An experimental study is described to explore the dominant sound generation mechanisms of the spectral components governing the overall noise level of centrifugal compressors. At the design speed with supersonic flow conditions in the rotor blade channels, blade tone noise and buzz-saw noise are the main contributors. On the inlet, rotor-alone noise is the main source while rotor-stator interaction noise dominates on the outlet side in case of vaned outlet diffusers. Over a large range of rotor speeds with subsonic flow conditions, radial compressor noise is dominated by tip clearance noise which is produced by the secondary flow through the gap between rotor blade tips and the casing wall which in turn gives rise to the rotating instability phenomena observed earlier in axial-flow machines.

The experimental study [1] is concentrated on the acoustic field on the suction side, only one measurement position is situated on the pressure side of the compressor. In order to gain more insight into the sound propagation to the pressure side of radial compressors, a numerical study using an unsteady RANS code from the DLR (TRACE, [2]) was performed by the University of Aachen (RWTH), the tonal result of which the TU Berlin in cooperation with the DLR is currently acoustically analyzing in terms of its mode constituents. The experimental and the numerical study will enable a deeper physical understanding of the main sound excitation mechanisms of radial compressors.
Figure 2: Acoustic measurement positions in the compressor inlet and outlet duct and on the casing of the shroudless compressor.

References