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Anelastic internal friction of dislocations in two-dimensional Yukawa solids

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The dislocation internal friction (IF) of two-dimensional (2D) dusty plasma solids is investigated using Langevin dynamical simulations under oscillating shear deformations. The magnitude of IF is quantified using the loss factor from the stress-strain hysteresis. It is discovered that the dislocation IF is significantly dependent on the dislocation's slip direction relative to the shear direction [1]. It is different from the elastic properties observed in [2,3] and plastic behaviors studied in [4] of 2D dusty plasmas, the dislocation IF in 2D dusty plasmas is found to be heavily dependent on the shear deformation frequency, while nearly independent of the shear strain amplitude, corresponding to a typical linear anelastic property [1].

In Figure. 1, we investigate the local strain caused by the slip motion of dislocations at the individual particle level. We find that the variation trend of dislocation IF with the dislocation's slip direction is related to the slip distance of dislocations. The energy dissipation process may be accomplished by the formation of shear bands caused by the slip motion of two dislocations.

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References

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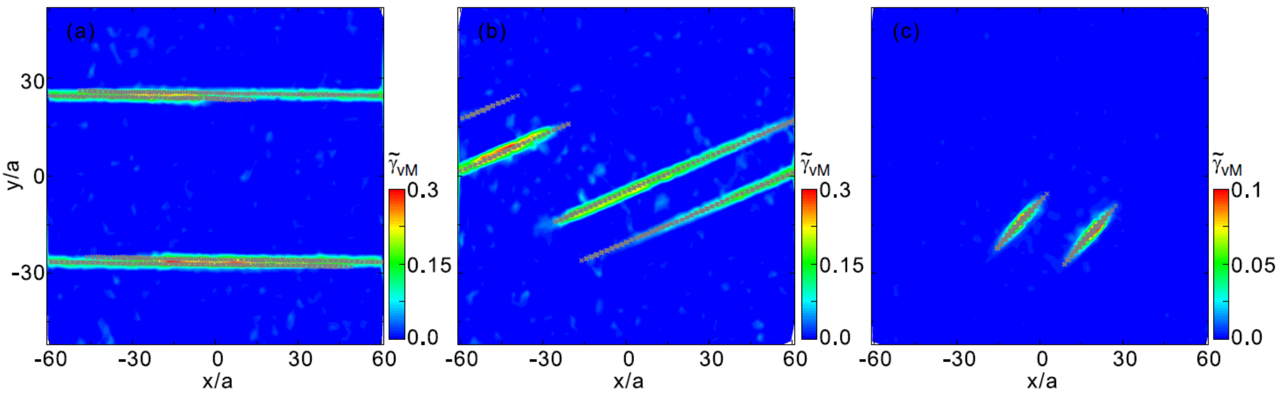

Figure. 1. Obtained distribution of the atomic shear strain in one shear deformation period for θ ≈ 0 (a), θ = π/9 (b), and θ = π/4 (c), respectively. When θ ≈ 0 in (a), the corresponding IF is the largest, where the trajectories of two dislocations result in two remarkable shear bands as they travel. However, when θ = π/4 in (c), the corresponding IF is nearly zero, where the two dislocations do not move further, so that the shear strain is localized within limited regions around the two dislocations. For θ = π/9 in (b), the strain evolution is somewhere between those for θ ≈ 0 and π/4.