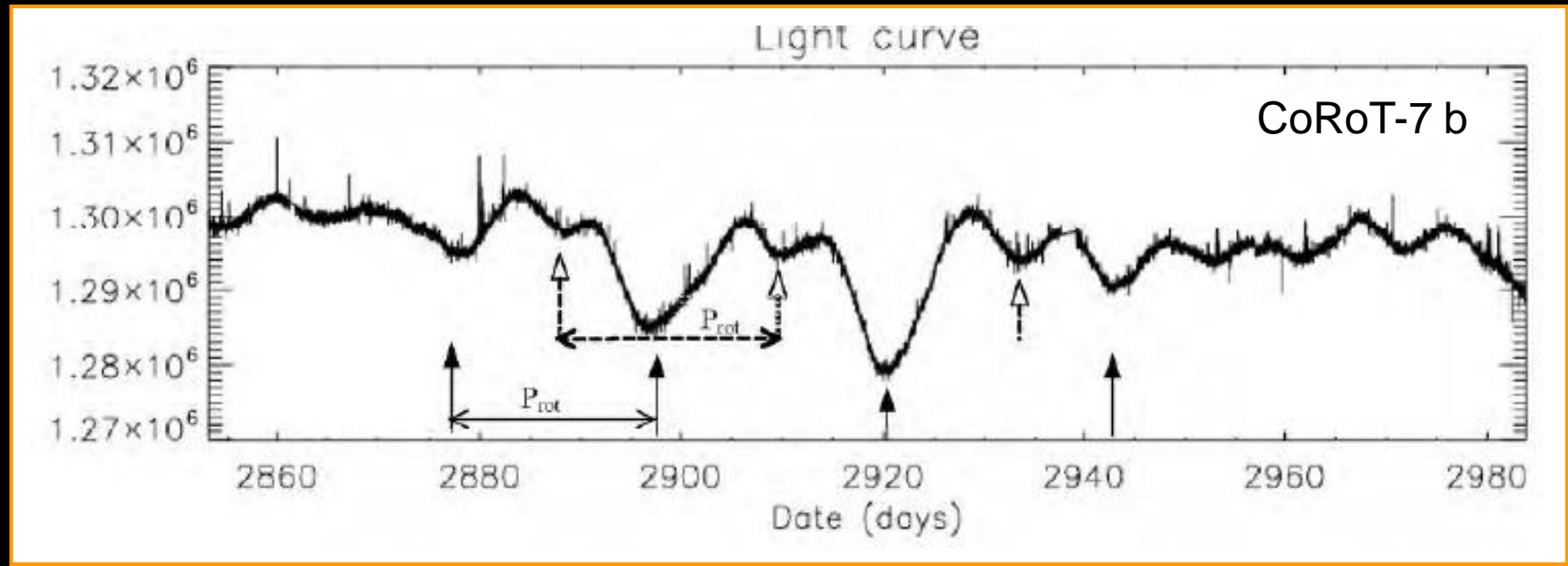
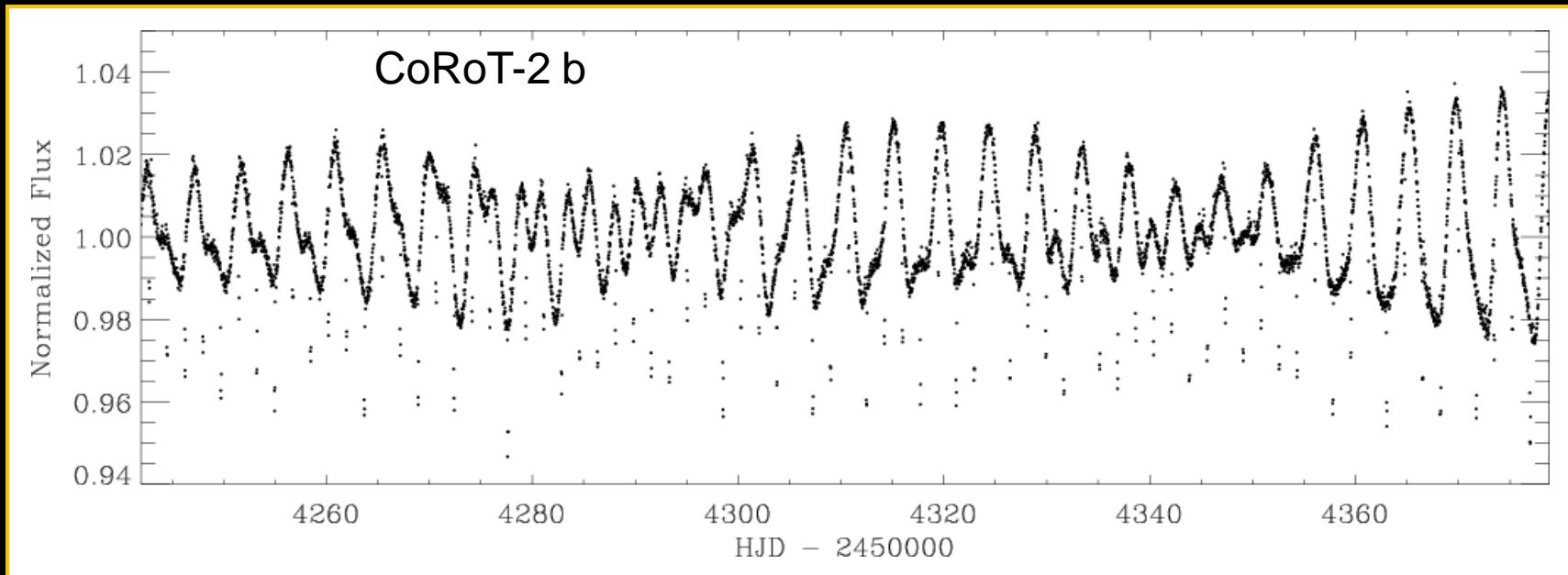
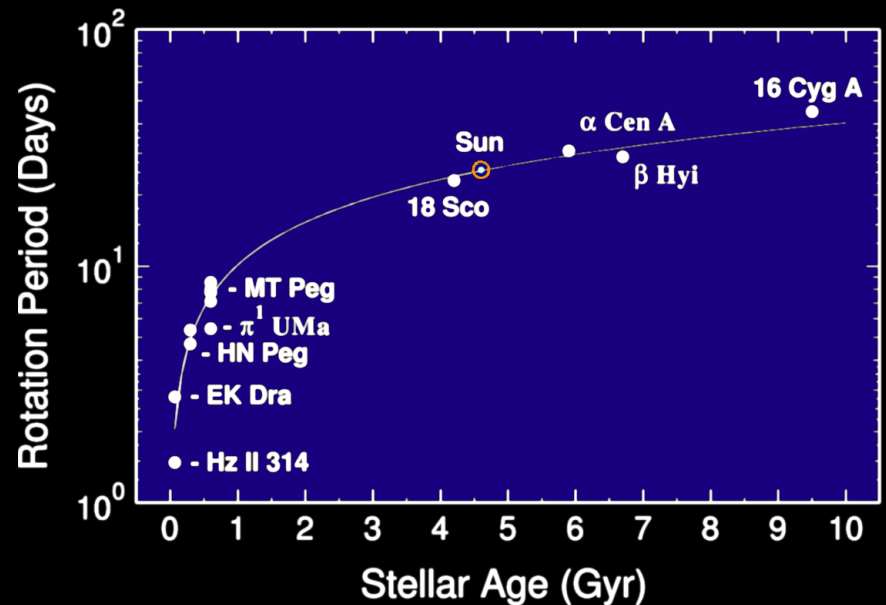


- **Photometric variability has many flavors**
 - **Intrinsic, e.g., pulsating variables**
 - **Extrinsic, e.g., binary stars (eclipsing, ellipsoidal)**
 - **Have a look at Debosscher et al. (2009, A&A, 506, 519)**
- **Focus on a particular class of variable stars: those showing activity-induced variations**
 - **Tell us about the existence, appearance and evolution of stellar surface features**
- **Space time-series are very powerful (CoRoT):**
 - **Silva-Valio et al. (2010, A&A, 510, 25)**
 - **Lanza et al. (2009, A&A, 506, 255; 2009, A&A, 493, 193)**
 - **Mosser et al. (2009, A&A, 506, 245)**



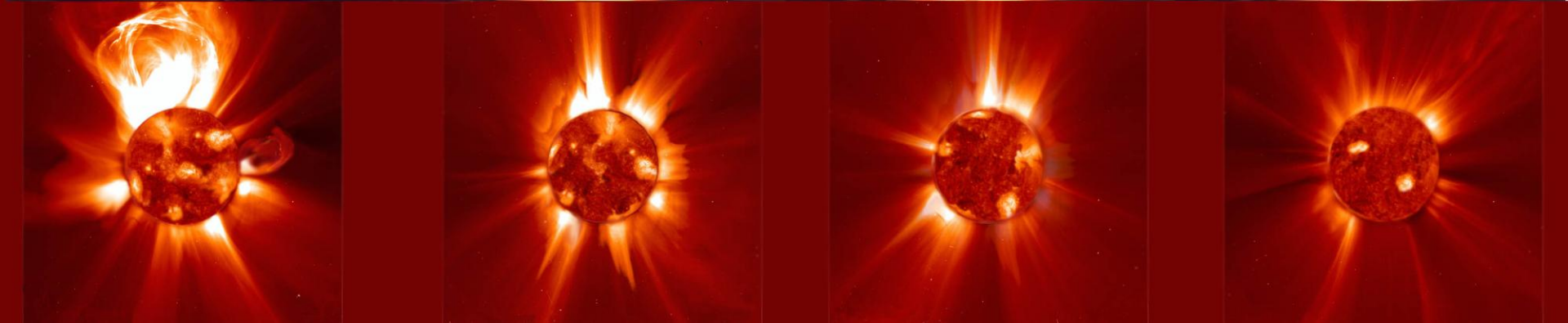
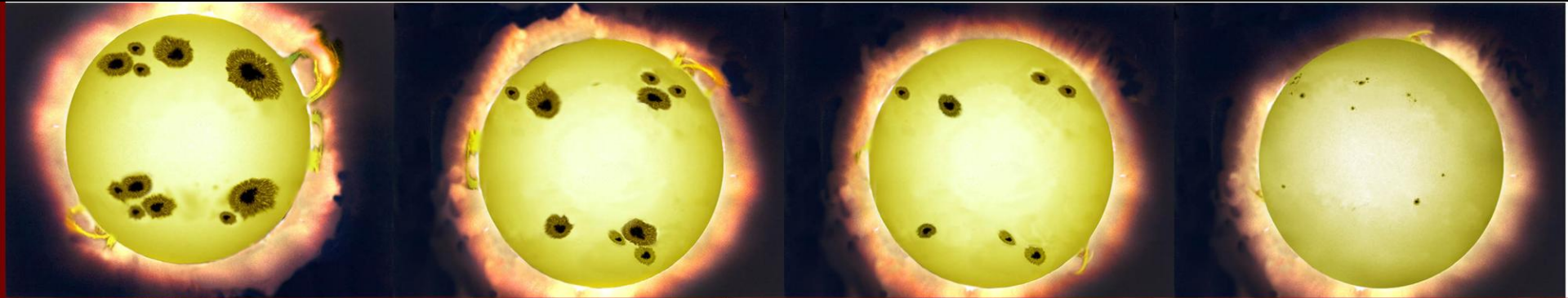
Gyrochronology / stellar activity

- Besides understanding activity, modulations can be used to extract additional info
- Slow-down of stars with convective envelope as they age (magnetized mass loss)
- For solar-type stars the relationship is well defined and quite tight
- Noticed by Skumanich (1972) \Rightarrow
 $\text{Prot} \propto t^{1/2}$



OUR SUN THROUGHOUT THE AGES

Age, Rotation, Spot coverage and Coronal X-ray Emission



< 300 Myr

~ 650 Myr

~ 2 Gyr

4 - 5 Gyr

$L_x \sim 5-10 E+29$ erg/s

$\sim 5-10 E+28$

$\sim 1E+28$

$\sim 1E+27$

P(rot) 2 -4 d; 10% spots

~8 d; 2- 5% spots

~14d; ~1% spots

~25d ; 0.2% spots

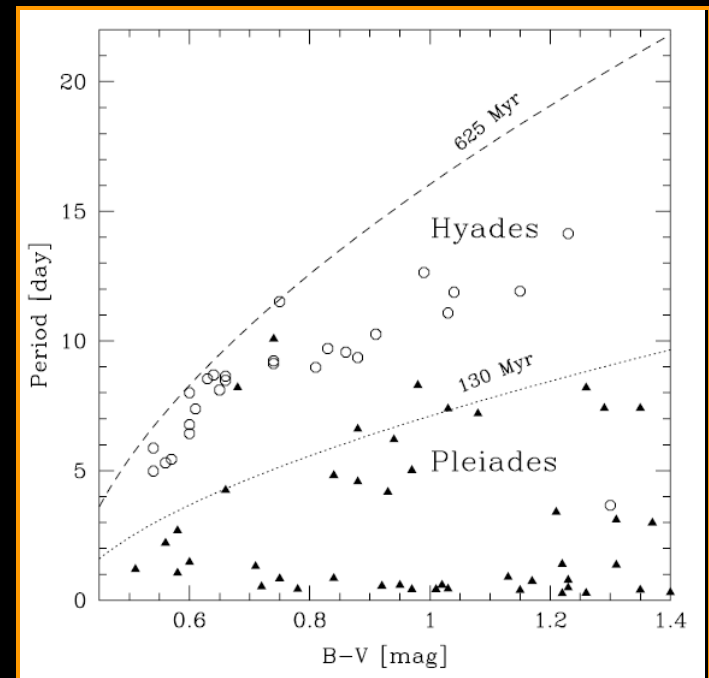
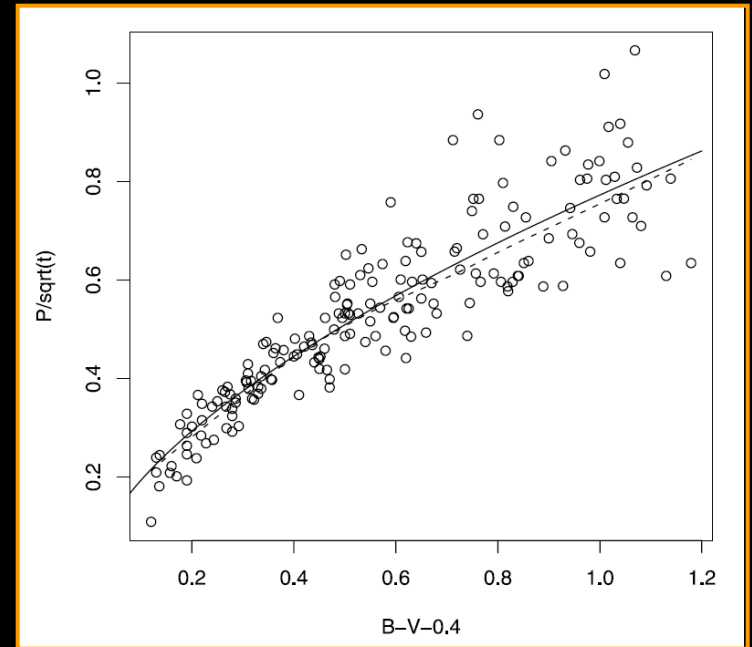
- **Calibration refined by Barnes (2007) for different spectral types**

$$P_{rot} = 0.7225 (B_0 - V_0 - 0.4)^{0.601} t^{0.519}$$

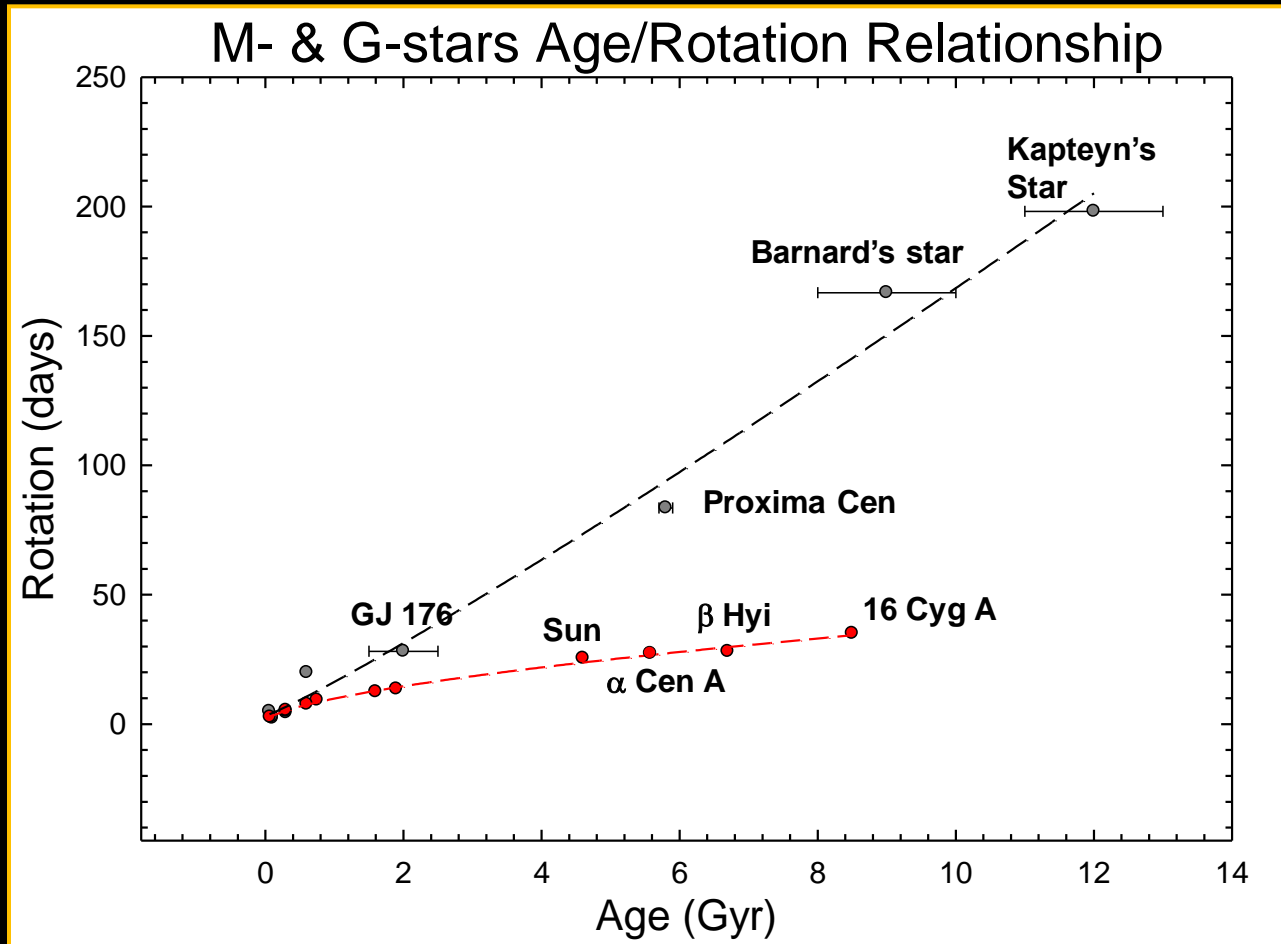
- **Error claimed to be around 15%**

- **BUT, important discrepancies found by Mamajek & Hillenbrand (2008)**

$$P_{rot} = 0.407 (B_0 - V_0 - 0.495)^{0.325} t^{0.566}$$



- **Calibrations for older ages are still TBD**
- **Some progress made**

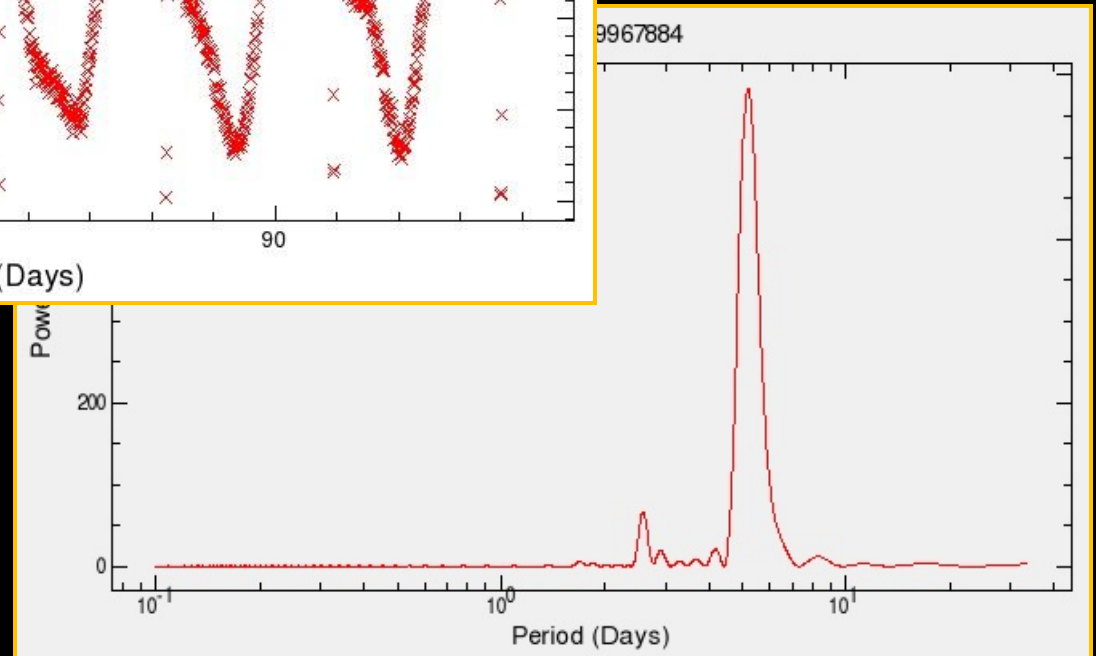
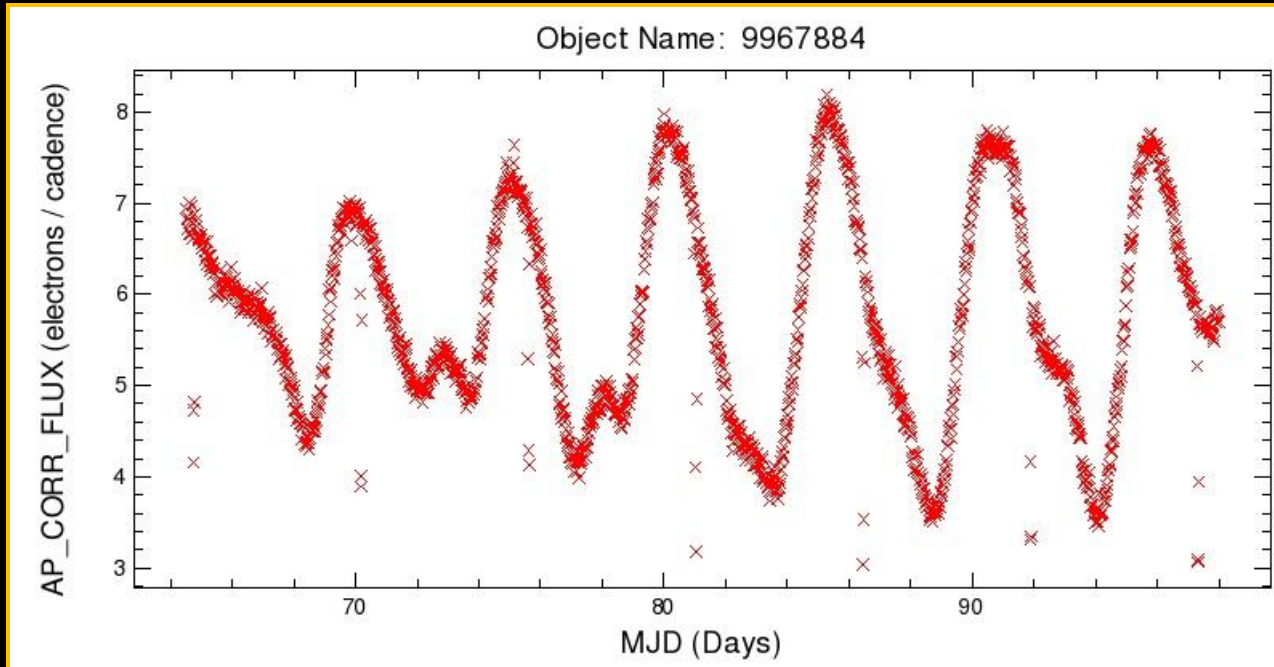


From Guinan & Engle (2009)

The project

- **Use Prot-age relationships and period-search tools in photometric time series to determine the ages of stars with planet candidates**
- **Tools:**
 - **Kepler archive**
 - **NStED toolbox (light curve retrieval, periodogram calculation)**
 - **Your own codes & favorite visualization software**

- **Data source: Borucki et al. (2010, arXiv:1006.2799)**
 - **Catalog of 306 planetary candidates**



Questions:

- 1. What are the ages of stars with planet candidates?**
- 2. Are they representative of the solar neighborhood?**
- 3. Is there any correlation with planet size?**
- 4. Do you see differential rotation?**
- 5. What is the fraction of doubly-synchronized systems?**
- 6. Can you put constraints on the mass of the planet candidate from tidal evolution?**