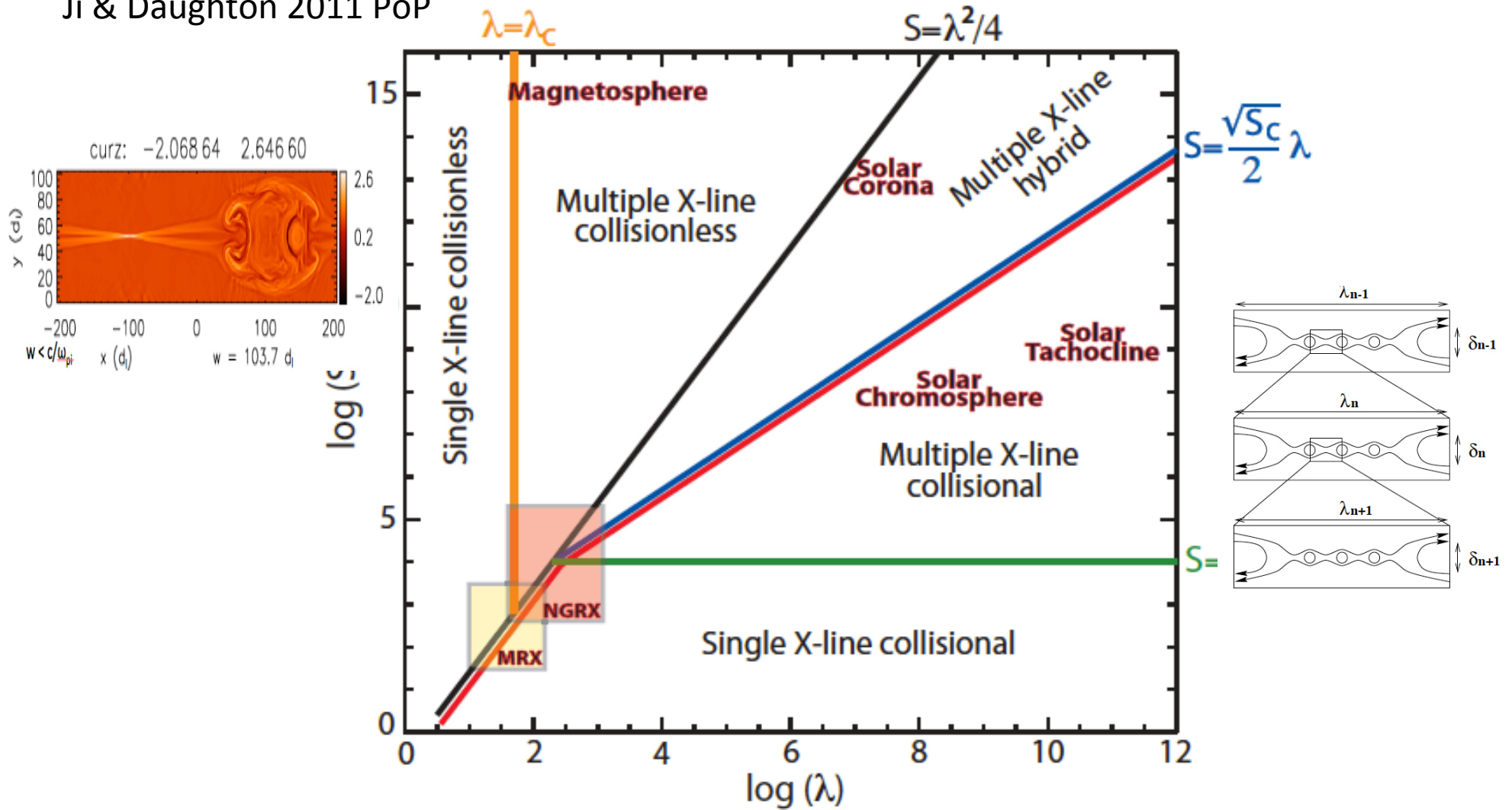


# 彩層のエネルギー散逸メカニズムを握る 空間分解以下の構造を超高速撮像で探る

磯部洋明、阿南徹、一本潔(京都大学)



- Dissipation occurs in small scales ( $\sim$ ion inertia length  $\sim 1$ m in corona)
- Structure and dynamics in reconnection region important, but too small to see

# Neutral effects

$$\frac{\partial B}{\partial t} = \nabla \times \left[ \overset{\text{Advection}}{V_n \times B} - \overset{\text{Hall}}{\frac{J \times B}{en_e}} + \overset{\text{Ambipolar}}{\frac{(J \times B) \times B}{c\nu_{ni}\rho_n}} - \overset{\text{Ohmic}}{\eta J} \right]$$

Ambipolar/Hall is important in small scale ... important in reconnection!

$$V_n \times B < \frac{(J \times B) \times B}{c\nu_{ni}\rho_n} \quad \longrightarrow \quad L < \frac{V_{An}\rho_n}{\nu_{in}\rho_i} \approx 1-10km \quad \boxed{\text{時間に直すと } L/V_A \sim 0.1-1s}$$

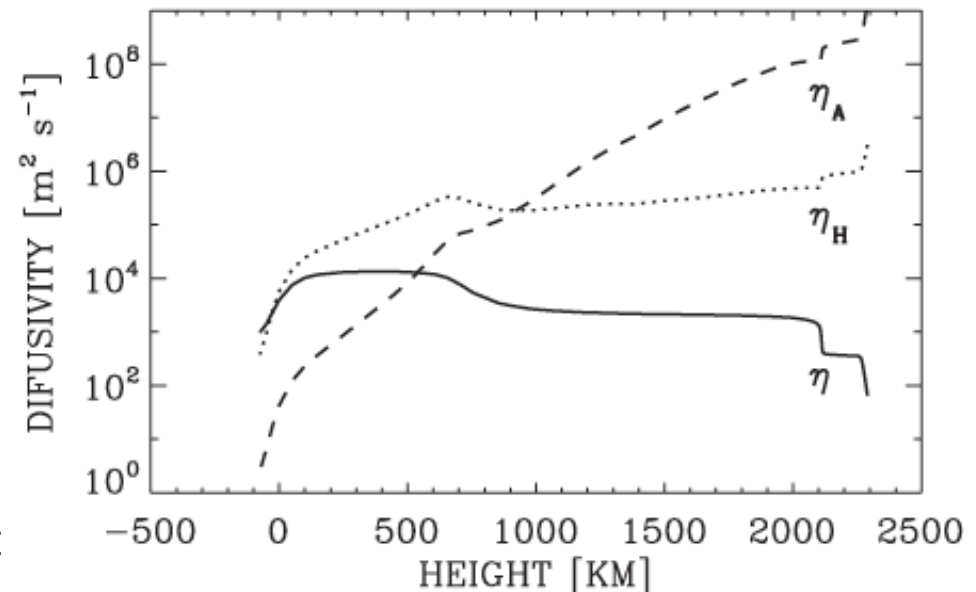
$$\text{Ambipolar/Hall} = \omega_{ci}/\nu_{in}$$

$\omega_{ci}$  : Ion-cyclotron freq  $\propto B$

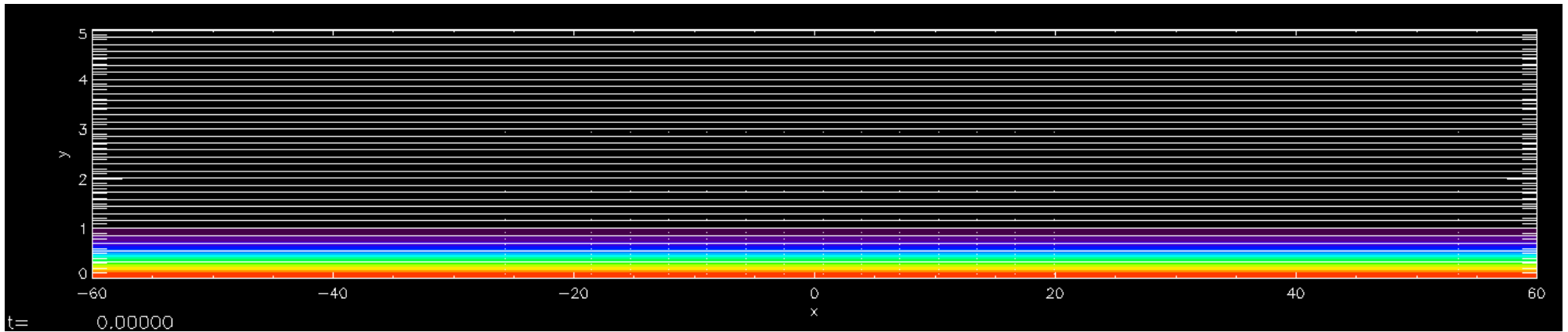
$\nu_{in}$  : Ion-neutral collision freq  $\propto n$

Photosphere: Hall dominant

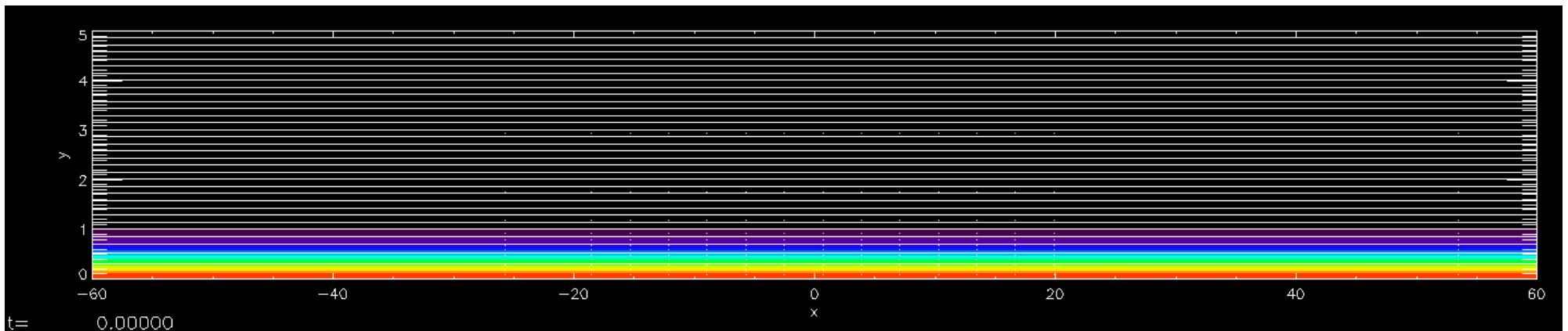
Chromosphere: ambipolar dominant



# Effect of non-uniform ambipolar diffusion



←→ Ambipolar diffusion  $\neq 0$



↔ Ambipolar diffusion  $\neq 0$

\*Ohmic resistivity is uniform

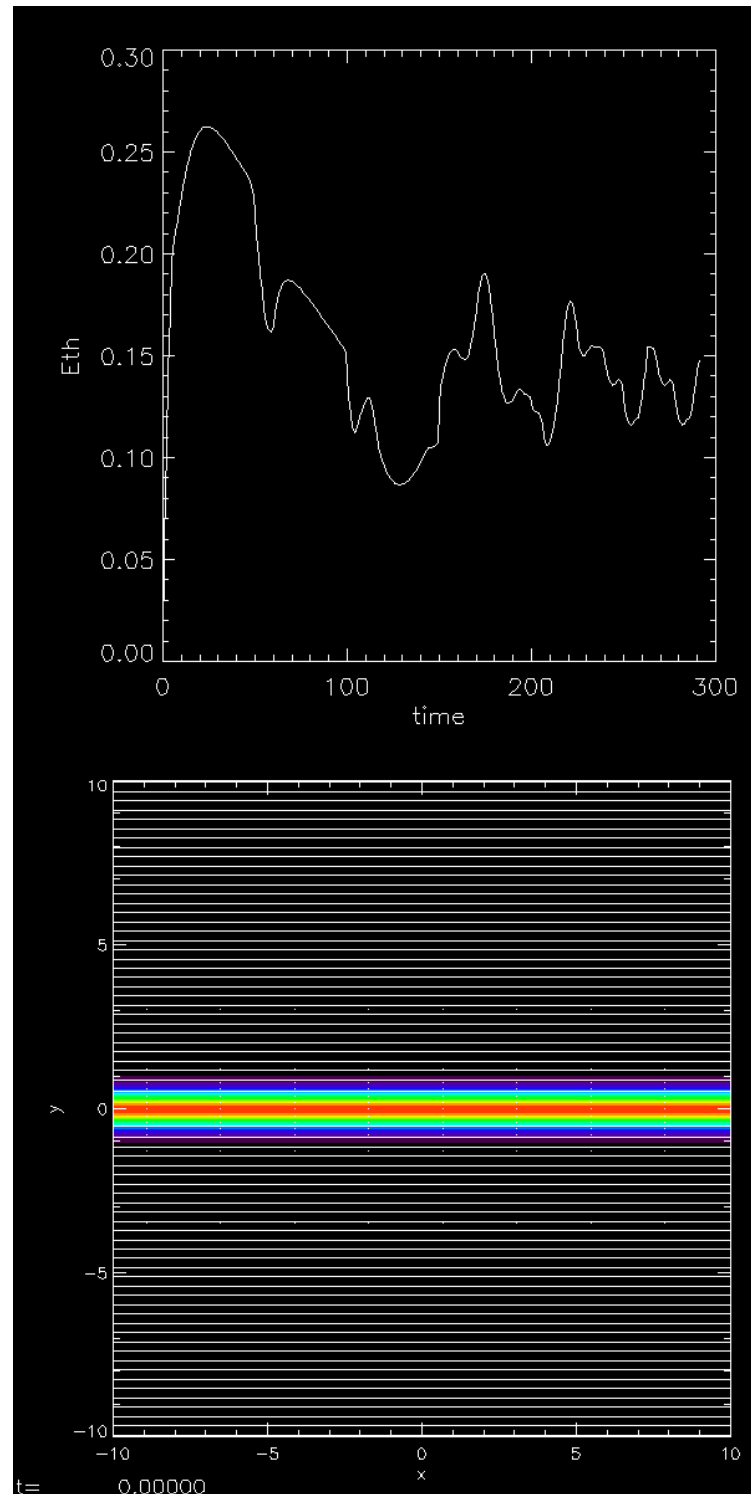
Pseudo light curve of the central region  
(total thermal energy)

Time scale of elementary peaks  $\sim 10$

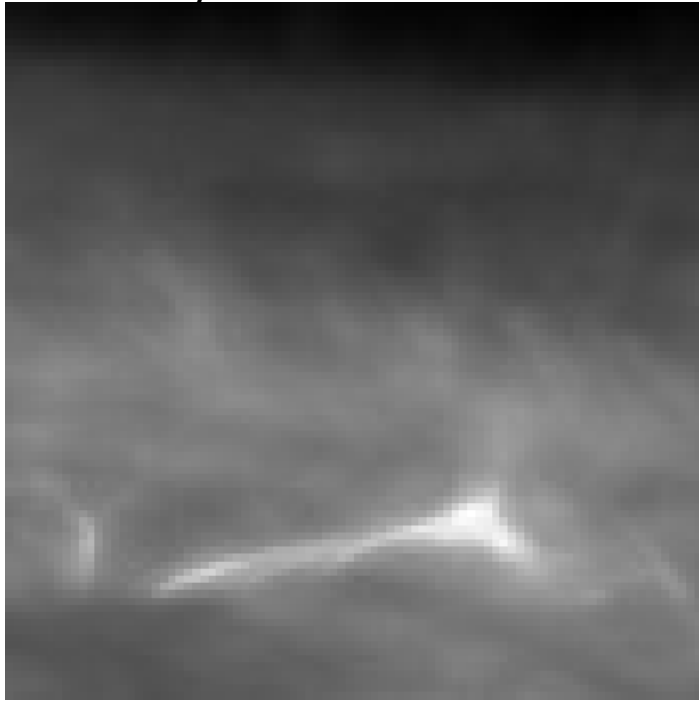
Plasmoid size  $\sim 10$

Alfven velocity  $\sim 1$

Size of unresolved structure is reflected in  
the temporal variation.



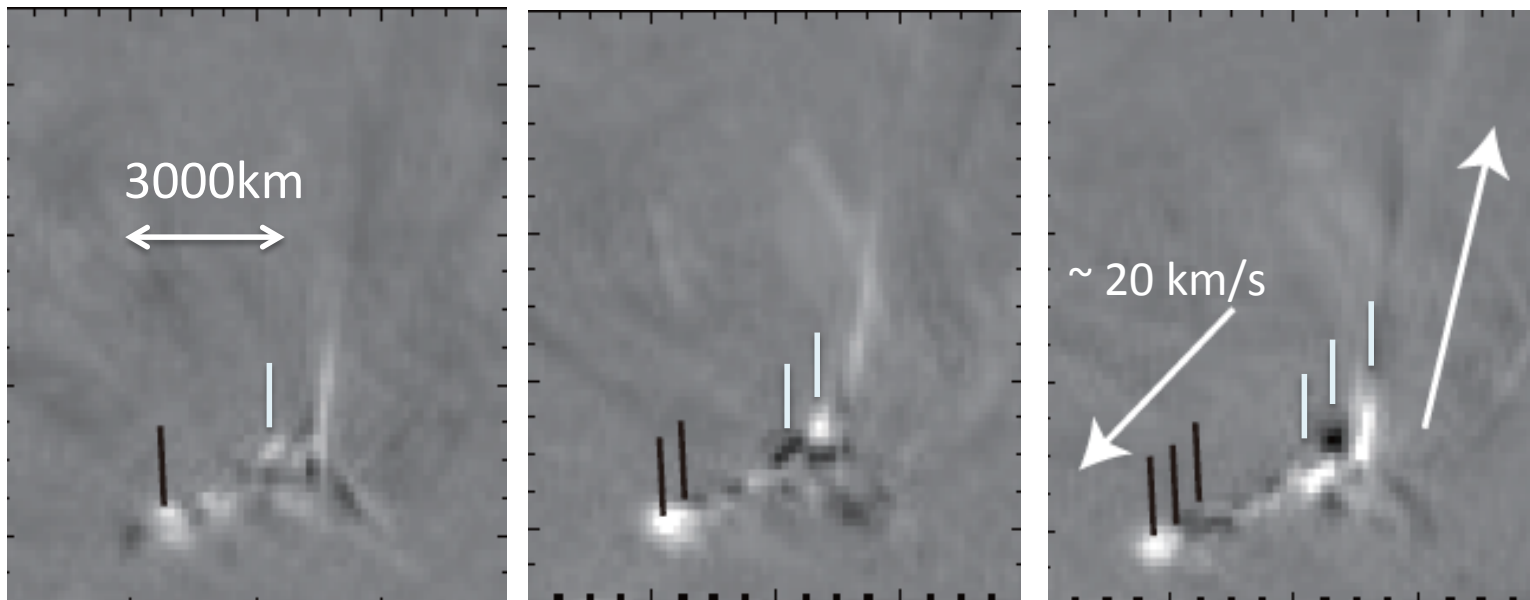
Hinode/SOT CaH



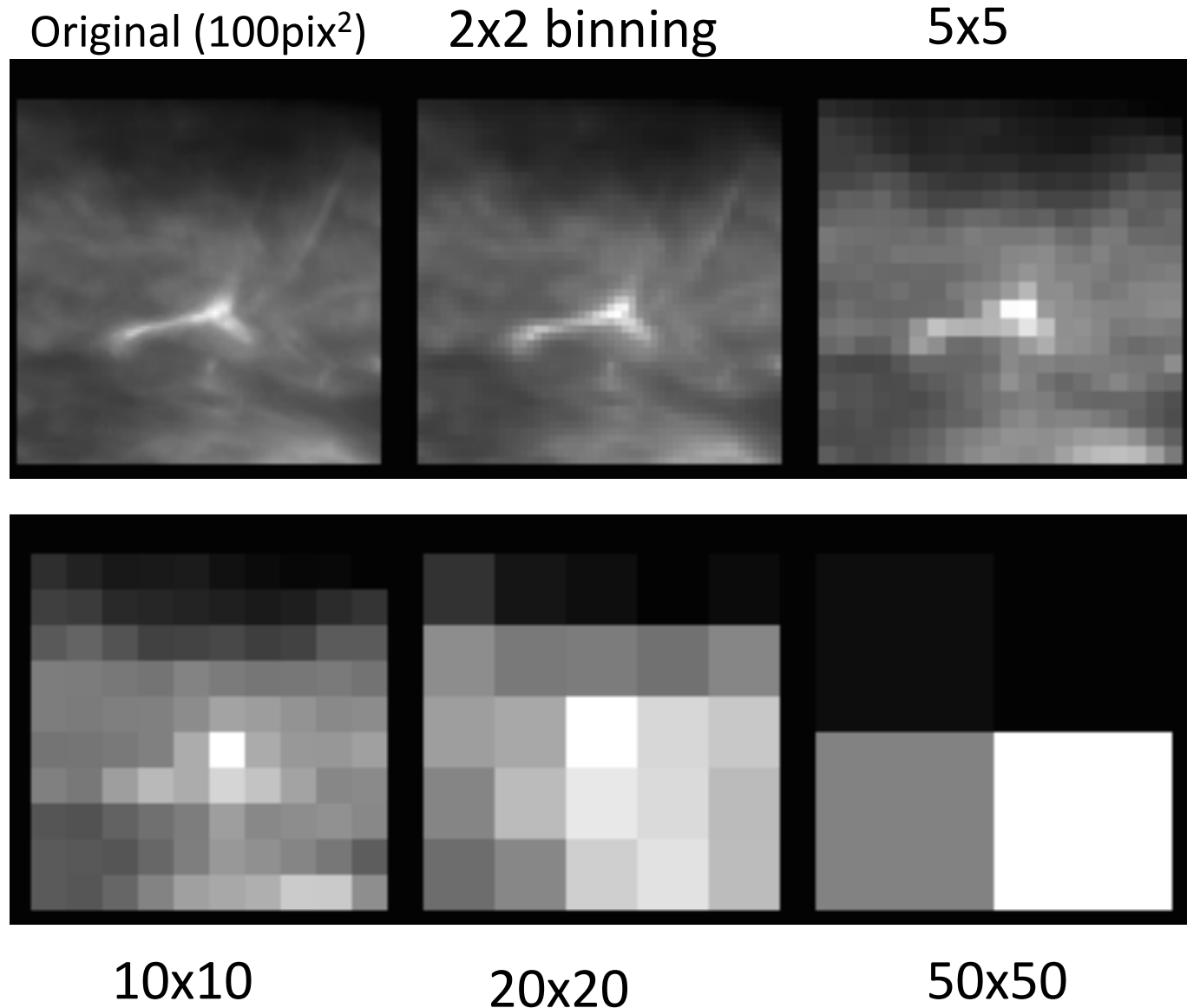
## Jet observed by Hinode/SOT

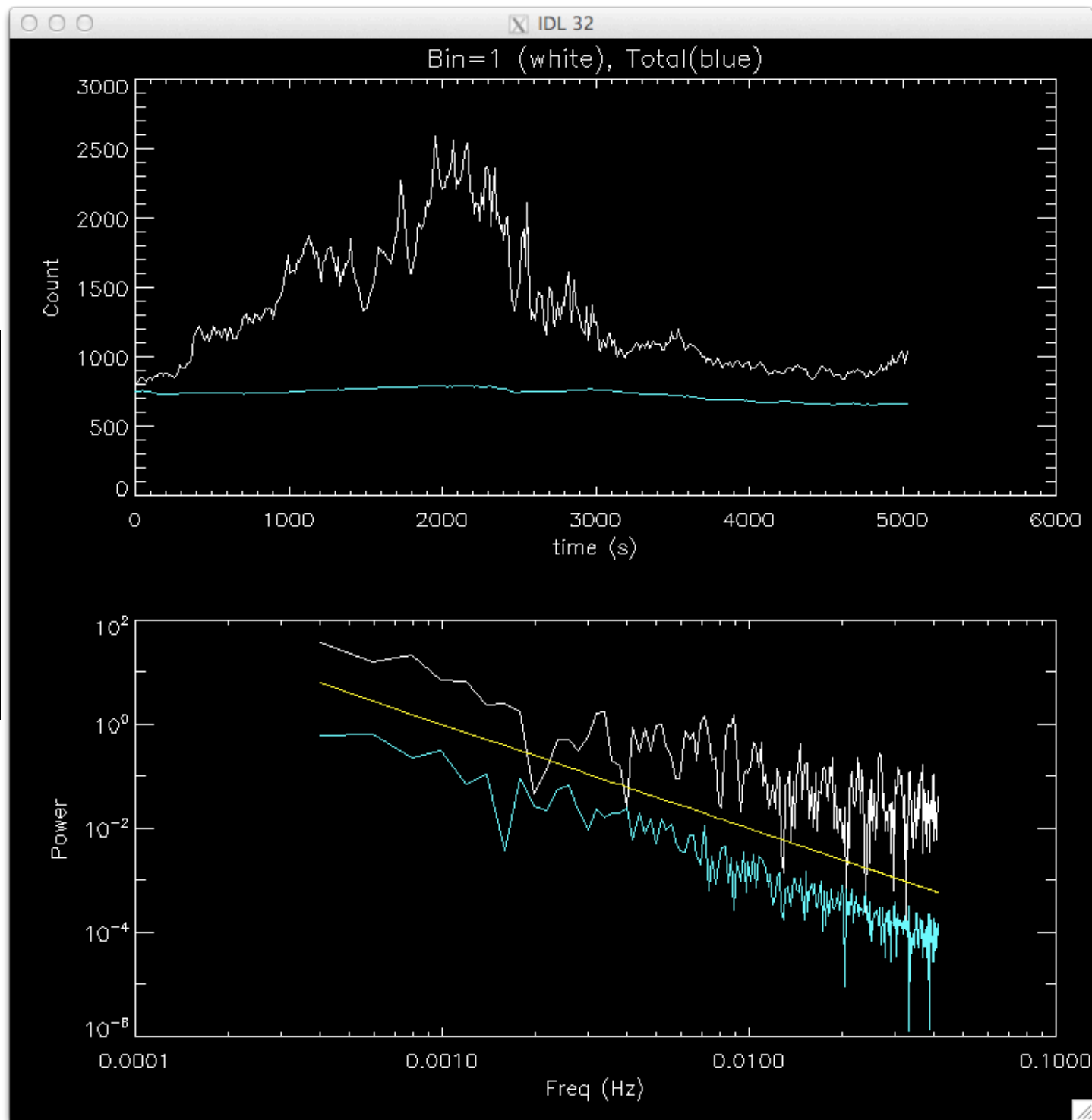
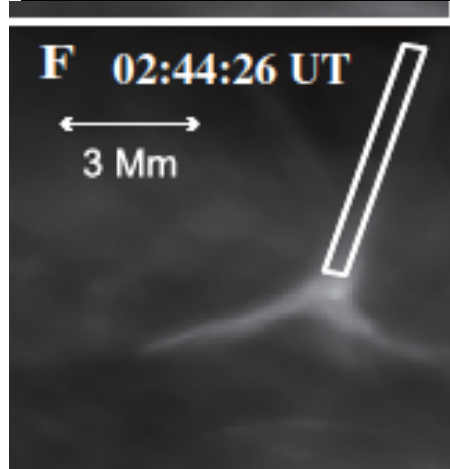
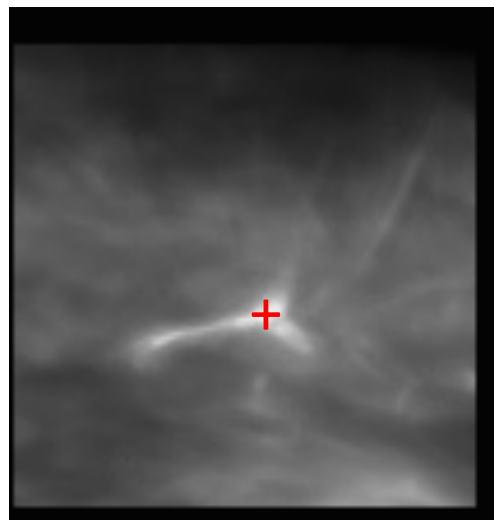
- 2007 Jan 14 jet (CaH)
  - 12s cadence, 0.1"/pix (resolution  $\sim 0.3''$ )
  - Count  $\sim 1000$  in QS,  $\sim 2000$  in jet
- 
- Multiple plasmoids
  - Size  $\sim 500\text{km}$
  - Timescale  $\sim 1\text{min}$

Singh et al. 2012

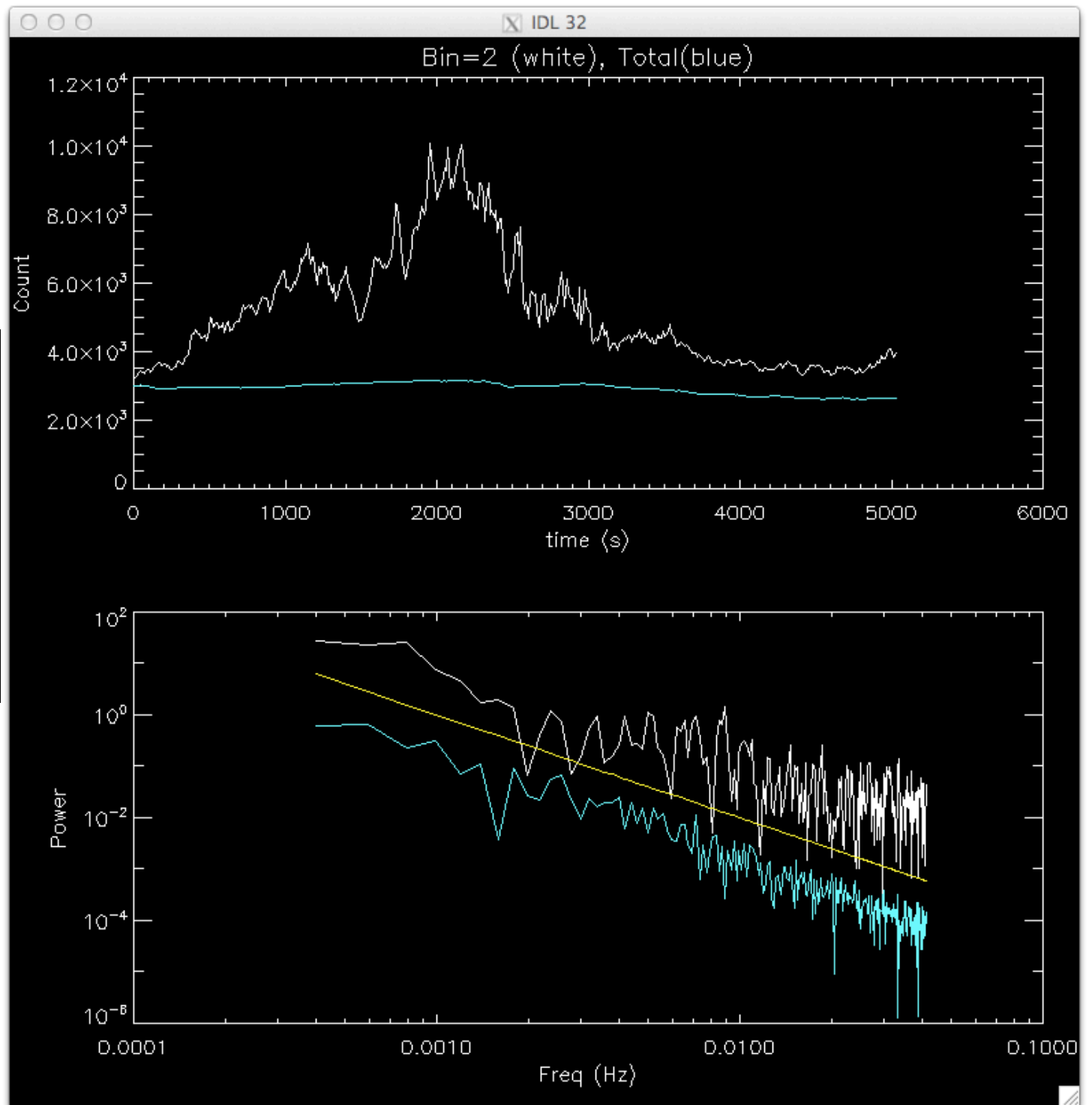
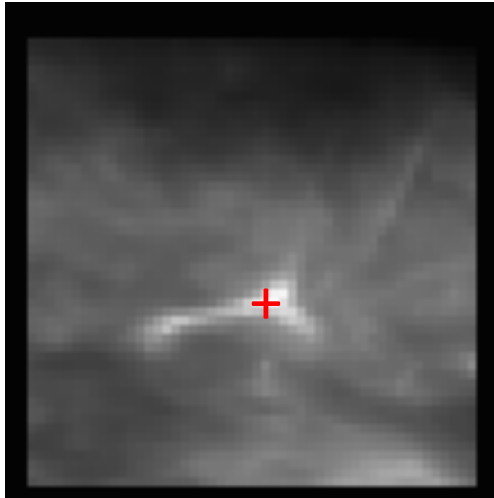


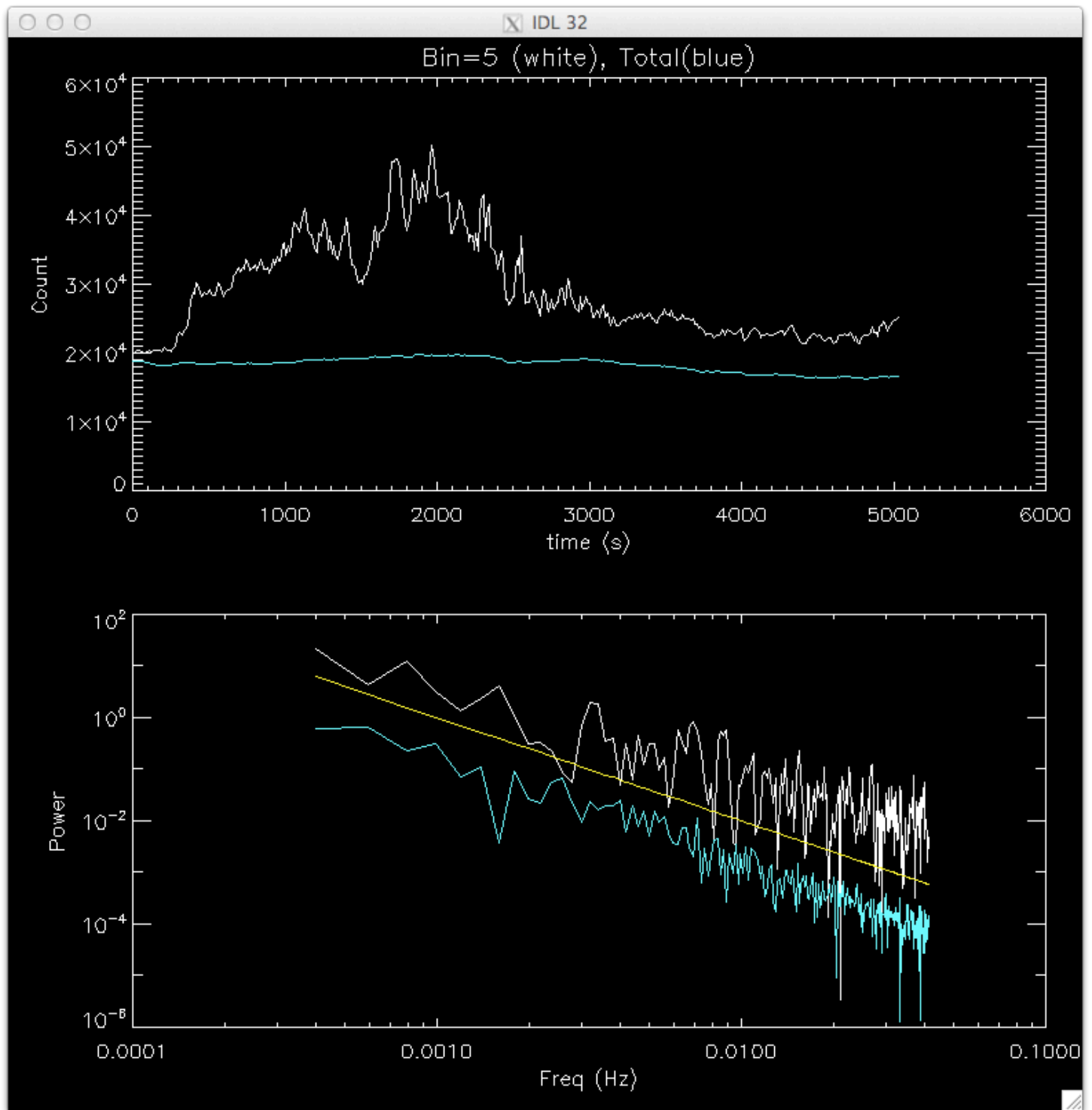
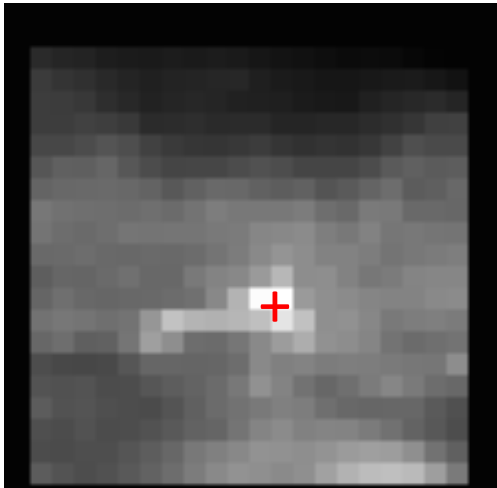
# Sub-resolution dynamics detectable?

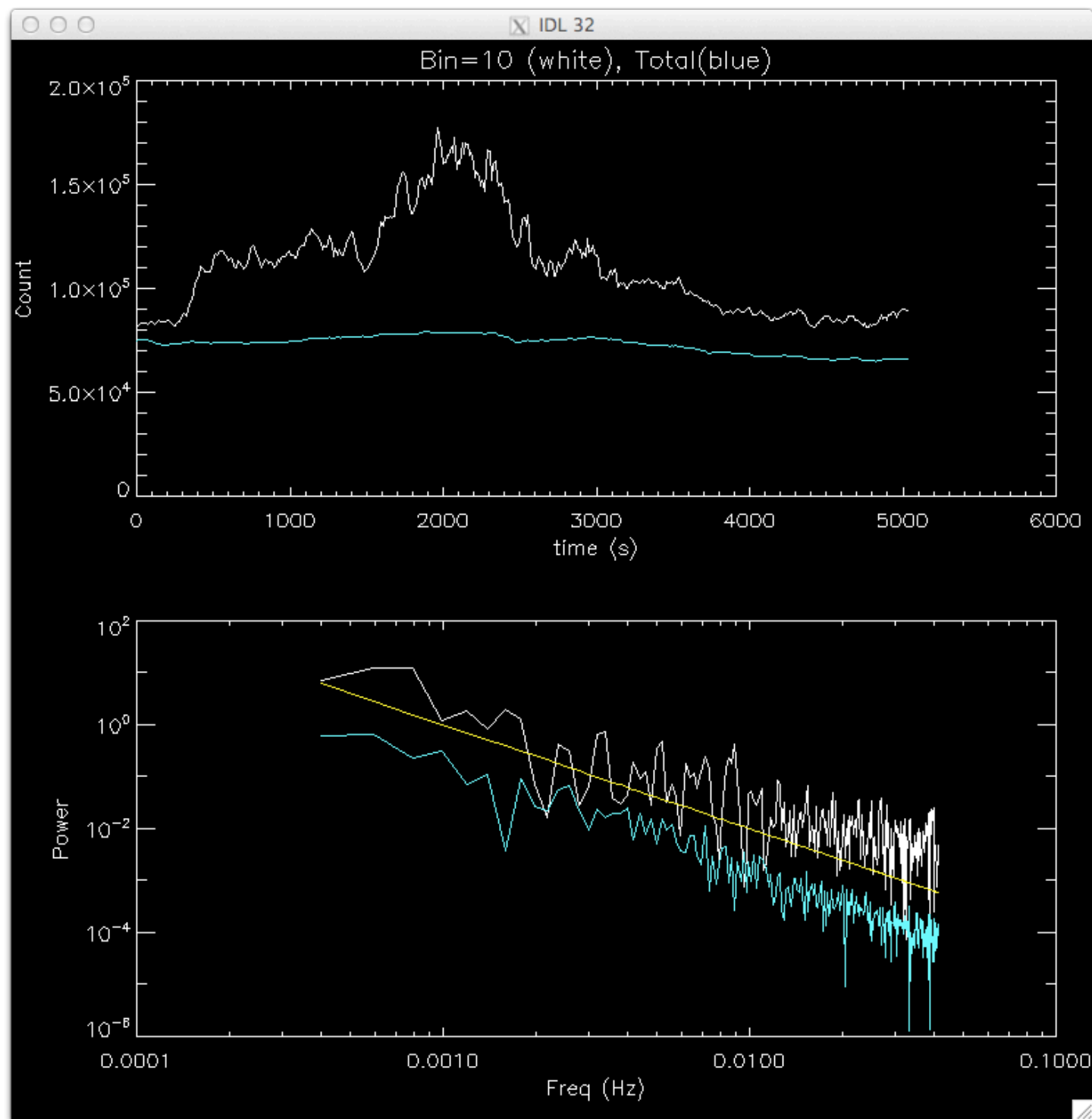
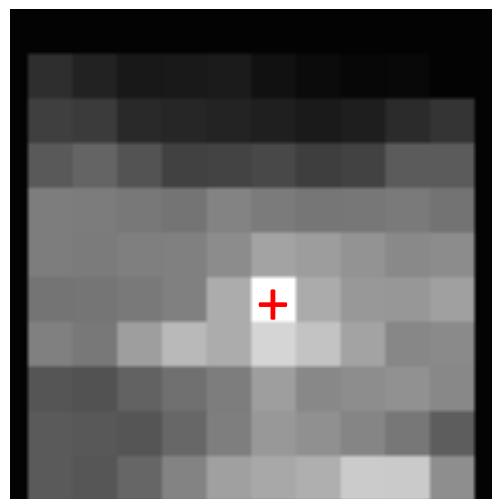


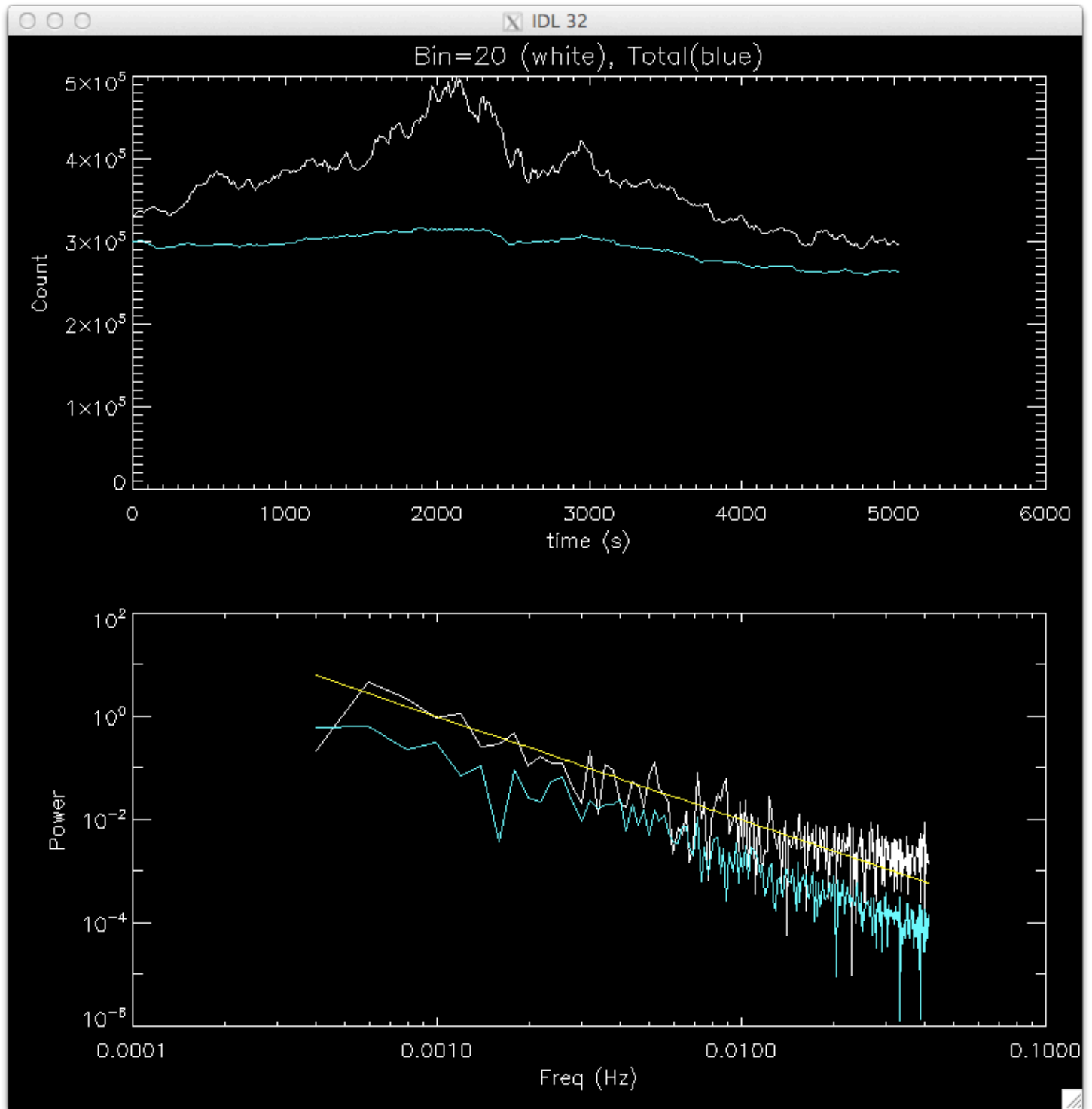
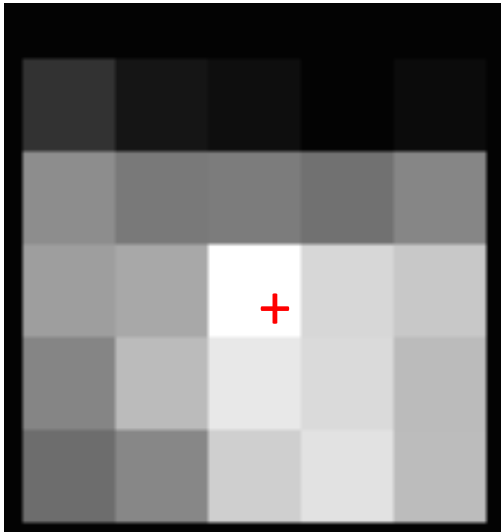


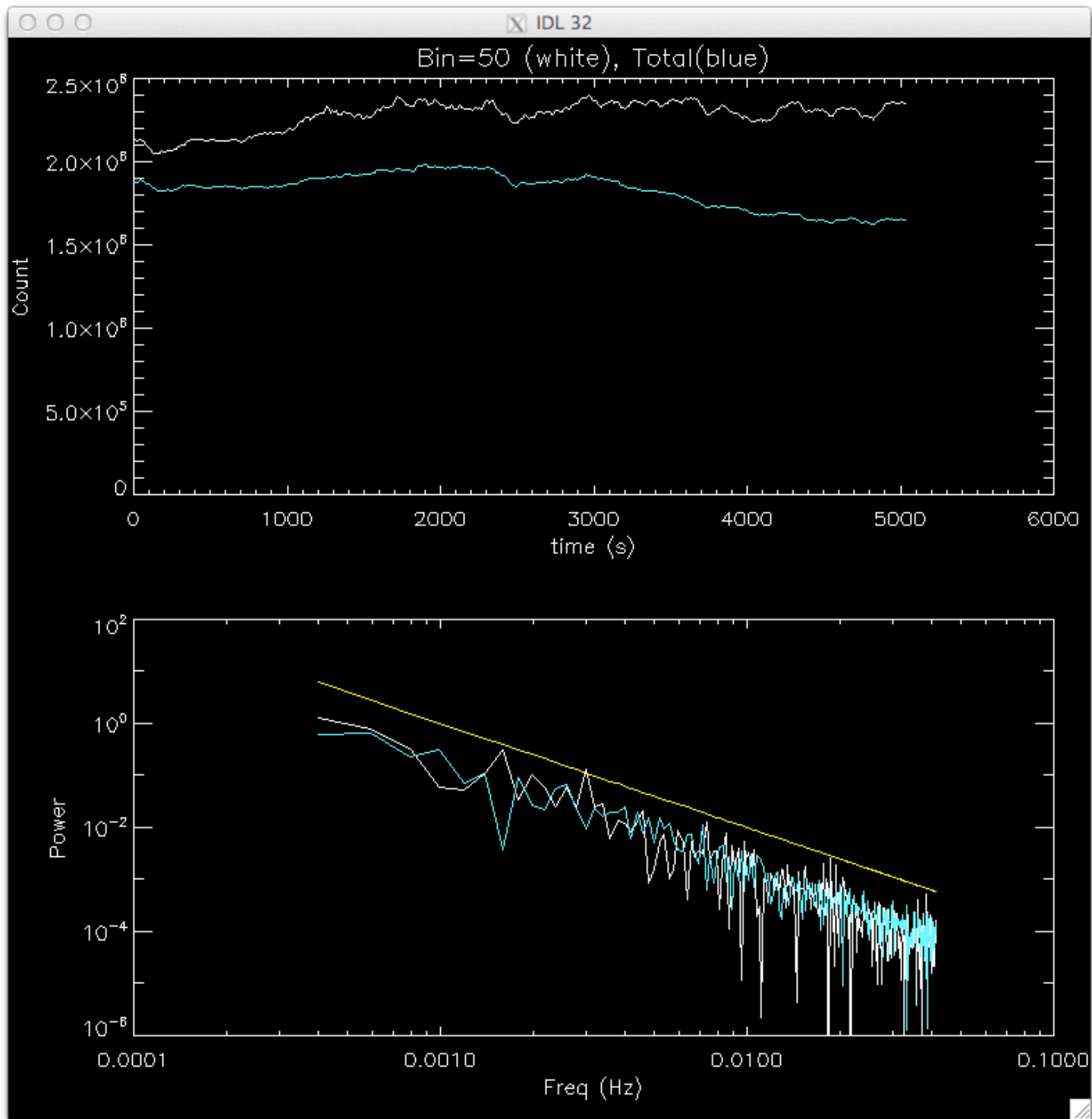
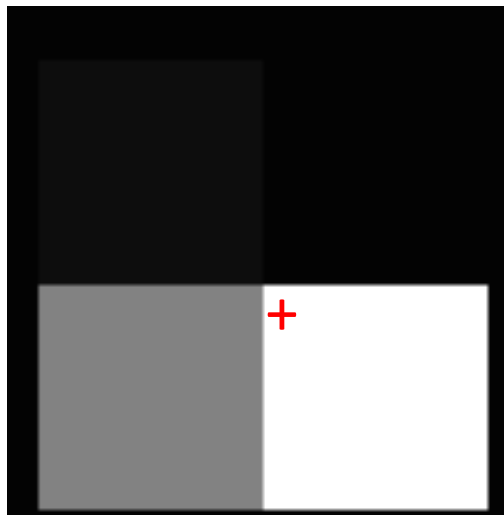






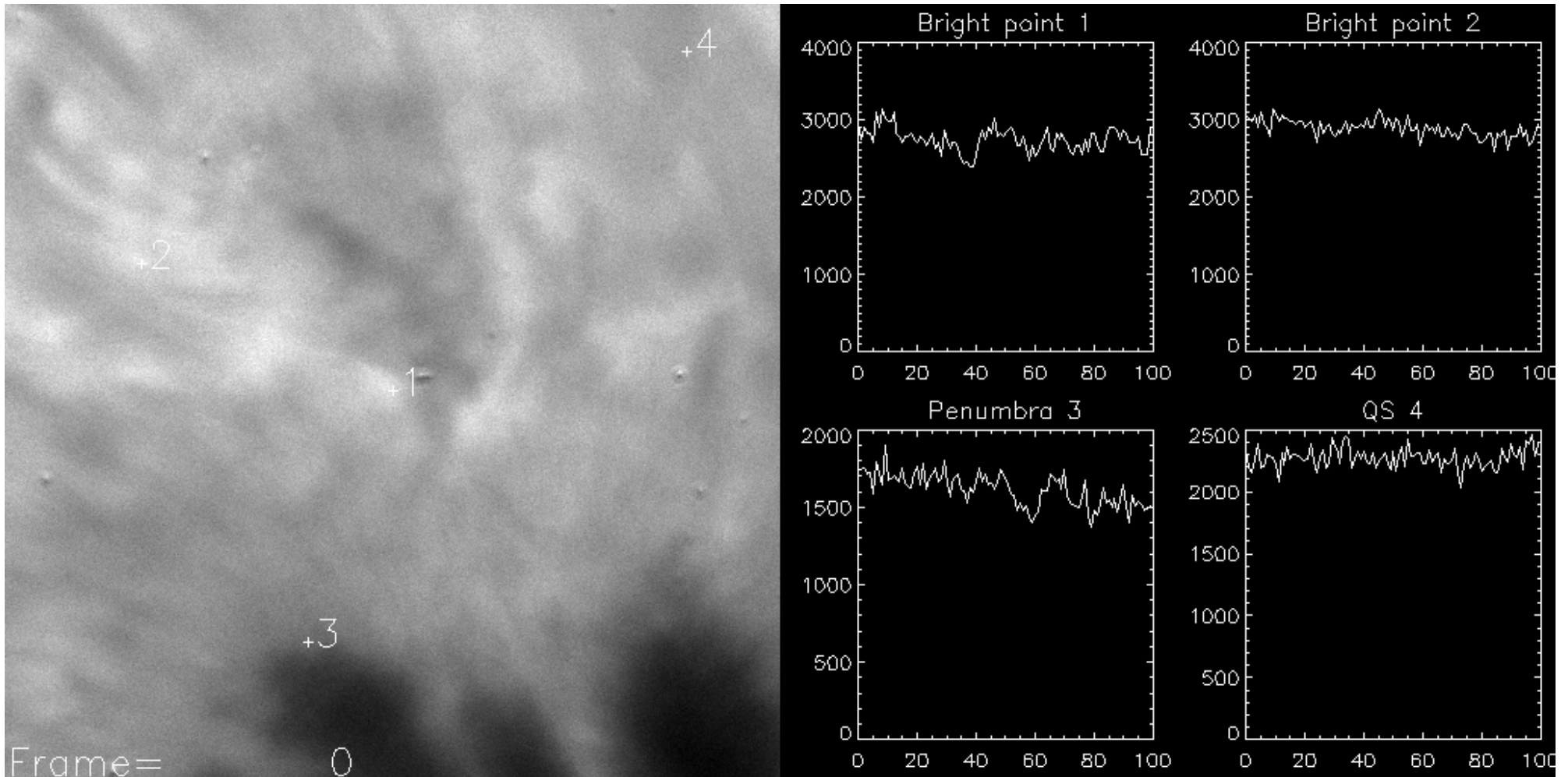






# Ultra-high-cadence observation of chromosphere

- High-sensitivity CMOS camera installed to Domeless Solar Telescope at Hida obs.
- Its high-sensitivity and fast read-out allow ultra-high cadence observation up to 100Hz
- Ha center/ $-0.5\text{\AA}$  images taken on 7/Jan/2014 with
  - 2048x2048 format
  - 3ms exposure,  $\sim 100\text{frame}/3\text{sec}$  cadence,
  - fairly good seeing
  - only 100 frames ( $\sim 3\text{s}$ ) recorded



Seeing dominant...

# Toward Solar-C/ALMA/DKIST

- Dissipation mechanism should be the next main target in Solar-C era.
- Hopefully ALMA may (may not?) acquire  $< 0.01'' \sim 7\text{km}$  resolution in solar chromospheric obs.
- Chromosphere is the only place where we can observe the global and dissipation scales at the same time!
- Other possible applications of ultra-high-cadence obs:
  - Flare emissions in chromosphere
  - High-cadence polarimetry