LETTERS TO THE EDITOR

Some critical remarks about the article "A simple air wedge shearing interferometer for studying exploding wires"

G. S. Sarkisov[a)]
Ktech Corporation, Albuquerque, New Mexico 87106

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I read with interest the article by Pikuz *et al.* about the "new type of shearing air wedge interferometer".[1] The first publication about the shearing air wedge interferometer was done in 1996[2] and it was applied successfully to investigating the Coulomb explosion phenomena[3–5] due to interaction of a 400 fs 10 TW laser with a gaseous target, and to other laser plasma and Z-pinch investigations as well. Because the authors of Ref. 1 are describing their interferometer as the improved version of device,[2] I would like to point out a few important features of the interferometer[1] that were not mentioned in their article.

The first look at the shearing interferometer presented in Ref. 1 suggests that the proposed device cannot work adequately as an interferometer with field visualization. This is due to the fact that the image in Ref. 1 is produced by Fresnel reflection from the internal face of a 90° prism at large angle ~30°–40°. It is well known[6] that at large angles of incidence onto the glass–air interface the reflection coefficient becomes strongly dependent on polarization and incidence angle. In Ref. 2 we used the reflection from the internal face of a 3°–5° wedge positioned at a small angle of 5°–10° to the incoming beam. In this case the beam is reflected from the internal face of a wedge at a small angle of incidence and the reflection coefficient then depends weakly on the polarization and angle of incidence.

Figure 1 shows the dependency on the angle of incidence of the relative intensity of the reflected light and the relationship between the intensities of the interfering beam for *S* and *P* polarizations for the shearing interferometer with an air wedge described in Ref. 1 (a) and Ref. 2 (b), for the $n = 1.5$. Let us examine how both schemes will work for a beam with conicity of 10°. Initial tilt for the scheme[1] is assumed to be 20° (as mentioned in Ref. 1), and for scheme[2] tilt is assumed to be 5°, and the wedge angle is 3° (which was used in the experiments[2]).

It can be seen from Fig. 1(a) that the scheme[1] exhibits a large sensitivity of the reflection coefficient to the light polarization. For example, for an incidence angle of 20° (used in Ref. 1) the ratio of reflection coefficients for *S* and *P* polarized light is ~84. Spatial distribution of the relative intensity (in the horizontal plane) for the reflected light is presented in Fig. 2. If one assumes that the beam intensity distribution in the plane of the object is uniform, then the reflected beam for a 10° cone intensity is diminished 45% for *S* polarization and 99.97% for *P* polarization. If the scheme works badly for *S* polarization, then it does not work at all for *P* polarization. Moreover, in Ref. 1 the depth of interfer-

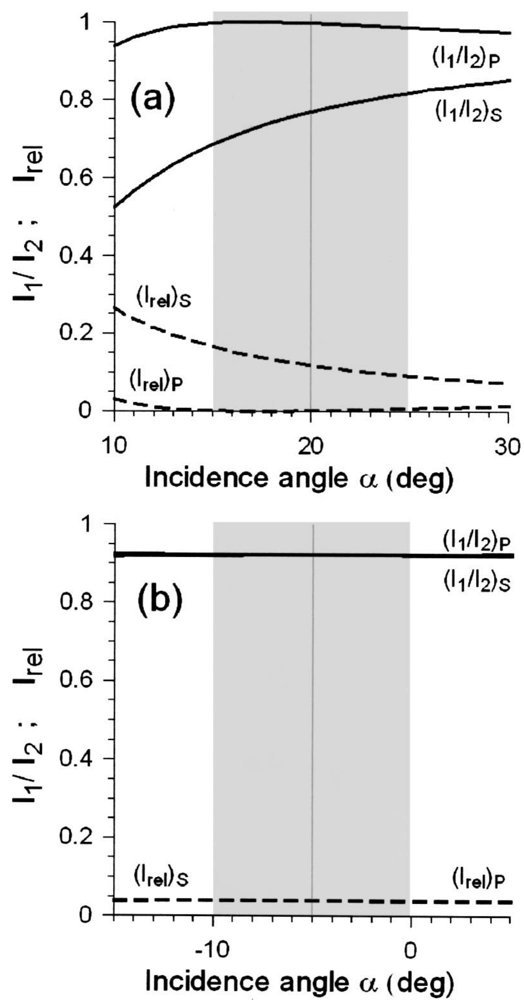

FIG. 1. Intensity ratio of interfering beams and relative intensity of the reflected beam for *S* and *P* polarized radiation vs incidence angle: (a) corresponding to a 90° prism-based shearing interferometer (Ref. 1) and (b) corresponding to a 3° wedge-based shearing interferometer (Ref. 2).

[a)]Author to whom correspondence should be addressed; electronic mail: gssarki@sandia.gov

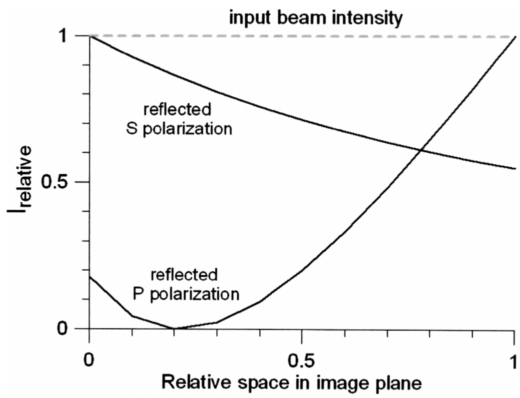

FIG. 2. Relative intensity in image plane for *S*- and *P*-polarized reflections for double-prism interferometer (Ref. 1).

ence modulation depends on the magnitude of the beam separation. The depth of modulation decreases with increasing beam separation and is changed along the image, once again. For a collimator-imaging scheme, where the cone angle equals zero, the aforementioned intensity effects are absent (except for polarization). But in any case all refracted beams will have intensity modulation that has nothing to do with light absorption, occurring simply as an artifact of the equipment. In my opinion, this effect gives the strongest influence on complimentary shadowgram in Ref. 1.

The interferometer scheme[2] based on 3° glass wedges in Fig. 1(b) is practically free from polarization sensitivity and has very weak dependency of the reflection coefficient on incidence angle. Thus for a 10° conical angle and a 5° reflection angle the change of intensity in the reflected beam is no greater than 1%. The balance of interfering beams is ~92%, does not depend on the beam separation, and is uniform along the image.

The claimed advantage of fewer aberrations of Ref. 1 than with an interferometer[2] makes no sense without examining the specific optical imaging scheme. Unfortunately the authors[1] do not give an analysis of this aberration for interferometers[1] and[2] for different imaging schemes and just claim higher aberration for Ref. 2 as a general, well-known fact.

In conclusion, optical imaging schemes using Fresnel reflection from the dielectric interface can work properly only at small incidence angles. The scheme for the ''simple air-wedge interferometer'' proposed by Pikuz *et al.* in Ref. 1 operates with large incidence angles and cannot produce the correct image free from intensity modulation due to the strong dependence of the instrument's reflection coefficient on angle of incidence and polarization.

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