### **Exotic variables from ZTF**







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WICKY TRANSIENT FACILITY







### Stellar variability is very common













### How did we find them





# CD-30 11223 - SN la progenitor candidate (P<sub>orb</sub> = 70min) - <u>found completely serendipitously</u>

Flux

- Lightcurve shows weak eclipses
- Analysis gives:

M<sub>sdB</sub> = 0.54 M<sub>sol</sub>; M<sub>WD</sub> = 0.74 M<sub>sol</sub> => Progenitor system most likely 3 + 4 M<sub>sol</sub> binary





Will get in contact in about 40 Myr

Will probably explode as SN Ia??



### Look for the freaks





### Two new CD-30 like systems from PTF -Parameter (very preliminary)





### Look for the freaks







# The population of freaks





### The sample of hot subdwarf stars





# Data minining





### The ZTF high-cadence Galactic Plane survey



# The fast and the furious - A fast cadence survey of the Galactic Plane

- <u>Time period:</u> mid 2018 mid 2019
- <u>Cadence</u>: continuous for 2 3 hrs
- <u>Coverage</u>: ~2500 square degrees



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### **Include time-domain information**

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### **Include time-domain information**



### **Include time-domain information**



# A new class of radial mode hot subdwarf pulsators



- Large amplitudes (photometry, velocity, Teff, surface gravity)
- 4 candidates, periods 3-8 min
- Observed mass and period is best consistent with cooling low mass helium white dwarf models with mass around 0.25 - 0.30 M<sub>sun</sub>
- Low mass He-core burning stars cannot be fully excluded

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Kupfer et al. in prep.



# Two new CD-30 like systems - Parameter (very preliminary)



- $M_{sdB} \sim 0.40 M_{sun}$
- $M_{WD} \sim 0.65 M_{sun}$

- <u>P<sub>orb</sub> = 76.3 min</u>
- M<sub>sdB</sub> ~ 0.35 0.4 M<sub>sun</sub>
- MwD ~ 0.7 0.8 Msun



# Two new CD-30 like systems - Parameter (very preliminary)

**ZTFJ0007** (b=-14.6deg)

(b=8.9deg)



- <u>Porb</u> = 72.1  $M_{sdB} \sim 0.40$ 

- <u>Porb = 108 min</u>
- typical sdB but no full RV curve yet

4 M<sub>sun</sub> M<sub>sun</sub>



 $M_{WD} \sim 0.65$ 

# ZTF J2130 - The most compact hot subdwarf binary



- very short orbital period: 39min
- velocity and phase shows that this is the shortest period hot subdwarf known
- The lightcurve is remarkable and inconsistent with a simple detached ellipsoidal system



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6.5

R (kpc)

- Kinematics shows its a member of the thin disc population

8.5

# The sky location of the presented 'exotic' variables



All systems are located at low Galactic latitudes



# Summary

'Exotic' objects can teach us a lot about stellar evolution and stars in general

- Combining many catalogs allow us to select 'exotic' from more 'normal' objects
  - In particular Gaia was a game changer
- Combing with time-domain surveys reveal even more information (e.g. binaries, pulsators)
  - Bottleneck now is follow-up (in particular spectroscopy)
  - Hot subdwarf catalog has about 1 star per square degree.
    - Perfect filler for multi-object spectrographs
      - Little price <-> high return



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