
- **VDL –** The large industrial company will assemble the mirror and integrate all supporting systems, which is very similar to the work in process for the European Southern Observatory's Extremely Large Telescope M1 mirror segment assemblies.
- **Hyperion Technologies –** The software provider will design and produce software to control the adaptable face of the mirror. Sensors on the wavefront send data that is analyzed by the software. Signals then go to the actuators in real time to make corrections to the mirror shape to improve telescope performance.

2.2-METER TELESCOPE

The University of Hawaii 2.2-meter telescope is known as one of the most productive observatories of its size in the world. Situated on Mauna Kea, a dormant volcano on the Big Island of Hawaii, the telescope started operating in 1970. It has a long history of technological innovation, including infrared array camera improvements, as well as advances in astrophysics. Scientists discovered the Kuiper Belt in the outer solar system using the 2.2-meter telescope in 1990.

UH 2.2-meter telescope

FUNDING

The U.S. National Science Foundation and the Government of the Netherlands have both invested in 2.2-meter telescope ASM. L3Harris, TNO, VDL and Hyperion Technologies have all provided internal research and development funds.

LOOKING FORWARD

Adaption of ASM technology in ground -based telescopes will improve the observational capabilities and data scientists gather in different locations around the world. This would boost investigations and research by improving data sets scientists share with one another. Additionally, ASM technology has other potential applications, including space situational awareness – tracking and protecting on-orbit assets, a vitally important need as space gets more and more crowded.

Adaptive Secondary Mirror

L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs. The company provides advanced defense and commercial technologies across air, land, sea, space and cyber domains.

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