# *Inertial particle focusing in curved ducts*


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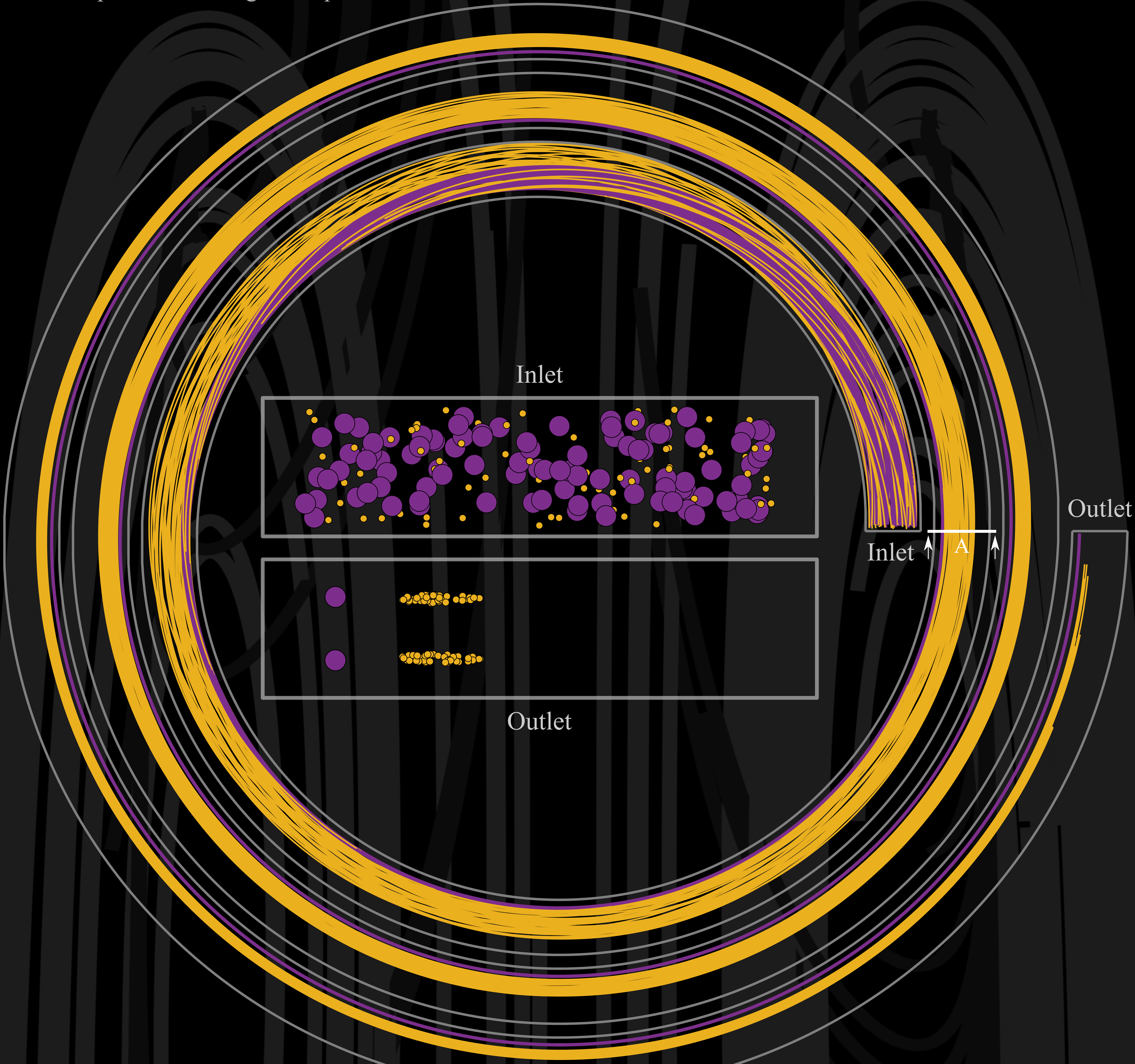
Particles in a fluid flowing through a curved (e.g. spiral) duct with appropriate geometry will focus to equilibrium locations within the cross-section due to a balance between two dominant forces: (i) inertial lift arising from small but non-negligible inertia of the fluid and (ii) drag due to cross-sectional vortices induced by the curvature of the duct. This is being exploited in novel technologies for separation of particles by size, for example isolation of rare circulating tumor cells from the many red and white blood cells in a blood sample which promises a new non-invasive method for cancer diagnosis and prognosis. Our asymptotic theoretical model reveals a complex dynamical landscape with bifurcations in the number and nature of particle equilibria as the bend radius of the duct changes. It allows identification of parameter regimes for optimal particle separation and potential new mechanisms for particle focusing and separation.

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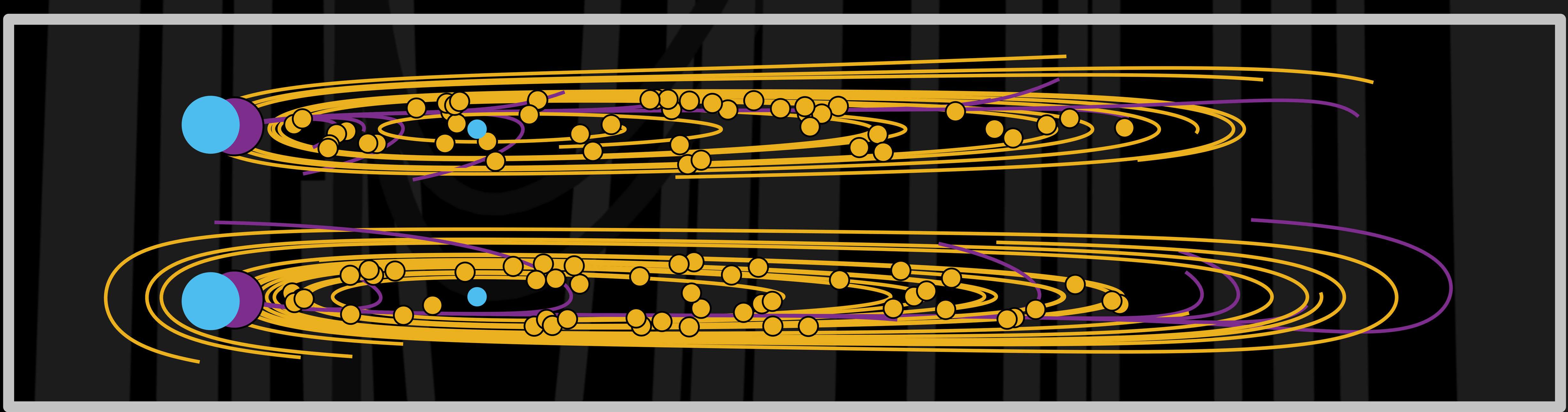

Position and trajectories of smaller and larger particles (yellow and purple) along with corresponding stable equilibria (blue) after one turn. These equilibria continuously shift with changing radius. The larger particles are focused and track their equilibrium; the smaller particles are still distributed. On reaching the outlet, smaller particles are more focused (see Outlet panel above).