ON THE ORIGIN HIGH LEVEL PULSATIONS IN VICINITY OF LATERAL EDGE OF BLUNTED TRIANGULAR PLATE IN SUPERSONIC FLOW

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The paper is devoted to an experimental studies on the nature of the origin of high amplitude fluctuations near the lateral edge of a flat blunted delta wing at M = 4, that was detected in [1]. Region of high level pulsations have been localized to the transverse coordinate and spread at a considerable distance downstream [1]. Similar phenomena were previously observed only at hypersonic speeds [2, 3]. Results of detailed study of the structure of disturbances, the characteristics of the mean flow and laminar-turbulent transition are presented in the paper.

The experiments were made in a supersonic wind tunnel T-325 of the ITAM with the test section dimension 200×200×600 mm at Mach numbers M=4.0. Measurements were performed on the model of a flat delta wing with a sweep angle of 55 º and blunted leading edge (the bluntness radius is 2 mm). The model was placed in the test section at zero angle of attack. The disturbances were measured by constant temperature hot-wire anemometer, including automatically scanning CTA bridge for the overheating sensor. The frequency spectra of disturbances were determined by the discrete Fourier transform.

The investigation of the high amplitude disturbance profiles in the no uniformity the flow near the lateral edge of the delta wing was made. It was shown that the intense pulsations (up to 20%) observed in a narrow region with width of about the radius of bluntness of the leading edge of the model and with the center around $|z| \approx 45 \pm 0.5$ mm. Downstream pulsation evolution closed to the model surface are presented in Fig.1. The high amplitude pulsation region extends from the leading edge of the delta wing. The location of the laminar-turbulent transition in this region is possible to estimate.

The structure of intense disturbances in the region of no uniformity of the flow near the leading edge of the delta wing was studied using a scanning hot-wire anemometer. A modified Kovasznay's method was applied to the interpretation of the hot-wire measurements in the supersonic flows. The technique of experiment and procedure of data processing and determination of an absolute level of controlled disturbances was described in [4] in details. It is shown that the main energy of these fluctuations is provided by low frequencies, which is typical for the transitional regime in the boundary layer on an attachment line of the swept cylinder. A detailed analysis of these data was made.

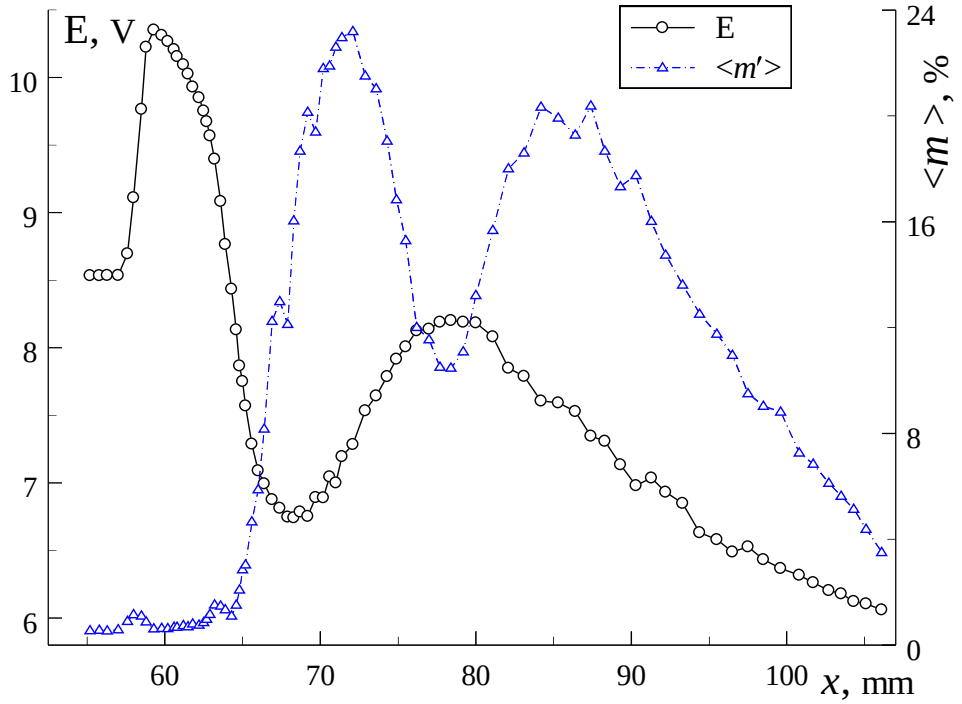

Figure 1. Examples of downstream pulsation evolution, M=4.0, z≈45 mm, α=0, y≈0.5 mm.

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