A New Chapter in Hard X-rays of the M87 AGN

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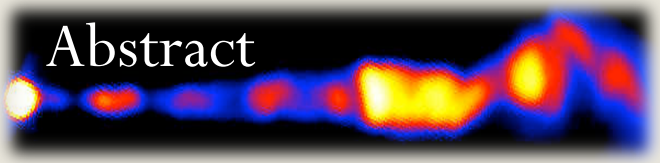
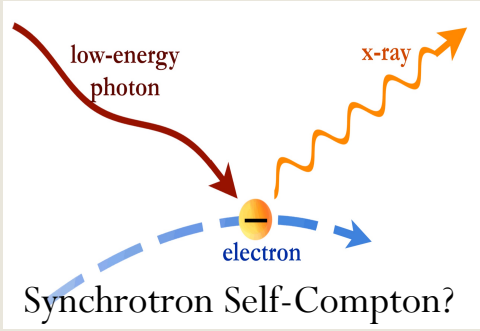
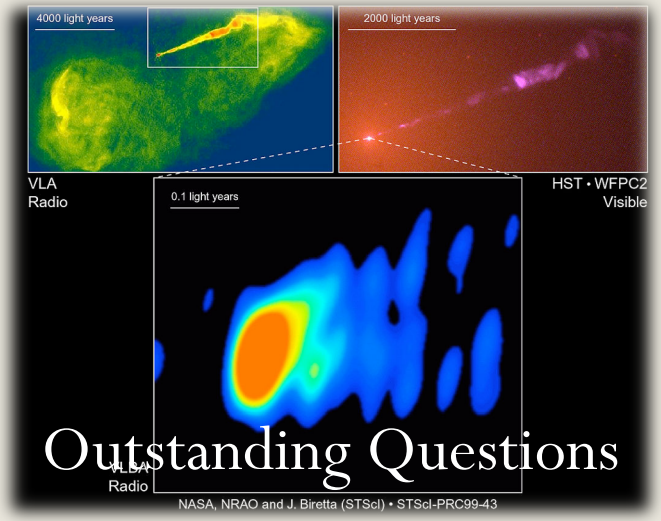
Abstract



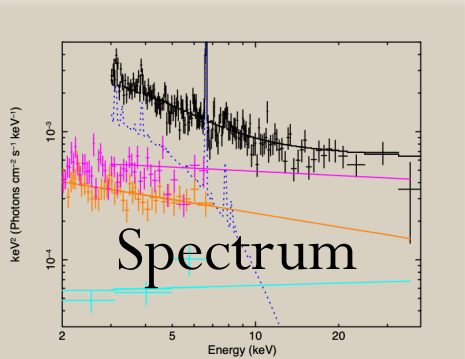
Imaging



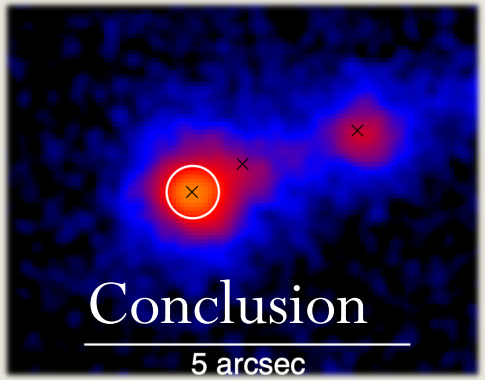
Outstanding Questions



Spectrum



Conclusion



Abstract:

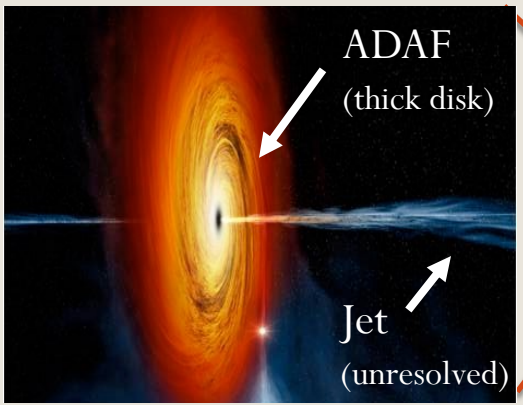
The nearby M87 hosts an exceptional relativistic jet. It has been regularly monitored in radio to TeV bands, but little has been done in hard X-rays above 10 keV. We have successfully detected hard X-rays up to 40 keV from its X-ray core with joint Chandra and NuSTAR observations, providing important insights to the X-ray origins. We argue that the hard X-ray emission mostly comes from the unresolved jet rather than the accretion flow. We found that the hard X-ray emission is significantly lower than that predicted by synchrotron self-Compton models introduced to explain the very-high-energy gamma-ray emission above a GeV. We report updates of our hard X-ray study and discuss recent models to understand these high energy emission processes.

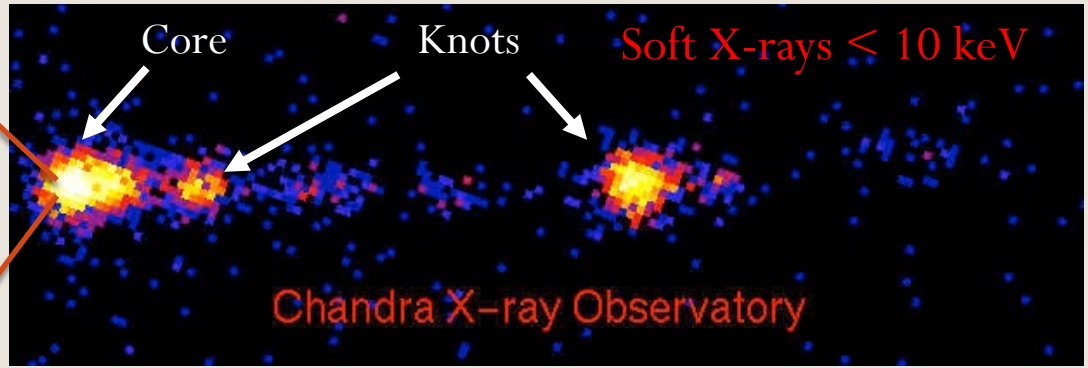
Outstanding questions that can be answered with NuSTAR:

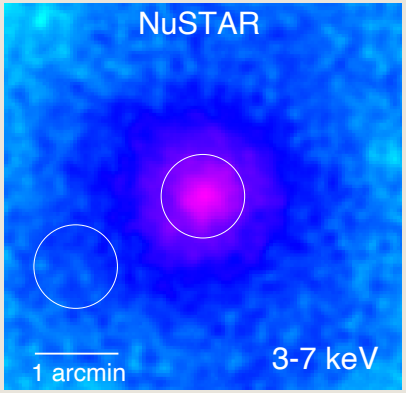
- What is the level of hard (>10 keV) X-rays from the M87 AGN?

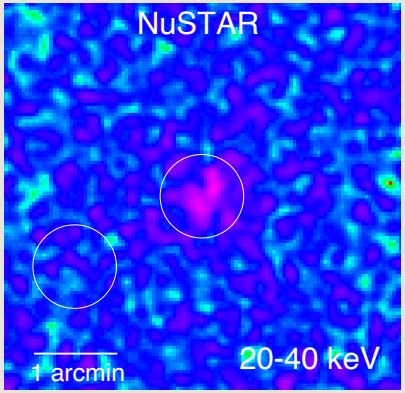
If detected:

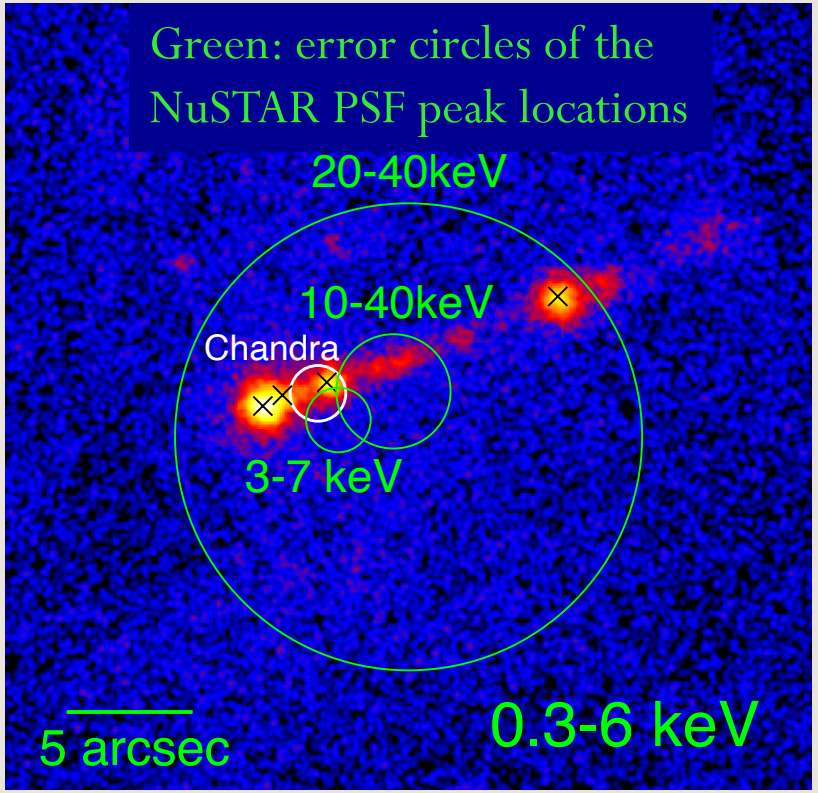
- Does the hard X-ray emission come from the core or the knots?
- Does the hard X-ray emission come the accretion flow (ADAF) or the (unresolved) jet?



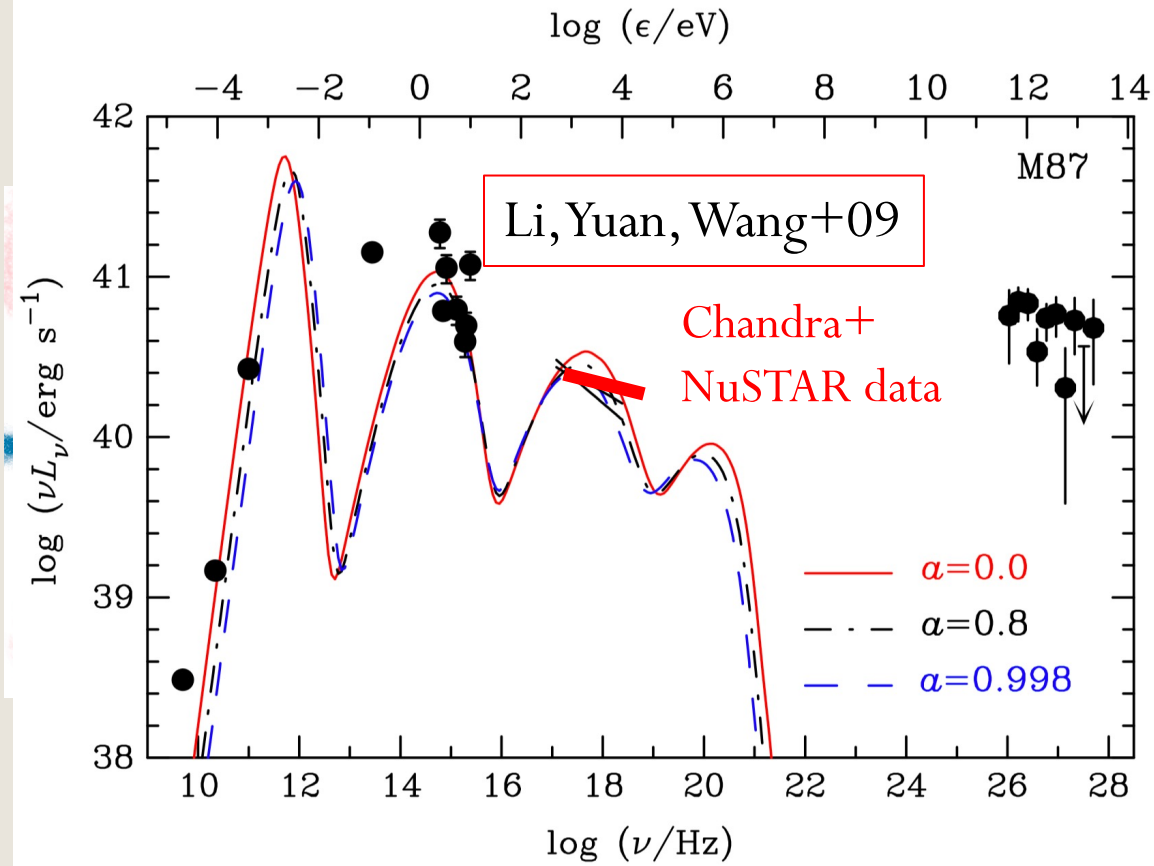


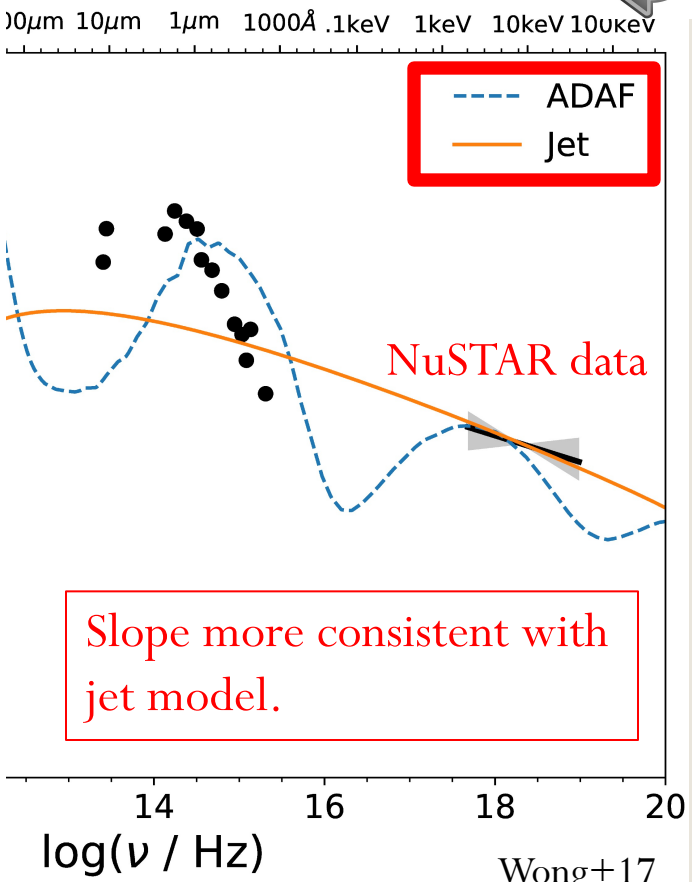






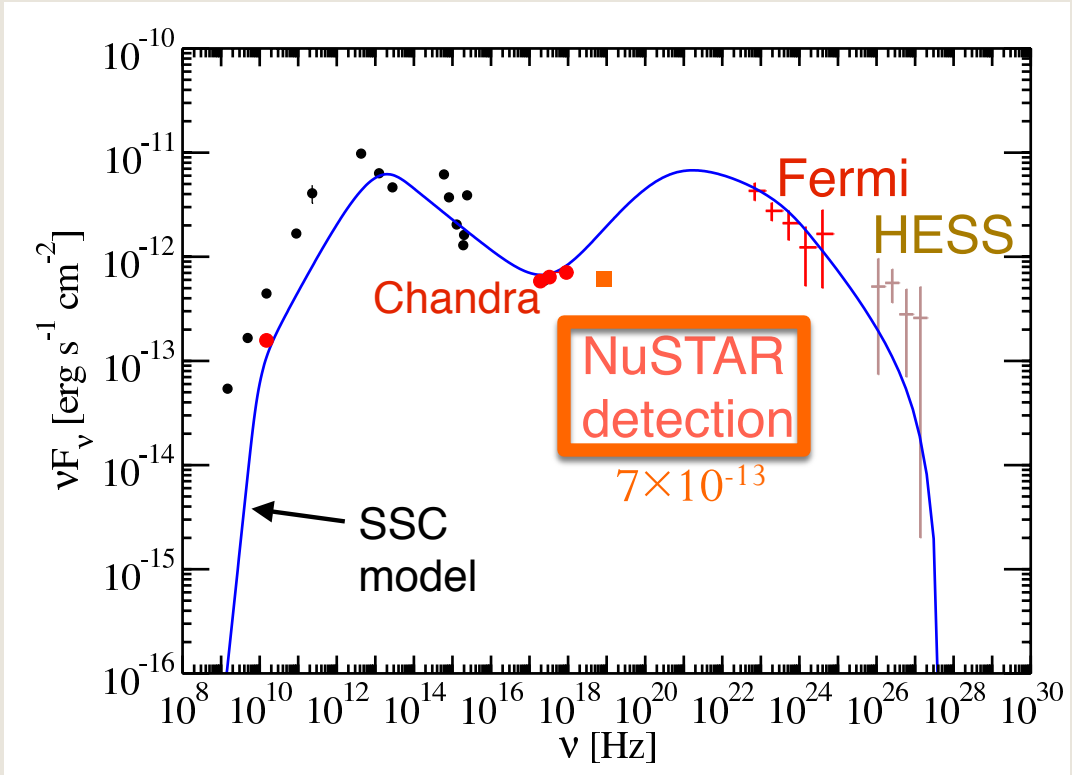
Locations of hard (>10keV) and soft (<10keV) emission peak consistent with one anther, or spatial structure of emission consistent with the same origin!
Note that the PSF of NuSTAR covers the whole jet shown on the right image.


log (ϵ/eV)
−4 −2 0 2 4 6 8 10 12 14
42
41
40
39
38
log (νL_ν/erg s^{-1})
M87
Li, Yuan, Wang+09
Chandra+
NuSTAR data
α=0.0
α=0.8
α=0.998
10 12 14 16 18 20 22 24 26 28
log (ν/Hz)


0μm 10μm 1μm 1000Å .1keV 1keV 10keV 10υκeV
ADAF
Jet
NuSTAR data
Slope more consistent with jet model.
14 16 18 20
log(ν / Hz)
Wong+17

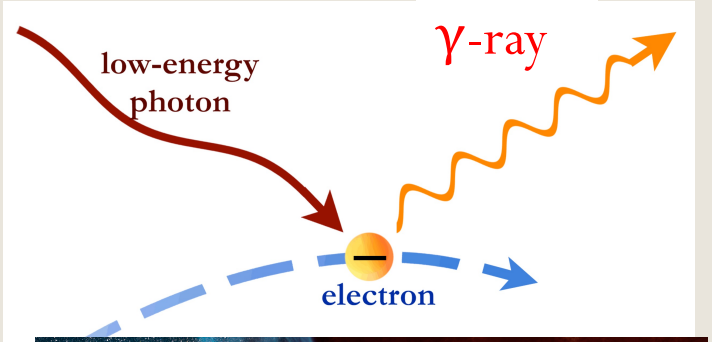
Synchrotron self-Compton models

significantly over-predict hard X-ray distribution!



Abdo+ 2009

Synchrotron self-Compton



Summary

- Hard X-rays detected from the core of M87, presumably in its quiescent state
- Consistent with a single power-law spectrum from 1 keV up to 40 keV
- Core emission consistent with jet-dominated model
- SSC models over-predict hard X-ray emission
- **Variability** of hard X-rays and multi-wavelength observations: further constrain the location (**size**) of the emission region