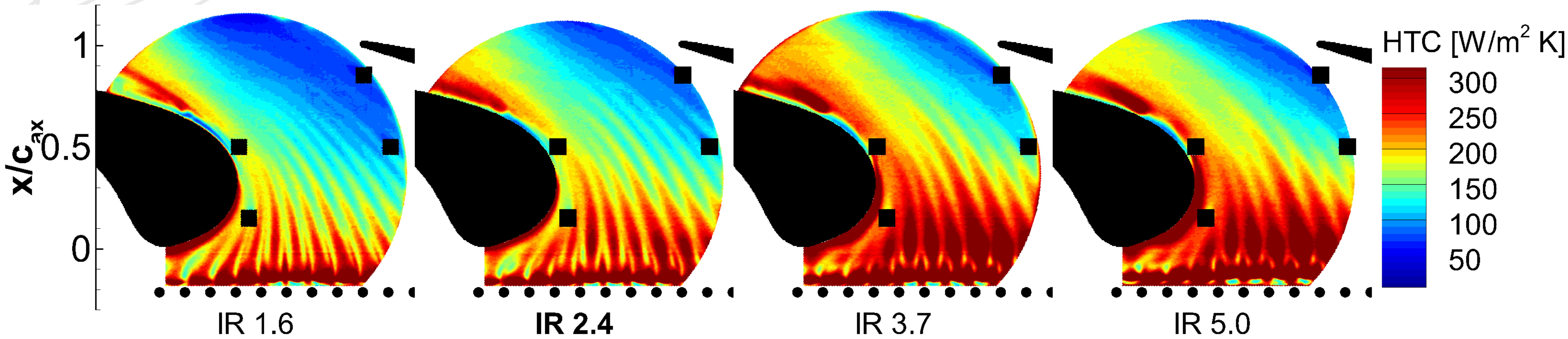
AG Turbo 2020 3.2.5

Combustor Turbine Aerothermal Interaction

TECHNISCHE UNIVERSITÄT DARMSTADT

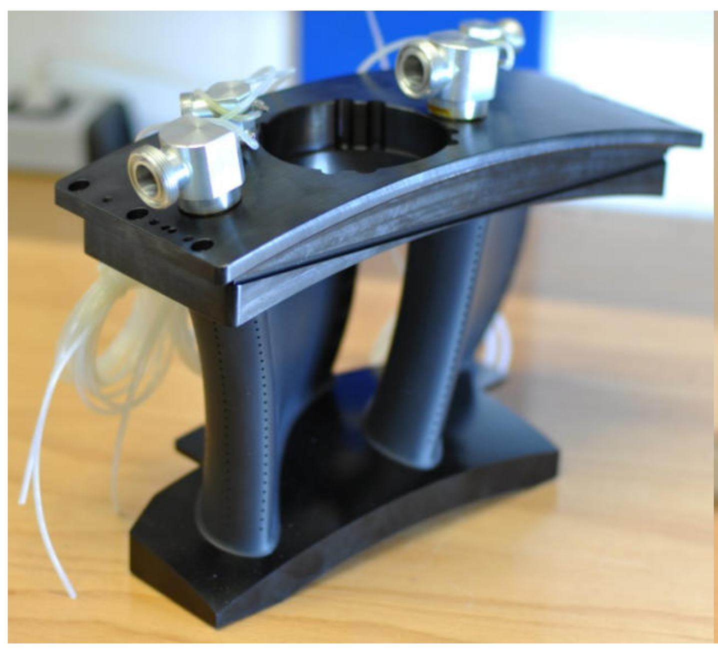
Research Objective

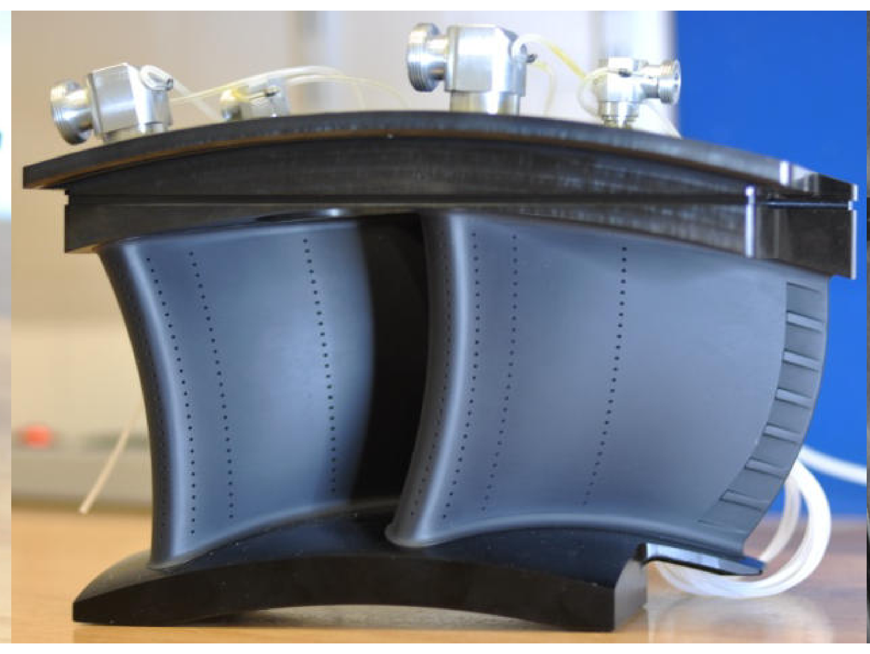
The lean combustion concept offers a way to further reduce emissions of especially NOx. Increased residual swirl and increased thermal loading on the endwalls compared to conventional RQL-combustors poses challenges for turbine designers. The research project AG Turbo 2020 3.2.5 focuses to acquire experimental data of NGV hub heat transfer and film cooling effectiveness for varied coolant injection rates (IR) and operating points, including different inflow conditions. Since also effects to coolant injection can be expected, film cooling effectiveness is studied on the NGV airfoil.

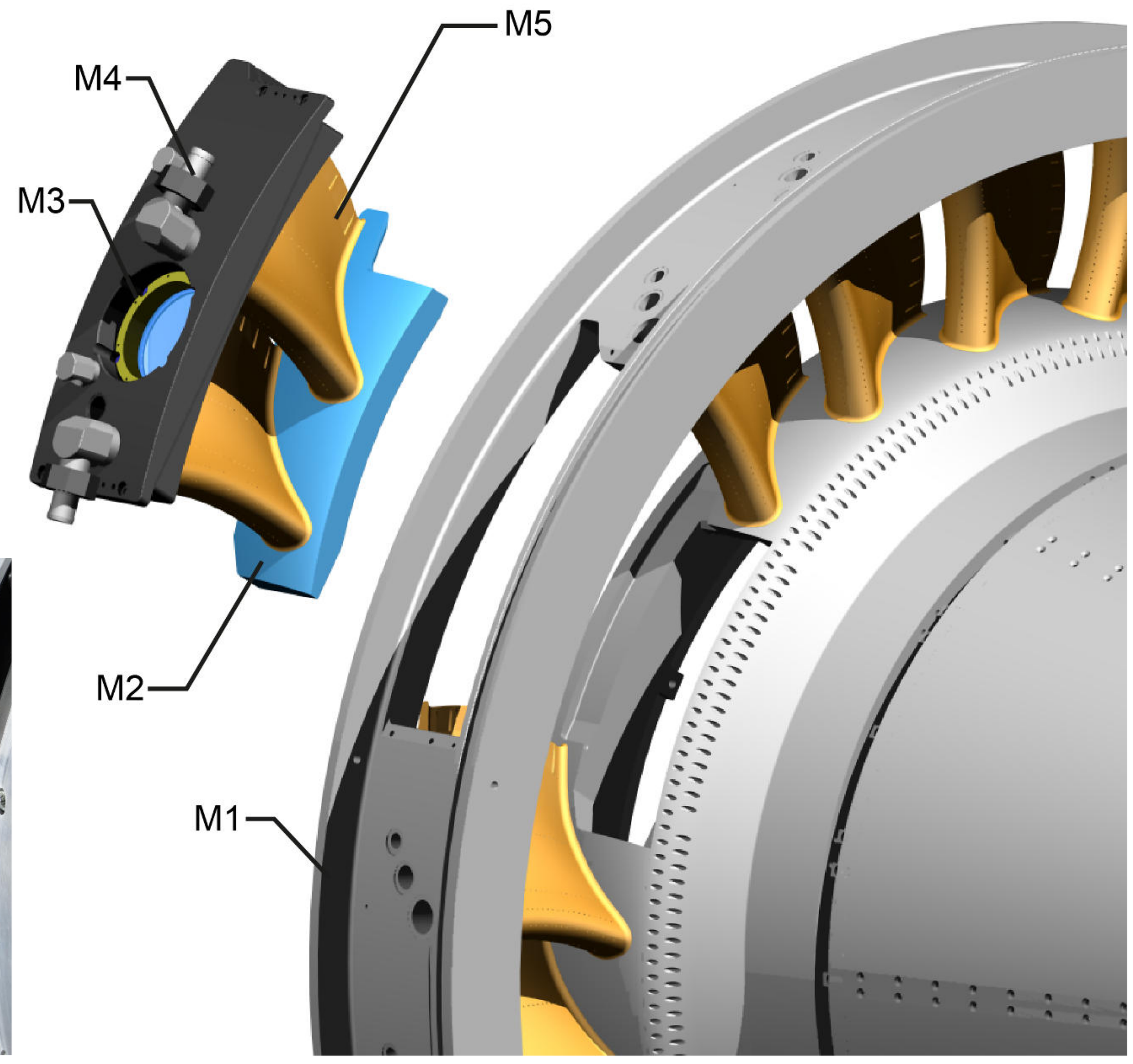


Measurement Vane Module

Two sets of measurement vane modules consisting of two adjacent nozzle guide vanes (NGV, M5) each are used to implement measurement techniques to the hub side endwall on an instrumented baseplate (M2). Optical access is available through a window insert (M3). The measurement vane module also features coolant supply (M4) for NGV film cooling. The module is assembled to the rig through openings in the casing ring (M1).

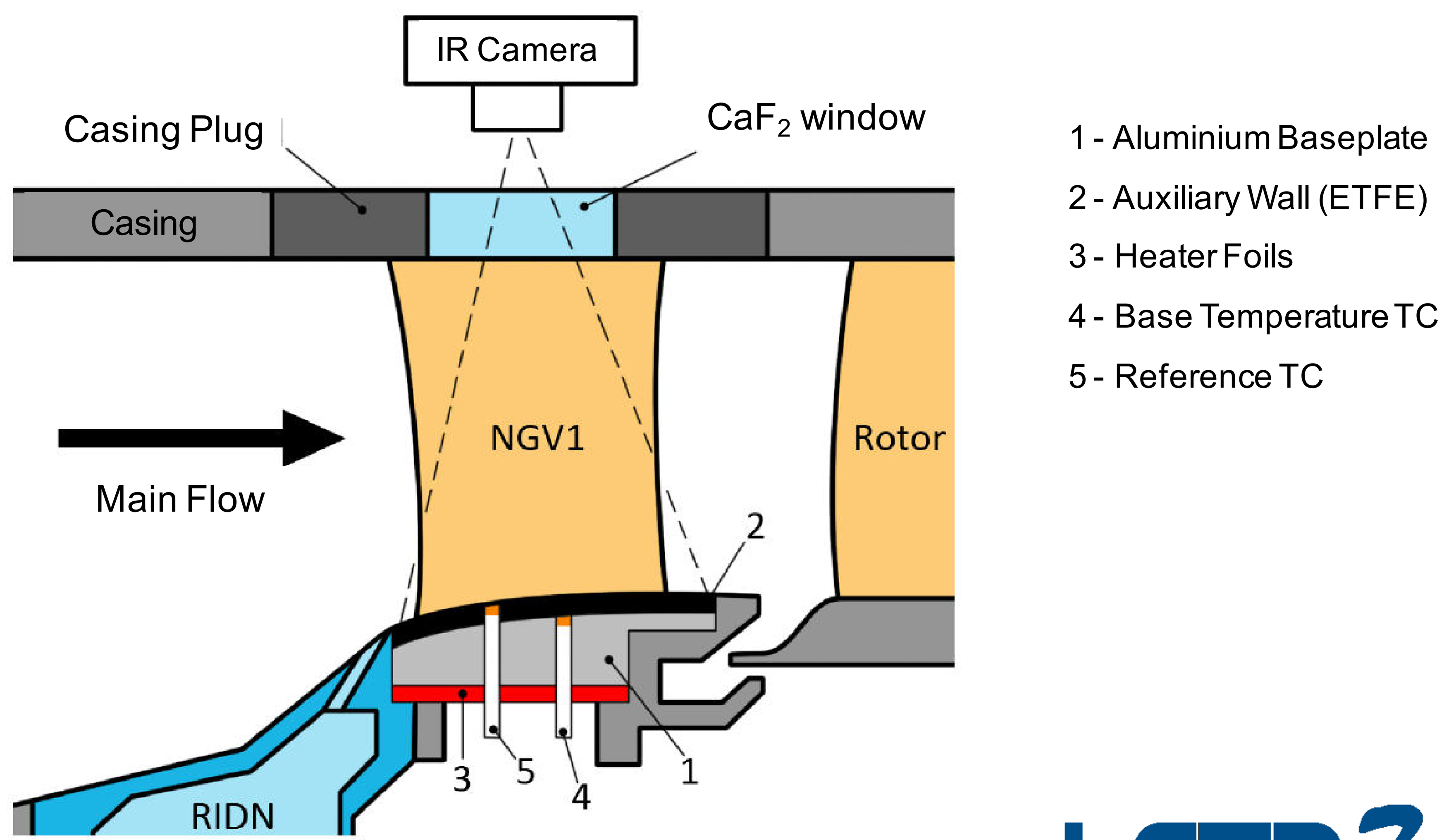






Heat Transfer Coefficient and Film Cooling Effectiveness Measurements

Infrared thermography is used to detect surface temperatures on the stator endwall. The endwall is heated to several quasi-steady-state conditions with constant wall temperature. Using an auxiliary wall of ETFE, adiabatic heat transfer coefficients are acquired. With a temperature difference between coolant and main flow, film cooling effectiveness contours can be derived as well. In addition, foreign gas injection to the coolant air flows is used to acquire gas samples on the endwall such that adiabatic film cooling effectiveness can be calculated using the analogy between heat and mass transfer.



LSTR3 LARGE SCALE TURBINE RIG · TU DARMSTADT

designed by Werschnik in 2014