Capella
With Chandra and ~~XMM~~

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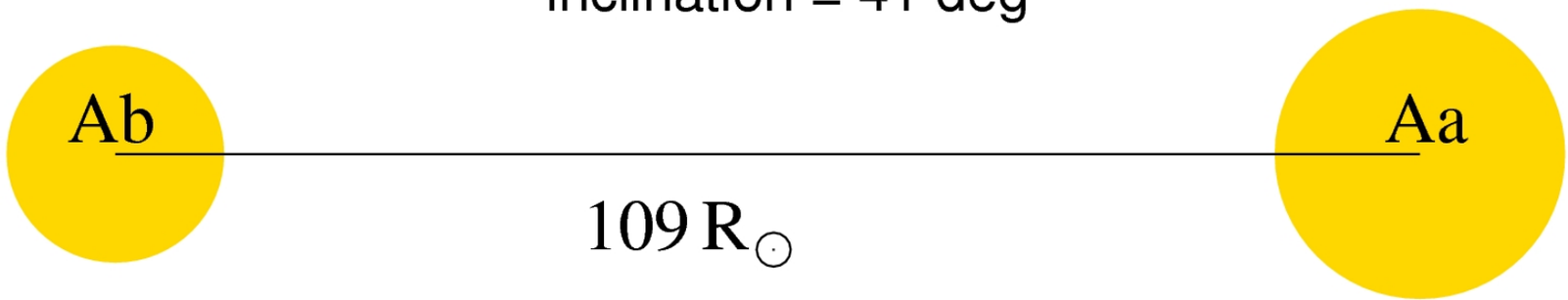
CAPELLA

α Aur / HD 34029 / HR 1708 / SAO 40186 / 13 Aur

distance = 13.4 pc

period = 104 days

inclination = 41 deg



G1 III

(F9 III)

Mass = 2.56 $M_\odot$

radius = 9.2 $R_\odot$

Teff = 5700 K

B–V = 0.74

Mv = 0.14

rotation= 36 km/s

↔ 10 $R_\odot$

G8 III

(K0 III)

Mass = 2.69 $M_\odot$

radius = 12.2 $R_\odot$

Teff = 4940 K

B–V = 0.87

Mv = 0.25

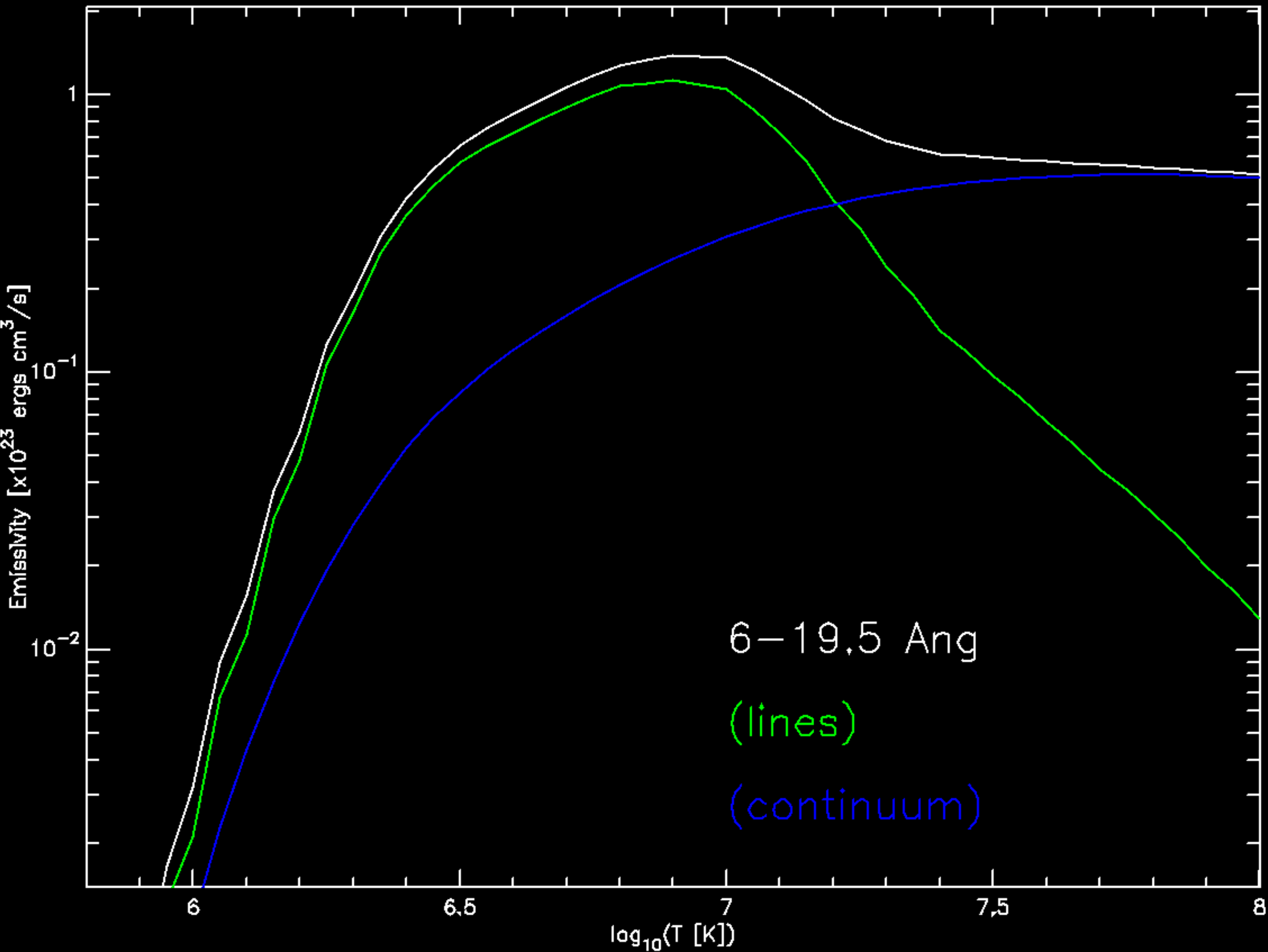
rotation= 3 km/s

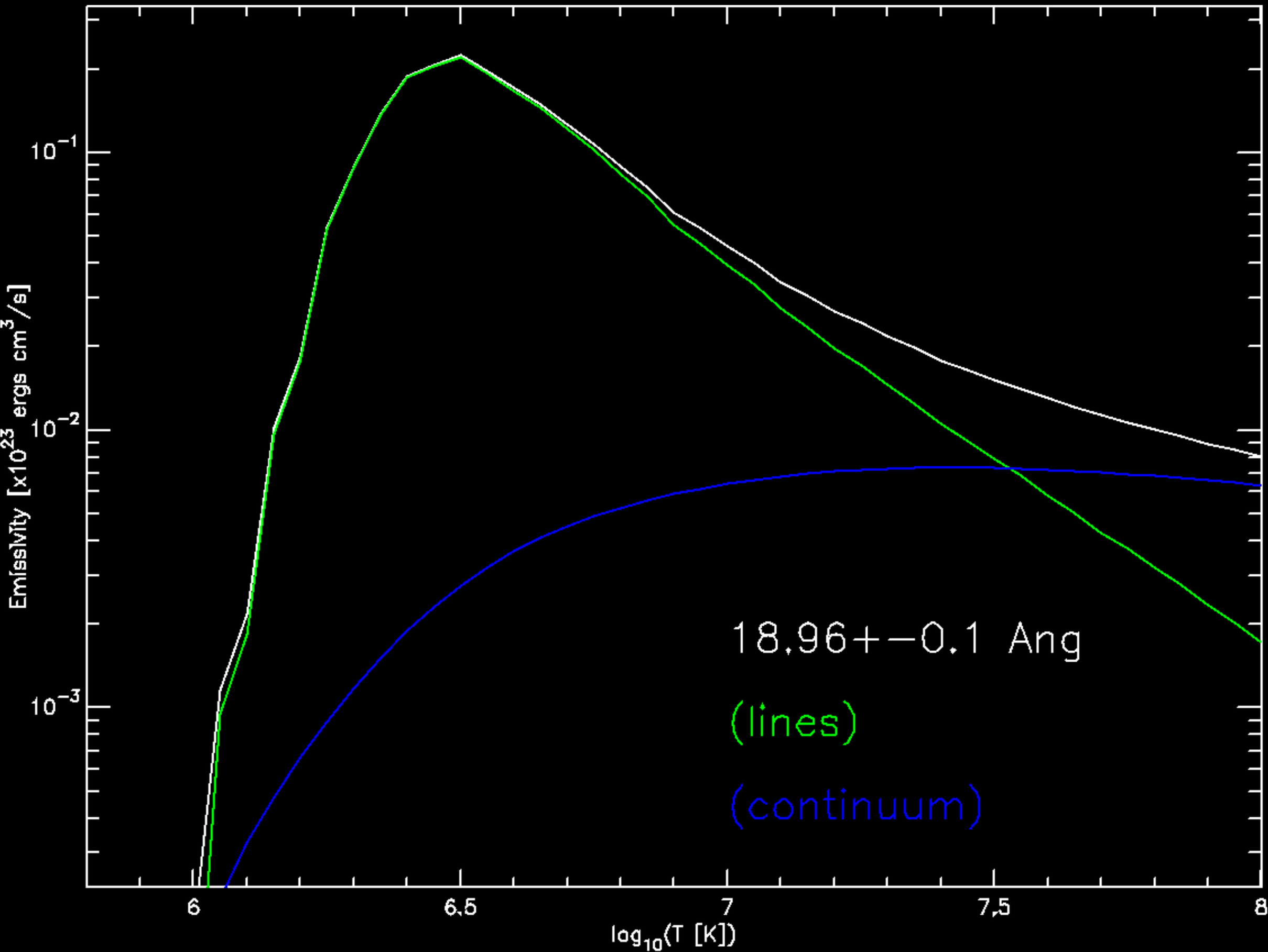
Basic Capella

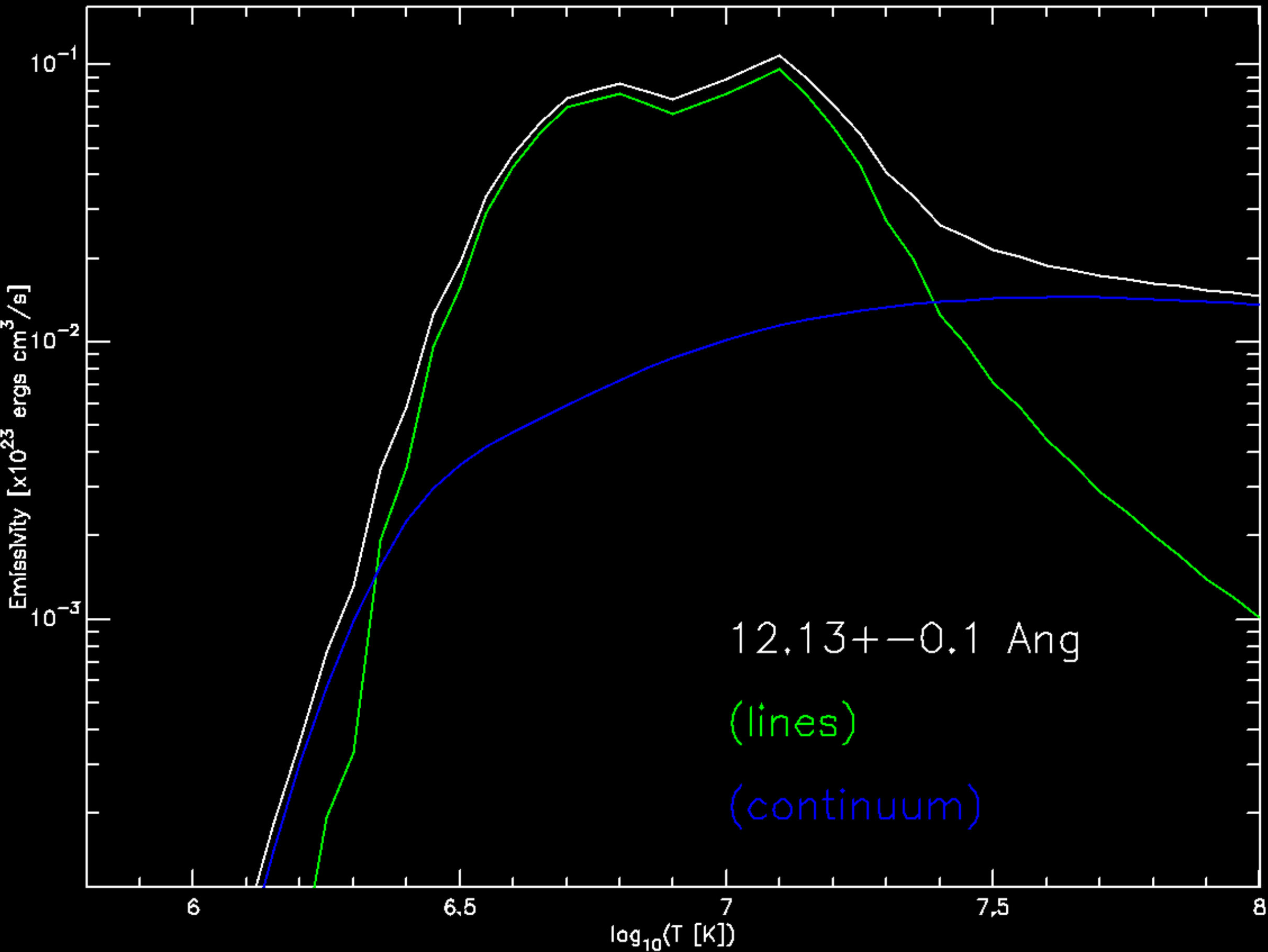
- Brightest accessible coronal source for a large number of instruments.
    - Has been observed regularly with both Chandra and XMM, often contemporaneously.
- Line dominated spectrum.
- Multi-thermal, but large, apparently stable, logT=6.8 component.
- No definitive short timescale variability. No flares yet.
- Low long timescale variability.

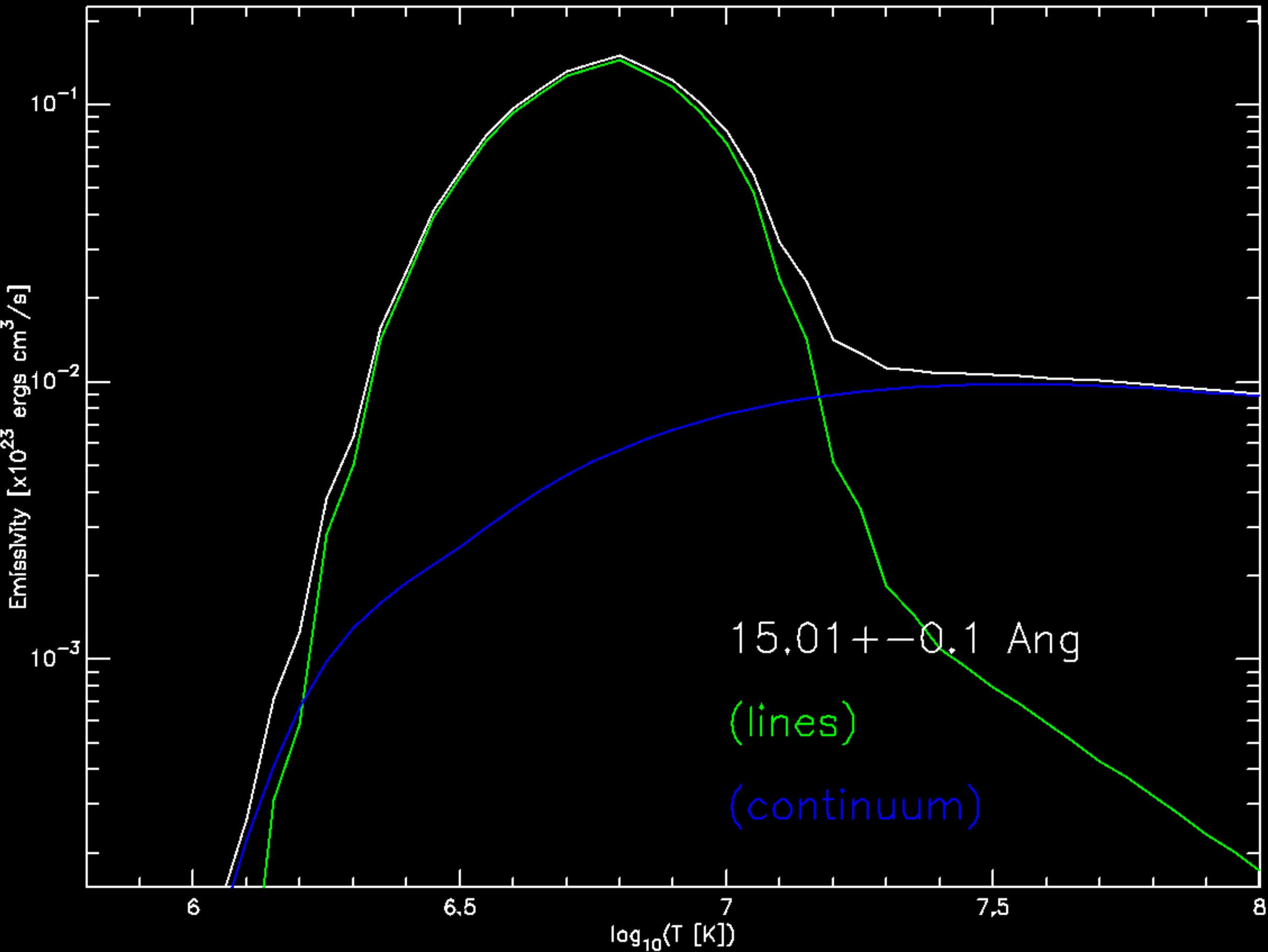
The Plan

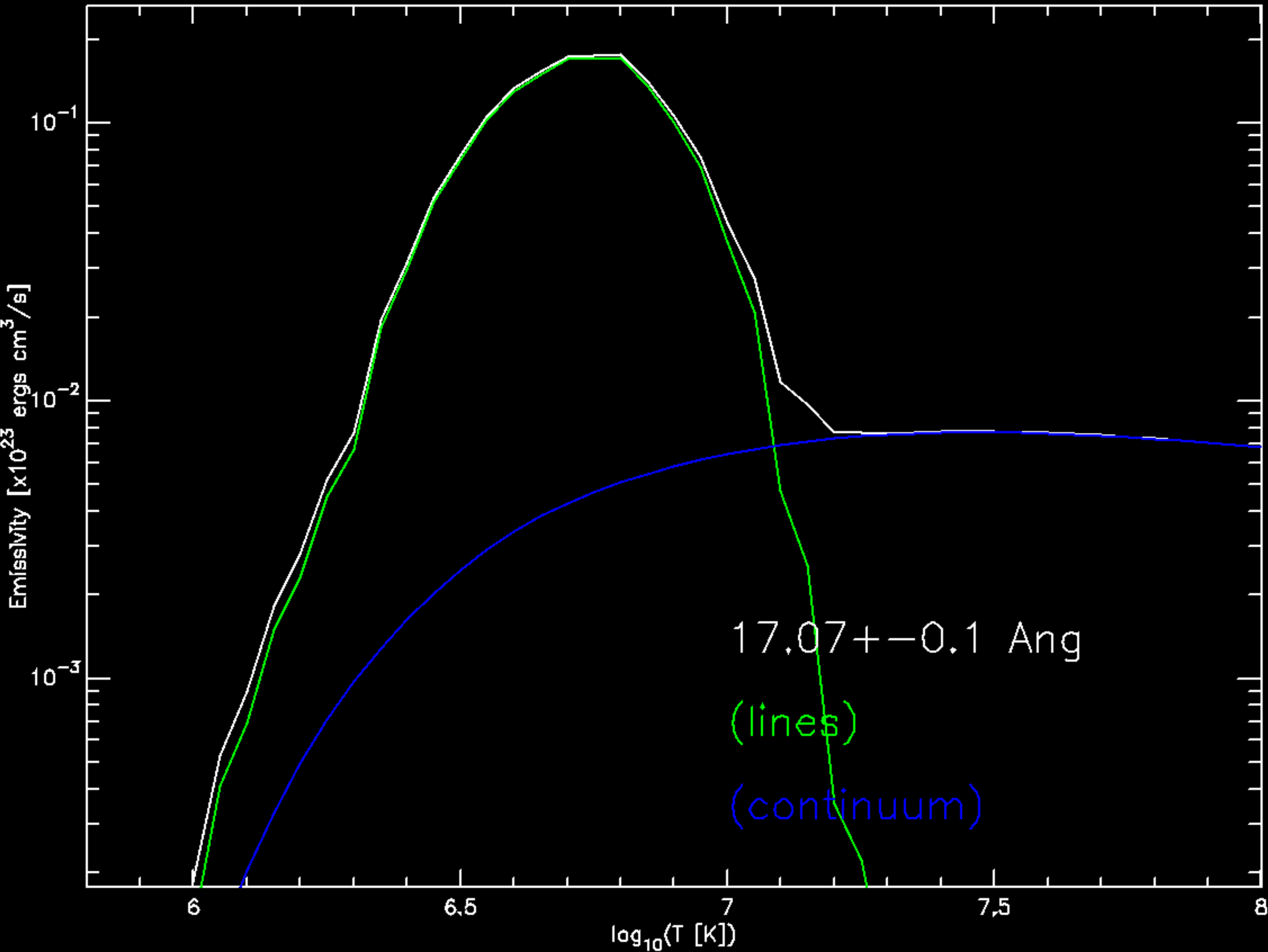
- Compare fluxes in some strong lines
  - O VIII 18.96 Å
  - Ne X 12.14 Å
  - Fe XVII 15.01 Å
  - Fe XVII 17.07 Å
- and over a common broad band
  - 6-19.5 Å [0.64-2.1 keV]


Emissivity [x10^-23 ergs cm^3/s]
1
10^-1
10^-2
6
6.5
7
7.5
8
log10(T [K])
6-19.5 Ang
(lines)
(continuum)


Emissivity [x10^-23 ergs cm^3/s]
10^-1
10^-2
10^-3
6
6.5
7
7.5
8
log10(T [K])
18.96+-0.1 Ang
(lines)
(continuum)


Emissivity [x10^-23 ergs cm^3/s]
10^-1
10^-2
10^-3
6
6.5
7
7.5
8
log10(T [K])
12.13+-0.1 Ang
(lines)
(continuum)


Emissivity [x10^-23 ergs cm^3/s]
10^-1
10^-2
10^-3
6
6.5
7
7.5
8
log10(T [K])
15.01+-0.1 Ang
(lines)
(continuum)


Emissivity [x10^23 ergs cm^3/s]
10^-1
10^-2
10^-3
6
6.5
7
7.5
8
log10(T [K])
17.07+-0.1 Ang
(lines)
(continuum)

The Process

- Collect events along dispersion axis for both source and background regions
- Assign effective areas for each event
- Filter on passband
- Make light curve of counts in 1000 sec bins
- For all events that fall in a given time bin, bootstrap to get flux and errors
  - generate Poisson counts for source and background, and if $N_D=N_S–N_B$, randomly choose N_D events from the sample to compute flux from
  - repeat 100 times and get stddev of bootstrapped sample as error on flux

Results

(preliminary)

common

f_x [10^{-12} ergs s^{-1} cm^{-2}]

800
600
400
200

0
200
400
600
800
1000
1200

1000.3759 sec bins

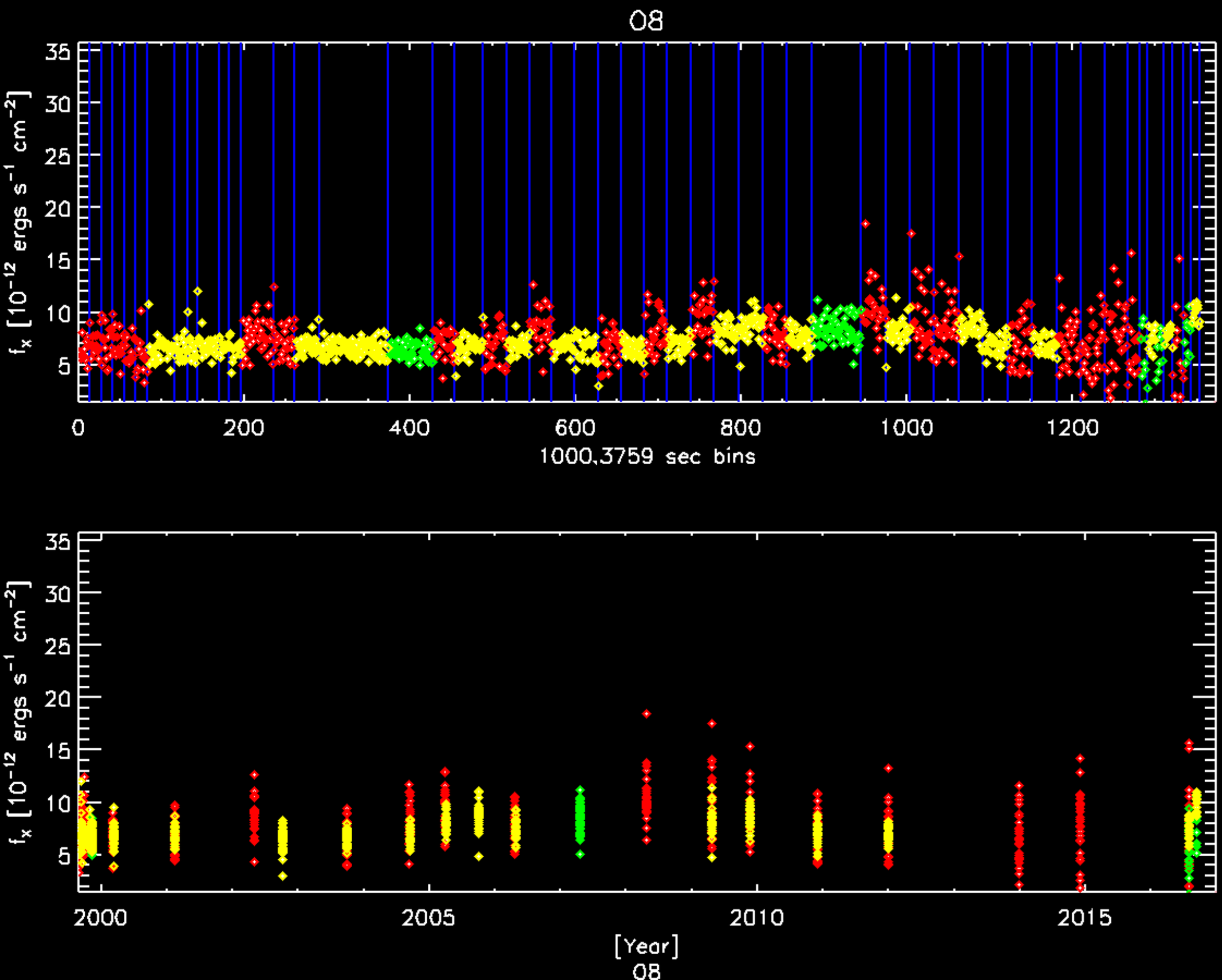
f_x [10^{-12} ergs s^{-1} cm^{-2}]

800
600
400
200

2000
2005
2010
2015

[Year]

common


08
f_x [10^{-12} ergs s^{-1} cm^{-2}]
35
30
25
20
15
10
5
0
200
400
600
800
1000
1200
1000.3759 sec bins
2000
2005
2010
2015
[Year]
08

Ne10

f_x [10^{-12} ergs s^{-1} cm^{-2}]

0 200 400 600 800 1000 1200

1000.3759 sec bins

2000 2005 2010 2015

[Year]

Ne10

Fe17_15

f_x [10^{-12} ergs s^{-1} cm^{-2}]

60
50
40
30
20
10

0 200 400 600 800 1000 1200

1000.3759 sec bins

f_x [10^{-12} ergs s^{-1} cm^{-2}]

60
50
40
30
20
10

2000 2005 2010 2015

[Year]

Fe17_15

Fe17_17

f_x [10^{-12} ergs s^{-1} cm^{-2}]

80
60
40
20

0
200
400
600
800
1000
1200

1000.3759 sec bins

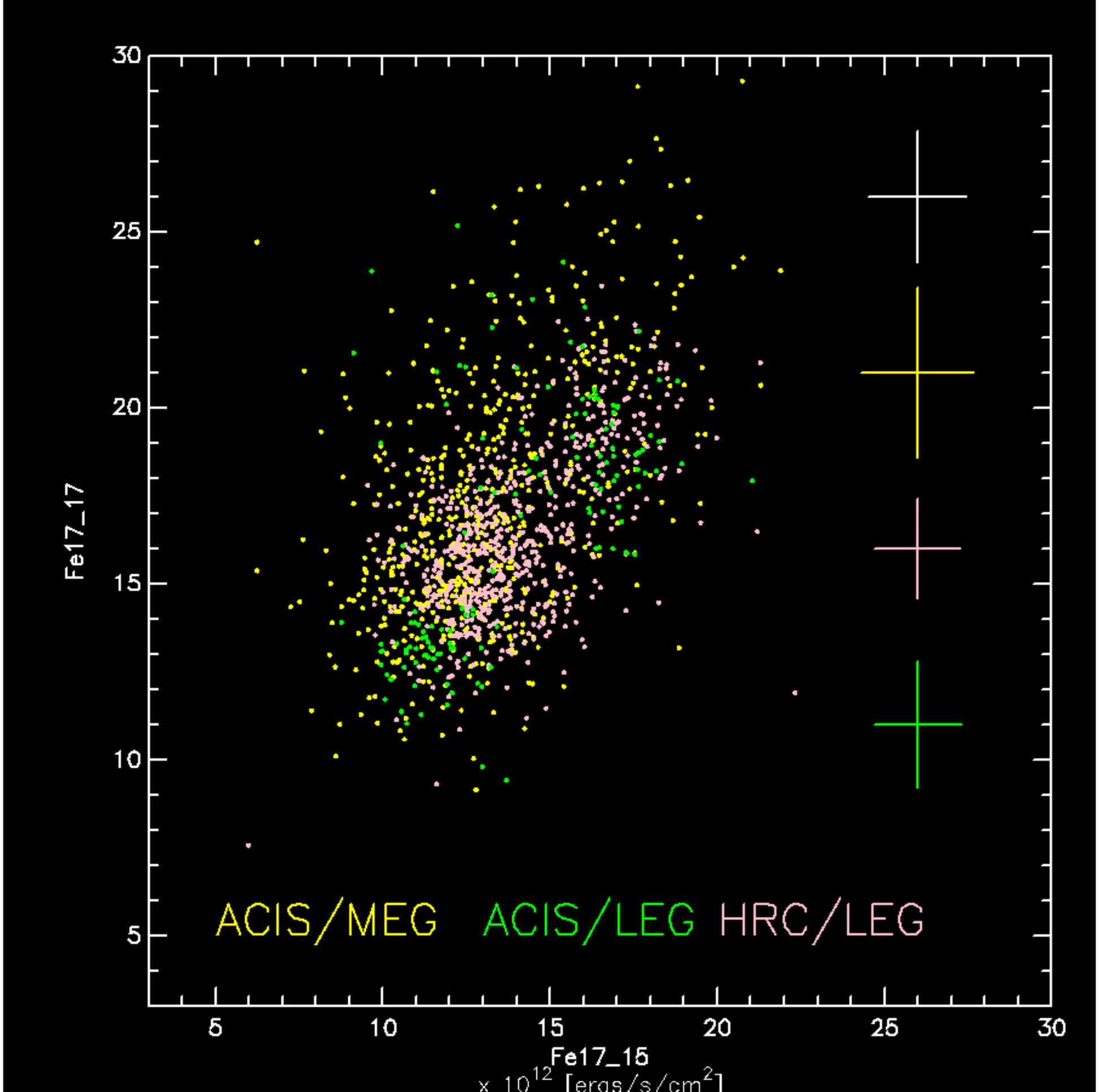
f_x [10^{-12} ergs s^{-1} cm^{-2}]

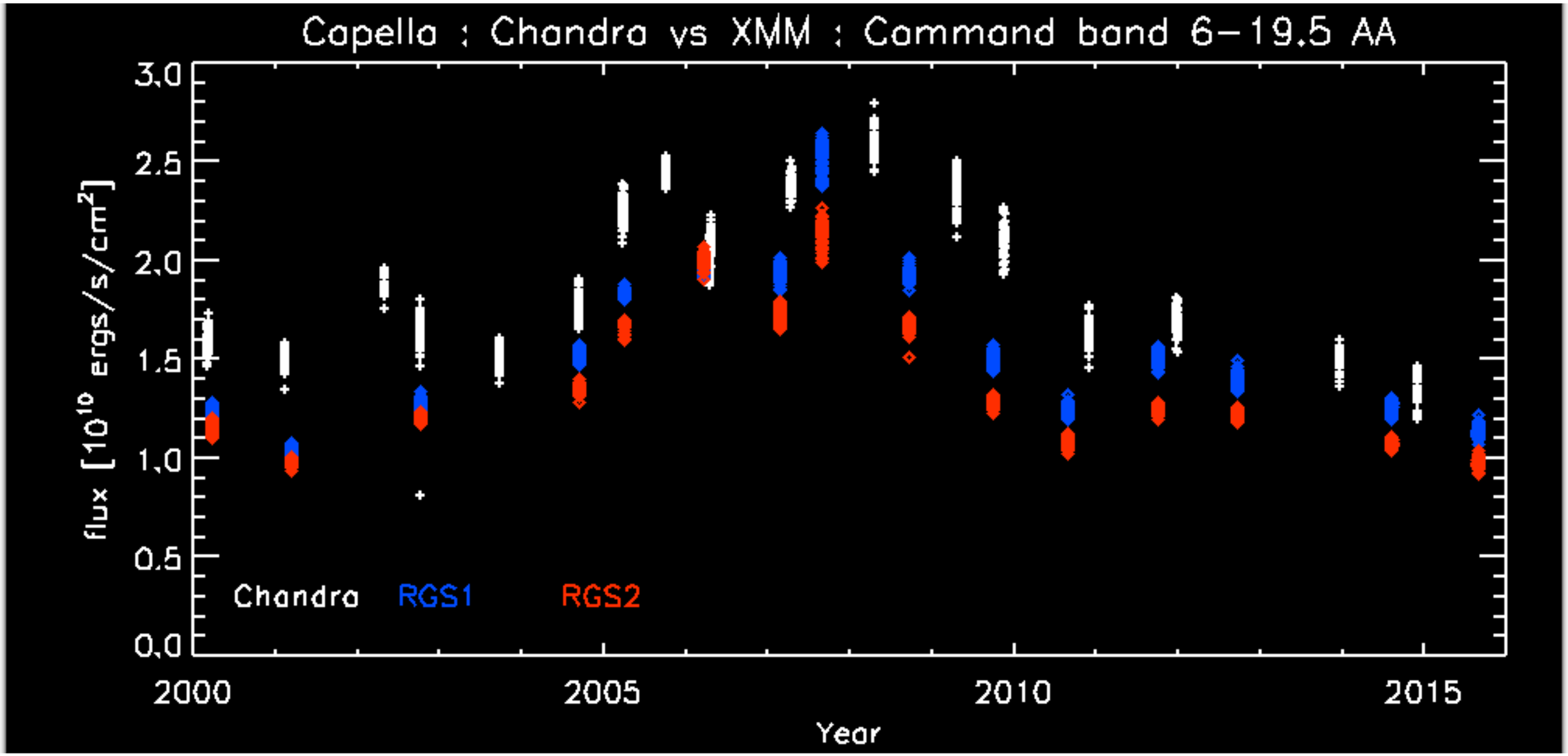
80
60
40
20

2000
2005
2010
2015

[Year]

Fe17_17


30
25
20
15
10
5
Fe17_17
5
10
15
20
25
30
Fe17_15
x 10^12 [ergs/s/cm^2]
ACIS/MEG
ACIS/LEG
HRC/LEG


Capella : Chandra vs XMM : Command band 6–19.5 AA
flux [10^10 ergs/s/cm^2]
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Chandra
RGS1
RGS2
2000
2005
2010
2015
Year

Results

- Xufei Wang and Yang Chen will discuss some aspects of the ACIS/MEG vs HRC/LEG differences during Cal Uncertainties WG meeting on Tues at 4pm

- Capella intrinsic variability
    - does show unambiguous variability over large timescales
    - short timescale variability discernible only as part of long-term trends
    - Fe XVII 15Å vs 17Å data show clustering at 2 activity levels

- XMM fluxes are preliminary, and are being worked on to eliminate systematics