Z103a `microjax`: A GPU-Accelerated, Auto-Differentiable Framework for Microlensing Modeling in the Roman Era

Shota Miyazaki, Hajime Kawahara (ISAS/JAXA)

The Nancy Grace Roman Space Telescope, scheduled for launch by NASA in 2026–2027, will conduct a wide-field near-infrared microlensing survey of the Galactic bulge, monitoring hundreds of millions of stars at 12-minute cadence. This survey will produce an unprecedented dataset expected to reveal $\sim 10^3$ cold exoplanets via gravitational microlensing, providing key constraints on the demographics of planetary systems beyond the snow line. To fully leverage Roman's high-cadence, high-precision, and large-volume dataset, forward models must incorporate subtle higher-order microlensing effects and flexible noise treatments while maintaining exceptional computational efficiency.

To meet these demands, we are developing `microjax`, a Python framework based on `JAX`, which combines GPU-accelerated inverse ray-shooting with automatic differentiation. This enables both fast forward modeling and scalable parameter inference, suitable for analyzing complex microlensing events. We present the current development status and demonstrate that `microjax` enables efficient, scalable, and differentiable modeling of complex microlensing events, laying the foundation for statistical analyses of Roman and future large-scale surveys.