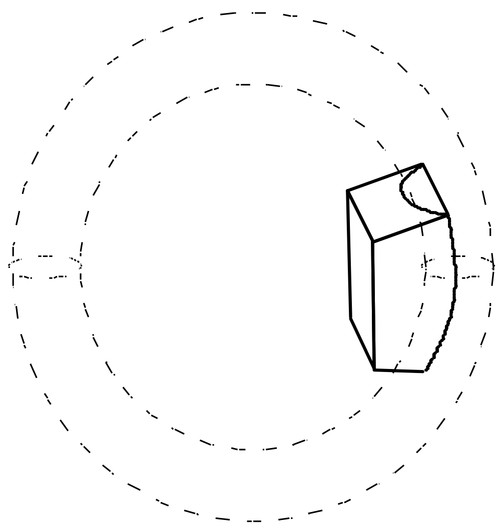
Title: The Band-Arc Telescope: design for an ultra-high-resolution, low-cost astronomical telescope.

Description: Current large astronomical telescopes depend on very-accurately polished mirrors as their primary light collector. Construction of such mirrors is expensive and demanding of technical skill, and the bigger the mirror, the more expensive and demanding it becomes. Larger mirrors provide greater resolution, but because they are heavier, maintaining their required shape under gravity poses engineering problems.

The design of the band-arc telescope sidesteps many of the problems of conventional telescope mirrors. Instead of a circular mirror, a flat band of material bent into an arc is used. Use of this construction means that the primary light collector of a band-arc telescope can be much cheaper to make and control, and can also be very much larger than conventional glass mirrors.

The key to success in constructing such a telescope is in the design of the secondary mirror. Because the band-arc does not bring light to a point focus, the secondary mirror must 'correct' the optics of the light rays to achieve an equivalent result. In a conventional refractor telescope, the secondary mirror is a flat one, reflecting the image into an eyepiece for viewing.



The saddle-shaped secondary mirror of a band-arc telescope

Before the current work was undertaken, it was not known whether the band-arc conformation was theoretically possible. The attached study by Brian Dodson shows that it is possible, with the normal flat secondary mirror replaced by a saddle-shaped mirror.

In principle, a band-arc telescope could be designed with a large arc length, more than 20 metres, and possibly as much as 50 metres. This compares with the biggest current single-mirror telescopes, at around 10 metres across. With increasing size comes increasing resolution -- the ability to distinguish between very close viewed objects -- so that the band-arc telescope brings within the range of possibility the ability to directly image the planets of stars outside our solar system.

Although the potential resolution is very high, this resolution is in a single plane. To resolve objects such as extra-solar planets, the band-arc would need to be turned so that its length was in the same orientation as the orbit of these planets around their star. A conventional square image could be achieved by combining the data from rotating the band-arc 90 degrees about the viewing axis.

The band-arc concept appears very suitable for a telescope in space, in view of its light weight and ease of construction. Moreover, rotating the telescope about the viewing axis should be relatively simple as a weightless body in orbit.

Further possible improvements to the basic concept are listed in Brian Dodson's report. In addition, since the secondary mirror in modern light-sensitive telescopes is often replaced by CCDs (charge-coupled devices) for direct computer processing, it should be possible to built the CCD unit to have its receptors in the saddle shape needed to achieve optical 'correction'.

The present study exemplifies how an initial idea can be progressed to a working concept with possibly outstanding potential for science at tiny cost, using the Zombal paradigm. The research in question was done for just $180.

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