Diffusion of Nanoparticles in Semidilute Polymer Solutions: The Effect of Different Length Scales. INDERMEET KOHLI, ASHIS MUKHOPADHYAY, Wayne State University — Gold nanoparticles (Au NPs) were used to investigate the length-scale dependent dynamics in semidilute poly(ethylene glycol) (PEG)-water solutions. Fluctuation correlation spectroscopy was used to measure the diffusion coefficients (D) of the NPs as a function of their radius, $R_o$ (2.5-10 nm), PEG volume fraction, $\phi$ (0-0.37) and molecular weight, $M_w$ (5 kg/mol and 35 kg/mol). Our results indicate that the radius of gyration, $R_g$ of the polymer chain is the crossover length scale for the NPs experiencing nanoviscosity or macroviscosity. The reduced diffusivity can be plotted on a single master curve as $D_o/D = \exp(\alpha (R_o/\xi)^\delta)$ for $R_g > R_o$ and as $D_o/D = \exp(\alpha (R_g/\xi)^\delta)$ for $R_g \leq R_o$, where $D_o$ is diffusion coefficient in the neat solvent, $\xi$ is the correlation length, $\alpha = 1.63$ and $\delta = 0.89$. In the intermediate size regime, $\xi < R_o < a(\phi)$, where ‘$a(\phi)$’ is the tube diameter for entangled polymer liquid, we found that $D \sim \phi^{-1.45}$ and independent of $M_w$. For $R_o > a(\phi)$, $D \sim \phi^{-4}$ was obtained. The results were compared with currently available theories.