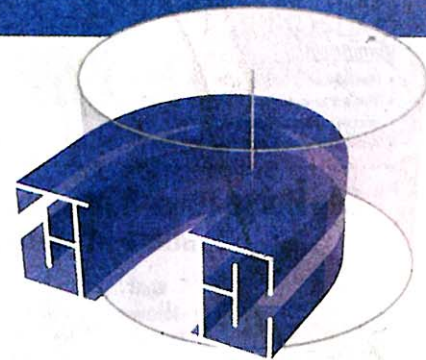
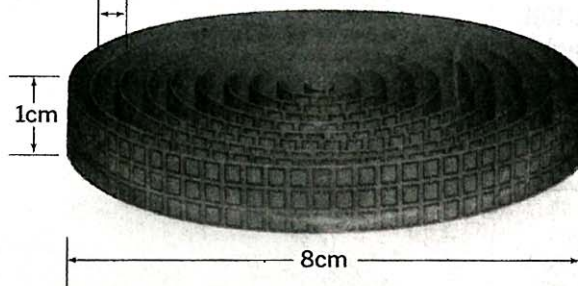


■ A PERFECT REFLECTOR

**Device that reflects microwaves perfectly back to their source, regardless of angle**

**Dimensions:** 10 concentric rings

0.4cm apart from each other



Microwaves beamed at the retroreflector are bounced back parallel to but in the opposite direction from their source, regardless of where they come from.

Source: NUS  
ST GRAPHICS

# Bright idea for bend theory

■ BY GRACE CHUA

CYCLISTS and runners may one day have perfect reflecting devices to keep them safe in night-time traffic.

Scientists here, working with theoretical physicists from Scotland and the Czech Republic, have married a theory of bending light with practical engineering.

They have built a device, known as a retroreflector, that perfectly reflects microwaves, parallel to their source, from all angles.

The same principle could also be used to reflect visible light.

Professor Ong Chong Kim of the National University of Singapore and Dr Ma Yun-Gui of Temasek Laboratories worked with theoreticians Ulf Leonhardt of the University of St Andrews in Scotland and Tomas Tyc of Masaryk University in the Czech Republic.

In a paper published last November, Drs Leonhardt and Tyc came up with a theoretical way to bend a broad spectrum of light around an object, rendering it invisible.

When Dr Leonhardt spent a semester at NUS as a visiting don last year, the collaborators realised that the principle could be used to make ultra-reflective materials that bend light and other waves to aim back at their source.

Their retroreflector – a cylinder about the diameter of an apple – is made of concentric rings of copper-printed circuit-board etched in a special pattern.

The pattern makes the circuit-board act as a metamaterial – a type of man-made material that can bend waves in unnatural ways.

Professor Ong said: “Hundreds of theory papers have appeared in this field in the last three years since it began, but only a handful of new experiments. Ours is definitely something not tried before.”

Their paper was published online this week in materials-science journal *Nature Materials*.

A microwave retroreflector could be used in radar-tracking systems, while light retroreflectors could be used for traffic safety, for instance.