Poly(N-isopropylacrylamide) (PNIPAM) microgel particles show a phase transition at LCST=32°C. Above the LCST the particles shrink. While the collapsed microgel network is immobile the uncollapsed network below the LCST is able to fluctuate. The multispeckle Dynamic Light Scattering (M-DLS) is an useful method to detect such fluctuations. The method uses a CCD-camera that takes pictures of the speckle pattern at a defined scattering vector in constant time intervals. By an average over the pixel-pixel correlation of two pictures the ensemble average is obtained. Multispeckle DLS allows to measure time resolved dynamics, i.e. the correlation function at a fixed correlation time, \( c(t, \tau=\text{const}) \), can be followed in time \( t \). The noise in \( c(t, \tau=\text{const}) \) depends on the fluctuations of the sample heterogeneities. To be sensitive on the microgel network only the PNIPAM-particles were immobilized by setting their concentration to a maximum (more than 70% volume fraction). On scattering angles higher than 70° multispeckle DLS is sensitive on length scales smaller than a particle diameter (in the concentrated system: \( \phi_{\text{particle}} = 400\text{nm} \)). A measurement series between 29°C and 35°C and at scattering angles higher than 70° shows a strong collapse of the noise in small \( \tau \)-channels, \( c(t, \tau=\text{small}) \). On smaller scattering angles, where particle-particle interaction is detected, and on higher \( \tau \)-channels (\( \tau>10\text{s} \)), where the motion of particles becomes visible, a phase transition is not or only weakly detectable in \( c(t, \tau=\text{const}) \). The internal fluctuations and the particle motions can be nicely separated by the choice of scattering angle and \( \tau \)-channel.

The variance of the time resolved correlation function measured at a scattering angle of 151° shows that network fluctuations collapse at the LCST=32°C.