# Cutting the costs of communication and astronomy

*When a major astronomy project was cancelled, few expected that out of its ashes would appear a technology set to drastically cut the price of cosmology and communication.*

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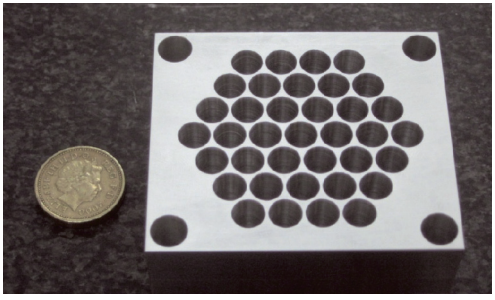
The UK-led Clover project, was an astronomy experiment designed to measure the polarisation of the Cosmic Microwave Background. Sadly, the project was cancelled due to a lack of funding - but it has left behind commercial spin-outs that will massively reduce the cost of telescopes and communications infrastructure of the future.

The Clover telescope required an array of hundreds of ultra-sensitive cryogenic detectors: superconducting devices cooled below 100mK that measure the electromagnetic signals from the sky. The signal to these devices was fed by high-performance horn arrays sat in the focal plane of the telescope. These horns had to be carefully designed in order to avoid loss or distortion of the signal - and they had to exactly preserve polarisation, since that measurement was crucial to the project's success.

To achieve that accuracy, grooves called corrugations are usually machined in the interior wall of horns. A typical horn might have more than 50 grooves that are just microns wide, each of which has to be individually machined into a cylinder of a few millimetres' diameter. That is both expensive and time consuming: each horn costs £2,000, or a total of over £500,000 for the project.





However, physicists at Oxford working on Clover developed a new type of horn that preserves the high performance of the originals, but has a radically different design, making it much easier to fabricate. The corrugations were replaced by three or four flare steps that, by carefully choosing their angle and location, could recreate the pattern of the conventional horn.

The team modelled the new horns using a genetic algorithm optimization, rather like biological evolution. A series of prototypes produced and tested, and the design was refined to perform just as well as the conventional corrugated horns.

Because the new design requires just a series of differently sloped flares, a single machine tool is needed to cut each aperture and can be used to create each horn in a matter of days, rather than months. The result is a method that, even including R&D costs, is capable of producing horn arrays at less then a tenth of the cost of the traditional technique.

The technology is now being spun-out as a commercial venture with the help of Isis Innovation. Wherever high-sensitivity, minimal-interference detectors are required - particularly in defence and communications - these horns will be of huge industrial interest.

http://www.physics.ox.ac.uk/research/experimental-radio-cosmology/

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