

Re: Resolution of synthetic aperture telescope?

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- *From:* Jim Klein <jameseklein@xxxxxxxxxxxxxx>
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Phil Hobbs <pcdh@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx> wrote:

Brian Huether wrote:

Let's say money wasn't an object and that you could build a huge number of large telescopes and deploy them in space to create a stable array. Would it be possible to create such a high resolution telescope that you could actually see the surface of distance planets? I am not necessarily talking about optical. I am just wondering if it is theoretically possible to 'see' a planet with enough detail to make out features (like plantlife, etc). And I am talking about very distant planets.

A useful rule for resolution is that to see an object of size S at a distance R ,

$$S/R \gg 10 \cdot D / \lambda$$

where D is the diameter of the telescope and λ is the wavelength of the radiation.

Thus to see an object the size of a dog (1 m) on a nonexistent planet of Alpha Centauri (~40 trillion metres away), using light of 1 micron wavelength, you'd need a diffraction limited system of aperture ~ 10,000 km.

As you scale an optical design up in size, the diffraction blur for a point source (PSF) becomes smaller, in object space, but since no optical design has zero residual geometrical aberrations over a non-zero field of view, these residual aberrations scale up and so given zero mfg errors and zero alignment errors, the design, as it scales up, becomes less diffraction limited.

Add that to the reality that there will always be mfg errors and alignment errors and that they become more difficult to handle as the design gets bigger, there will be a point when no \$ budget large

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enough will exist to pay for a large design which can keep giving you higher resolution.

As time passes and technology improves, we get the same built design for a smaller fraction of the GNP but there will be a limit when even that stops yielding resolution.

James Webb is IR and not visible and that helps some as the wavelength gets longer.

At some point in time, it will be cheaper to build a warp drive and just go there. My guess is that this will be some time between 2100 to 2400 AD :-)

The fact that our lives are not long enough to see some of this really cool future stuff really sucks.

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