# Polarization Interferometric nulling coronagraph for high-contrast imaging

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We propose a novel nulling interferometer based on polarization interferometry, which we call a polarization interferometric nulling coronagraph (PINC), for direct detection of extrasolar planets[1]. The PINC is a fully-symmetric modified Michelson interferometer using polarizing beam splitters (PBS), in which achromatic half-wave plates (HWP) such as Fresnel rhombs are installed. Two crossed polarizers (±45°) are also installed in front of and behind the interferometer. The HWPs provide an achromatic $\pi$-phase difference between two light beams from subapertures ($SA_1$, $SA_2$) extracted from a telescope pupil, and eliminate an on-axis star light (Fig. 1, *top*).

From Jones calculus, the achievable contrast of the PINC has been estimated to be about $10^{-10}$ at 5 $\lambda/D$ over a wavelength range from 1.6 to 2.2 $\mu$m. We also carried out laboratory experiments on the PINC using two laser light sources (wavelengths of $\lambda$ = 532 and 671 nm). Figure 1(*bottom*) shows a picture of the laboratory simulator of the PINC. As the HWPs, we used commercially-available Fresnel rhombs made of BK7. Figure 2*a*,*b* shows results of the laboratory experiments. As a result, we obtained a halo suppression level of about $10^{-6}$ at 5 $\lambda/D$ for both wavelengths.

The experimentally acquired contrast curves (Fig. 2*a*,*b*) were well fitted to those of the computer simulations assuming a phase aberration of 3 nm rms and an optical-path difference (OPD) error of 3.7 nm (Fig. 2*a*',*b*'). Thus it is expected that higher contrasts will be realized by introducing a high-performance OPD control and an extreme adaptive optics system.

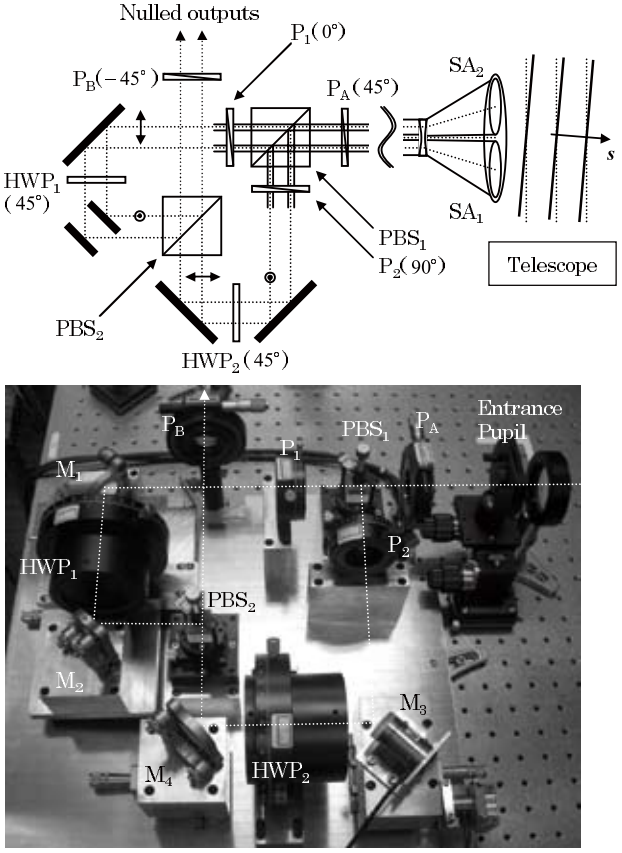


**Figure 1**: (*Top*) A principle and (*bottom*) a laboratory simulator of the PINC.

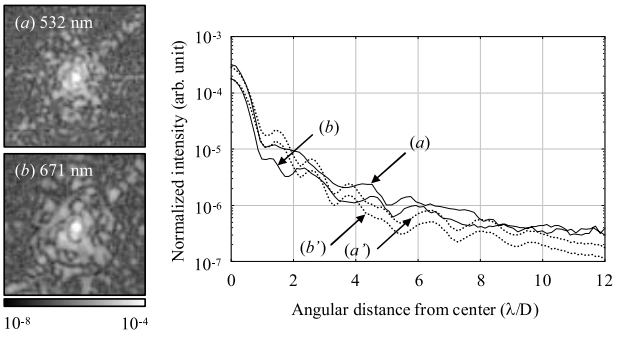


**Figure 2**: Experimental results of laboratory demonstrations: (*left*) acquired coronagraphic images and (*right*) radial profiles of coronagraphic images obtained by (*a*,*b*) experiments and (*a*',*b*') numerical simulations.

## Reference

[1] Murakami, N., et al.: 2010, *Appl. Opt.*, **49**, D106.