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Single file diffusion in microtubules ANDREW RUTENBERG, SPENCER FARRELL, AIDAN BROWN, Dalhousie University — We investigate the single file diffusion (SFD) of large particles entering a confined tubular geometry, such as luminal diffusion of proteins inside microtubules or flagella. While single-file effects have no effect on particle density, we report significant single-file effects for individually-tracked tracer particle motion. Both exact and approximate ordering statistics of particles entering semi-infinite tubes agree well with our stochastic simulations. Considering initially empty semi-infinite tubes, with particles entering at one end starting from an initial time $t = 0$, tracked particles display super-diffusive effective exponents just after they enter the system and trends towards diffusive exponents at later times. Equivalently, if diffusive exponents are assumed the effective diffusivity is reduced at early times and enhanced at later times through a logarithmic factor $\log N$, where N is the number of particles in the tube. When we number each particle from the first ($n = 1$) to the most recent ($n = N$), we find good scaling collapse of the effective diffusivity for all n. Techniques that track individual particles, or local groups of particles, such as photo-activation or photobleaching, will exhibit single-file effects.

Andrew Rutenberg
Dalhousie University

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