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Linear Non-Equilibrium Thermodynamics of Human Voluntary Behavior: A Canonical-Dissipative Fokker-Planck Equation Approach Involving Potentials Beyond the Harmonic Oscillator Case

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My project is a study of the ventricular-subventricular zone of the lateral ventricles of the mouse brain, a site where new neurons are formed. This prominent stem cell niche is capable of generating new neurons and glial cells to populate the developing brain. These stem cells give rise to ependymal cells, which function to help circulate cerebrospinal fluid and aid in waste clearance. I am focused on the mechanism by which the stem cells divide to form ependymal cells and how this is reliant on developmental time point and position (caudal-rostral gradient) along the lateral ventricle wall. In order to monitor stem cell differentiation, I will use a method called lineage tracing, which tracks the progeny of a single cell.

Specifically, I am interested in determining whether the stem cells are dividing symmetrically or asymmetrically. Symmetric division would be shown by the radial glial cells dividing into either two stem cells or two ependymal cells. In contrast, asymmetric division would generate one stem cell and one ependymal cell. My hypothesis is that earlier divisions are largely asymmetric to support stem cell number retention, whereas the final rounds are symmetric to deplete the stem cell pool. The data I collect will be used to generate a computational model that can serve to predict developmental alterations in cases of hydrocephalus or other development brain disorders. We hope to provide clinical insight on the best way to treat this condition by studying curvature and stem cell development along the lateral ventricles.

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