Improved telescope sees through atmosphere with pinpoint sharpness

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A sharp view of the starry sky is difficult, because the atmosphere constantly distorts the image. Eindhoven University of Technology researcher Roger Hamelinck developed a new type of telescope mirror, which quickly corrects the image. His prototypes are required for future large telescopes, but also gives old telescopes a sharper view.

The atmosphere contains 'bubbles' of hot and cold air, each with their own refractive index, which distort the image. As a result, the light reaching ground-based telescopes is distorted. Hamelinck's system tackles this problem with a deformable mirror in the telescope. Under this ultrathin mirror there are actuators, which can wherever necessary quickly create bumps and dimples in the mirror. These bumps and dimples correct the continuously changing distortion created in the atmosphere. This is of crucial importance to the new generation of large telescopes in particular. Hamelinck: "In principle, larger telescopes also have a higher resolution, but attaining an optimal optical quality is hampered by the atmosphere. Therefore you absolutely need these corrections."

The principle of the 'adaptive deformable mirror' has been known some fifty odd years, but was limited especially by the technology. Thus, the actuators of earlier systems generated much heat, which caused the systems themselves to become a source of distortion. "Contrary to the old systems, this new system has an ultrathin mirror, so that very little power is needed for its deformation ", Hamelinck explains. "In combination with the efficient, electromagnetic reluctance actuators, this

reduces the heat generation of the system to a very low level. Thanks to this, no active cooling is required." Hamelinck's working prototype has a five-centimeter diameter. Given that the design is scalable and expandable with modules, the system is suited for very large telescopes, such as the future 42-meter-big E-ELT (European Extra Large Telescope). The E-ELT is fitted inter alia with an adaptive mirror of 2.4 meters.

Research institute TNO is so enthusiastic about Hamelinck's work, that the institute is going to market it. Not only so for new telescopes, but also for existing ones. "It can be built into any telescope in the world", says Ben Braam, business developer Space & Science of TNO. "When you turn on the system, the image is suddenly enhanced. As if it is putting on new spectacles at long last." Affordable spectacles, in Braam's opinion. "I'm thinking in terms of fifty to one hundred thousand euro. Which is relatively cheap for that world."

Admittedly, the system does not correct for everything. Clouds continue to be a problem, for example. Consequently the best places for telescopes are still locations where one can enjoy a clear, cloudless sky most of the time. That would exclude the Netherlands, then.

Provided by Eindhoven University of Technology