

# HOW LUNAR LASER RANGING WORKS

It takes about 2.5 seconds for the laser pulses to travel from Earth to the moon and back. The length of time reveals the distance between the two heavenly bodies: 384,000 km.

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**2** Diameter of the laser pulses when they reach the moon: about 2 km.

**3** Diameter of the laser pulses when they reach Earth; about 15 km.

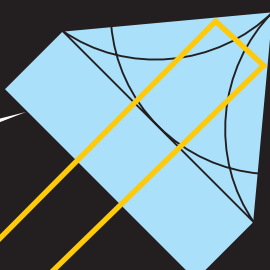
**1** Ground control sends about 20 laser pulses per second toward the moon. Each pulse contains about 300 quadrillion photons ( $300 \times 10^{15}$ ).

**4** Only one of every one quadrillion photons hits the reflector and returns to ground control. Although the loss rate is  $10^{15}$ , the few photons that are captured enable a precise measurement.

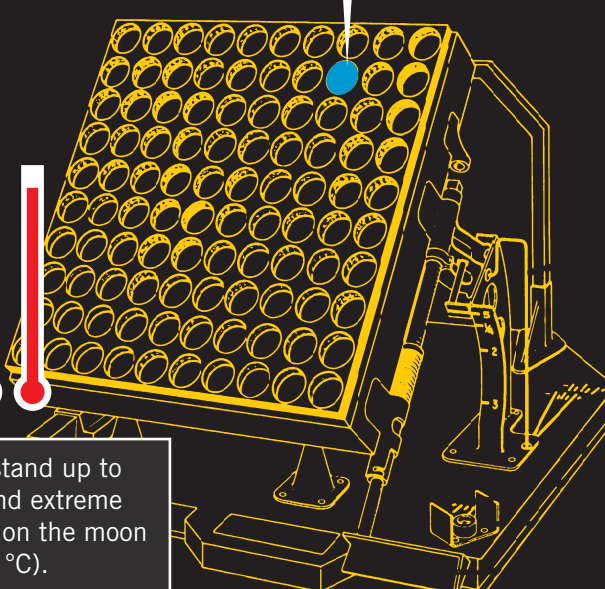
# HOW THE RETRO-REFLECTOR ON THE MOON WORKS

Despite the forbidding environmental conditions on the surface of the moon, the retroreflector has been working perfectly for 50 years. The secret is in the quartz glass triple prisms.


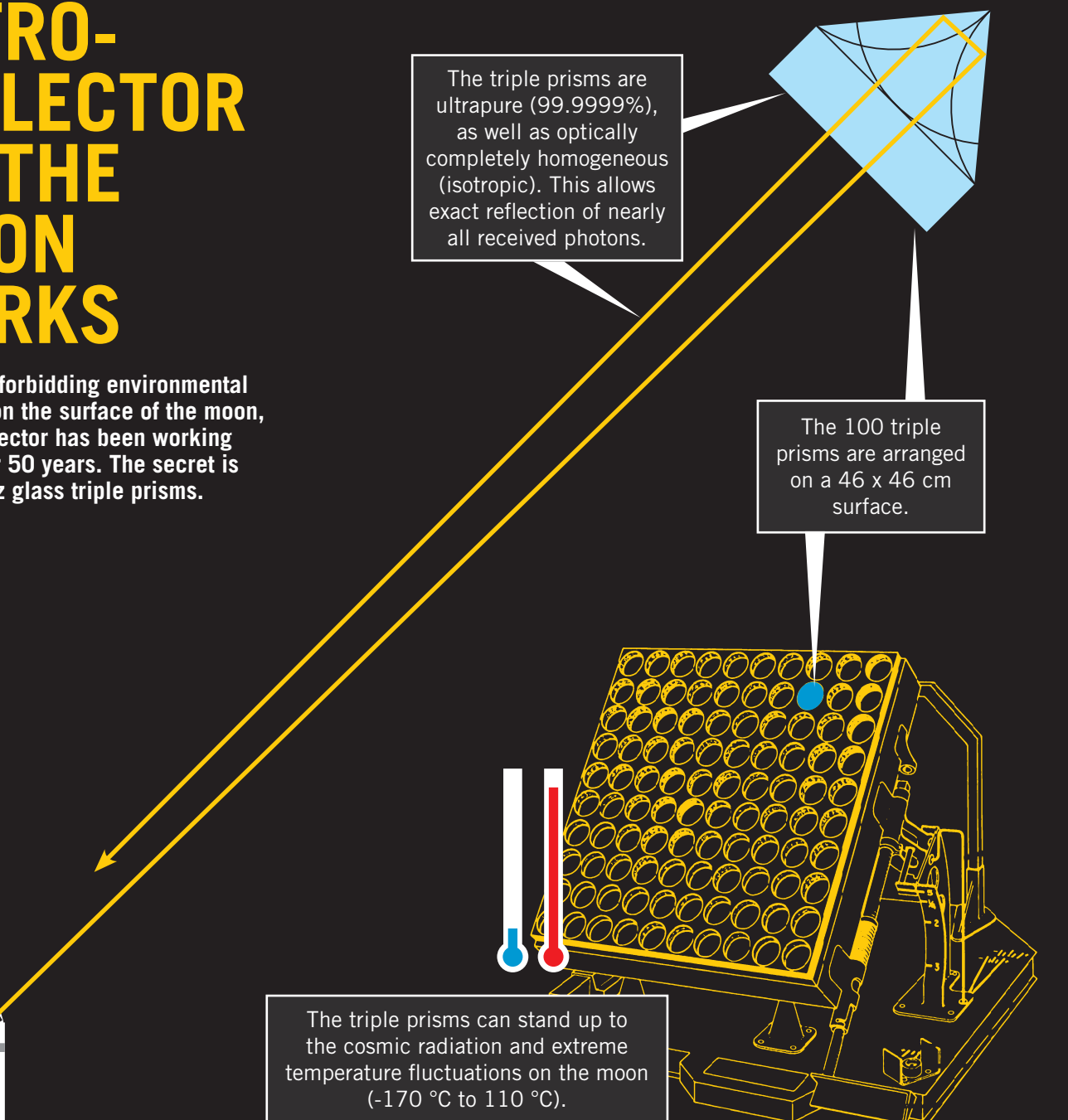

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The triple prisms are ultrapure (99.9999%), as well as optically completely homogeneous (isotropic). This allows exact reflection of nearly all received photons.



The 100 triple prisms are arranged on a 46 x 46 cm surface.



The triple prisms can stand up to the cosmic radiation and extreme temperature fluctuations on the moon (-170 °C to 110 °C).