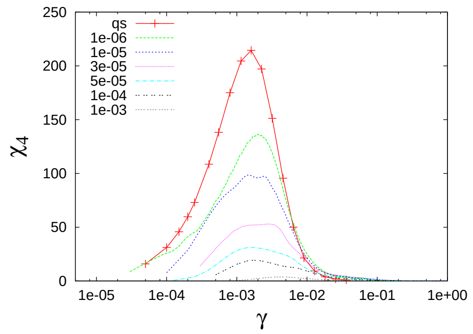

Figure 9: $\chi_4(\gamma)$ for different strain-rates $\dot{\gamma}$ and $a = 0.01$. comparison with quasistatic ('qs') simulations. Note the different boundary conditions used. MD simulations are with walls, while quasistatic simulations have periodic boundary conditions. This may explain the difference in the amplitude.

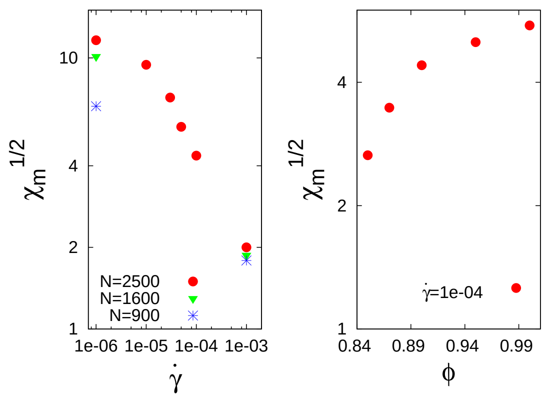

Figure 10: (Left) Peak-height $\chi_m = \chi_4(\gamma_m)$ as determined from Fig. 9. The saturation at small strain-rates is an indication of the quasistatic limit, in which $\chi_m \sim N$. In contrast, at high strain-rates no significant dependence on system-size is observed. (Right) Peak-height χ_m as function of volume-fraction.

ently dominated by system-size effects, as already shown in previous works .[14,15,28,47] Note, that this system-size dependence is of different origin than the finite-size effects present within the above mentioned intermittent regime, which occurs close to ϕ_c. The intermittency can be avoided by staying away from ϕ_c. In contrast, the system-size dependence encountered here is quite independent of volume-fraction, but rather a generic feature of the quasistatic regime, as we show now.

To this end let us turn to the molecular-dynamics simulations. We will show that the dependence on system-size indeed reflects the saturation of a length-scale that is finite for larger strain-rates and increases towards the quasistatic regime [6] . As Fig. 9 shows, the amplitude of χ_4 increases when reducing the strain-rate ($a = 0.01$, $\phi = 0.9$) and approaches the quasistatic limit for small strain-rates. Also the strain γ_m, at which χ_4 is maximal is very well reproduced in the dynamic simulation.

Fig. 10 demonstrates a saturation of the amplitude $\chi_m \equiv \chi_4(\gamma_m)$ at small strain-rates indicating that the quasistatic regime is entered. Comparing with the quasistatic simulation, we find somewhat smaller values for the amplitude. It should be remembered, however, that different boundary conditions have been used. The rough walls used in the molecular dynamics simulations are likely responsible for the reduction of the peak-height as compared to the quasistatic simulations (which are performed with periodic boundary conditions).

The presence of the quasistatic regime is also evidenced by the fact that the amplitude χ_m within the plateau depends on system-size, just as in the quasistatic simulations. Outside this regime, on the other hand, no significant N-dependence is observed. In effect this means that the quasistatic regime shrinks with increasing system-size. The strainrate $\dot{\gamma}_{\rm qs}(N)$ that describes the crossover to the quasistatic regime decreases with N. This is in line with Refs.,[14,15] where a power-law dependence $\gamma_{\rm qs} \sim 1/N$ is reported. From our data we cannot make any definitive statement about this dependence.

The results are furthermore consistent with those of Ono *et al.*[48] The lowest strain-rate accessible in the latter study was $\dot{\gamma} = 0.0001$. At this strain-rate the correlation length was observed to be on the order of 3 in agreement with our data.

We also probed the volume-fraction dependence, by performing runs at $\phi = 0.85, 0.87, 0.9, 0.95$ and 1. The resulting amplitude of χ_4 is given in Fig. 10. Interestingly we observe a mild increase in the am-

[6]A more detailed account of these simulations will be presented in: P. Chaudhuri and L. Bocquet, in preparation (2010).