Microlens Parallaxes with warm Spitzer

Andy Gould (Ohio State)
Halo Macho Dark Matter?

MACHO “yes”/EROS “upper limits”
To Fully Determine Lens Nature: SIM

\[ \vec{r}_e \Delta u = d_{SIM} \]

(a) \[ \vec{r}_e = \frac{d_{SIM}}{\Delta u} \]

(b) Magnification

(c) Time of Observation (days)
... or, more immediately: Spitzer
From a paper written 8 years ago ...

MICROLENS PARALLAXES WITH SIRTF

ANDREW GOULD

Ohio State University, Department of Astronomy, 174 West 18th Avenue, Columbus, OH 43210; gould@astronomy.ohio-state.edu

Received 1998 July 27; accepted 1998 November 2

\[ t_{0,S} = t_{0,\oplus} + \Delta t_0 , \]

\[ \frac{\Delta t_0}{t_{e,\oplus}} = \Delta u_x \cos \theta - 2(\Omega_{\oplus} t_{e,\oplus})^{-2} \gamma_{\oplus} \sin^2 \theta ; \]

\[ \beta_S = |\beta_{\oplus} \pm \Delta \beta| , \quad \Delta \beta = \Delta u_x \sin \theta + (\Omega_{\oplus} t_{e,\oplus})^{-2} \gamma_{\oplus} \sin 2\theta ; \]

\[ t_{e,S} = t_{e,\oplus} + \Delta t_e , \]

\[ \frac{\Delta t_e}{t_{e,\oplus}} = \Delta u_x \Omega_{\oplus} t_{e,\oplus} \sin \theta + (\Omega_{\oplus} t_{e,\oplus})^{-1} \gamma_{\oplus} \sin 2\theta ; \]

\[ \gamma_S = \Delta u_x (\Omega_{\oplus} t_{e,\oplus})^2 \cos \theta + \gamma_{\oplus} \cos 2\theta . \]

\[ \frac{\sigma_{\Delta u}}{\Delta u} = \frac{\sigma_\gamma}{\gamma \sec \phi} = 0.17N^{-1/2} \frac{\sigma_0}{0.01} \frac{\tilde{v}}{275 \text{ km s}^{-1}} \left( \frac{t_e}{40 \text{ days}} \right)^{-3/2} \frac{S(\beta)}{8} . \]

\[ b_{ij}\left( \frac{t_0}{t_e}, \gamma \right) = \frac{64}{u^5(u^2 + 4)^{3/2}(u^2 + 2)\sigma_0^2} \left( \begin{array}{cc} 2\tau^2 & -\tau^4 \\ -\tau^4 & \tau^6/2 \end{array} \right) , \]

\[ \sigma_{t_0} \frac{t_e}{t_c} \sim \left( \frac{25}{12} \right)^{1/2} \beta \sigma_* , \quad \sigma_* = \left( \frac{5}{3} \right)^{1/4} \beta^{1/2} \sigma_0 \]

\[ \begin{bmatrix} 1 \\ \frac{\sqrt{2}}{3} \beta \end{bmatrix} , \]
HALO favored over SMC
THE MASS SPECTRUM OF MACHOs FROM PARALLAX MEASUREMENTS

CHEONGHO HAN AND ANDREW GOULD

Received 1994 September 15; accepted 1995 January 13
Mass Estimates of $t_E=10$ day event:
With and Without Microlens Parallax
90 OGLE Bulge Events

Peak in 38 days
... of which: 66 detected before peak

(24 with I_peak < 17)
Conclusions

• A few Spitzer microlens parallaxes toward LMC/SMC would settle nature of lenses

• 120 Bulge Parallaxes over 5 years would give good statistical information on disk brown-dwarf mass function