

First high dynamic range and high resolution images of the sky obtained with a diffractive Fresnel array telescope

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Received: 8 September 2011 / Accepted: 23 November 2011 / Published online: 13 December 2011
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Abstract This paper presents high contrast images of sky sources, obtained from the ground with a novel optical concept: Fresnel arrays. We demonstrate the efficiency of a small 20 cm prototype Fresnel array for making images with high brightness ratios, achieving contrasts up to 4×10^5 on sky sources such as Mars and its satellites, and the Sirius A–B couple. These validation results are promising for future applications in space, for example the 4 m array we have proposed to ESA in the frame of the “Call for a Medium-size mission opportunity for a launch in 2022”. Fresnel imagers are the subject of a topical issue of *Experimental Astronomy* published in 2011, but only preliminary results were presented at the time. Making images of astronomical bodies requires an optical component to focus light. This component is usually a mirror or a lens, the quality of which is critical for sharp and high contrast images. However, reflection on a mirror and refraction through a lens are not the only ways to focus light: an alternative is provided by diffraction through binary masks (opaque foils with multiple precisely etched sub-apertures). Our Fresnel arrays are such diffractive focusers, they offer weight, price and size advantages over traditional optics in space-based astronomical instruments. This novel approach requires only void apertures of special shapes in an

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