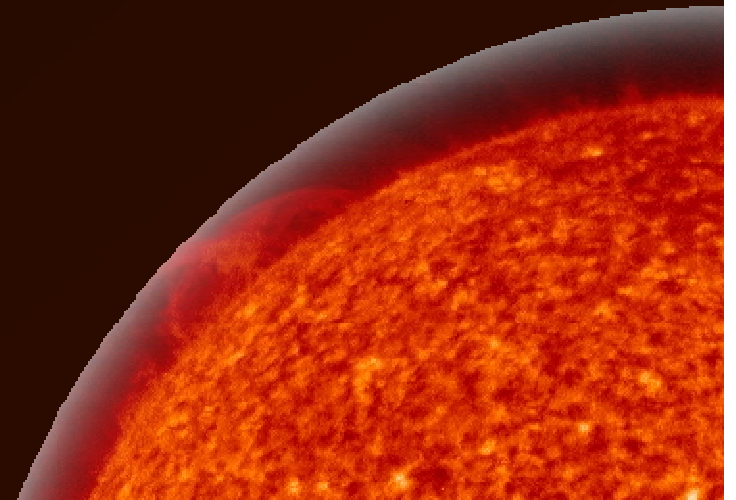


Robo-AO Astrometry (1)

Nicholas Law

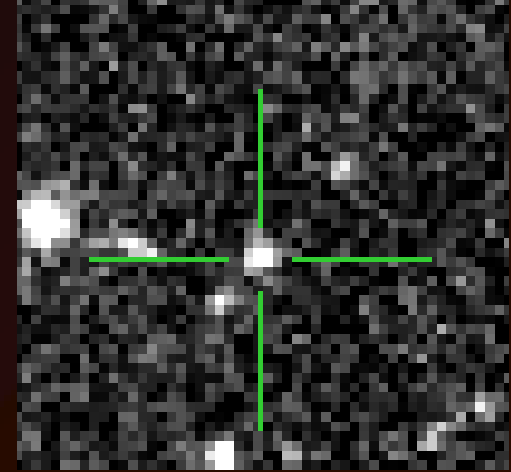


Astrometric Performance

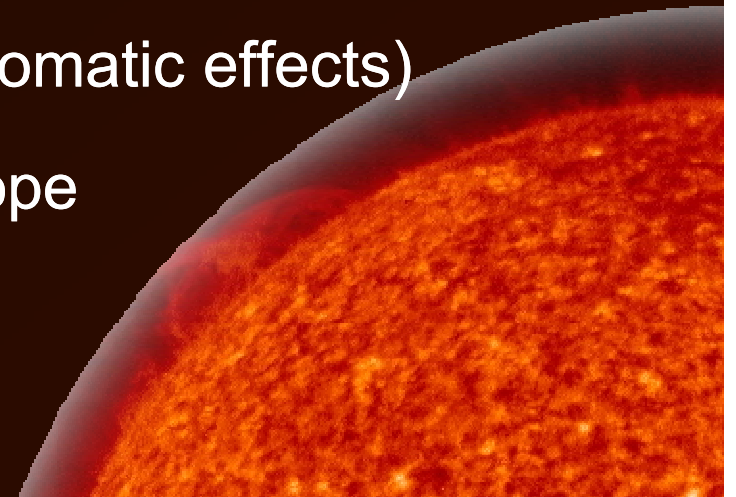
Limits

- Signal, noise, and image size (photon statistics):

$$\sigma_x \propto \frac{\text{FWHM}}{\text{SNR}}$$



- Systematics
 - Focal plane distortion
 - Atmospheric refraction (inc. chromatic effects)
 - Changes in instrument / telescope
 - Atmospheric turbulence



Astrometric Performance

Limits

- **Focal plane distortion**

- ☑ Detailed calibration using crowded fields

- **Atmospheric refraction (inc. chromatic effects)**

- ☑ Work in narrow bands in the near-IR:

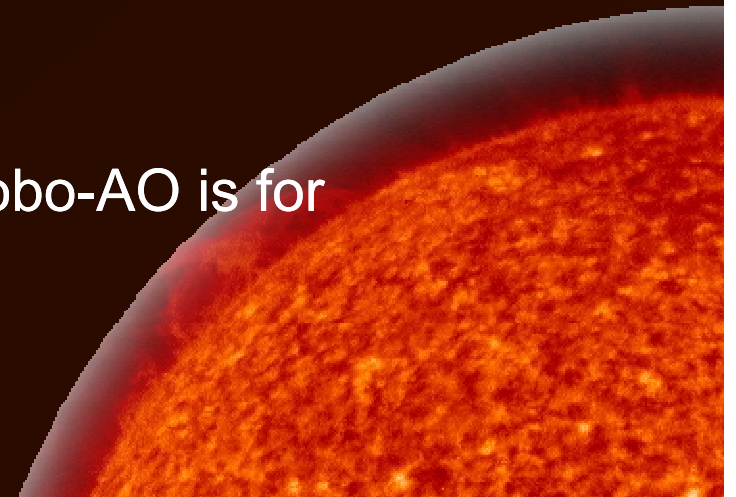
in a 30nm bandpass at $2.0\mu\text{m}$ refraction effects are $< 50\mu\text{as}$

- **Changes in instrument / telescope**

- Don't do that! Robo-AO won't

- **Atmospheric turbulence**

- ☑ Complicated... but that's what Robo-AO is for

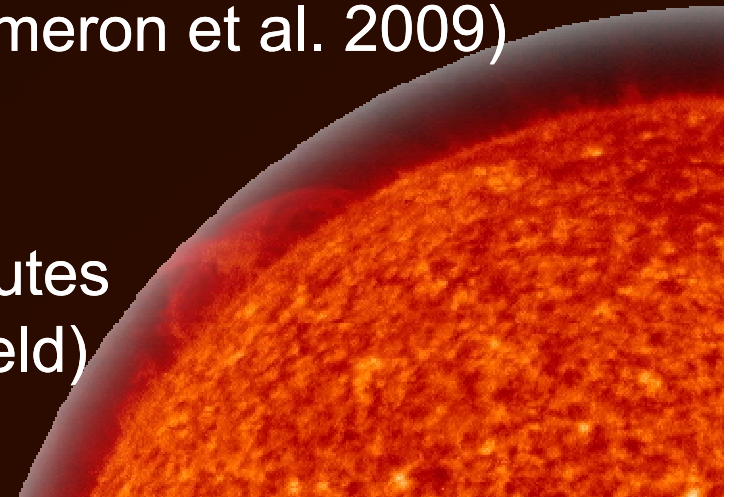


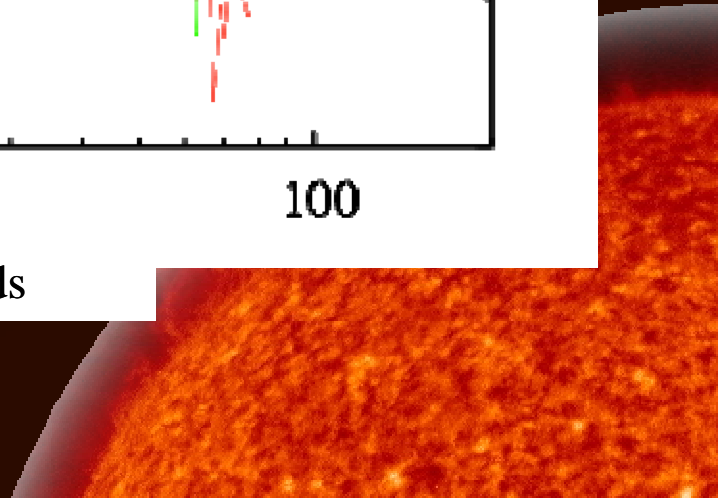
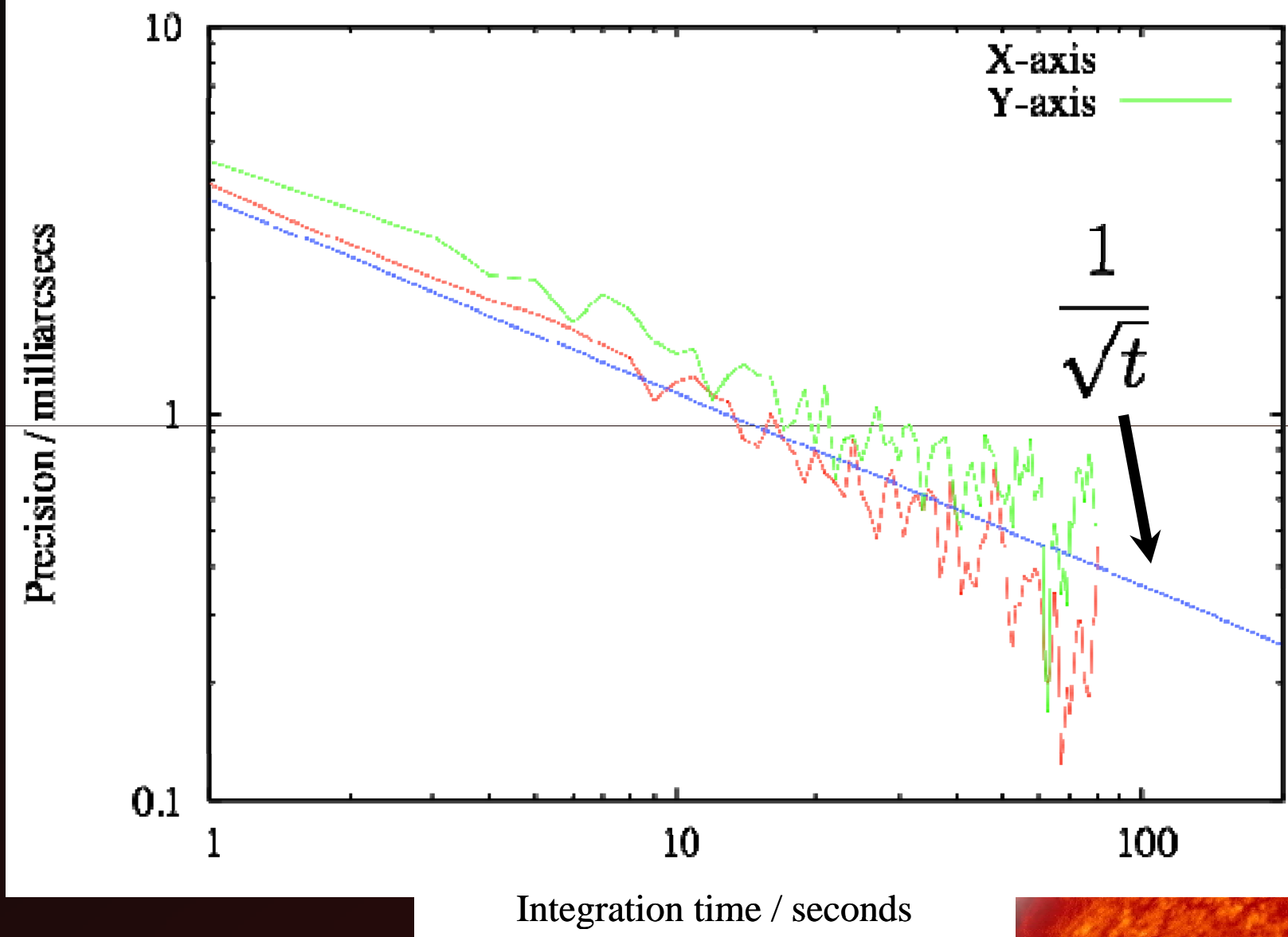
Robo-AO Astrometry

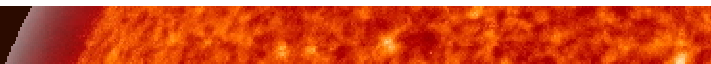
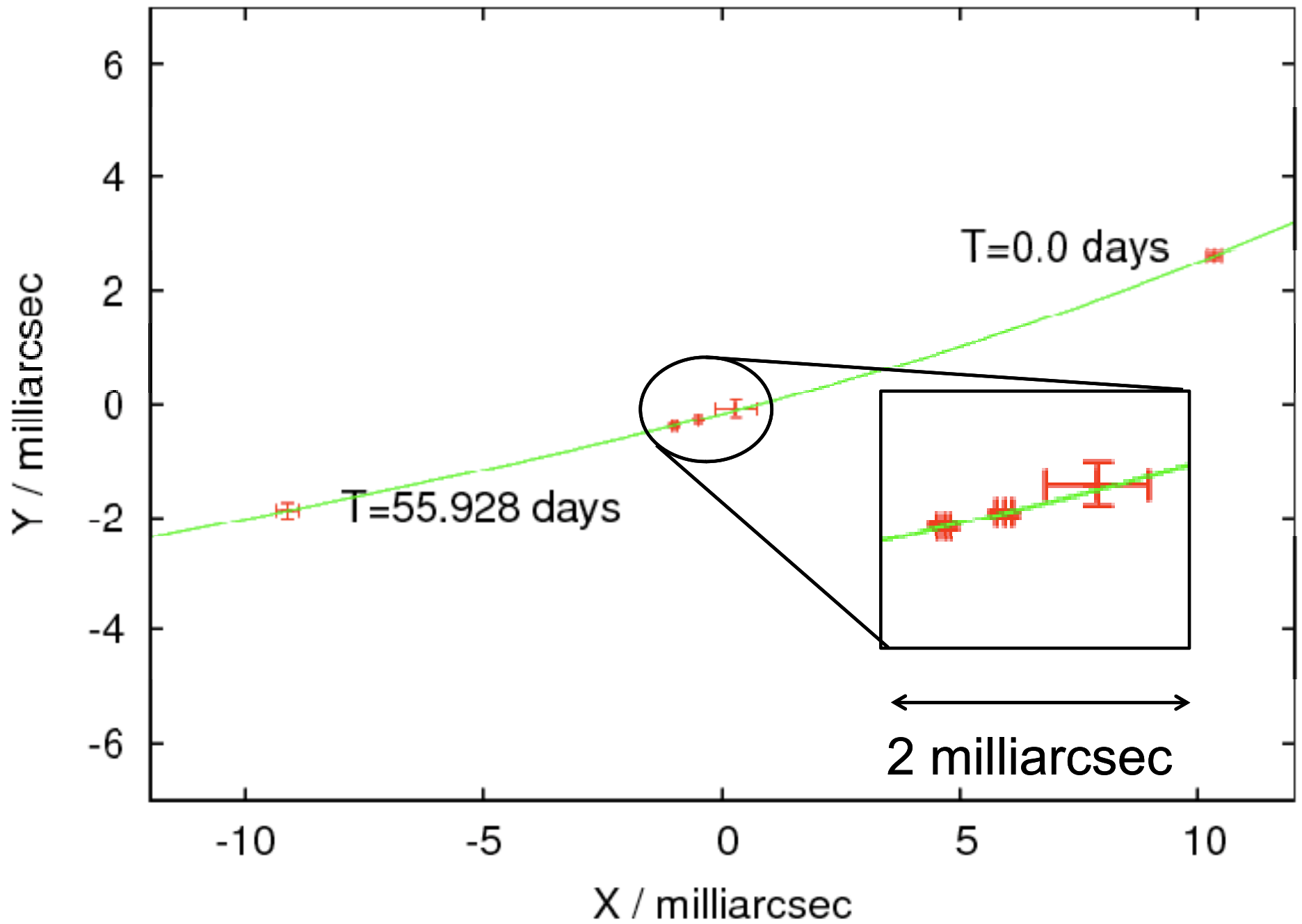
$$\sigma_x \propto \frac{\text{FWHM}}{\text{SNR}}$$

Band	SNR Compared to 1.5 m	SNR Compared to 4 m	FWHM (1" is typical)	Strehl
J	2.9X	0.4X	0.2"	50%
H	7.1X	0.98X	0.26"	70%

- Astrometric precision gains in FWHM & SNR
- With careful experimental design, performance limited by atmospheric tip/tilt jitter (see Cameron et al. 2009)
- Prediction of performance:
 - 100-200uas precision in 10-30 minutes
 - (depending on details of target & field)

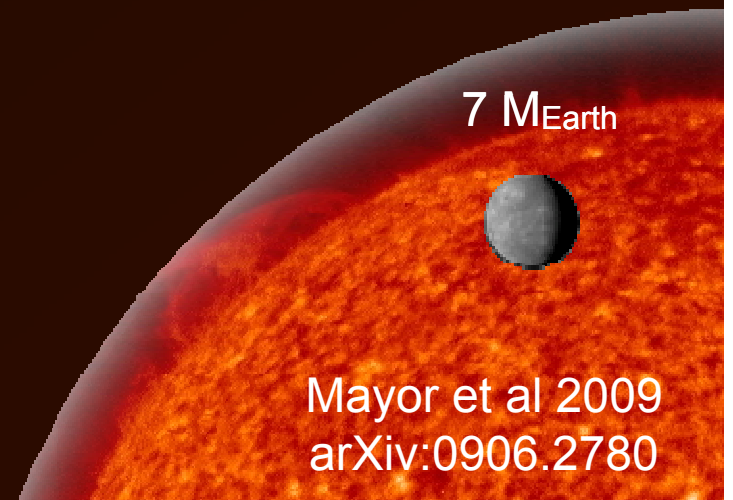
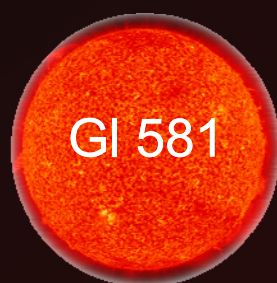






M-dwarf Planetary Populations

- Only 16 planetary systems detected around M-dwarfs ($< \sim 0.6$ solar masses)
- Several hundred detected around solar-type stars
- M-dwarfs are very **FAINT and red** for RV searches
 - Only the highest-mass M-dwarfs ($< M3$) have been probed with radial velocity searches
- Even so, some of the most interesting systems have been found around M-dwarfs



Mayor et al 2009
arXiv:0906.2780

M-dwarf Astrometric AO Planet Survey



- Target M-dwarfs in galactic plane
- Few hundred microarcsec precision per epoch
- Sensitive to Jupiter-mass planets in few-month orbits
- Competitive with (future) ~ 10 m/s radial velocity surveys around mid M-dwarfs for few month orbits

