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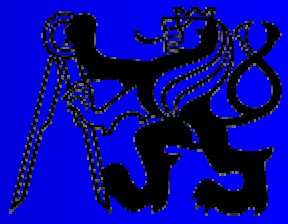

RECORDS OF UNSTEADY TRANSONIC FLOW PAST BLADE CASCADES BY MEANS OF OPTICAL METHODS

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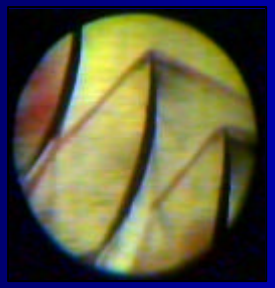
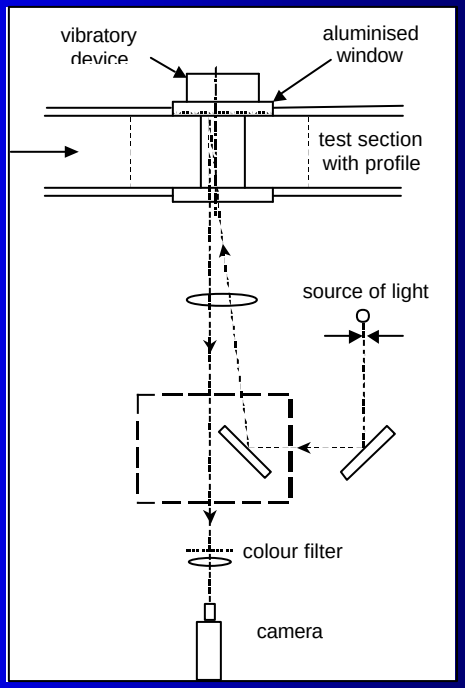
INTRODUCTION

RESEARCH OF THE UNSTEADY TRANSONIC FLOW

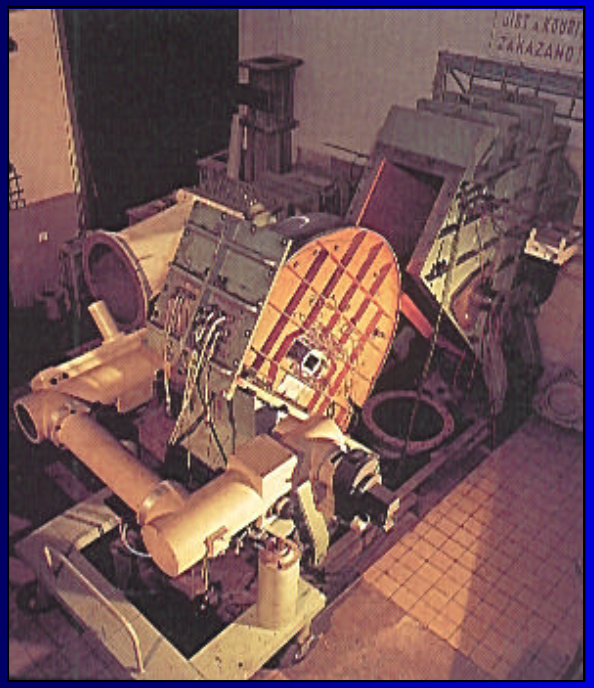
- Increasing Mach number (NACA 0012)
- Increasing frequency of oscillation (NACA 0012)
- Shock wave oscillations (NACA 0012)
- Transonic instability (DCA-S compressor blade cascade)
- Continuous change of the incidence angle (DCA-S compressor blade cascade)
- Oscillating turbine blade in the cascade



THE OPTICAL MEASUREMENT SYSTEM

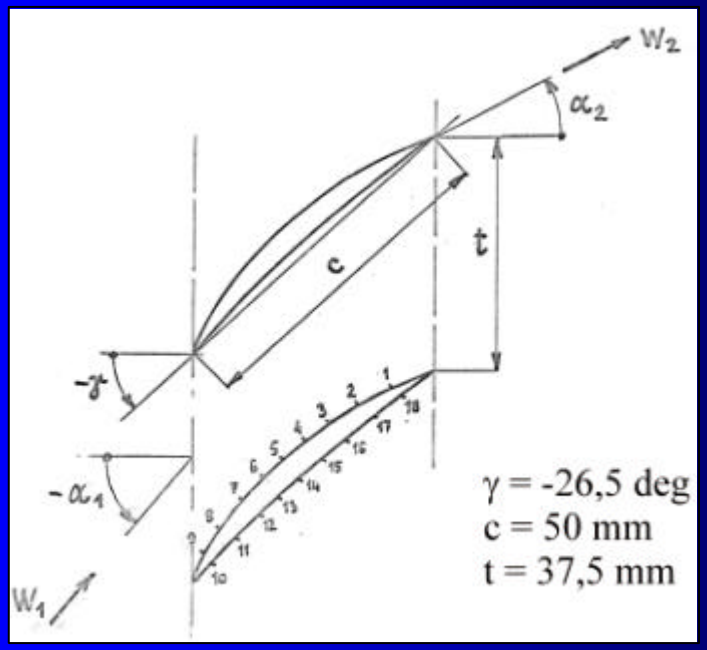


Optical arrangement for schlieren method – oscillating profile configuration.



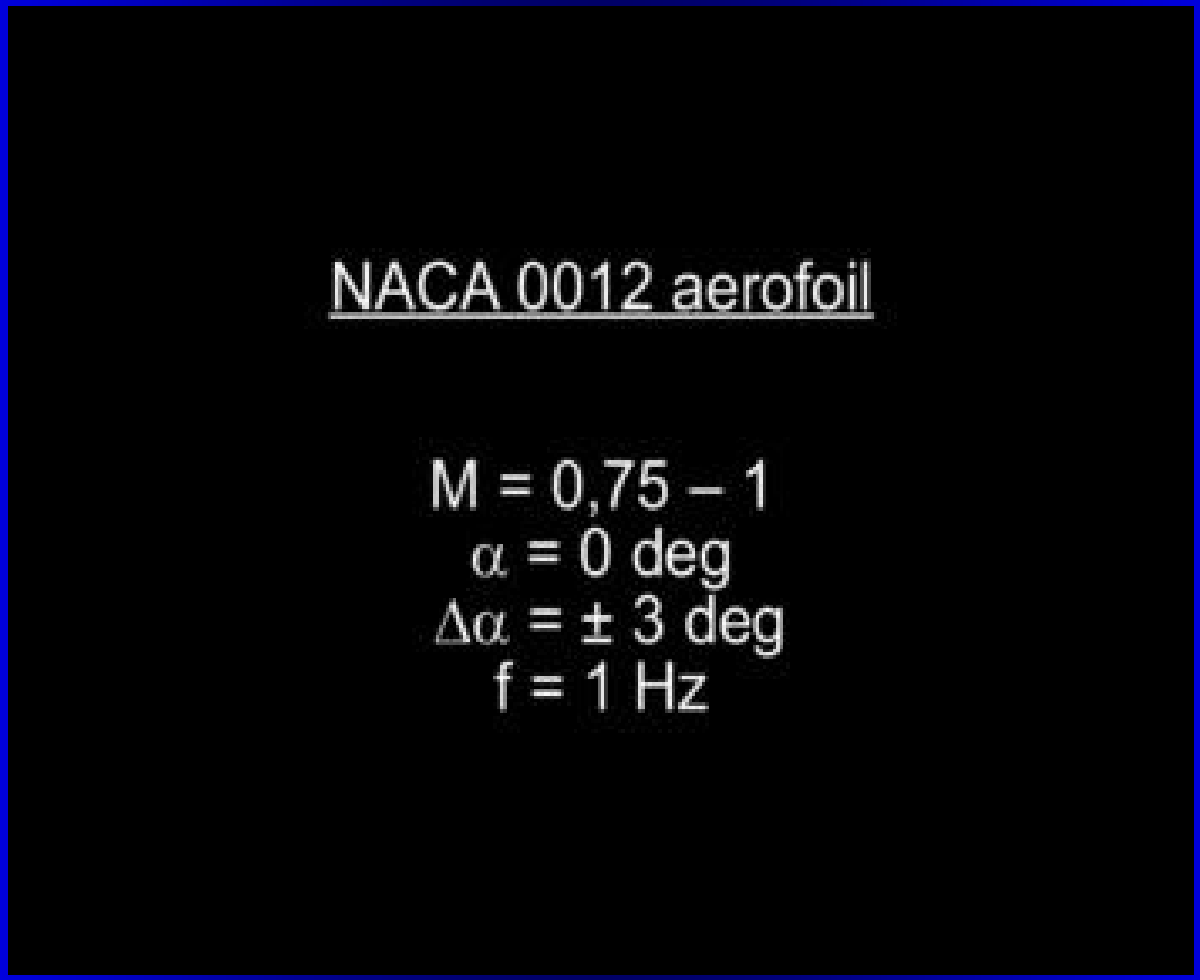
Continuous wind tunnel with the ZEISS 80 schlieren device.

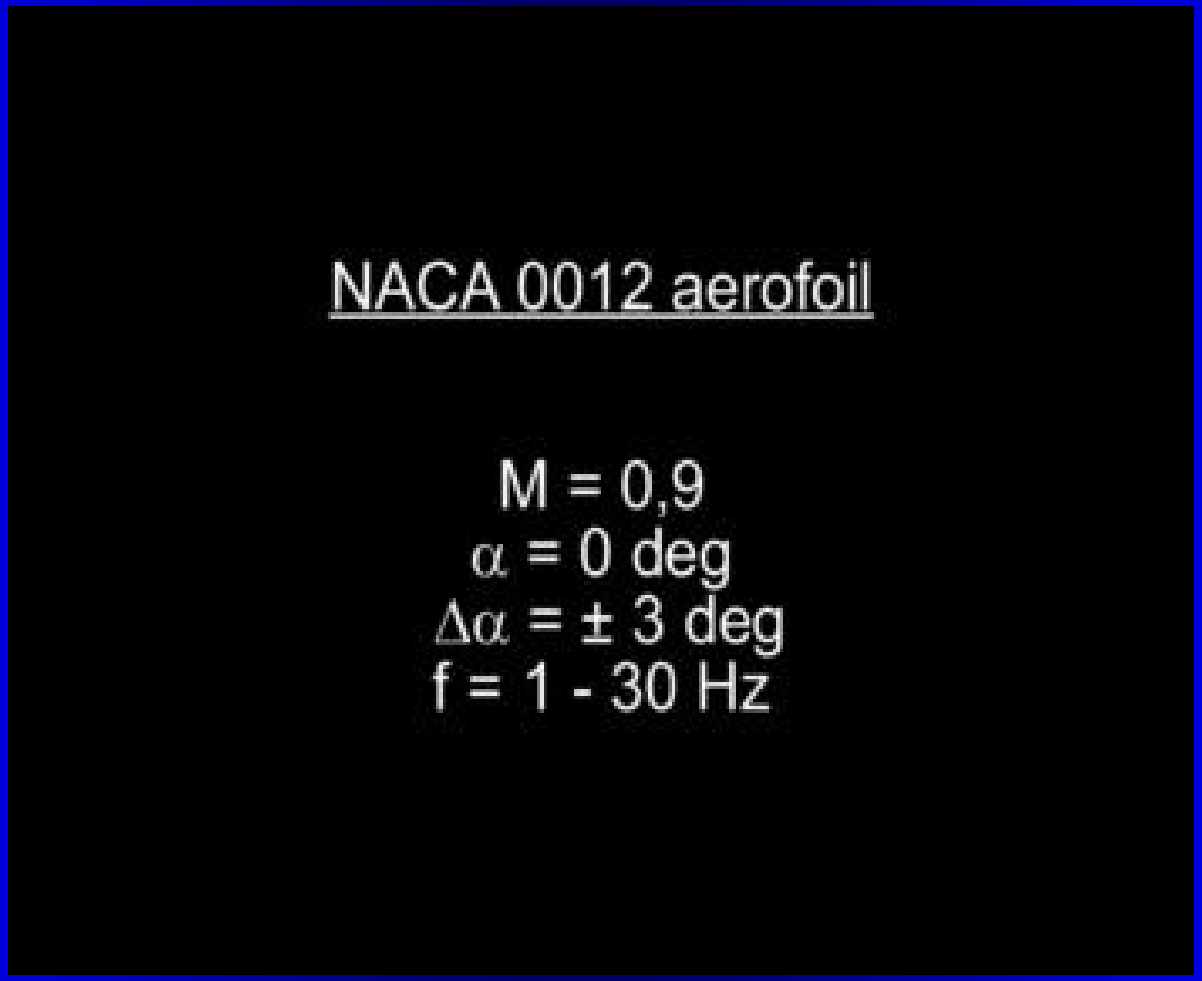
THE MODELS



The scheme of the DCA-S compressor blade cascade.

- **NACA 0012**
- **DCA-S compressor blade cascade**
- **Experimental turbine blade cascade**


NACA 0012 aerofoil
M = 0,75 – 1
α = 0 deg
Δα = ± 3 deg
f = 1 Hz


NACA 0012 aerofoil
M = 0,9
α = 0 deg
Δα = ± 3 deg
f = 1 - 30 Hz

DCA-S compressor blade cascade

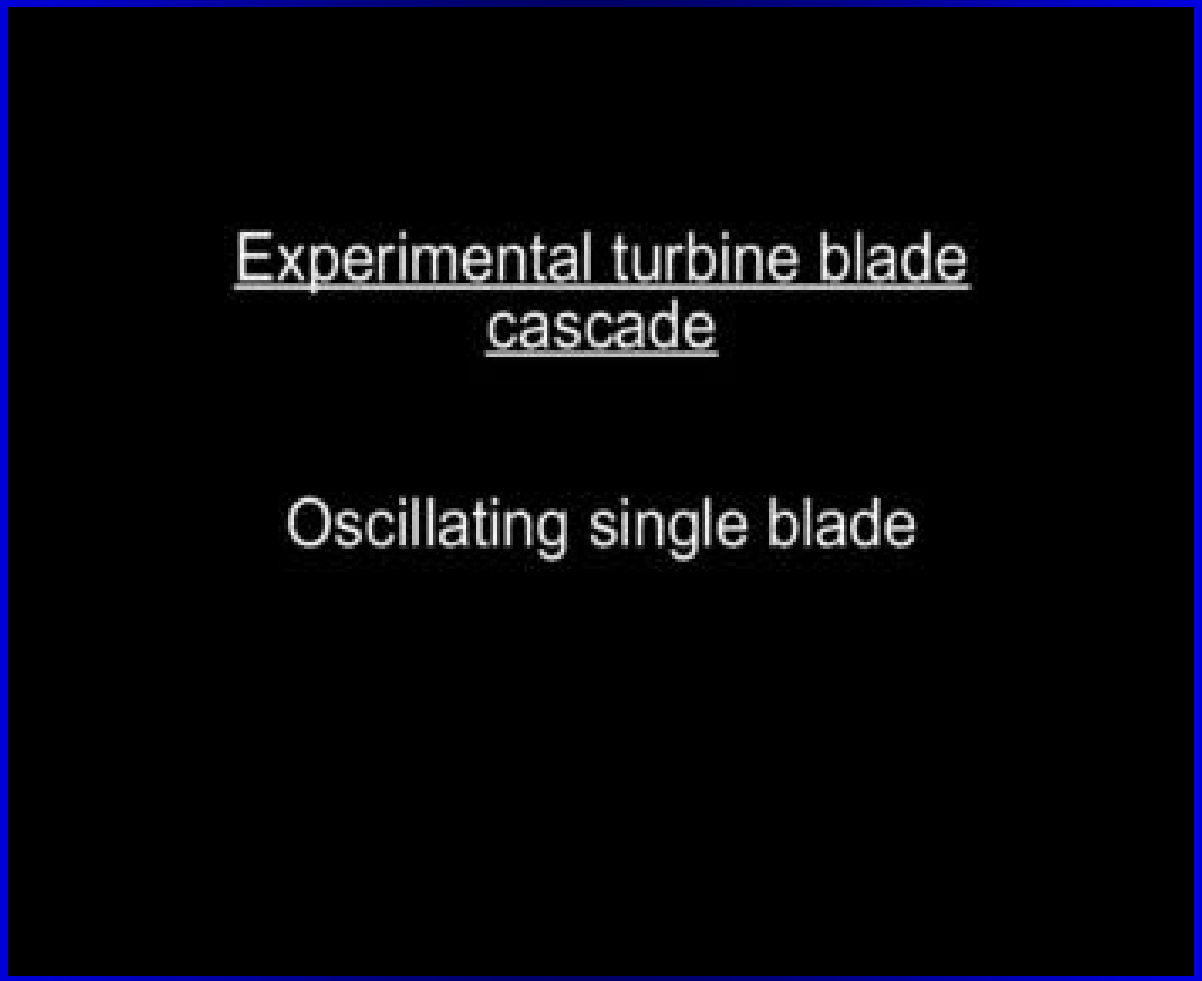
Increasing inlet Mach number
M_1 = 0,6 - 1,15
α_1 = - 60 deg

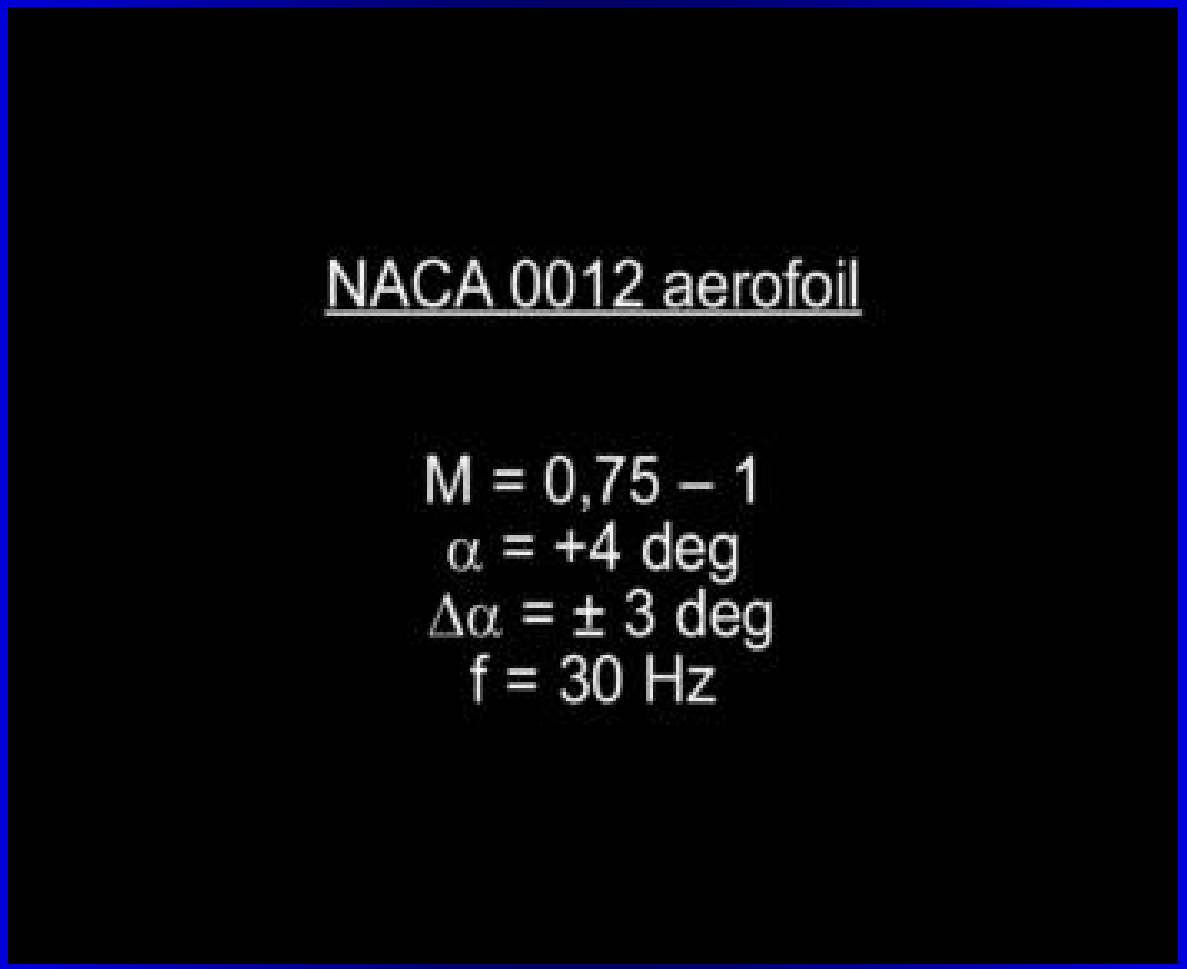
Transonic instability

DCA-S compressor blade cascade

Increasing inlet Mach number
$M_{1max} = 1,1$

Continuous change of the incidence angle
$\alpha_1 = -60 - -40$ deg

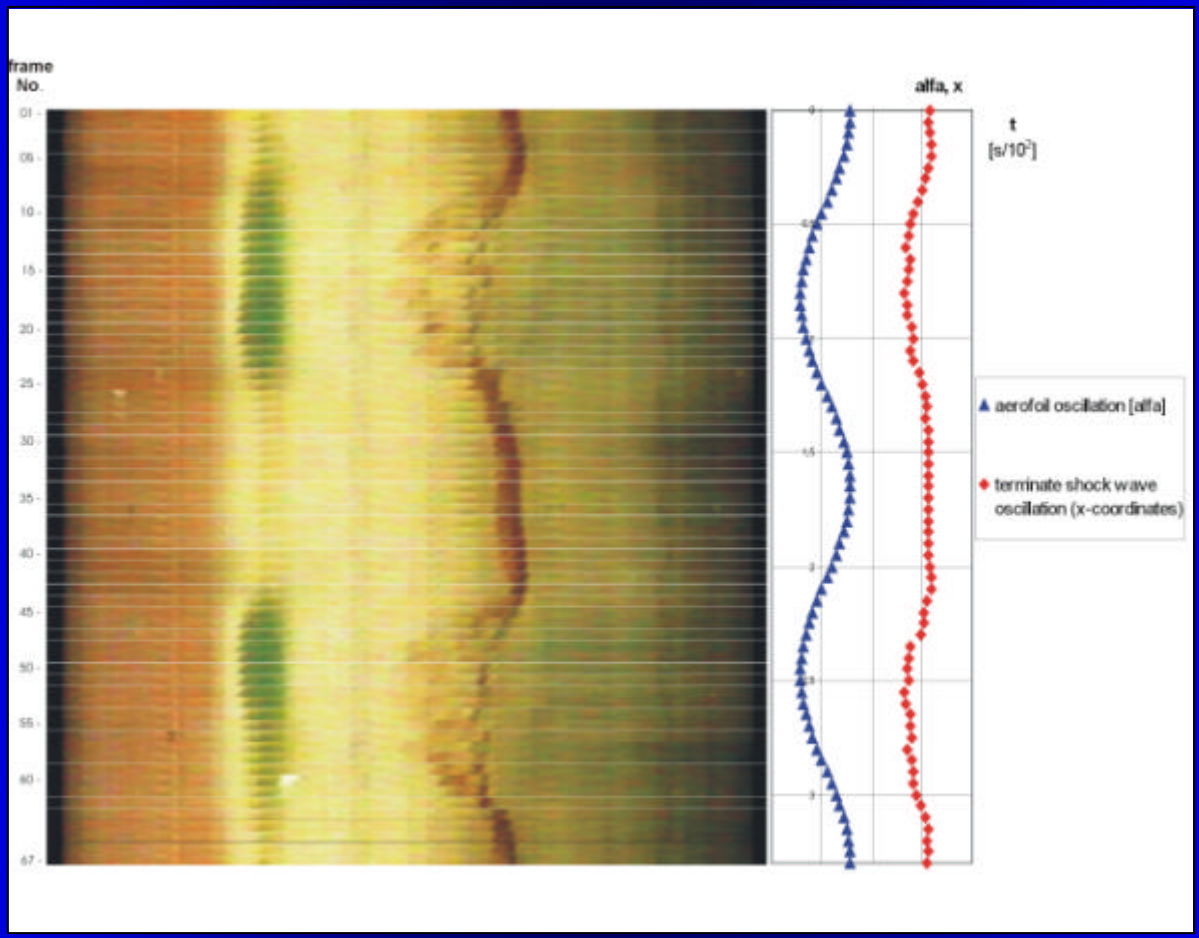

Experimental turbine blade cascade
Oscillating single blade


NACA 0012 aerofoil
M = 0,75 – 1
α = +4 deg
Δα = ± 3 deg
f = 30 Hz

COLOUR STREAK SCHLIEREN METHOD

The principle of the colour streak schlieren method.

- **time oscillation of the terminate shock wave as the response on the profile oscillation**
- **the periodic changes of the supersonic region development**
- **assessment of the shock wave oscillation with considerably higher frequency after the flow separation**
- **the phase shift between the aerofoil and the terminate shock wave oscillations**



The colour streak schlieren method - NACA 0012 aerofoil, M_{∞} = 0,9, a = +4 deg, Da = ± 3 deg, f = 30 Hz.

CONCLUSION

- **schlieren video images provide an insight into the real transonic flow fields under the unsteady conditions**
- **electronic data processing makes possible to refine the records and to reveal hardly observable phenomena**
- **new approach to the flow field analysis (CSSM) allows us to acquire more information from schlieren pictures**

ACKNOWLEDGMENTS

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