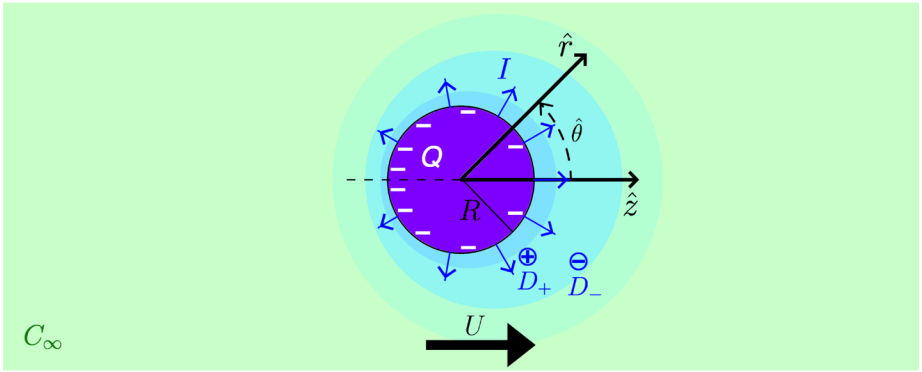
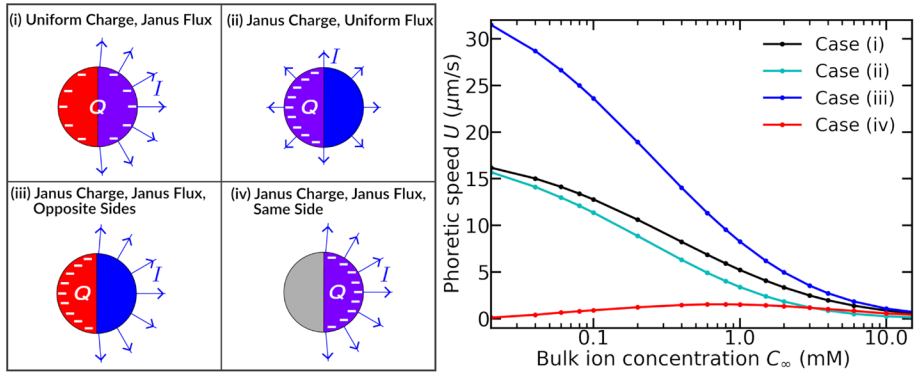
Enhanced Catalytic Self-Propulsion





Top: Schematic of a self-propelling particle with asymmetric surface charge that produces fluxes of ions. Bottom: Propulsion speed of Janus nanoparticles as a function of bulk ion concentration for four different configurations of surface charge and ionic flux.

A. Shrestha and M. Olvera de la Cruz, *Enhanced phoretic self-propulsion of active colloids through surface charge asymmetry,* submitted to Phys. Rev.(2023). Preprint at https://arxiv.org/pdf/2305.01102v1.pdf

Scientific Achievement

Directed self-propulsion of chemically active colloidal particles is enhanced by surface charge asymmetry.

Significance and Impact

Our findings suggest a new avenue for the design of biomimetic microcompartments through specification of size and surface properties that optimize self-transport in ionic media.

Research Details

- We employ a combination analytical continuum theory and numerical finite element simulations to quantitatively determine the propulsion velocity under varied conditions of surface asymmetries and bulk ion concentrations.
- Janus nanoparticles of sizes smaller than or comparable to the Debye length, that are endowed with surface charge and ionic flux asymmetries placed on opposite sides, results in optimal propulsion speeds of the order of μm/s or higher.