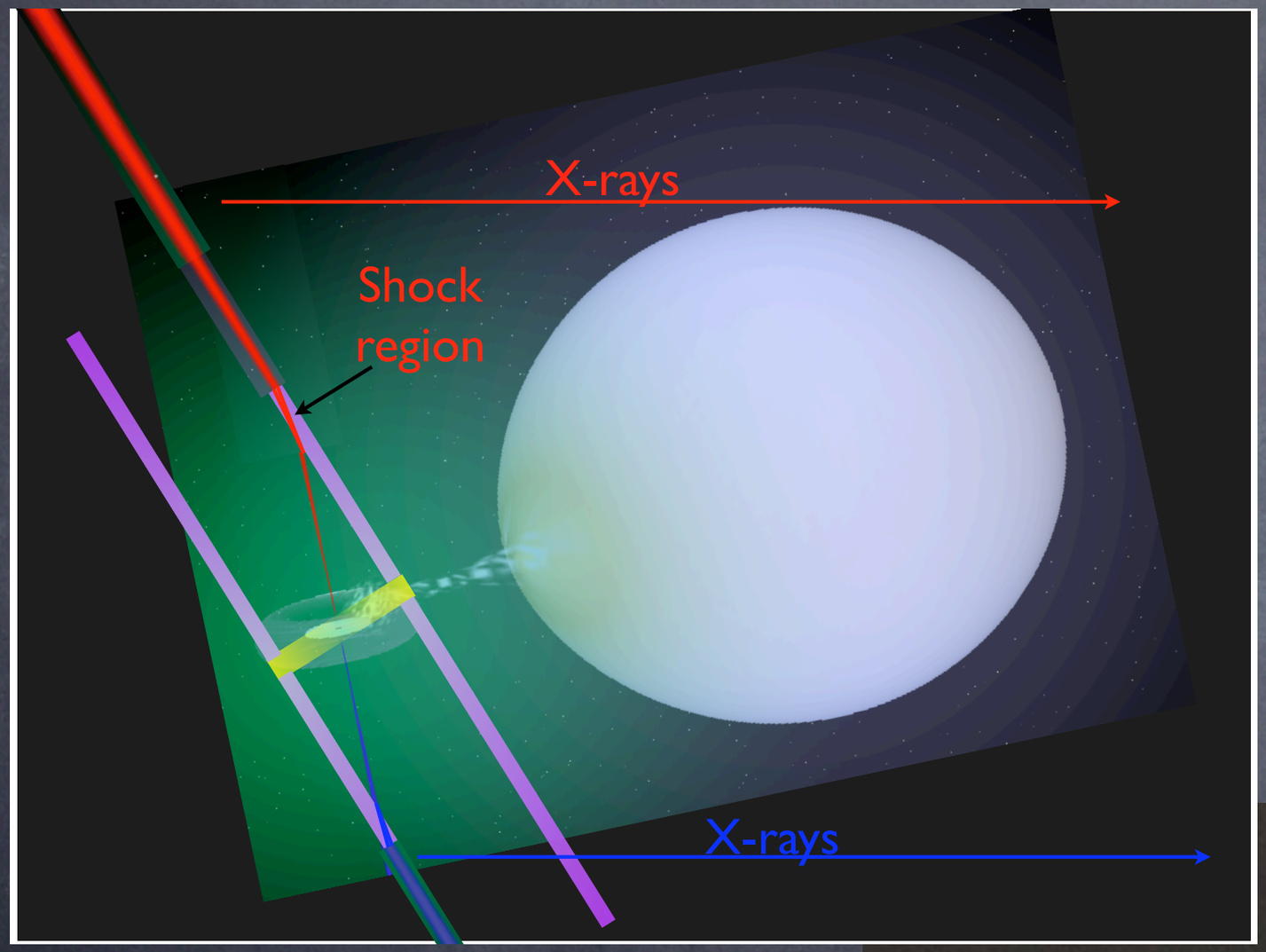
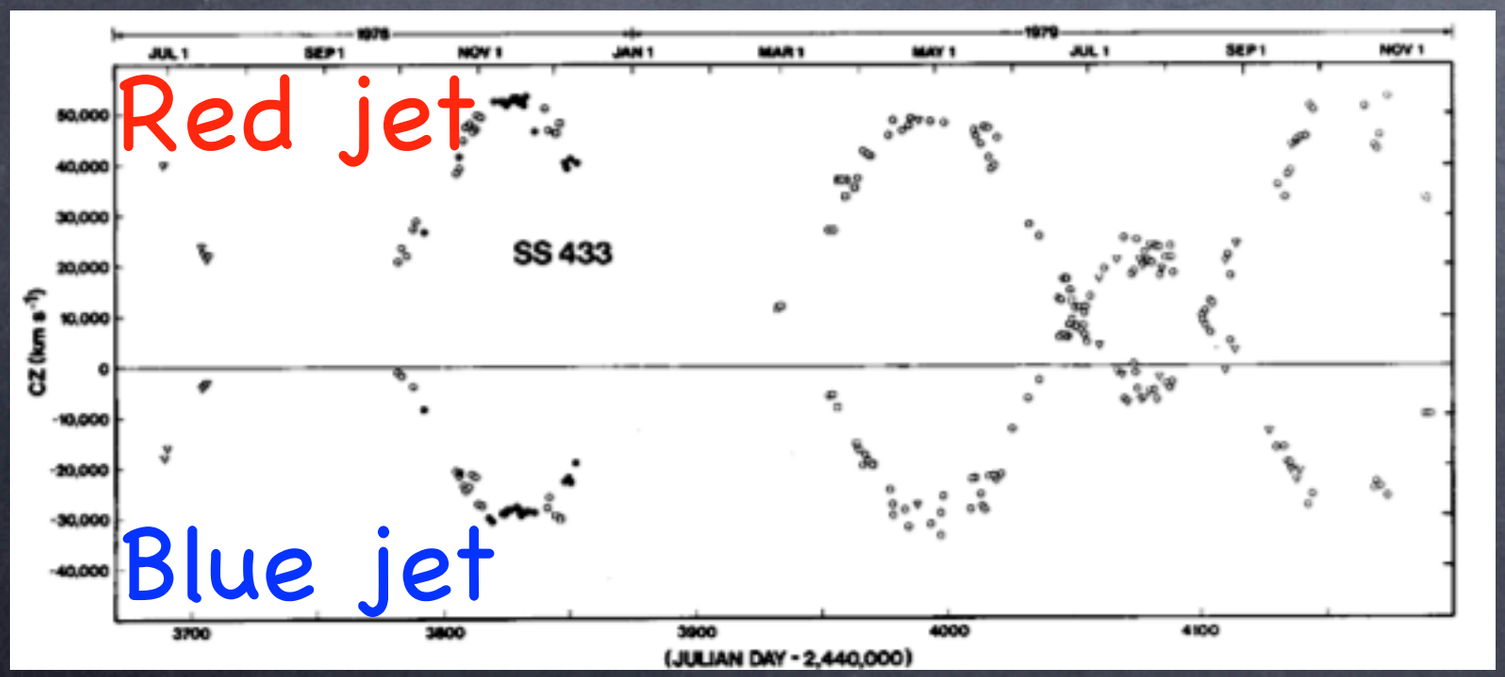
Observing SS 433 with eXTP

Herman L. Marshall (MIT Kavli Institute)

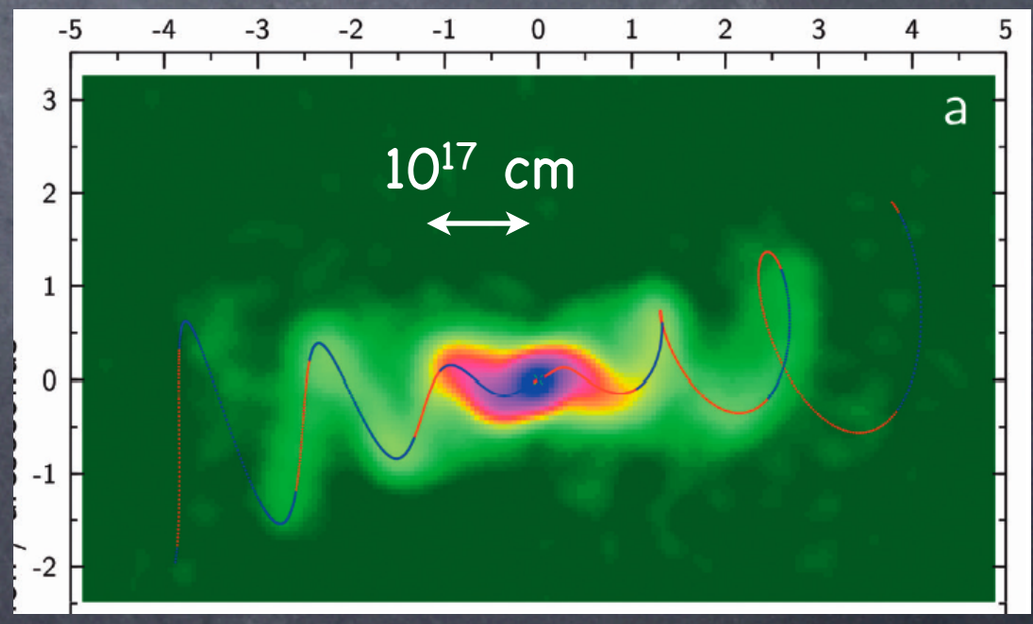


SS 433 Background

- Periodically Doppler shifting Hα HeI and H β
- Model: oppositely directed jets at 0.26 c
  - Precession period: 162 days
  - Orbital period: 13.08 days
- Radio: sets orientation, B ~ 0.1–1 G in knots
- Only relativistic jet known to contain baryons



Margon et al. 1980



Blundell & Bowler 2005

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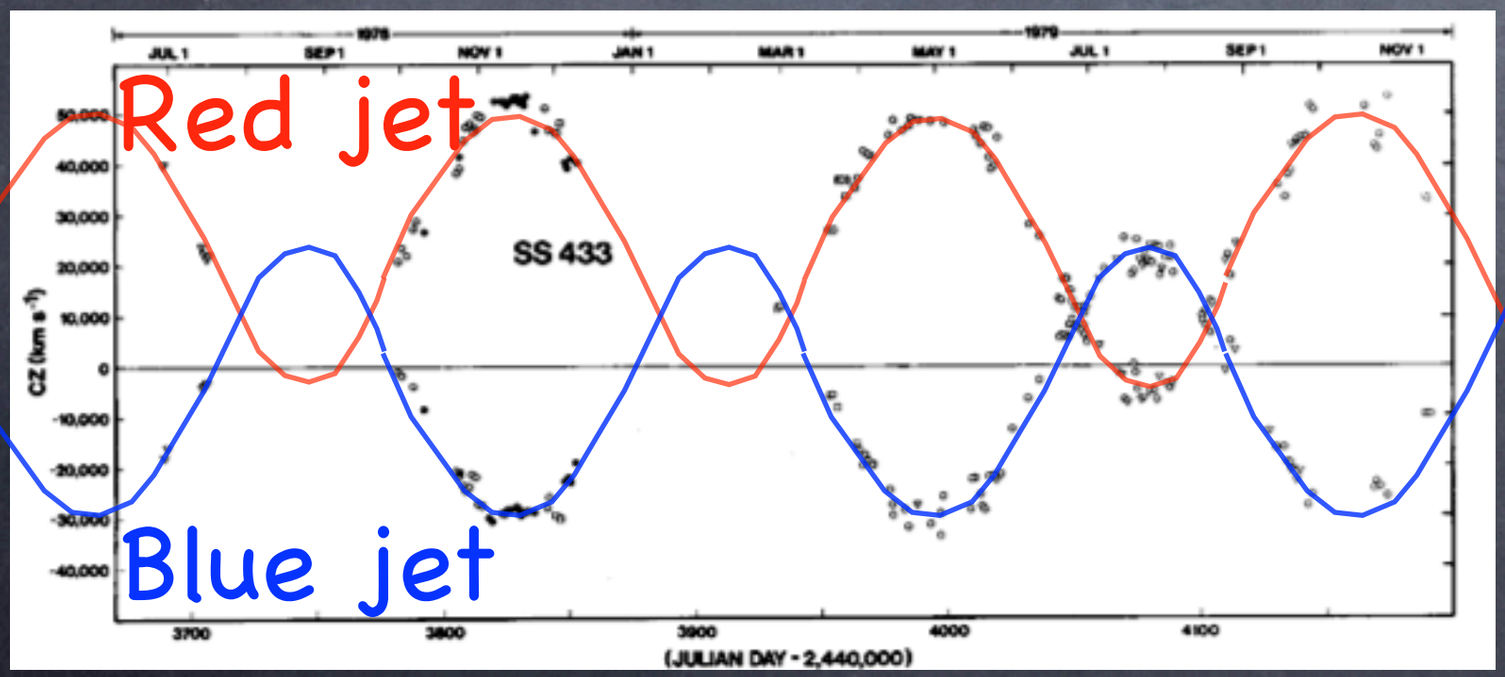

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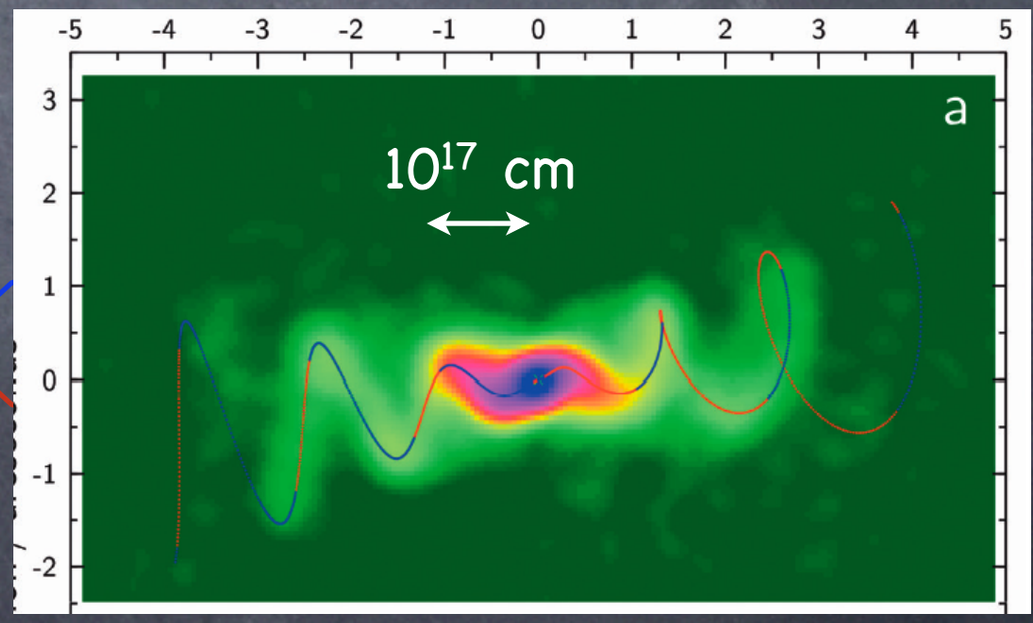

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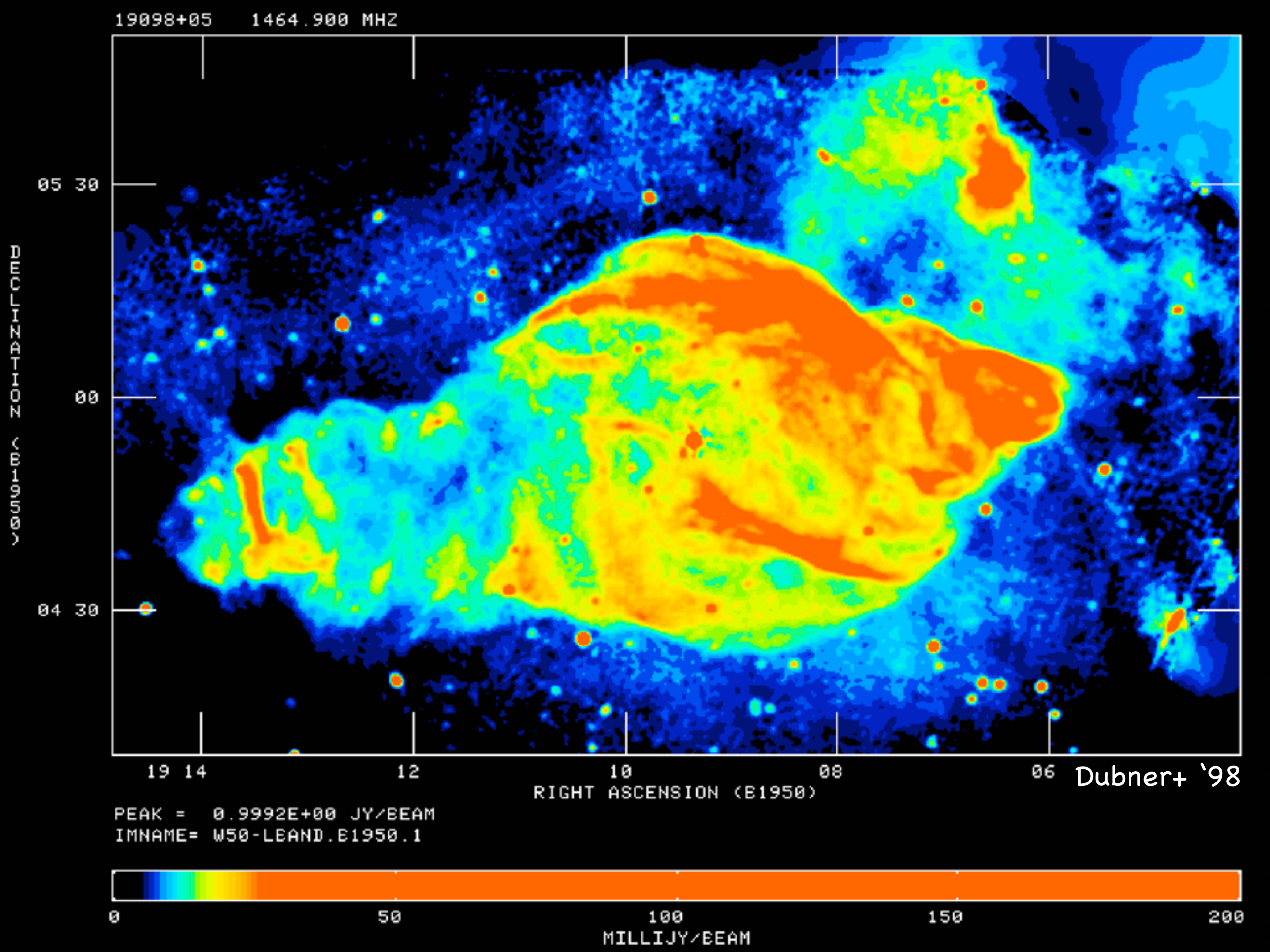
19098+05 1464.900 MHZ
05 30
00
04 30
DECLINATION (B1950)
19 14
12
10
08
06
RIGHT ASCENSION (B1950)
PEAK = 0.9992E+00 JY/BEAM
IMNAME= W50-LBAND.B1950.1
0
50
100
150
200
MILLIJY/BEAM
Dubner+ '98

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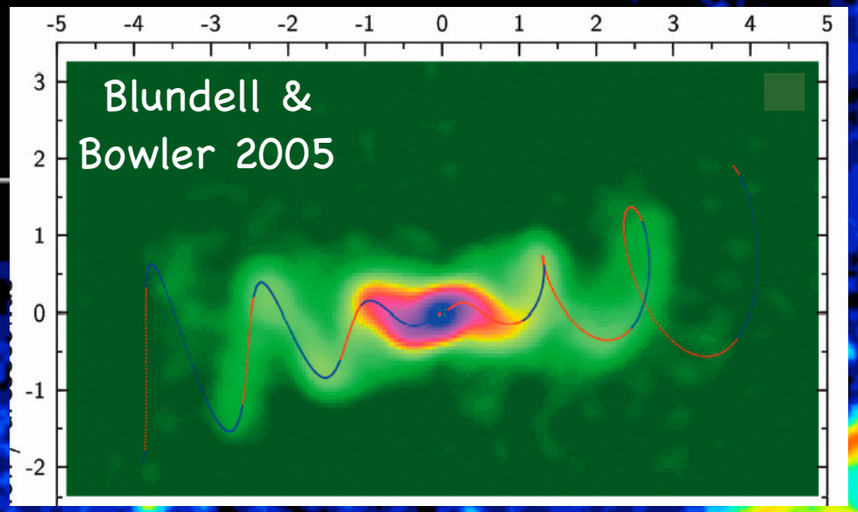

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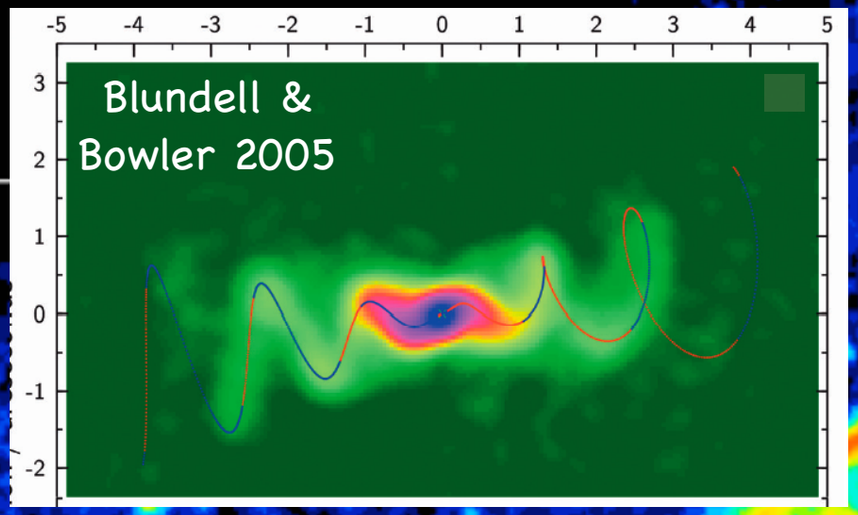

05 30

00

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DECLINATION (B19

19 14 12 10 08 06

RIGHT ASCENSION (B1950)

Dubner+ '98

PEAK = 0.9992E+00 JY/BEAM
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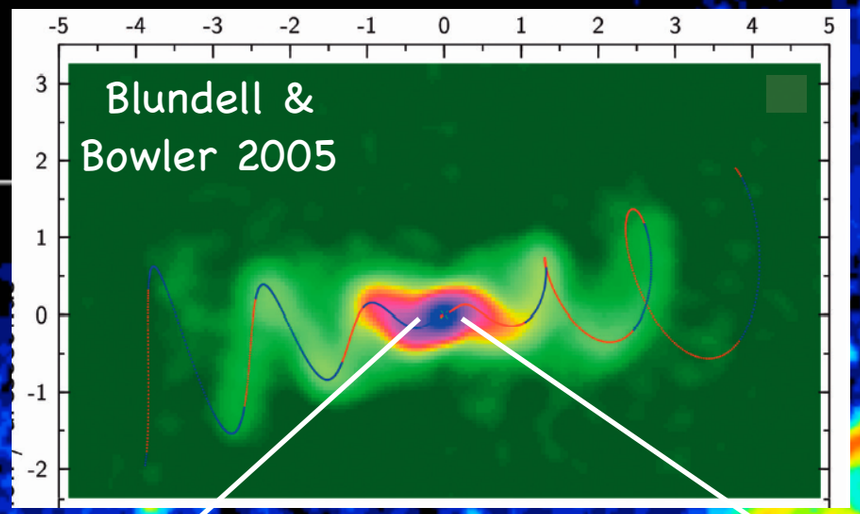

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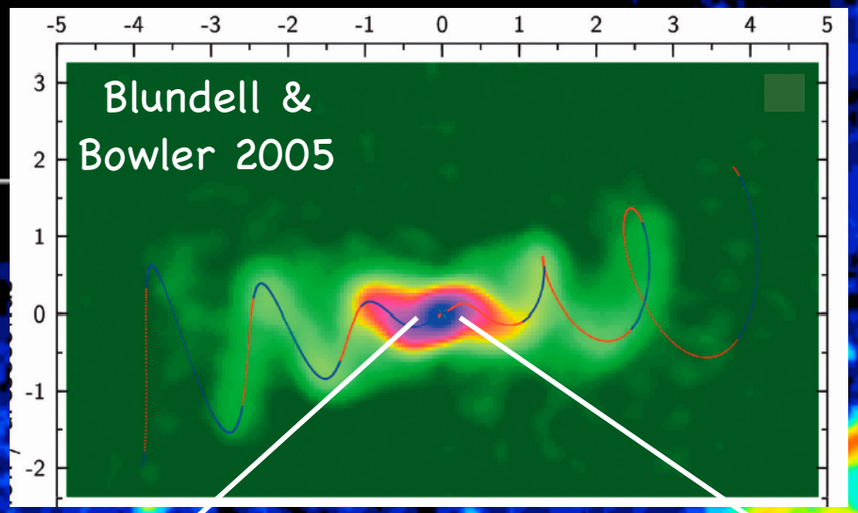

SS433
VLBA

Amy Mioduszewski
Michael Rupen
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Greg Taylor

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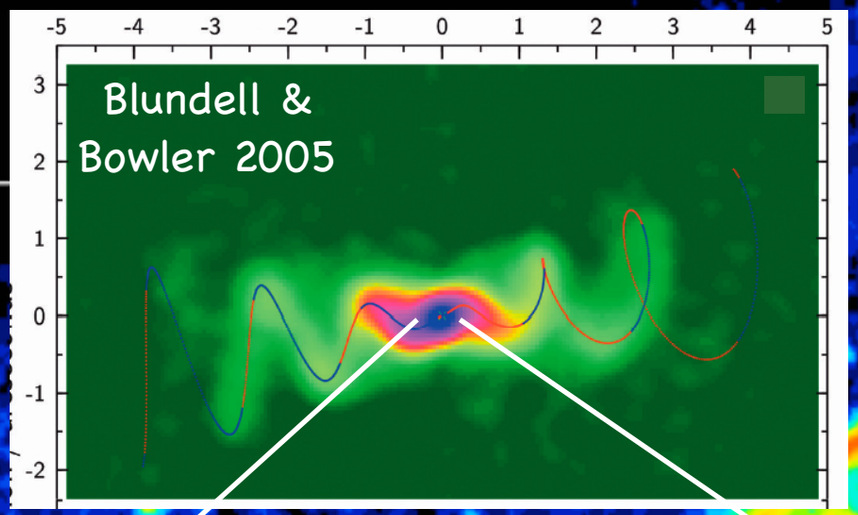

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10^{20} cm

Kotani '98

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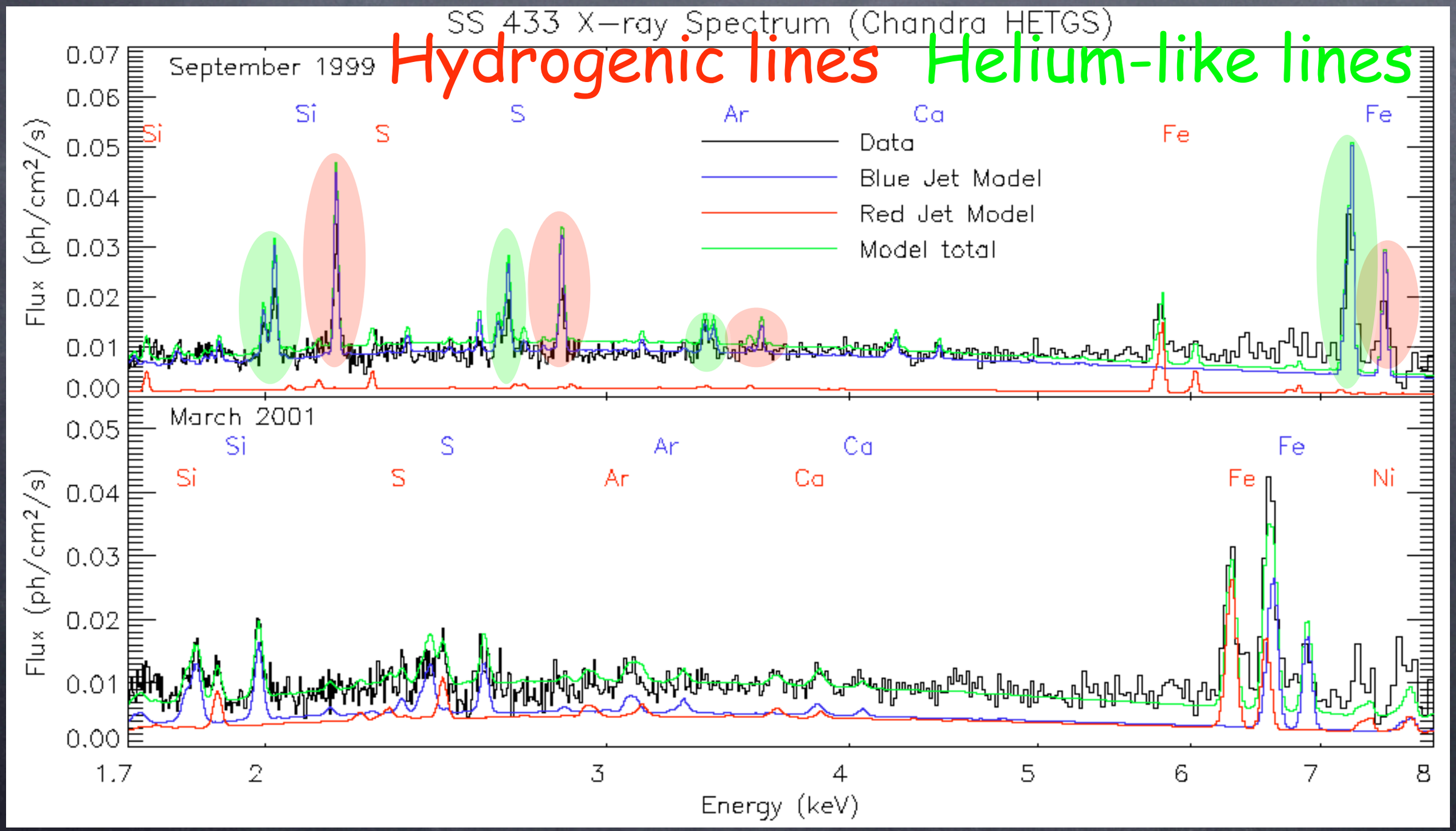
MILLIJY/BEAM

Observing SS 433 with eXTP

- SFA:
  - Moving emission lines
  - Eclipse mapping of the jets
- LAD:
  - Resolving the jet cooling time
  - Sign of the compact object?
- PFA:
  - Nonthermal emission from core
  - Jet interaction with ambient medium

Two HETGS Spectra

(Marshall+ '02, Lopez+ '06)



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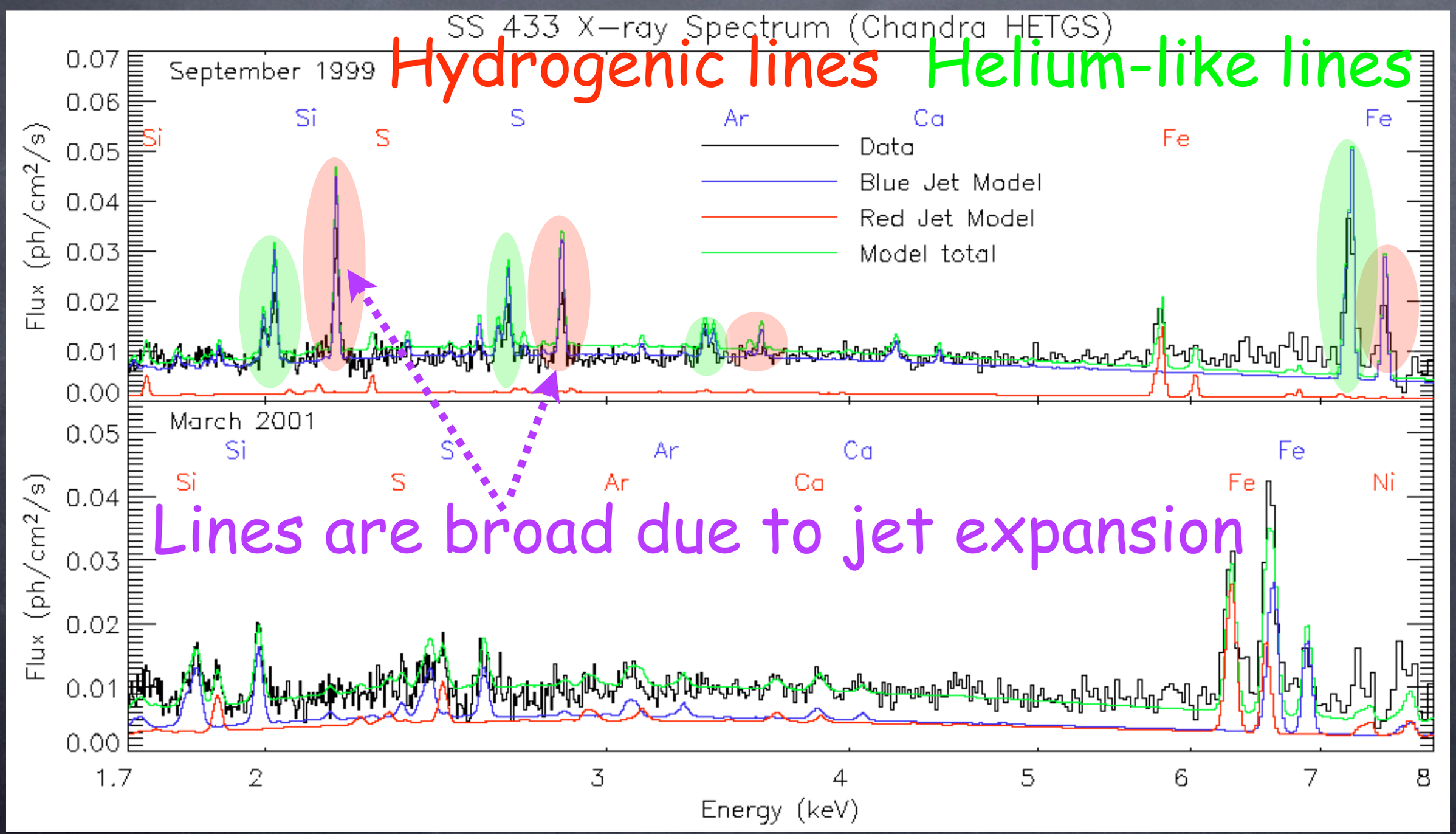
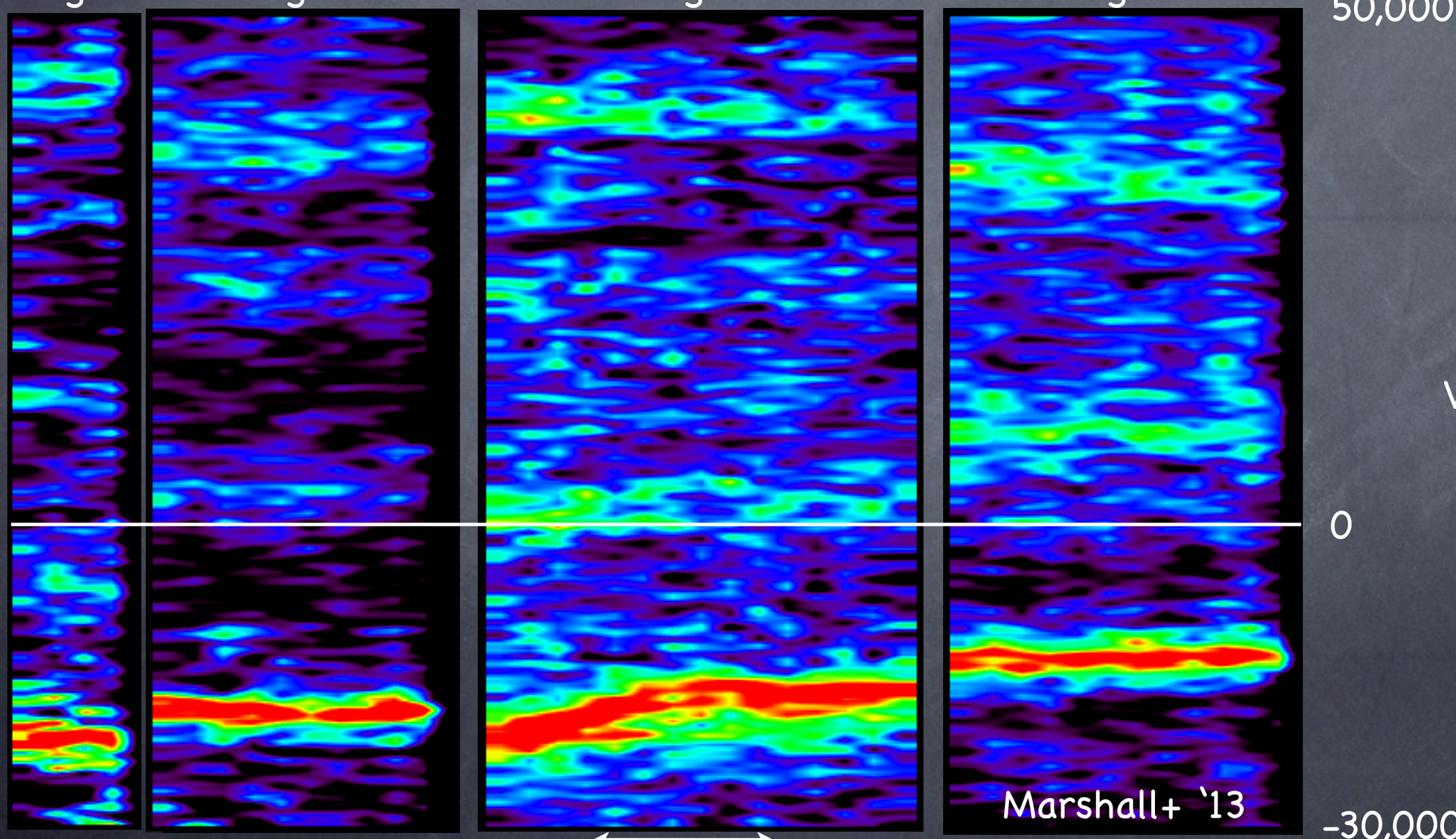
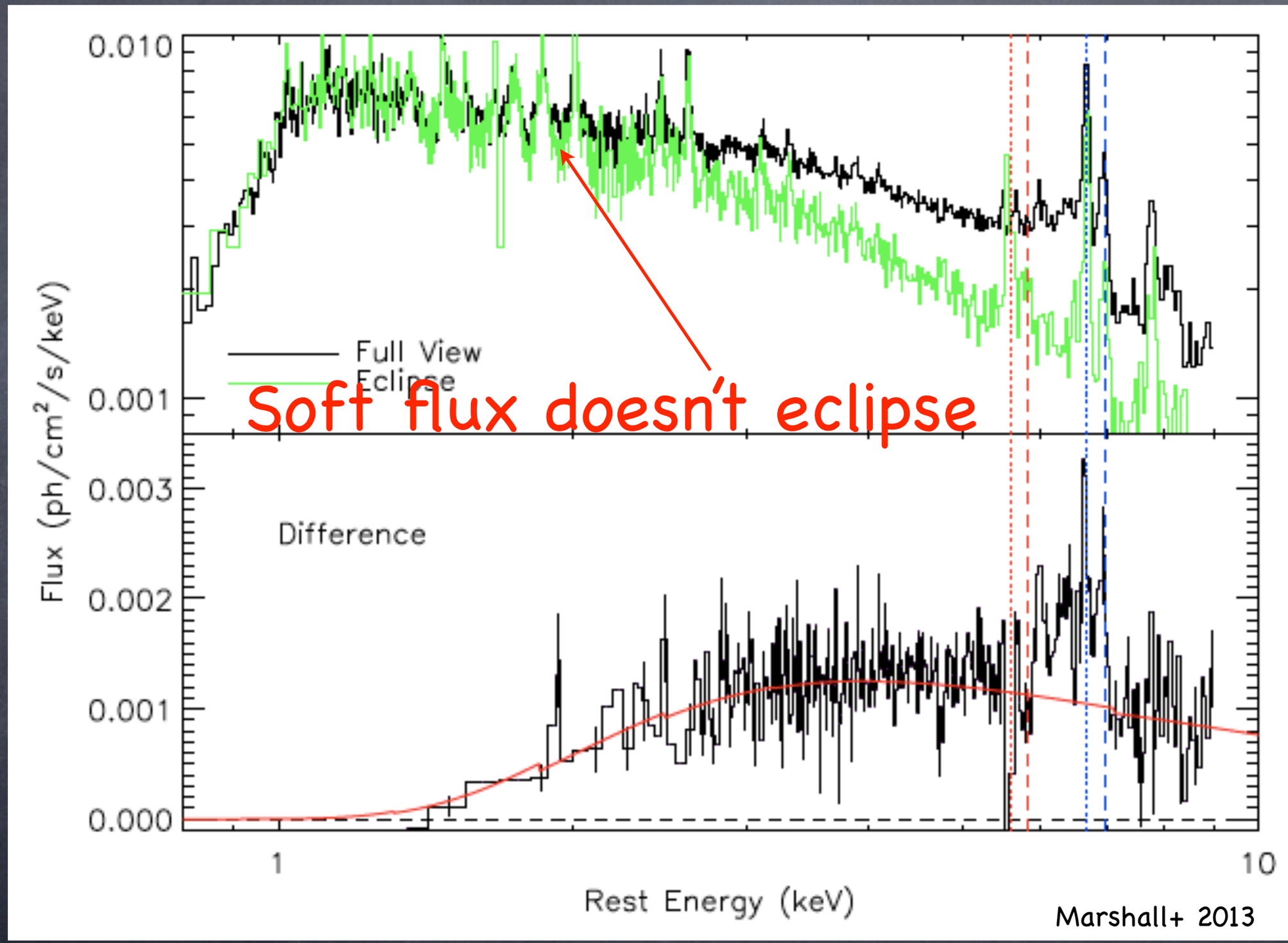


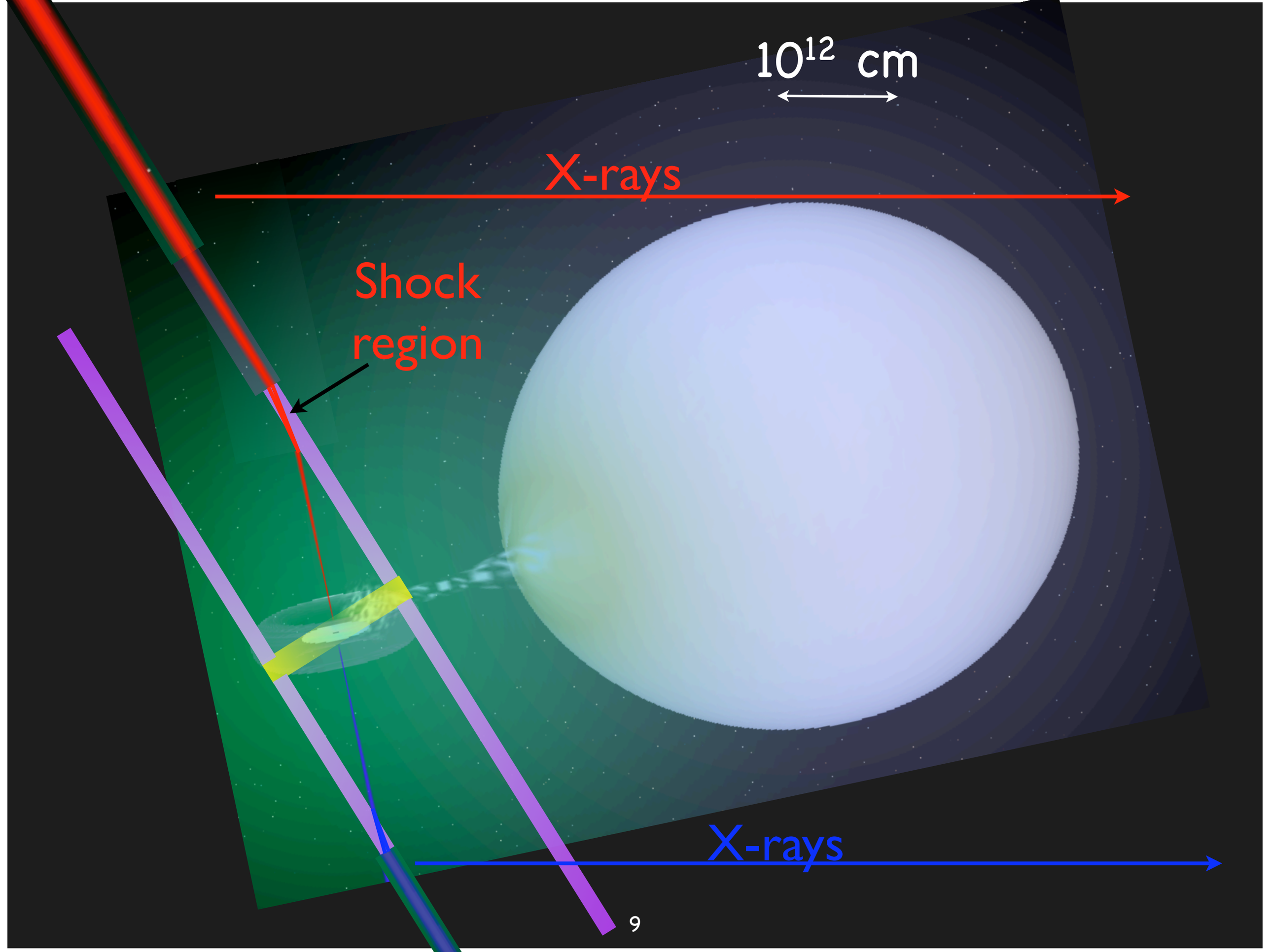
Trailed Spectra

- Made by Doppler Shifting to rest frame
- Used many lines: Mg XII, Si XIV, Fe XV, etc.



Eclipse Spectrum

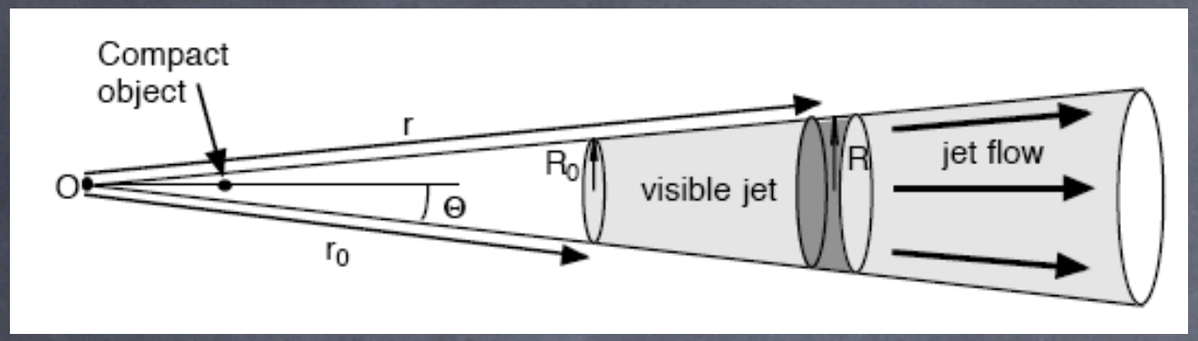


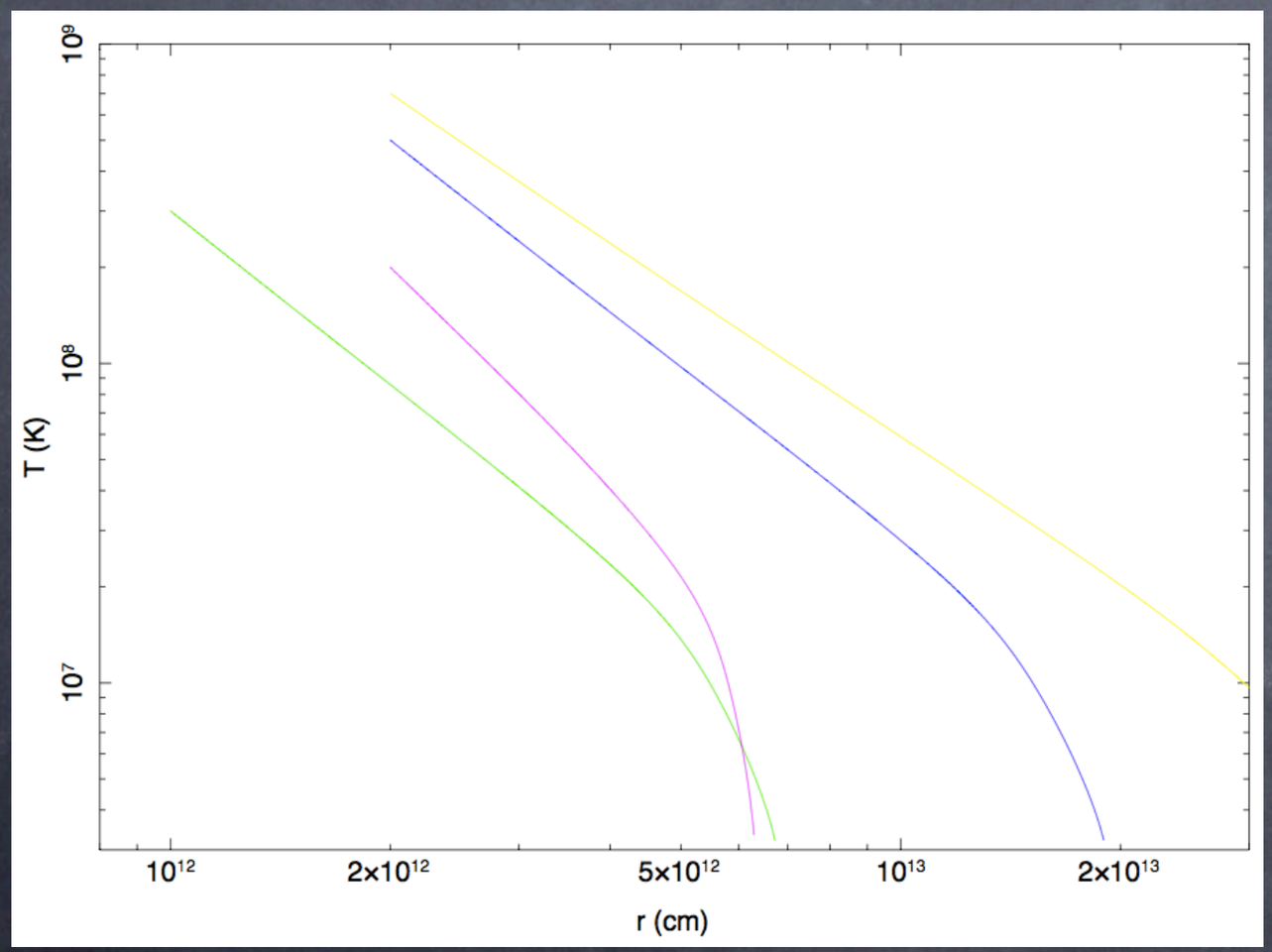

10^{12} cm
X-rays
Shock
region
X-rays

Jet Model

- Jet is clumped > 10^{15} cm, radio-dominated > 10^{16} cm
  - Clumps move ~ ballistically over x1000 in r
  - Atomic H, He recombination emission at 10^{15} cm
- Jet cools from kT > 15 keV
  - Flow at constant speed, spreading & cooling
  - Flow is continuous over 10^{12-14} cm
  - Radiative cooling limits length in X-rays
  - Length comparable to size of companion star
  - Contains common elements (Ni is 10x solar)
  - Direction is separately set for opposite jets
- Shock model: jet bent by wind from outer disk

Jet Line Tomography





- Jet is stratified
- High T gets eclipsed
- Cooling time:
  - HETGS: < 5000 s
  - density sensitive
- eXTP, SNR = 10 (Fe 26):
  - SFA: 500 s
  - LAD: 10 s
- Jet mapping:
  - v* ~ 150 km/s
  - resolve ~10^{8-9} cm
- Apply to several lines

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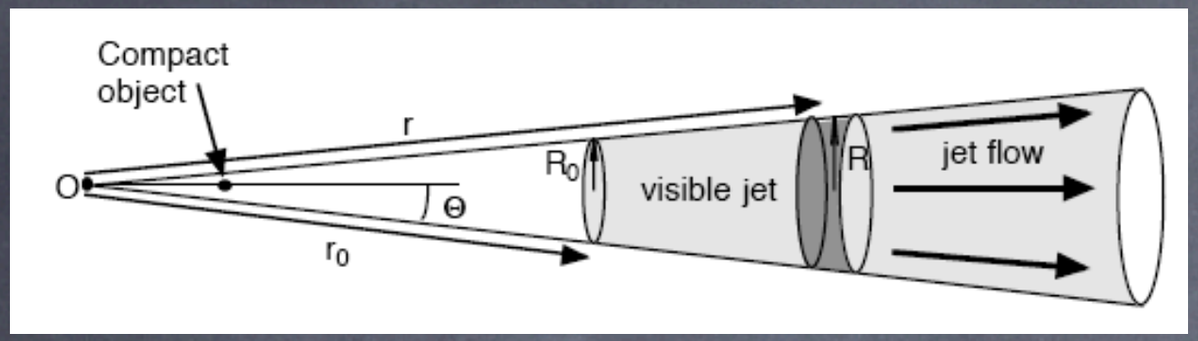

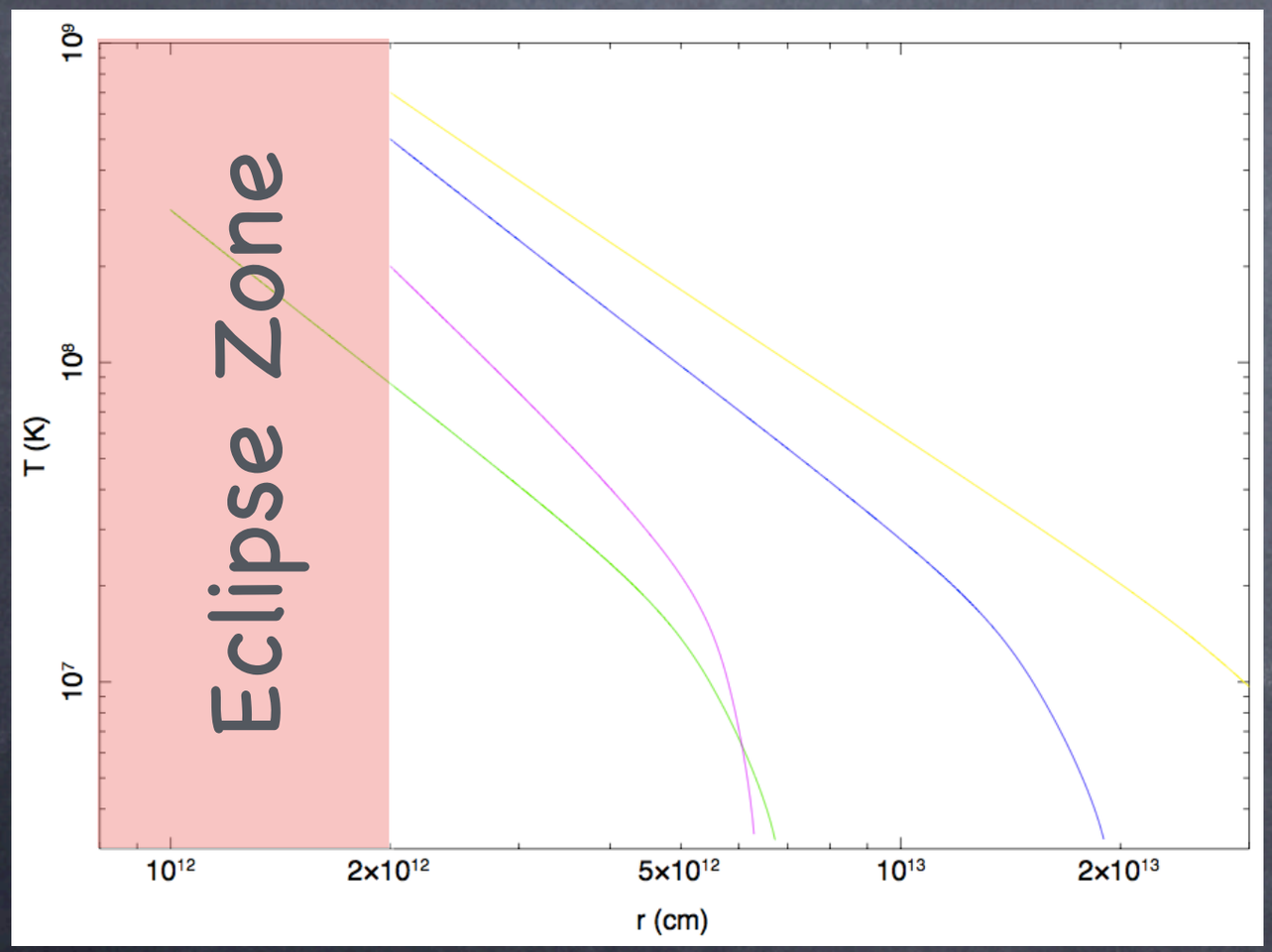

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Observing SS 433 with eXTP: Summary

- SFA:
  - Moving emission lines: measure fragmentation, jumps
  - Eclipse mapping of the jets: Si 14 to Ni 27
- LAD:
  - Resolving the jet cooling time: high T lines of Fe, Ni
  - Compact object telltale? 1000 cps (E > 10 keV)
- PFA:
  - Nonthermal emission from core: MDP = 3% in 75 ks
  - Jet interaction within W50: MDP = 5% in 150 ks