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Temperature spectra and the light beam depolarization in laboratory Rayleigh-Benard convection with the Rayleigh number between 10^8 to $5 \cdot 10^9$

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The turbulent flow impresses a subtle modification on the passing light and they are most pronounced in the nearforward direction i.e. in the direction of the light propagation. These effects can be observed either in phase (via the arrival angle) measurement or they can be observed in polarimetric measurements, as the change of light polarization state. Our measurements were carried out in a Rayleigh-Bernard convective tank with dimensions 0.3 m x 0.3 m x 0.3 m and flow with Rayleigh numbers 10^8 to $5 \cdot 10^9$. Using profiling thermistor and collocated 2D PIV system we have derived spatial temperature spectra collocated with the flow velocity fields. The length of the time series spans a few large eddy times, allowing the capture of energy and temperature fluctuations. The tank was also equipped with optical measurements which included 1D Shack-Hartmann wavefront sensing system and CCD based diffractometer allowing us to measure the nearly instantaneous respectively temperature spectra and the light beam linear polarization state. The optically obtained 3D temperature spectra were in agreement with fast thermistor spatial spectra. The optically measured temperature spectra in the far dissipation region yield Kraichnan scalar spectrum as predicted by numerical simulations. The diffractometer results show that the turbulence-induced depolarization rate depends on the strength of the turbulent flow, suggesting that light beam depolarization from turbulent flow may contain useful information regarding the smallest length scales of turbulent flow.