

# Finding Milky Way Black Holes with the NGVLA



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# Searches for accreting BH binaries can answer:

How many BH X-ray binaries are there?

Current estimates span  $10^2$ – $10^8$  (Tetarenko+ 2016)

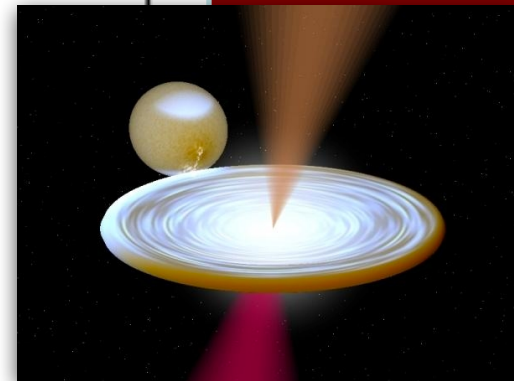
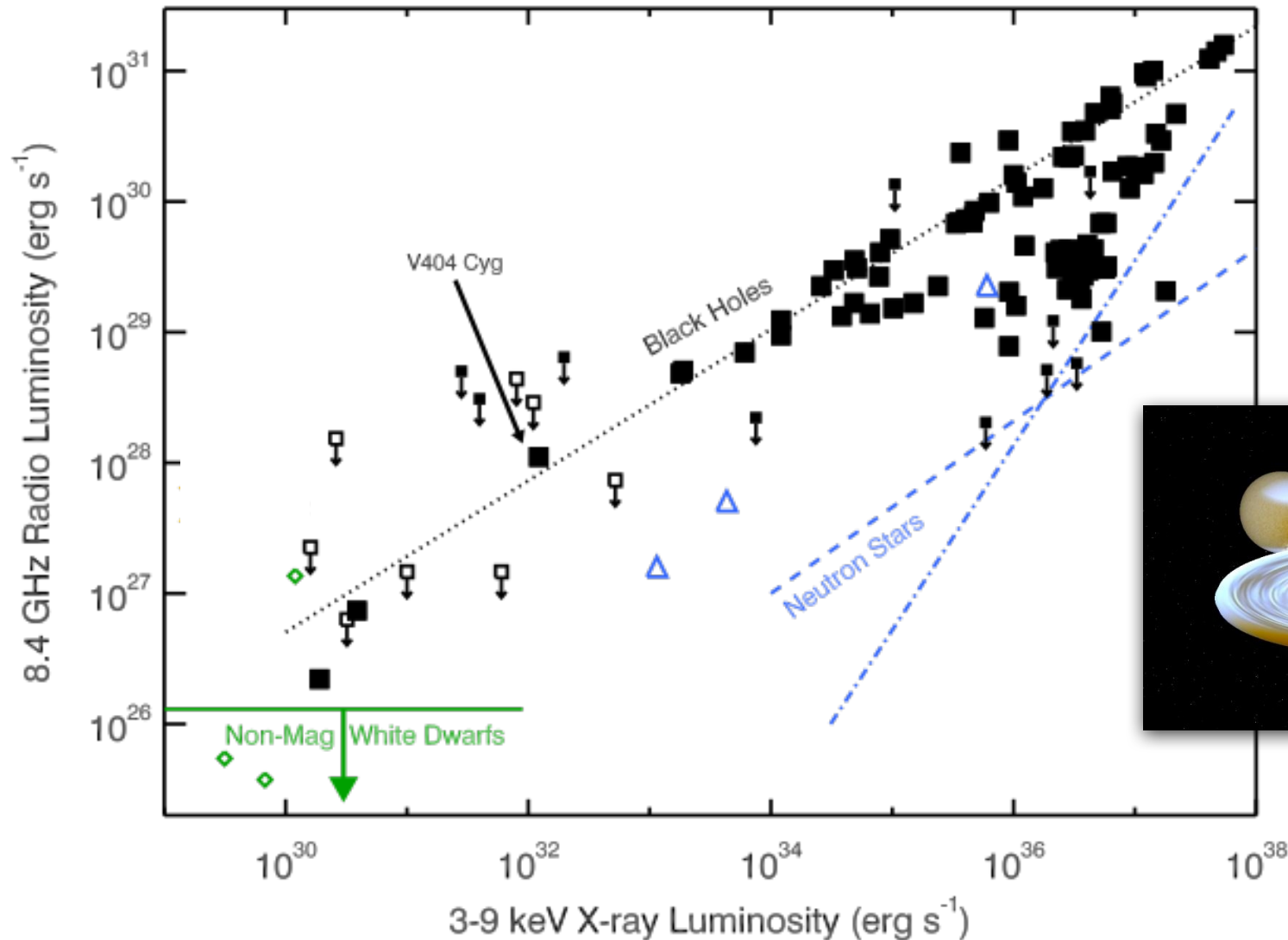
What natal kicks do BHs receive?

What is the mass spectrum of stellar-mass BHs?

What is the relative importance of dynamical and binary channels in forming LIGO mergers?



# Finding low-luminosity Black Holes with radio/X-ray

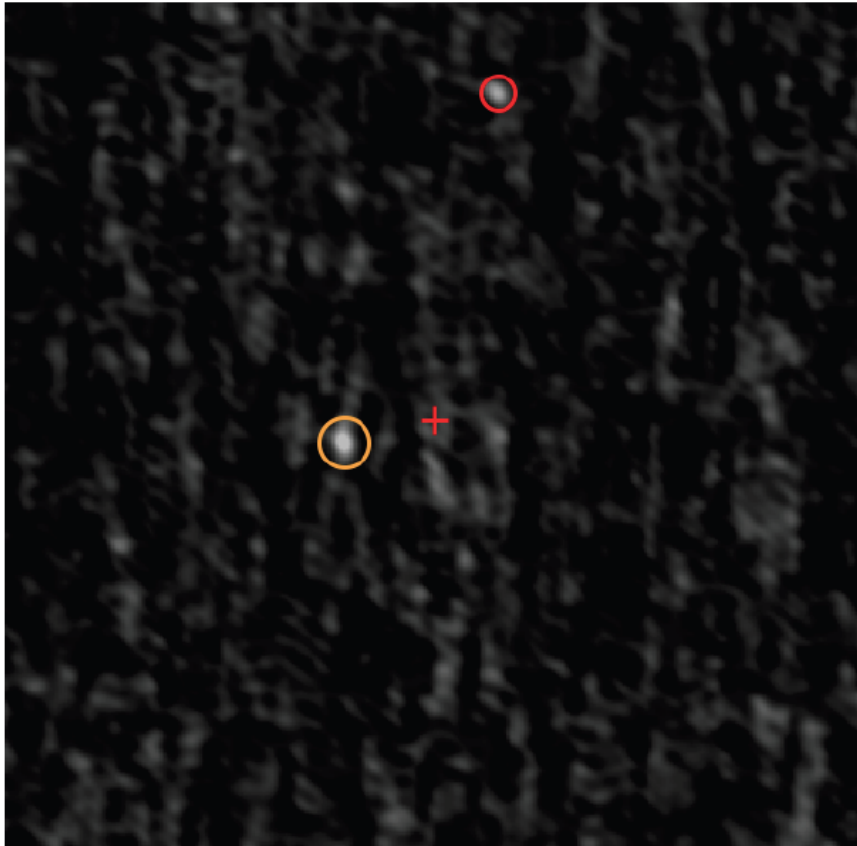


# What BH candidates look like

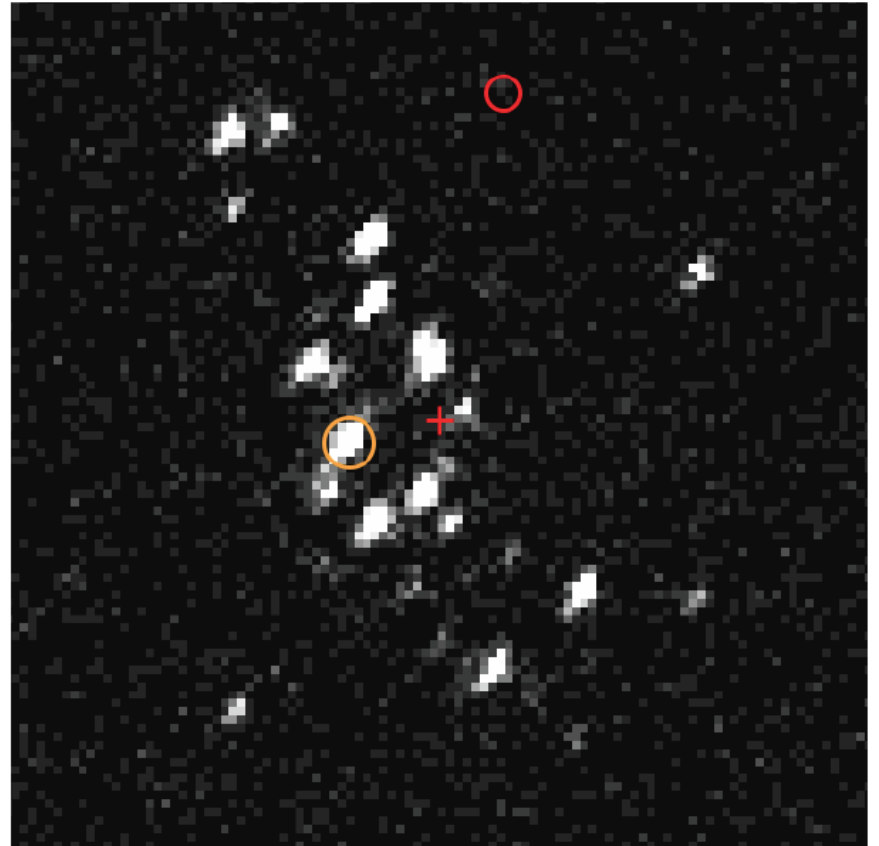
25''

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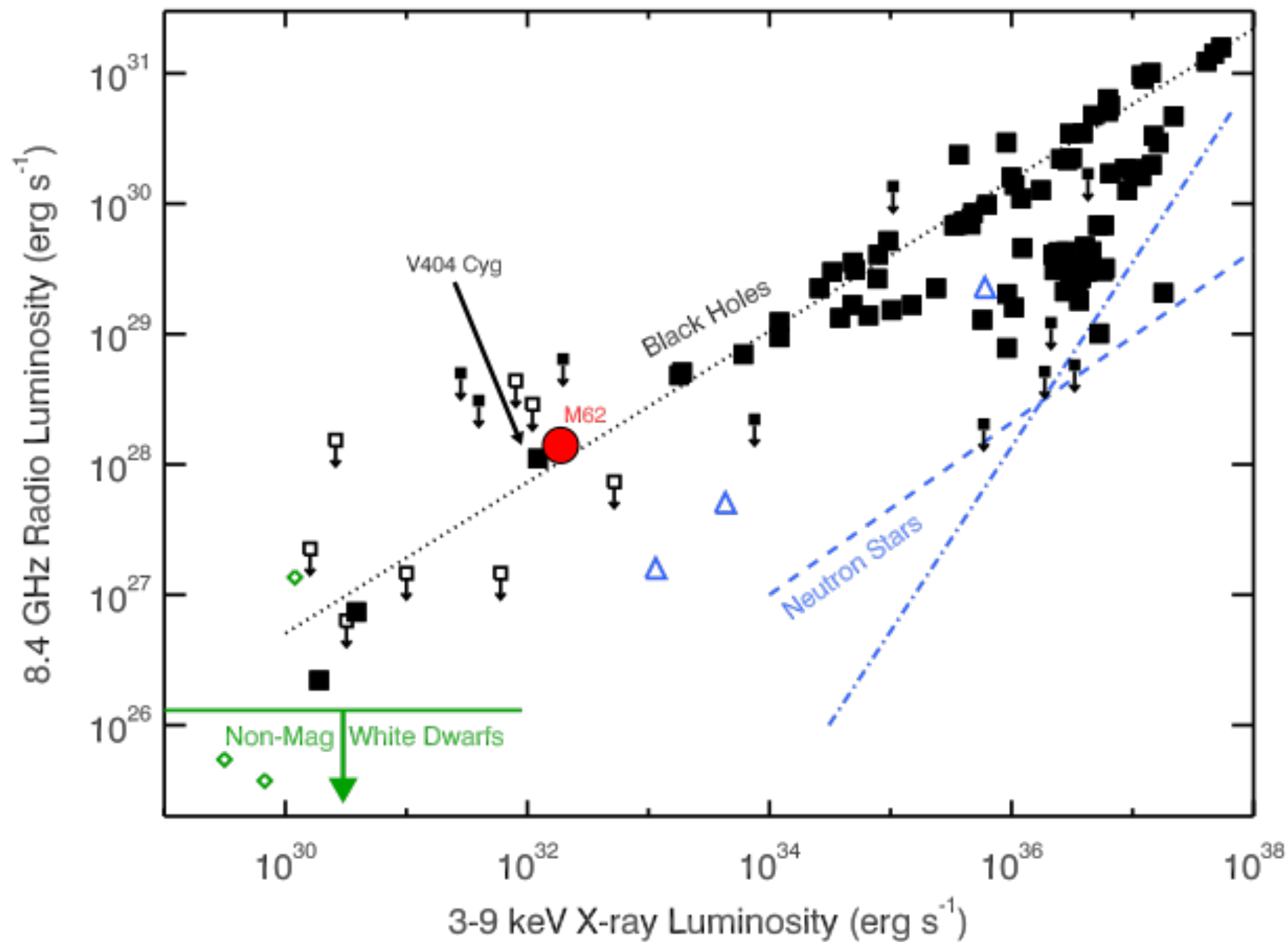
Chomiuk et al. 2013



VLA

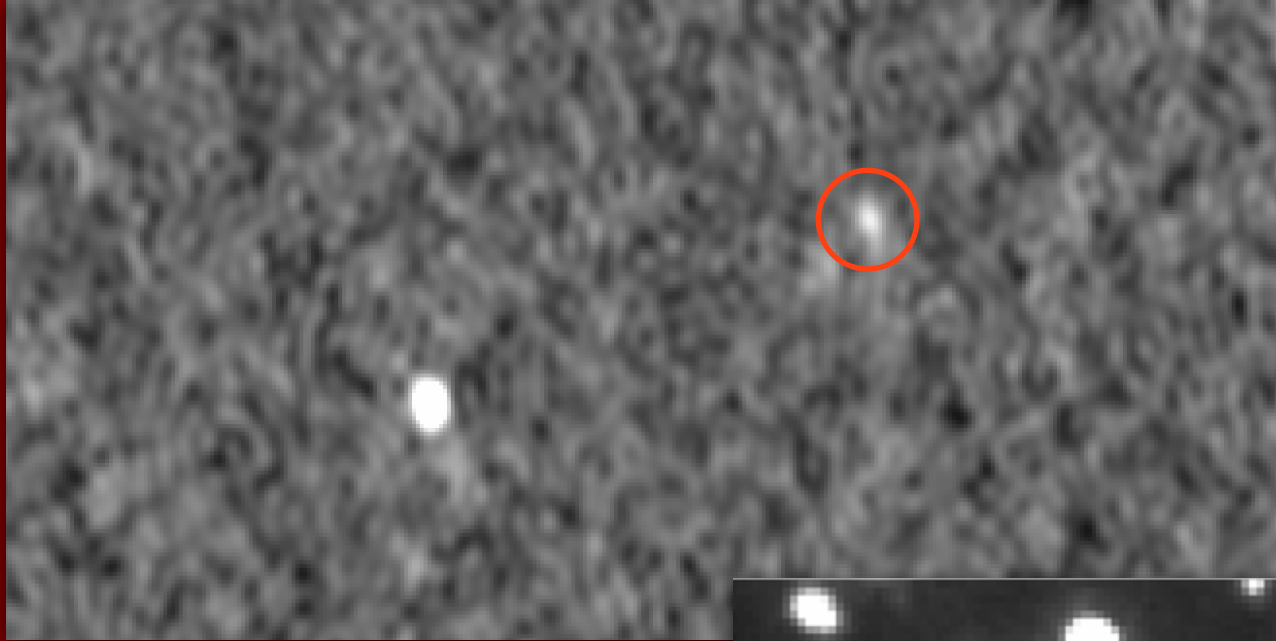


Chandra



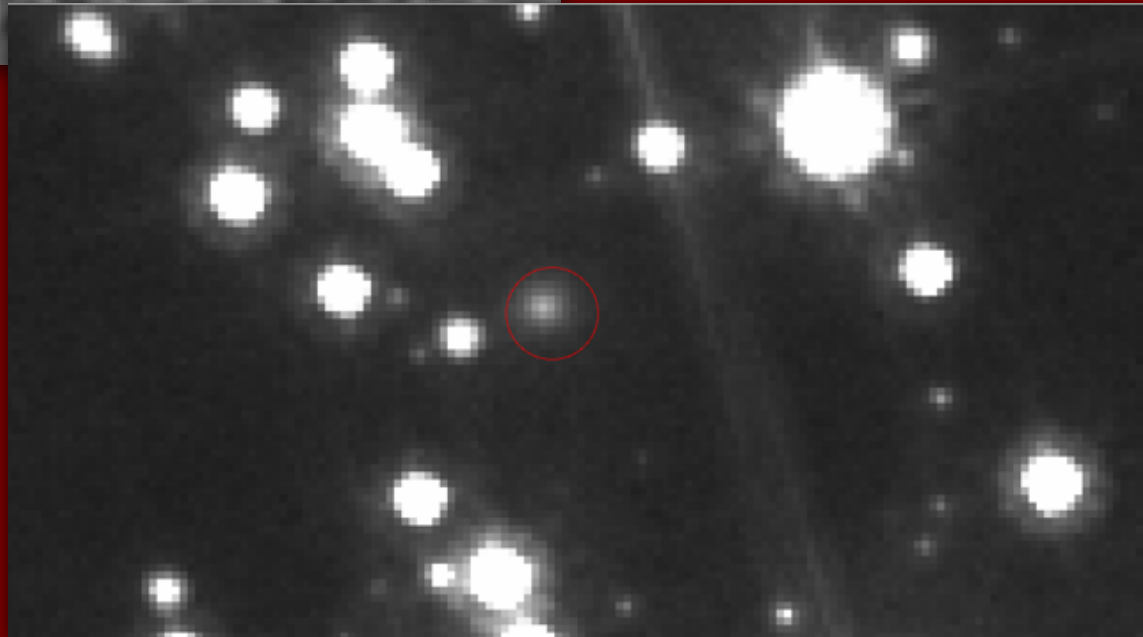


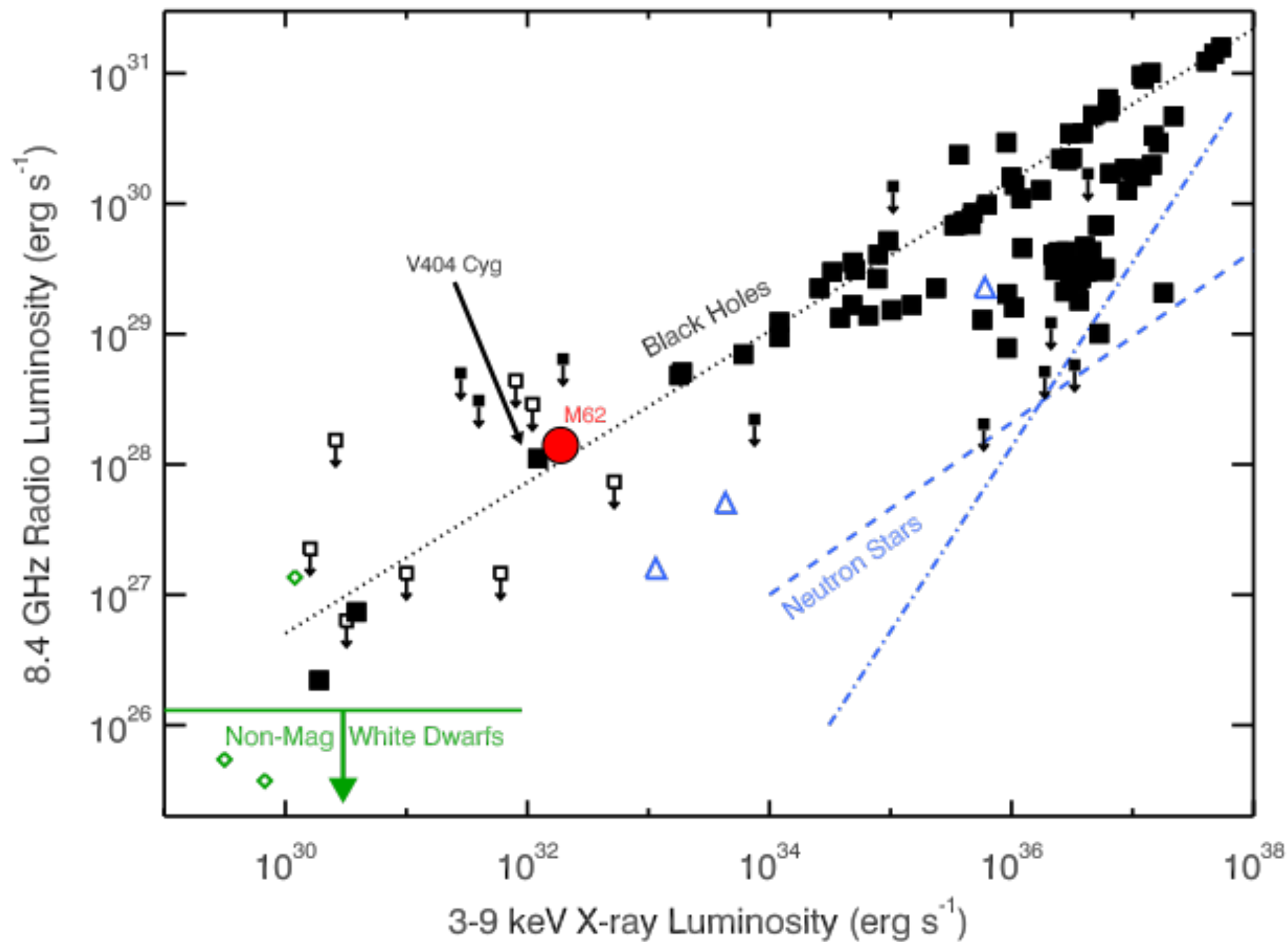
# We can find contaminants.



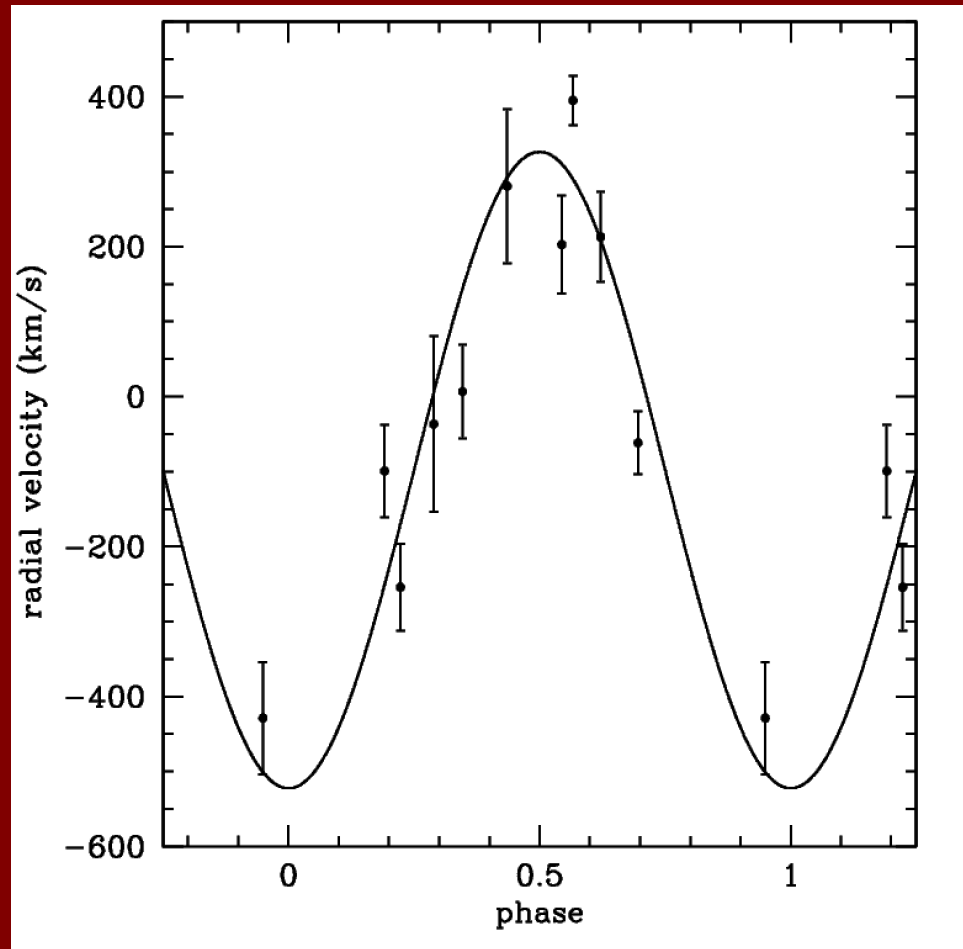
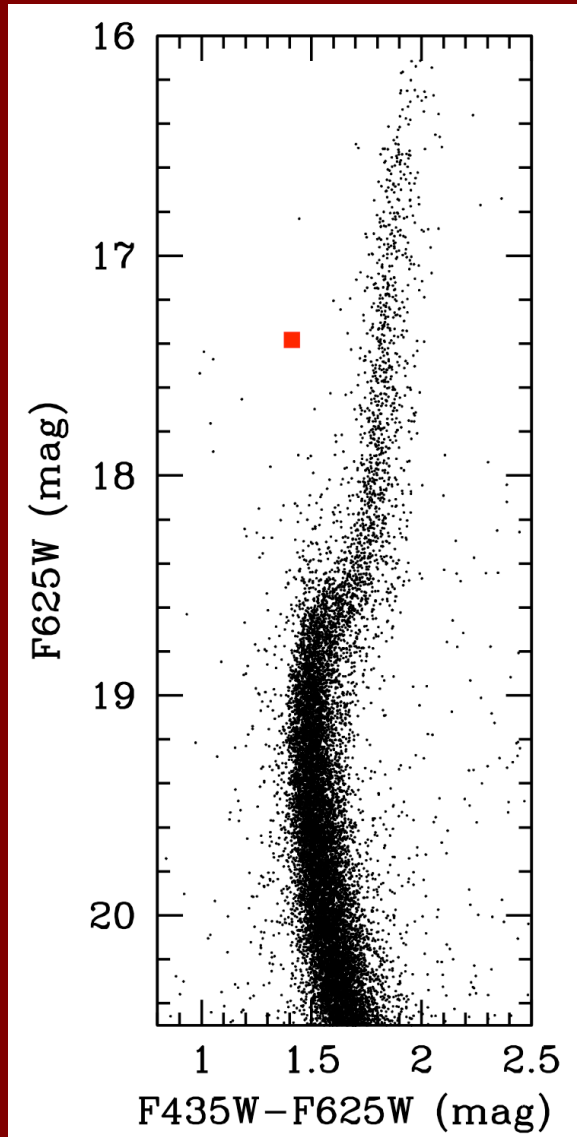
Select for  
flat-spectrum  
radio sources

Background AGN  
are visible as  
galaxies in  
optical images.





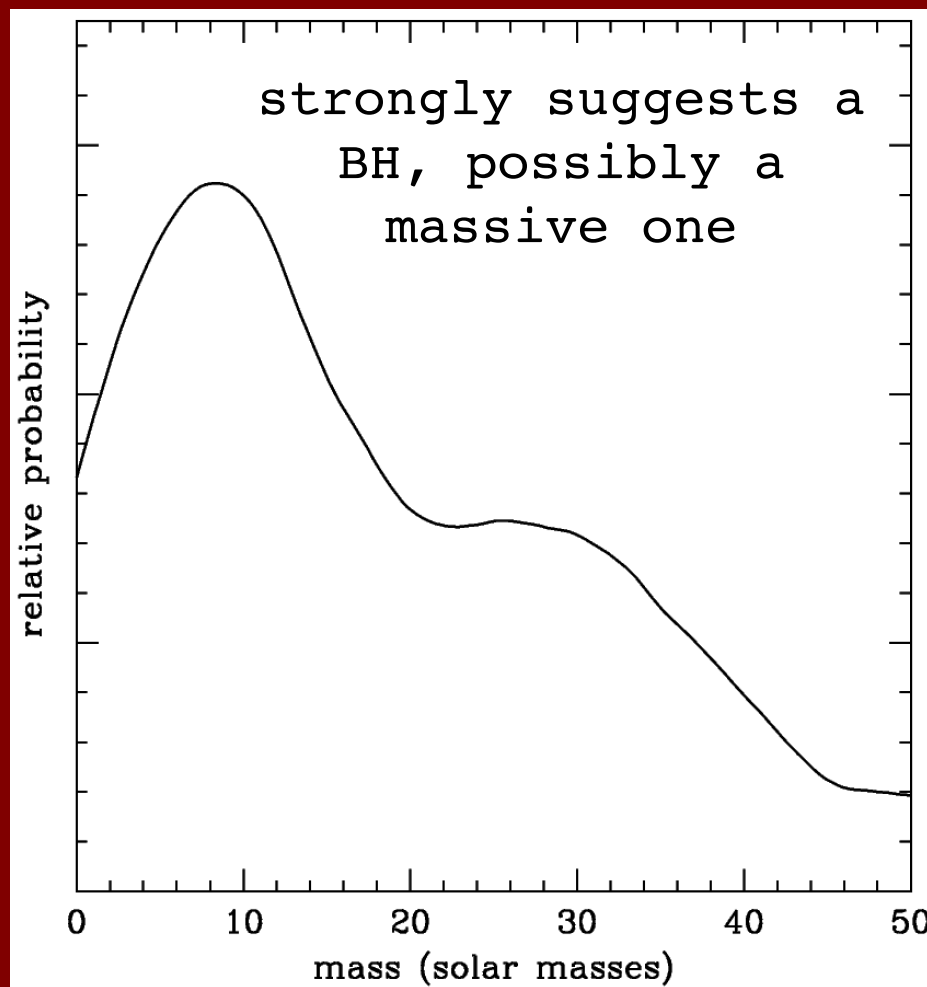
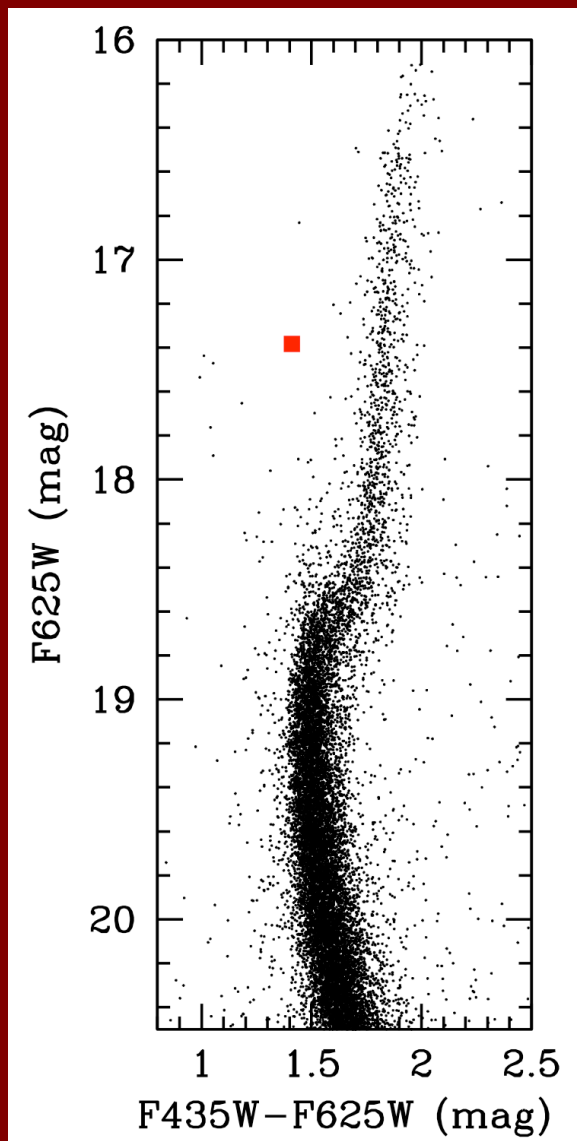
# M62 BH Candidate



Radial velocities of the red giant companion constrain the mass of the invisible compact object

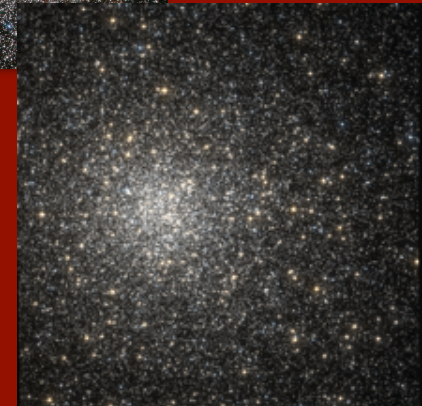
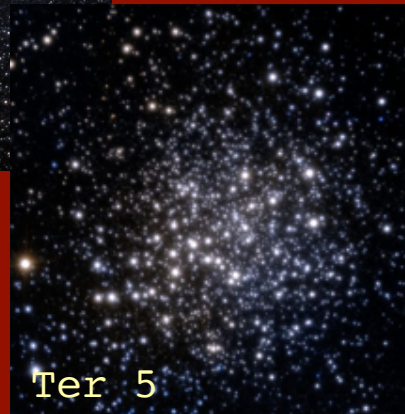
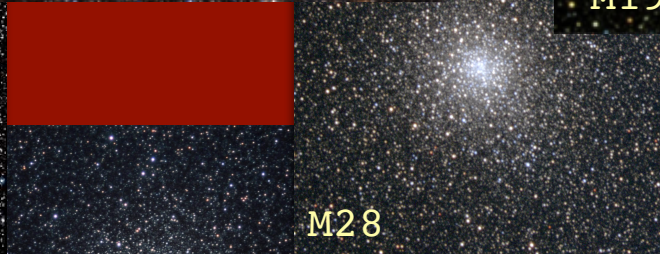
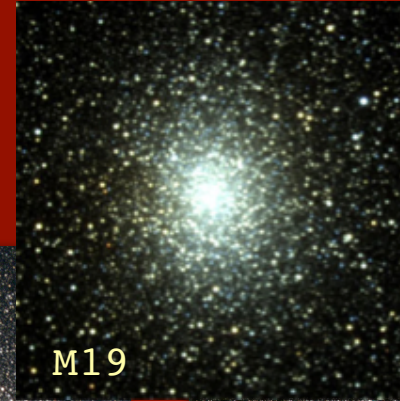


# M62 BH Candidate



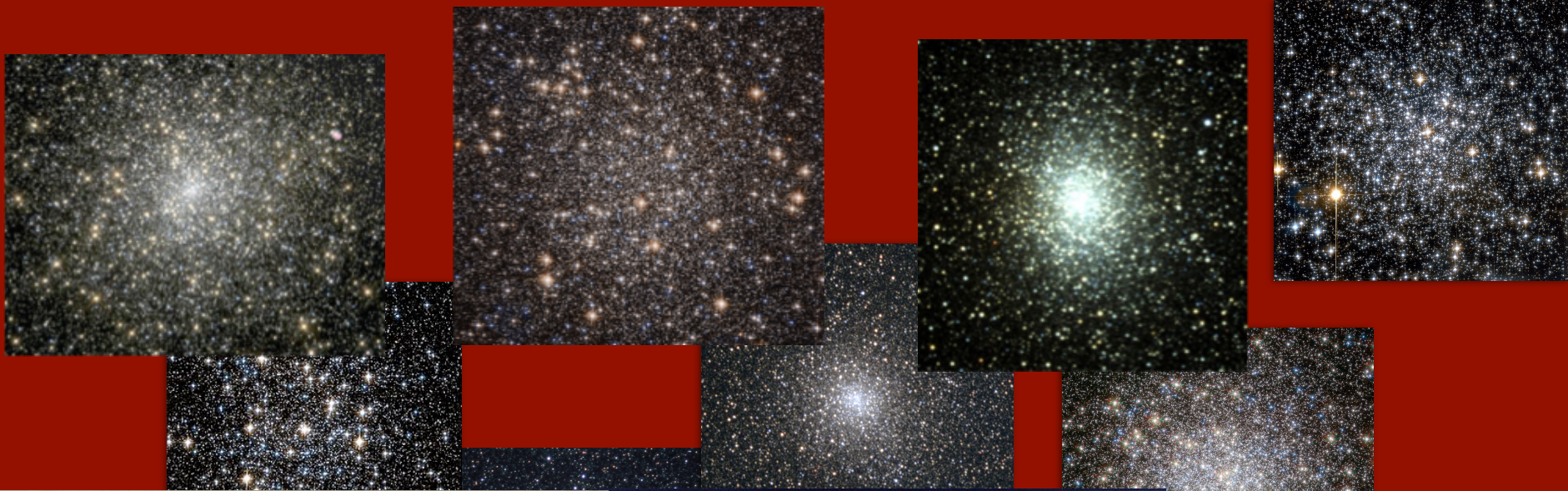
Radial velocities of the red giant companion constrain the mass of the invisible compact object

# Searching for more black holes in globular clusters





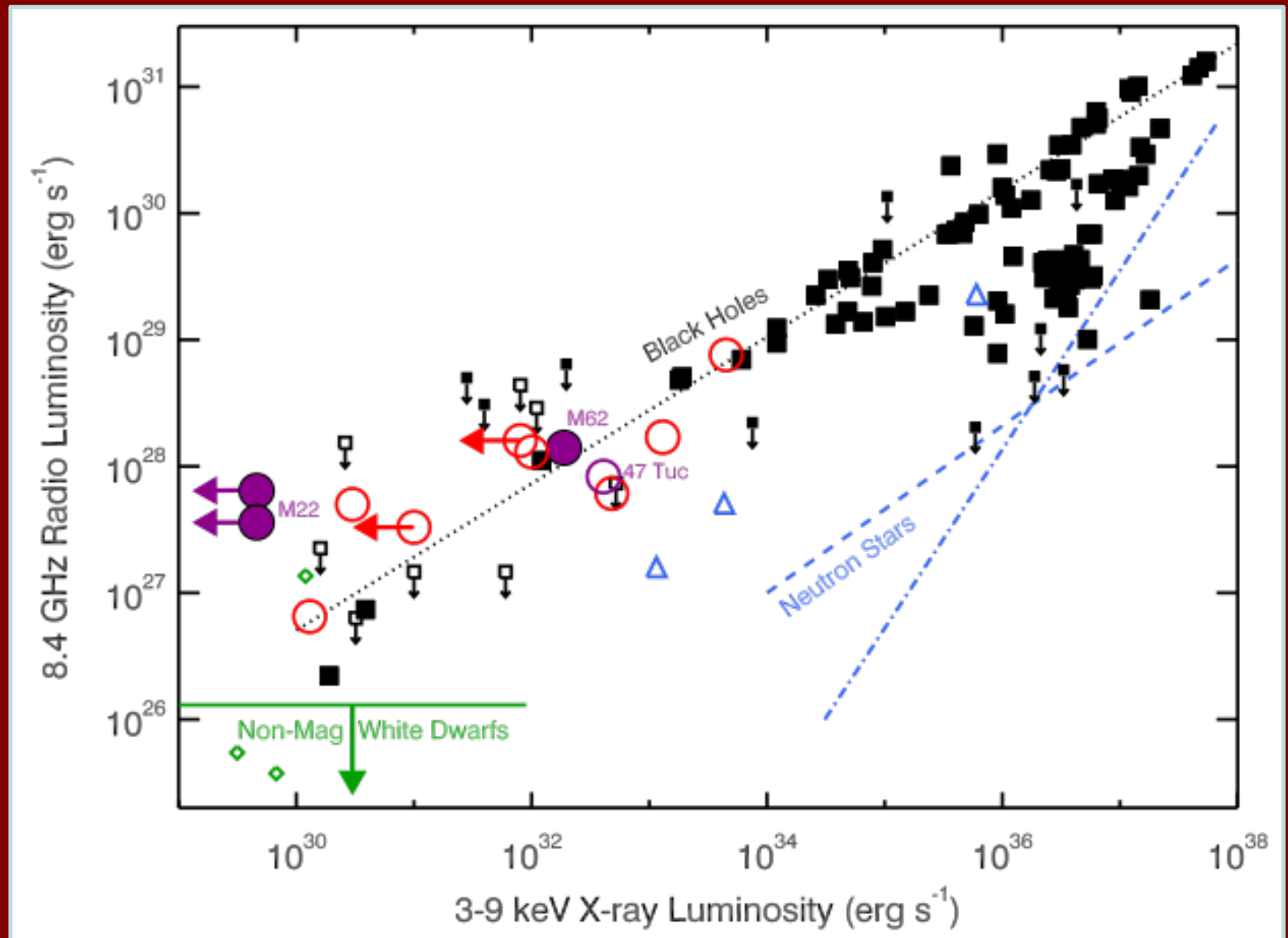
# Searching for more black holes in globular clusters



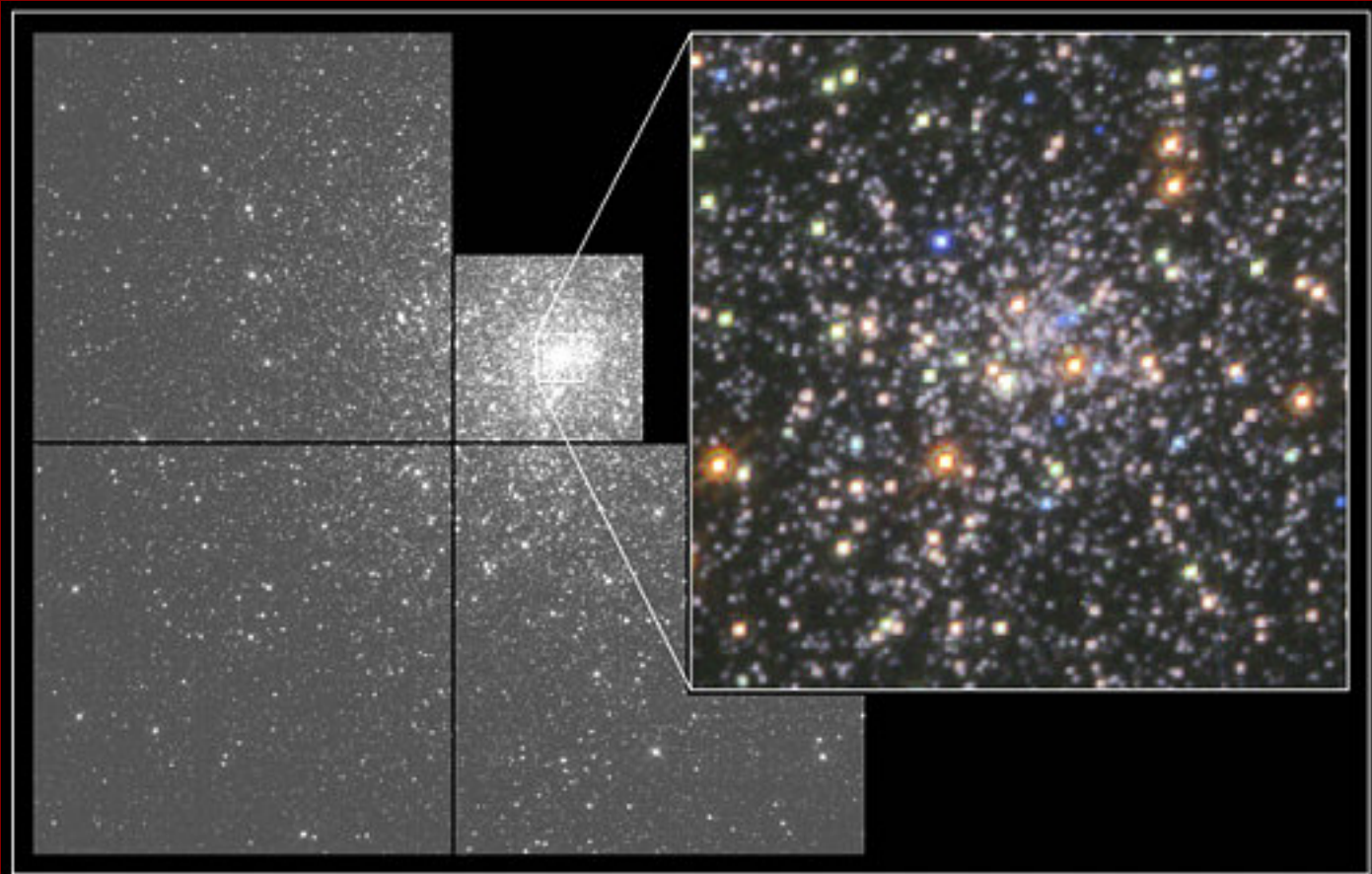
Search 54  
clusters  
for radio  
emission



26% of GCs have BH candidates



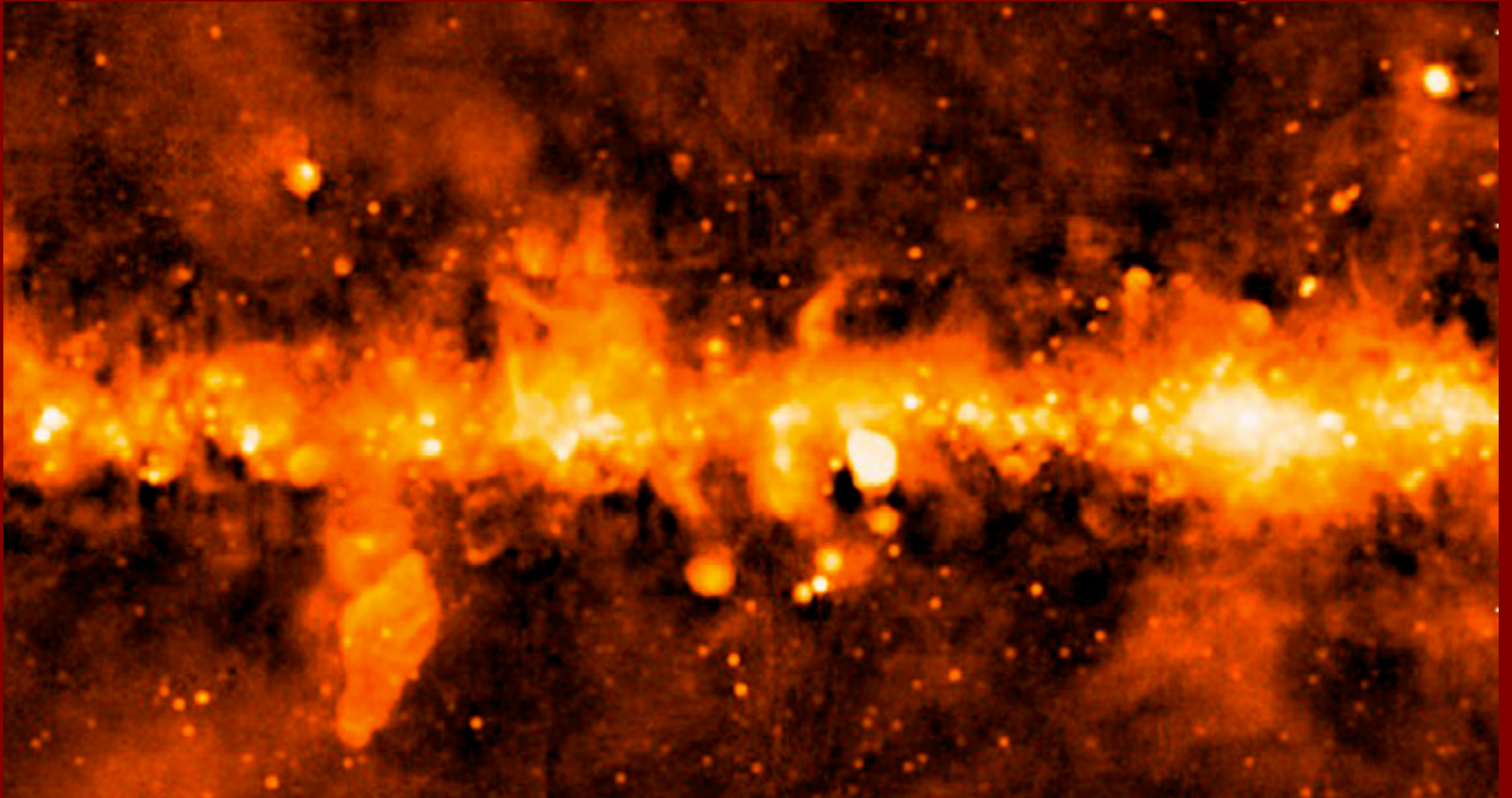
This technique works well in globular clusters, where we focus on small core regions.



**Globular Cluster M15**

Hubble Space Telescope • Wide Field Planetary Camera 2

But it can be extended to  
the Galactic plane.





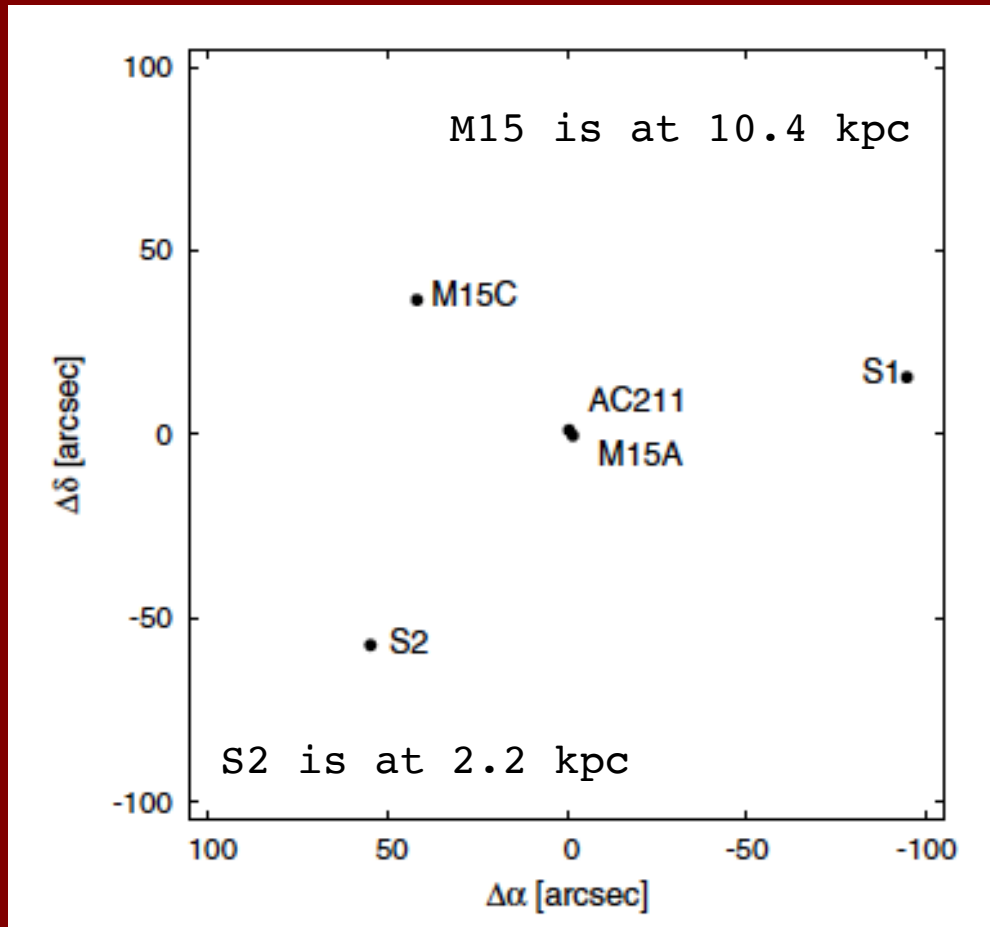
# BH Searches with NGVLA

- Survey the Galactic plane/bulge---We can detect V404 Cyg out to 10 kpc in just 4 min!
- Wide bands enable focus on flat-spectrum objects
- LSST/WFIRST will enable star/galaxy separation.
- X-ray survey facilities like eROSITA or Lobster will be needed to constrain  $L_R/L_X$ .

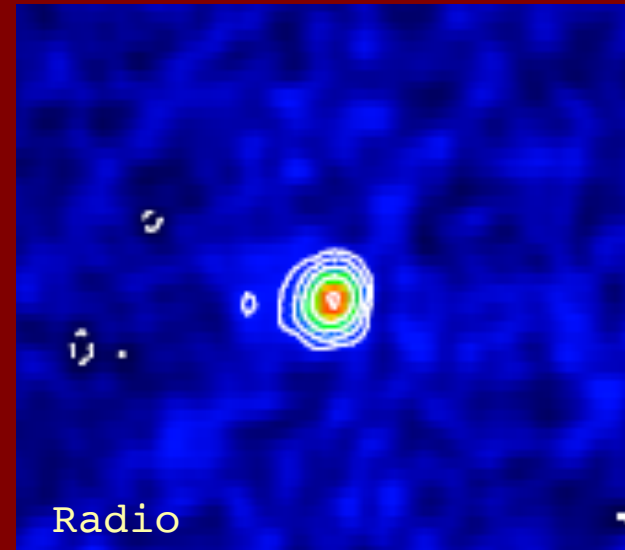
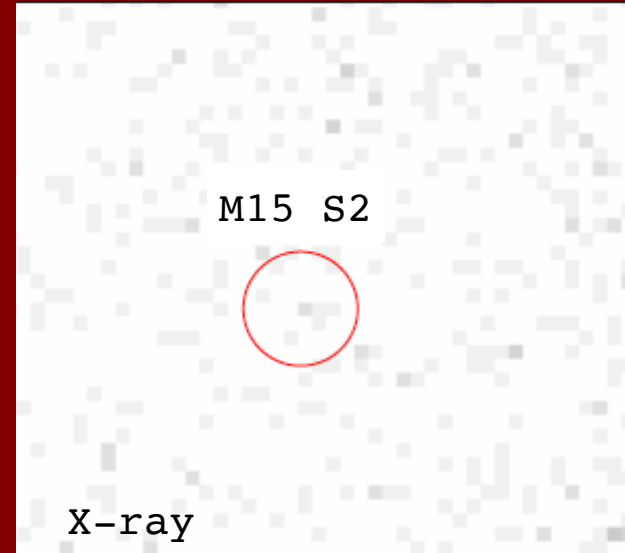
end

# The curious case of M15 S2

Parallax says:



Kirsten et al. 2014



Tetarenko et al. 2016

# Radio bright Galactic objects (BHs?)

