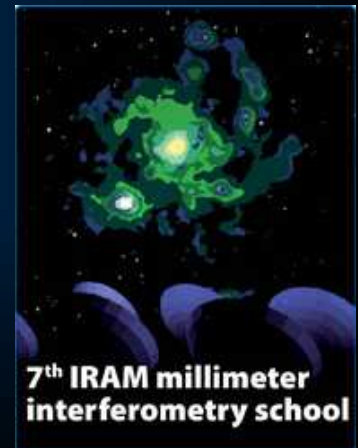


Absolute Flux Calibration

Melanie Krips



Outline

- I. Primary/Secondary Flux Calibrators
- II. Practical Tips to Calibrate the Fluxes of your Sources

Motivation

What do we want in a flux calibrator?

- strong ($>1\text{Jy}$) emission at mm wavelengths
- compact ($\ll 1''$) emission at mm wavelengths
- emission should not be variable in time
- preferentially with long LST range (i.e., high declination source)
- no or only little sun-avoidance
- preferentially well known properties (such as SED, size)

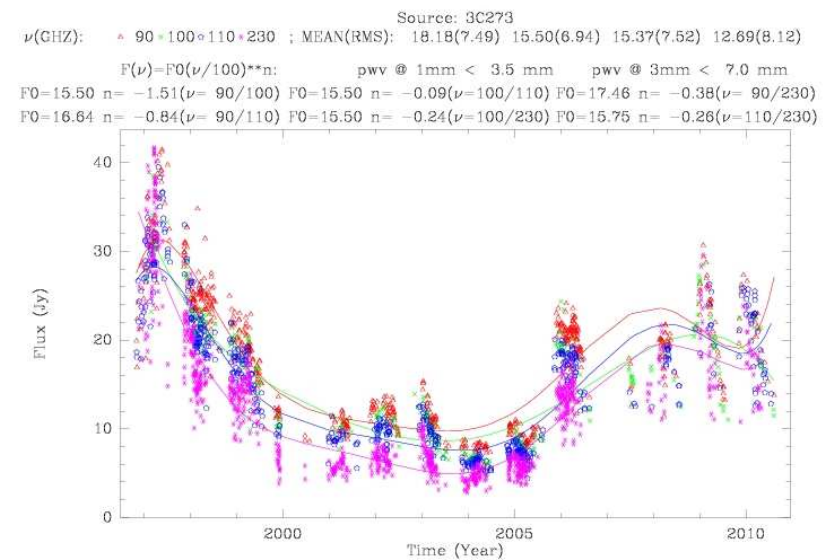
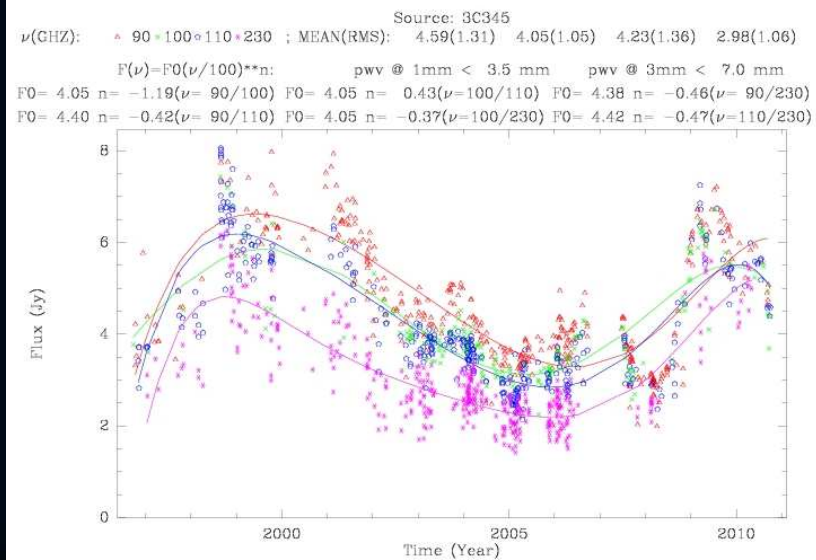
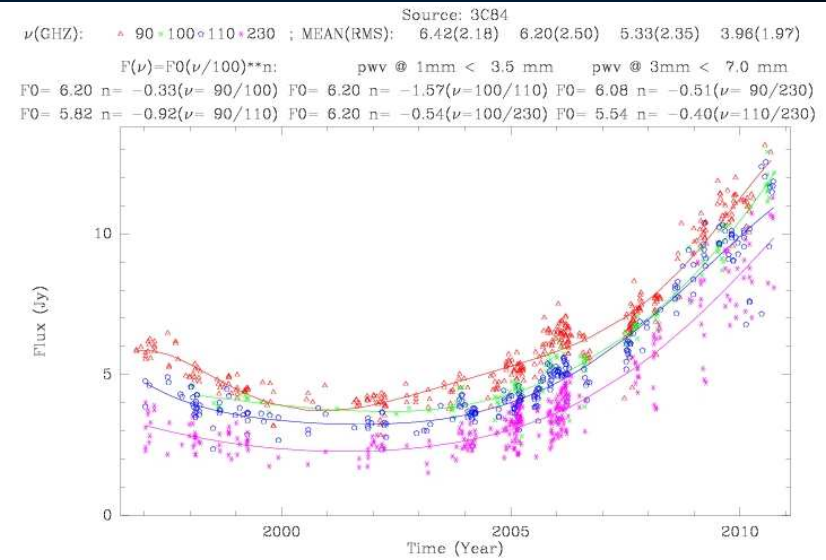
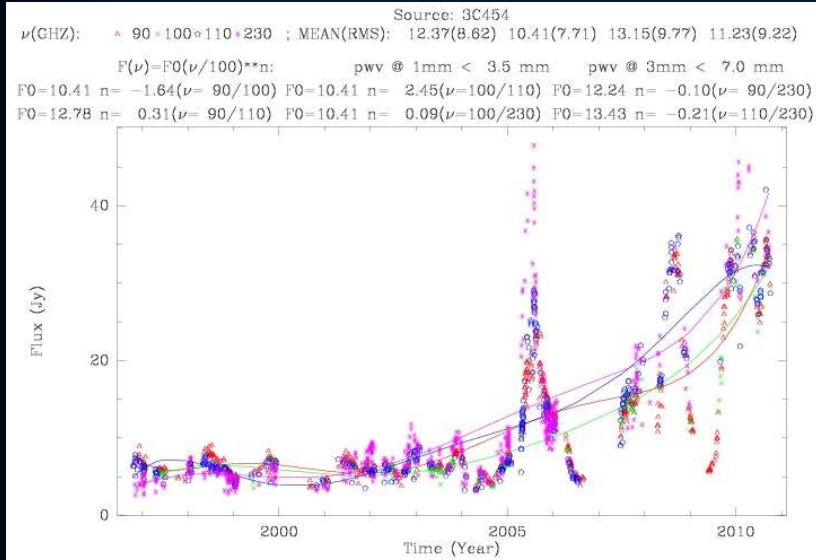
Flux Calibrators

1. Quasars
2. Planets
3. Solar Bodies
(Satellites, Asteroids,
Dwarf Planets)
4. Radio Stars
5. Antenna Efficiencies?

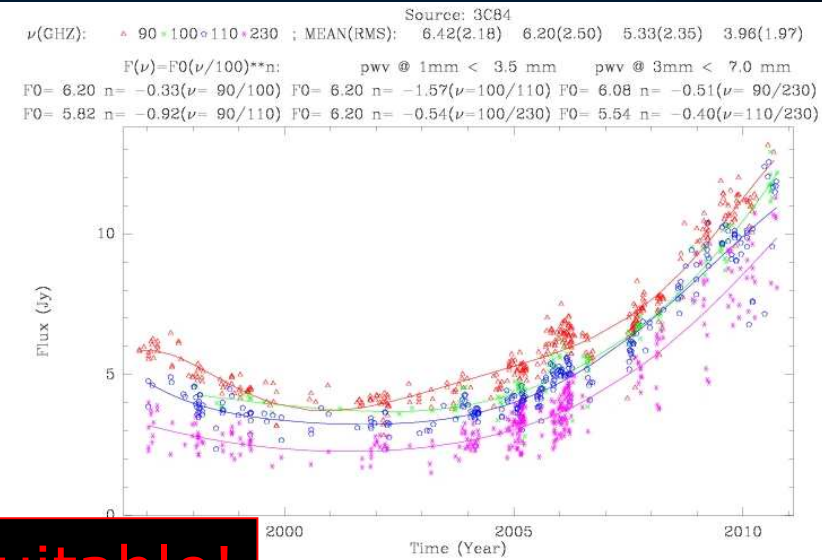
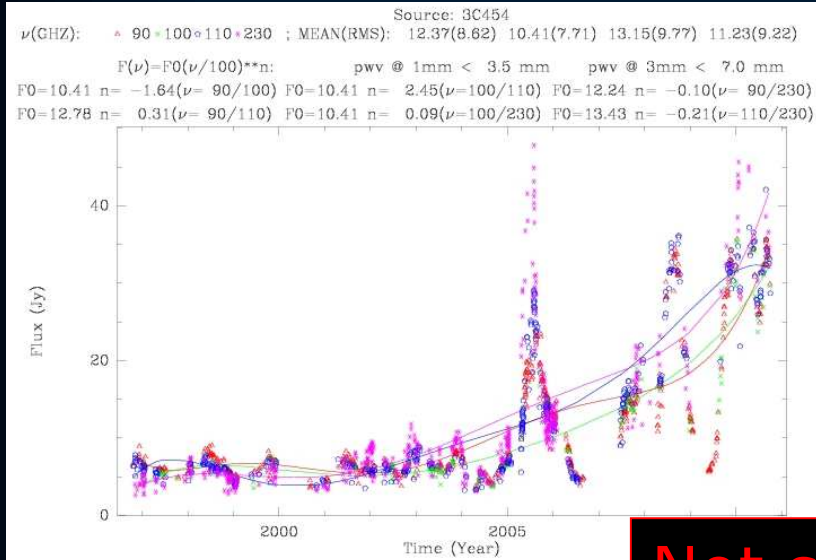
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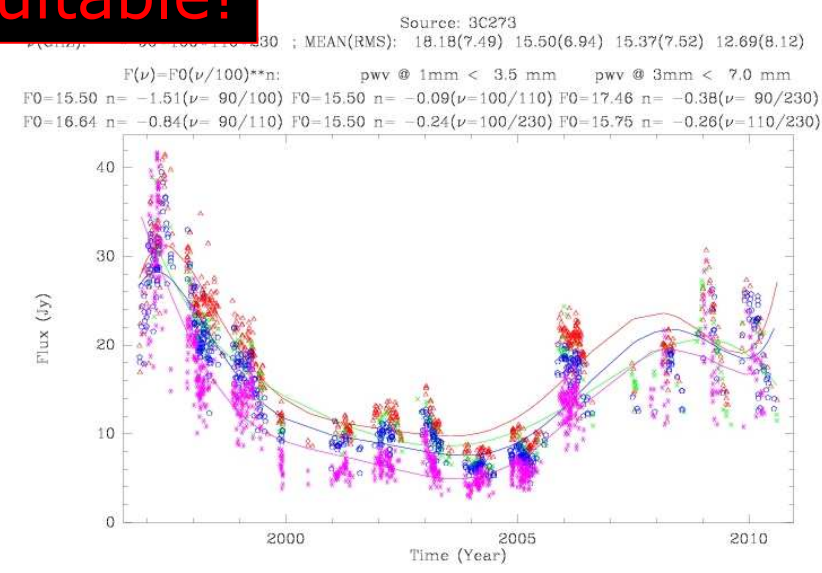
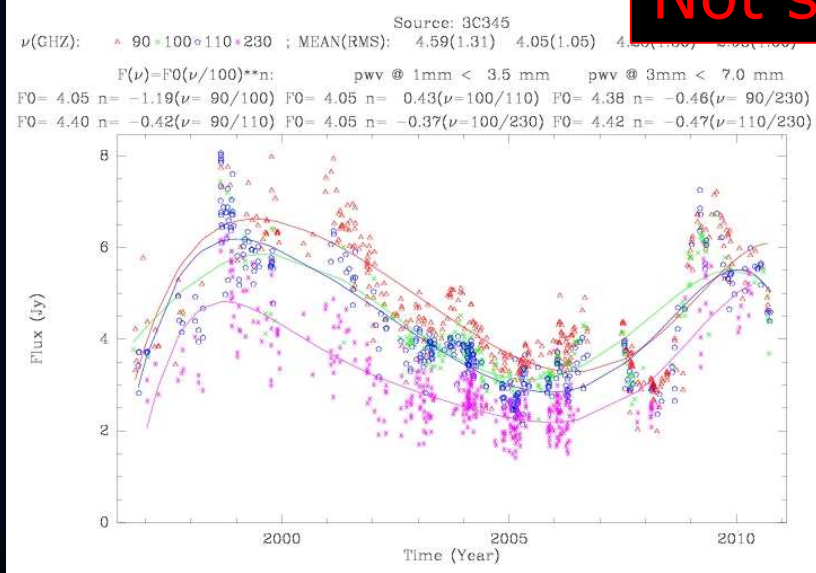
Flux Calibrators: Quasars



Flux Calibrators: Quasars



Not suitable!



Flux Calibrators

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Flux Calibrators: Planets

- Pro:
 - most of the solar planets have strong mm-emission and reasonably well derived flux models
- Contra:
 - 1.) Fluxes not completely constant
 - 2.) They start to be resolved ($\geq 3''$) already at 3mm
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 - 4.) Not always visible, i.e., more constraints due to sun-avoidance, short LST ranges

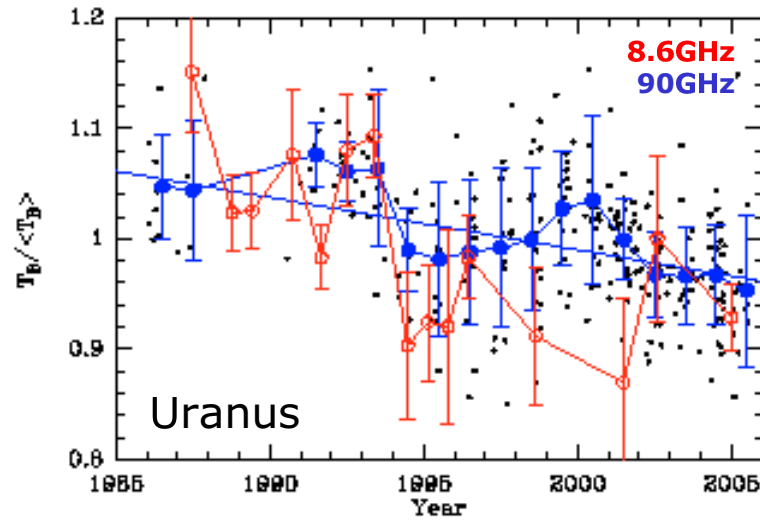


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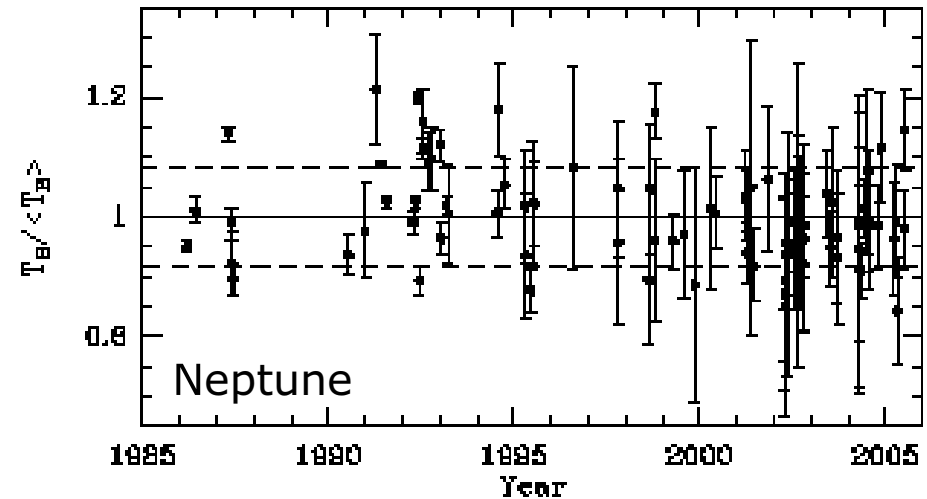
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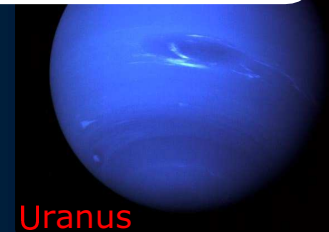
Flux Calibrators: Planets



Kramer et al. (2008)



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Uranus



Jupiter

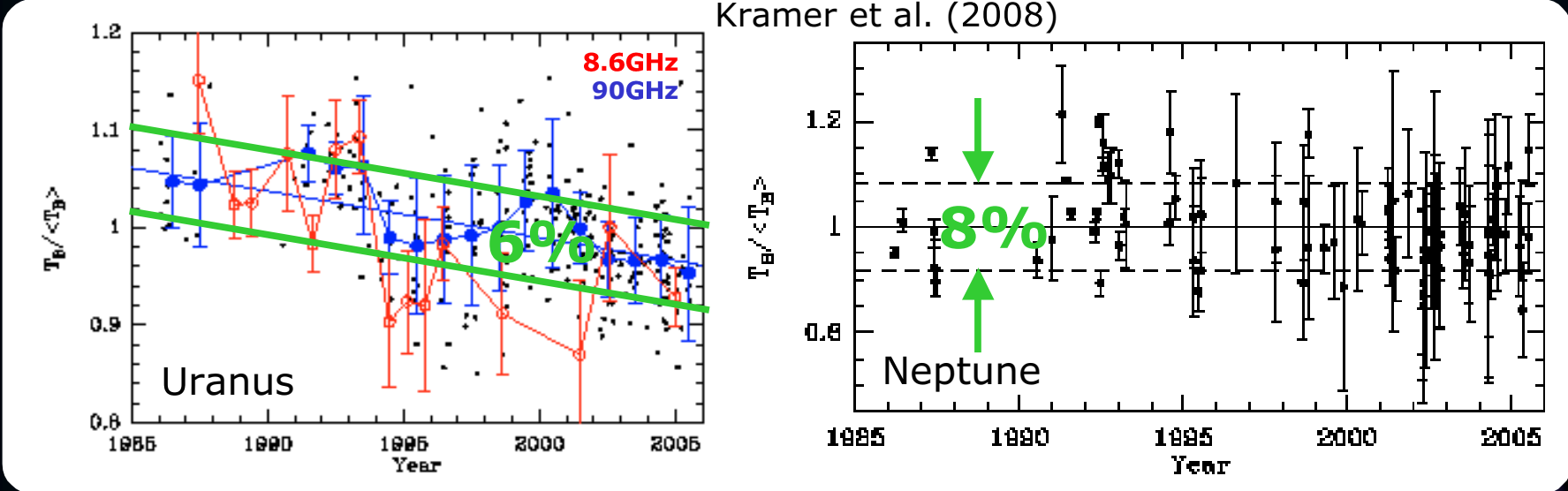


Saturn

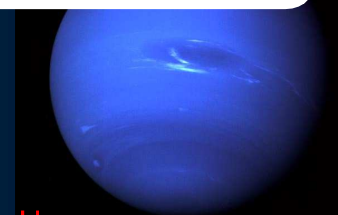


Neptune

Flux Calibrators: Planets



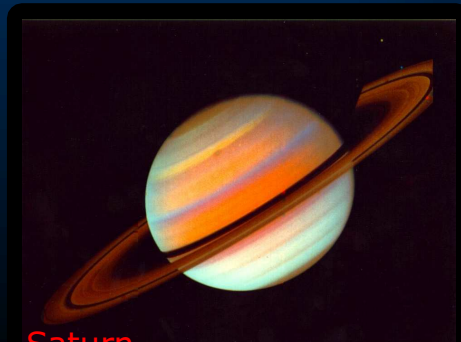
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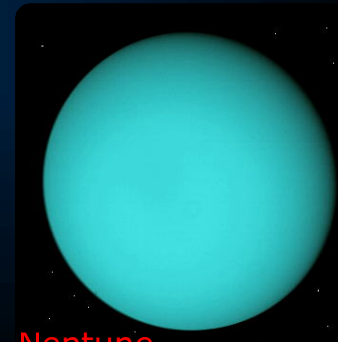
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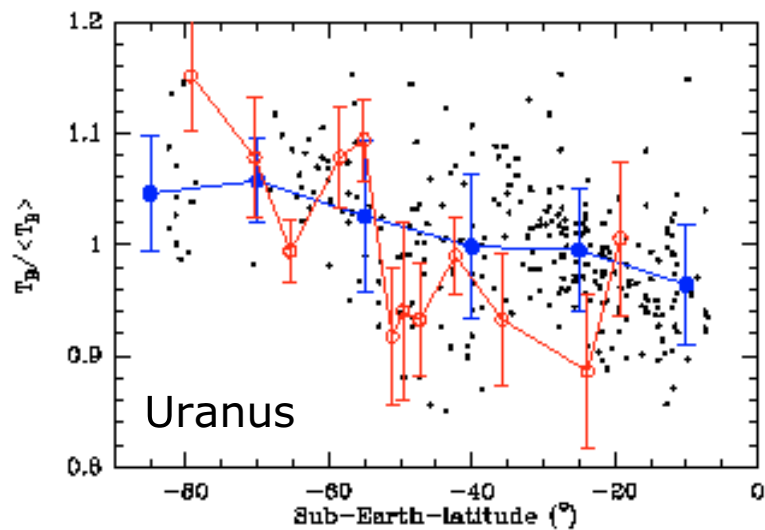
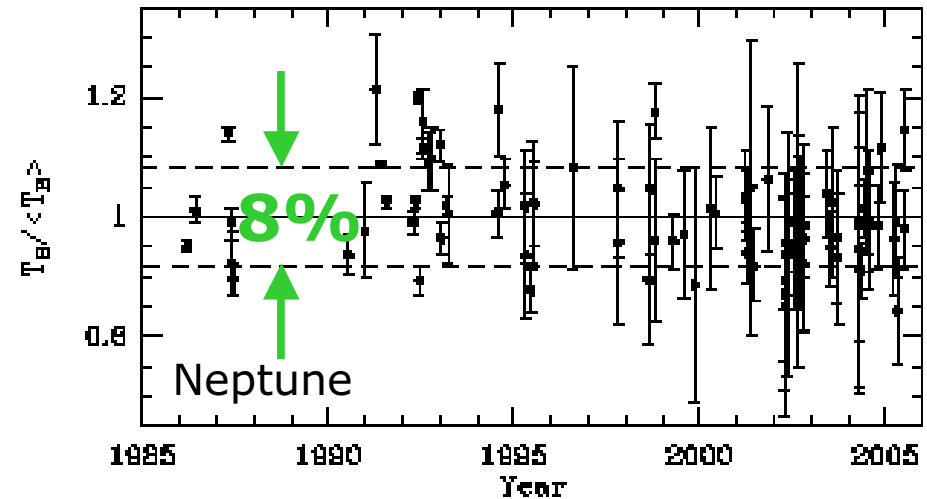
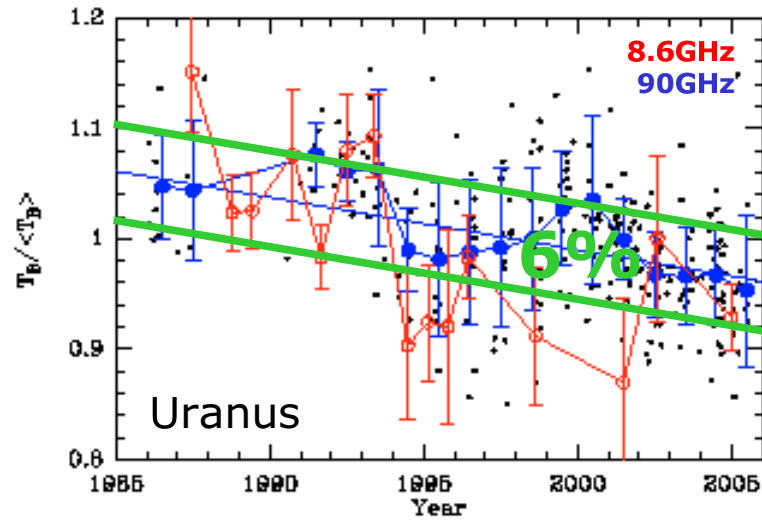
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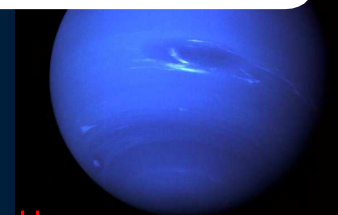
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the constraints due to sun-

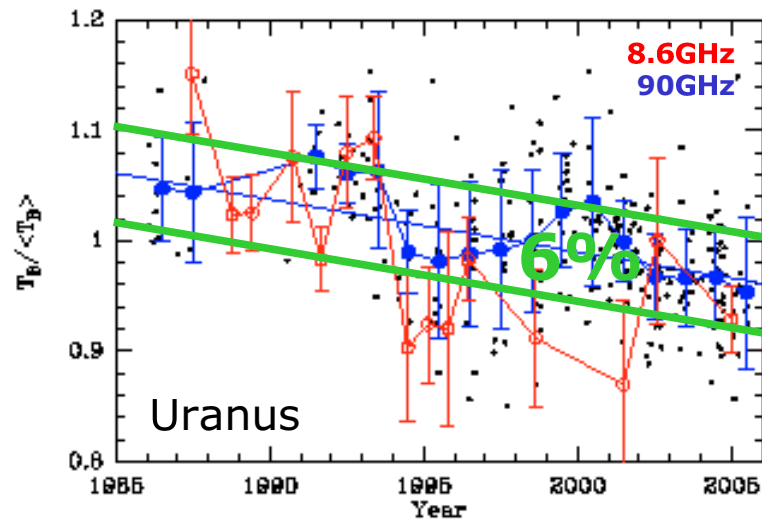


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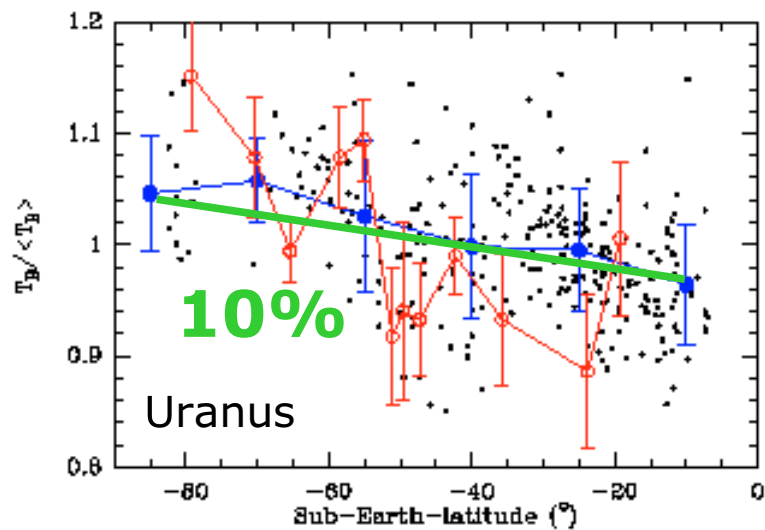
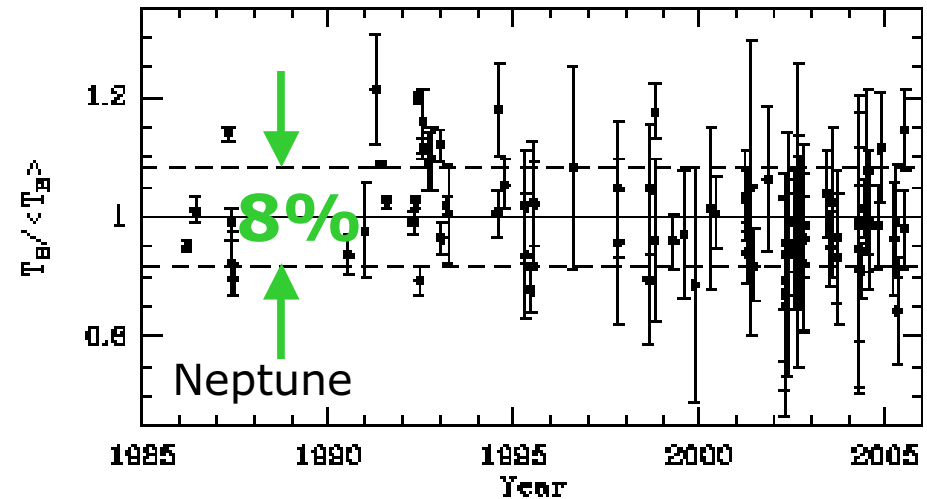
Saturn

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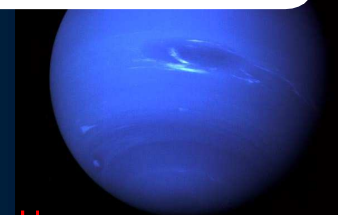


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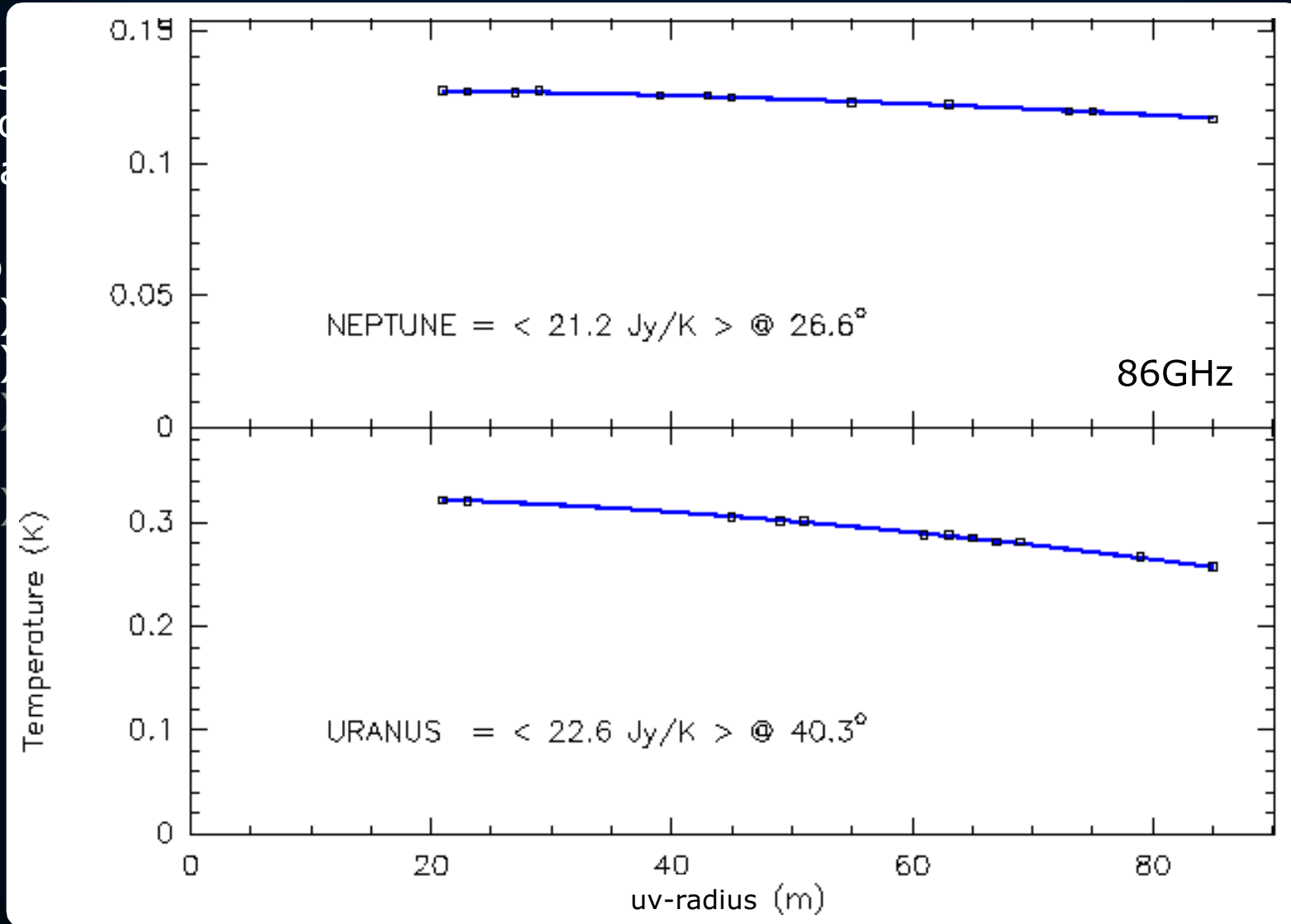
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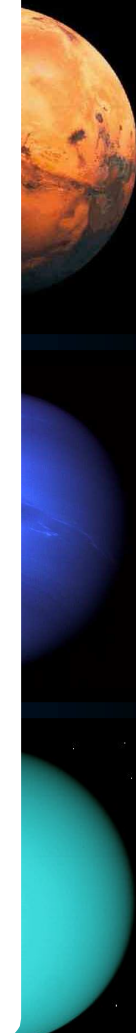
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- 1.)
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Jupiter

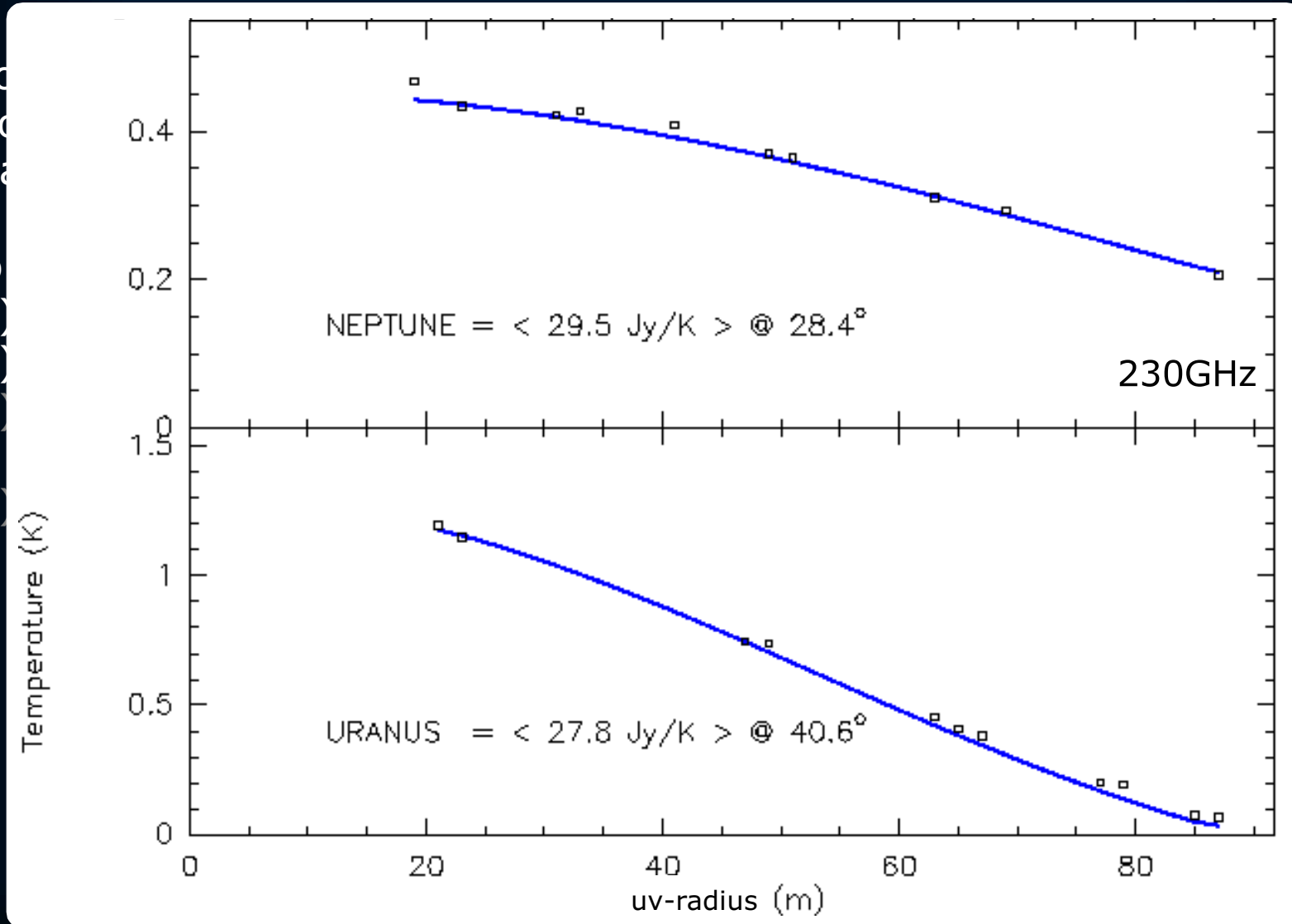
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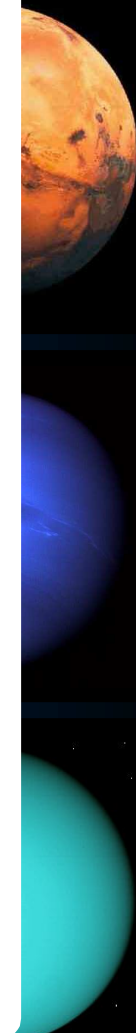
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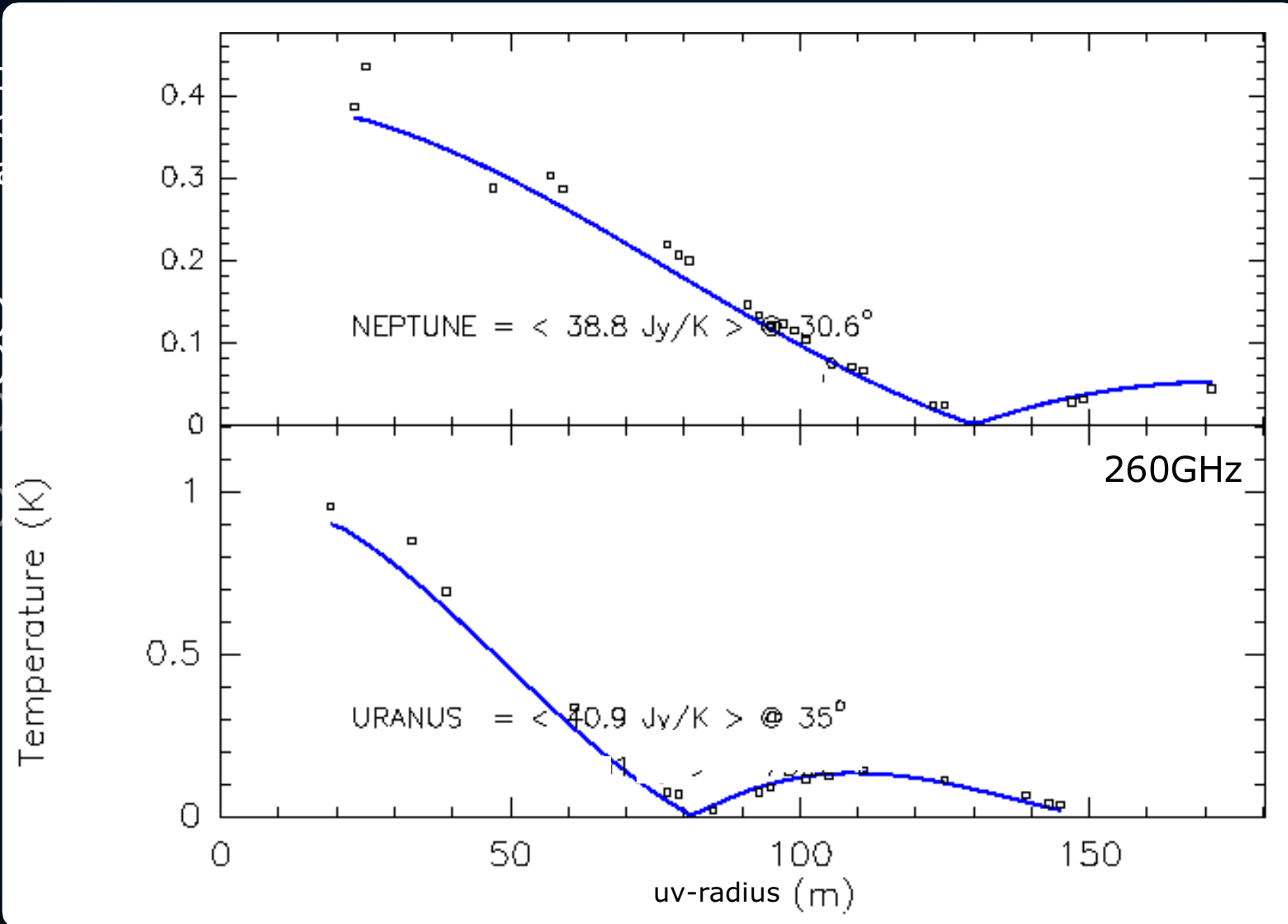
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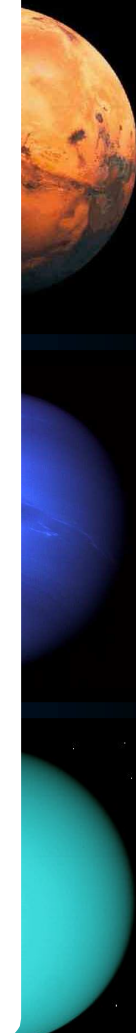
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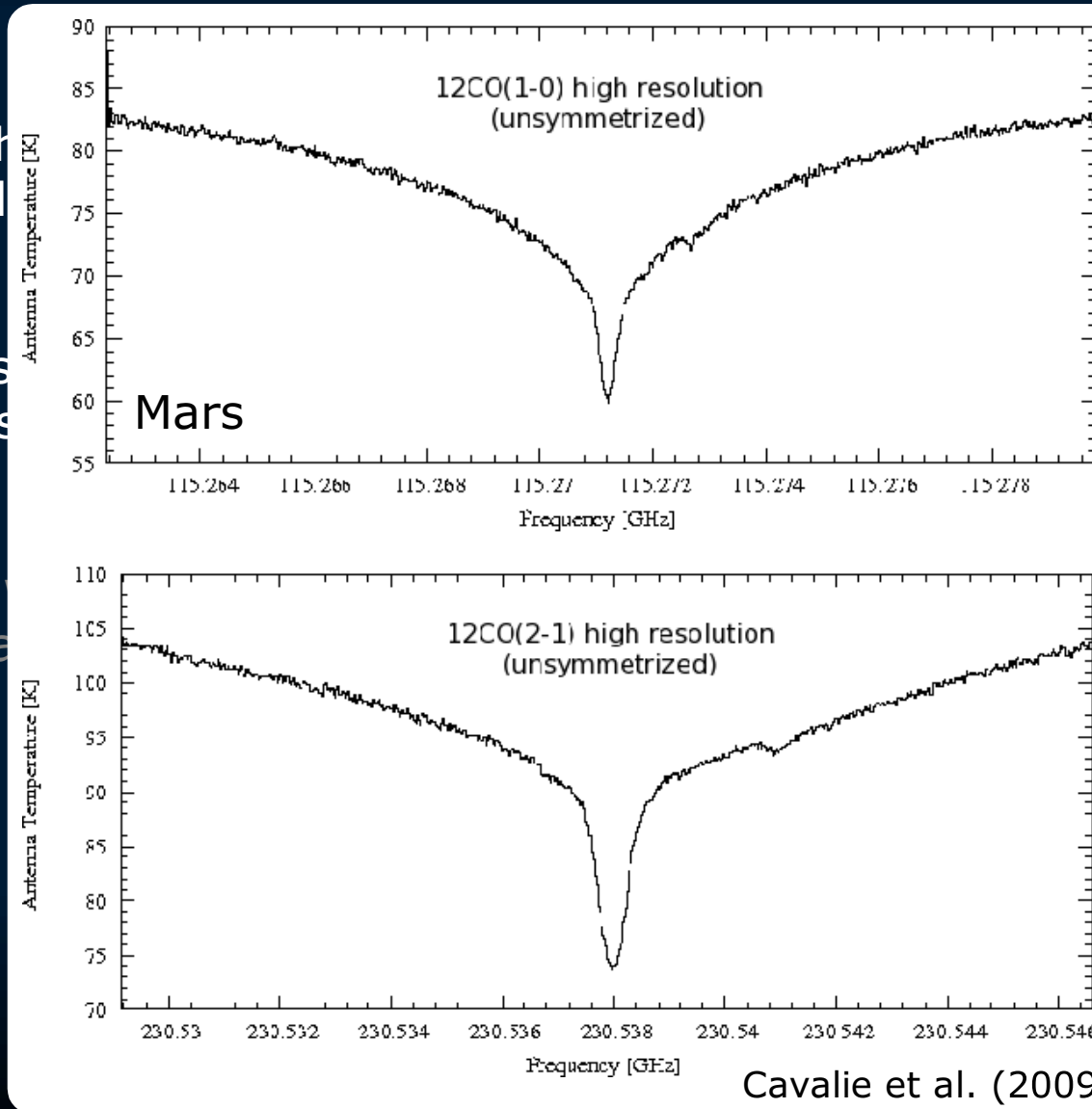
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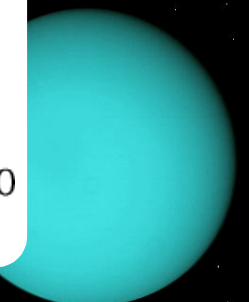
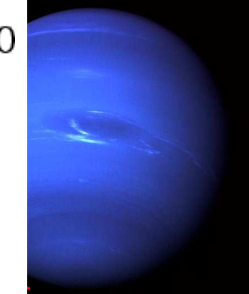
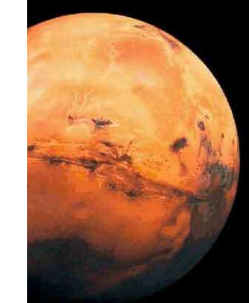
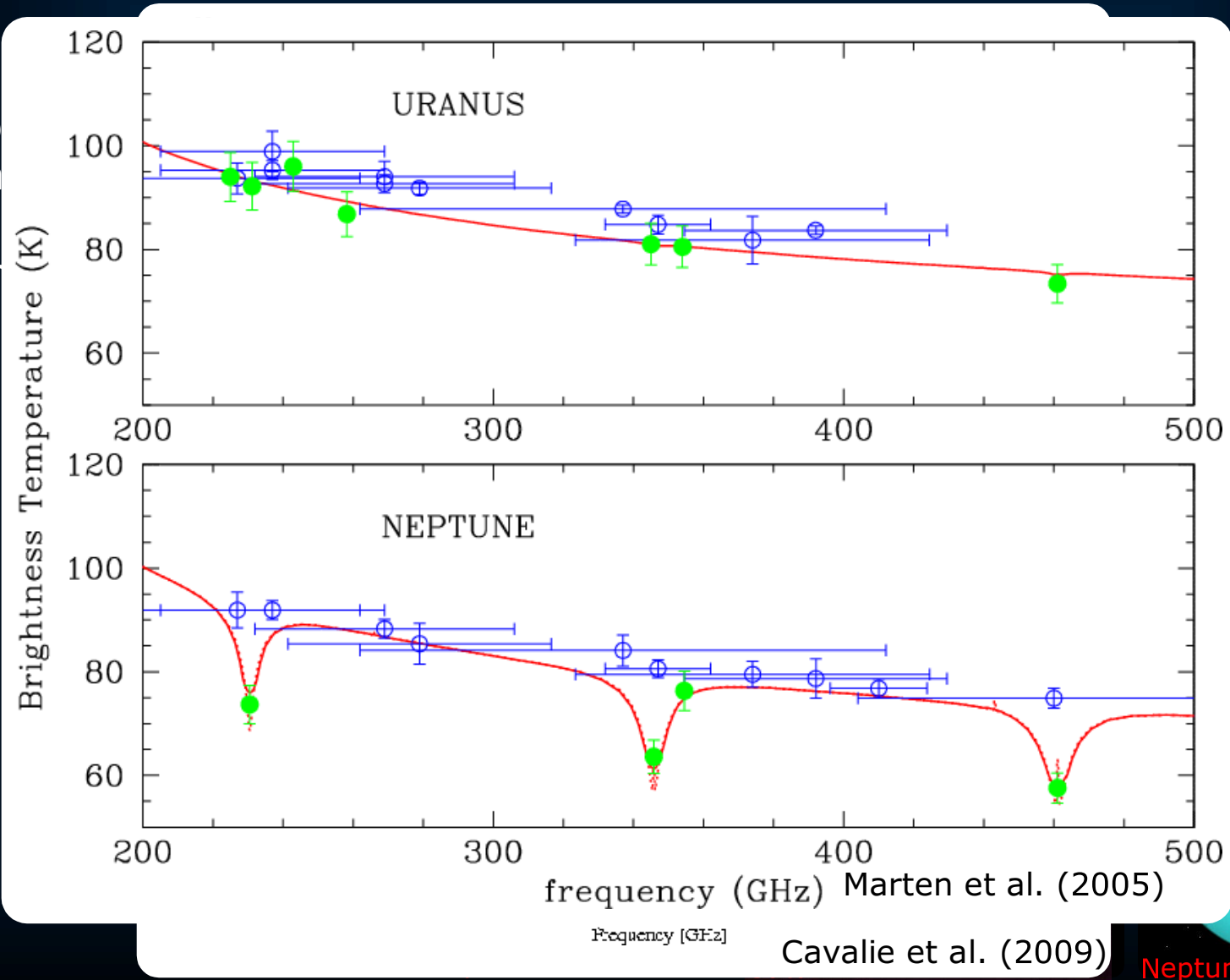
Flux Calibrators: Planets

- Pro:
 - most of the flux is in a reasonably narrow band
- Contra:
 - 1.) Fluxes are low
 - 2.) They are not isotropic
 - 3.) Some lines are very narrow (e.g., $^{12}\text{CO}(1-0)$)
 - 4.) Not all planets are available



Flux Calibrators: Planets

- Pro
- mo
- rea
- Cor
- 1.)
- 2.)
- 3.)
- 4.)



Neptune

Flux Calibrators: Planets

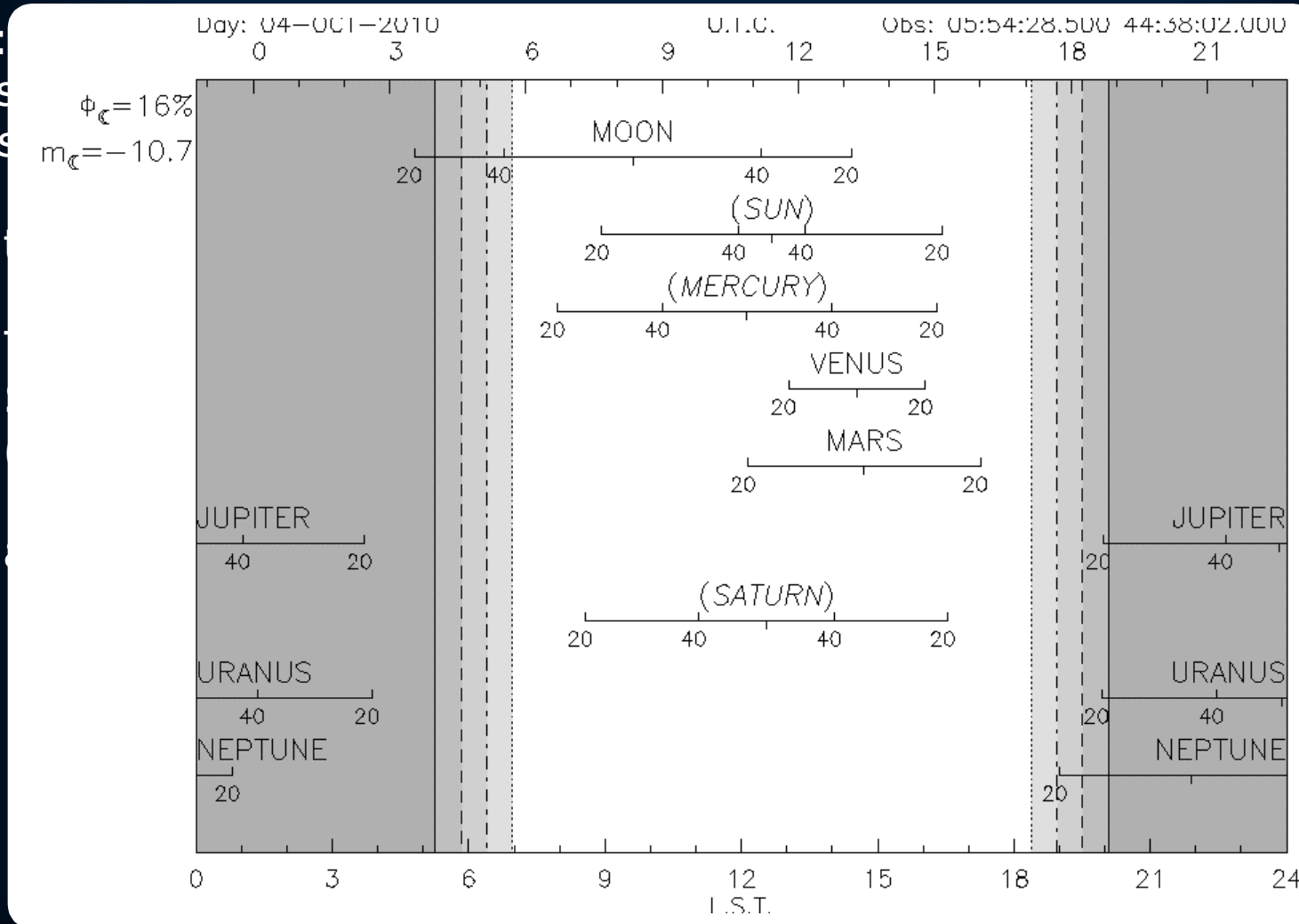
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Flux Calibrators: Planets

- Pro: mos reas
- Cont

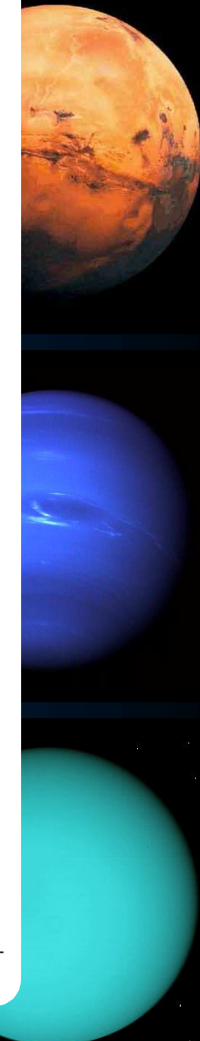
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Jupiter

Saturn

Neptune



Flux Calibrators

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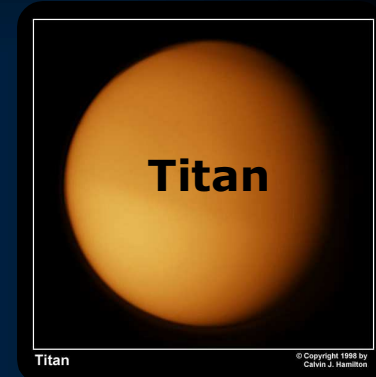
Flux Calibrators: Satellites

- Pro:
 - They are quite compact (hence better for extended configurations and/or higher frequencies than planets) and still sufficiently bright ($>500\text{mJy}@3\text{mm}$)
- Already regularly used at the SMA:
Titan, Ganymede, Callisto
- Contra:
 - Titan also shows broad molecular lines
 - they are not always useable especially when they are too close to their 'mother'-planet (or each other); one needs at least $3x\text{PB}$
 - flux models not as well constrained as for planets



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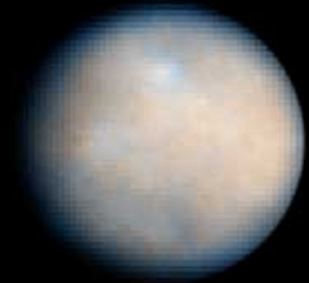
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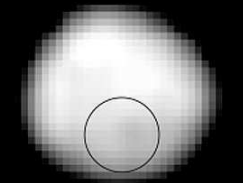
Flux Calibrators: Asteroids/Dwarf Planets

- Pro:
 - bright and relatively small solar bodies
- Contra:
 - Fluxes not (yet) well determined; some of them known to vary quite significantly within a day
 - irregular shapes

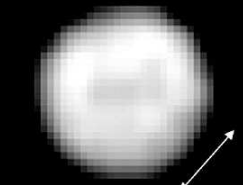
Ceres



Palla

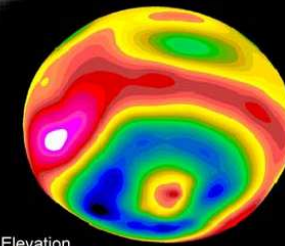
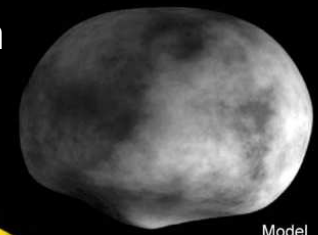


332 E 75 E 152 E



258 E 348 E 78 E

Vesta



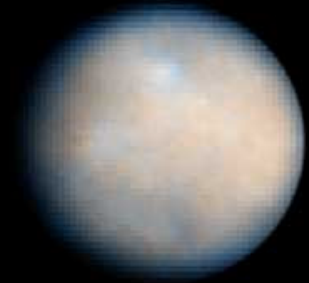
Elevation

-12km +12km

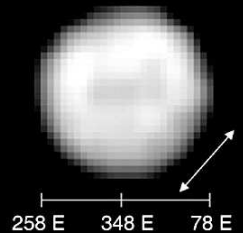
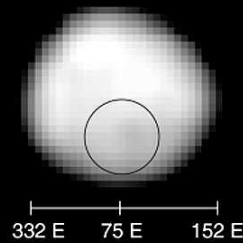
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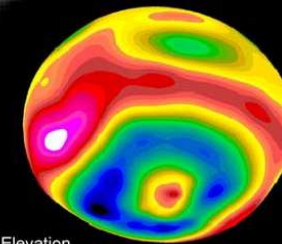
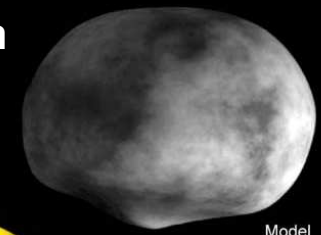
Ceres



Palla



Vesta

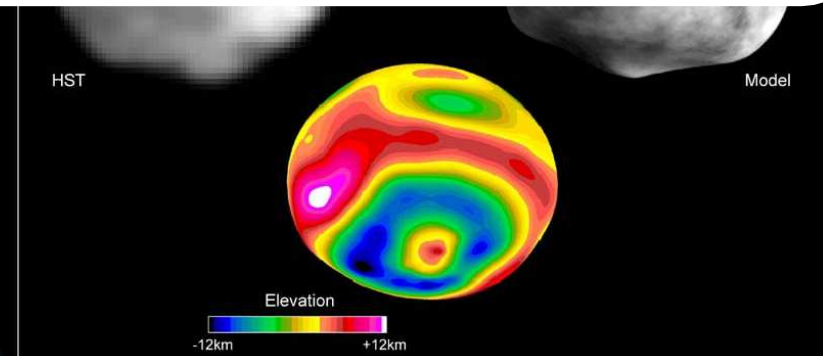
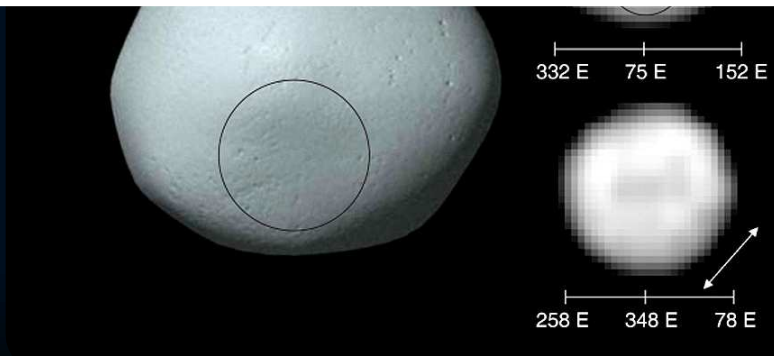
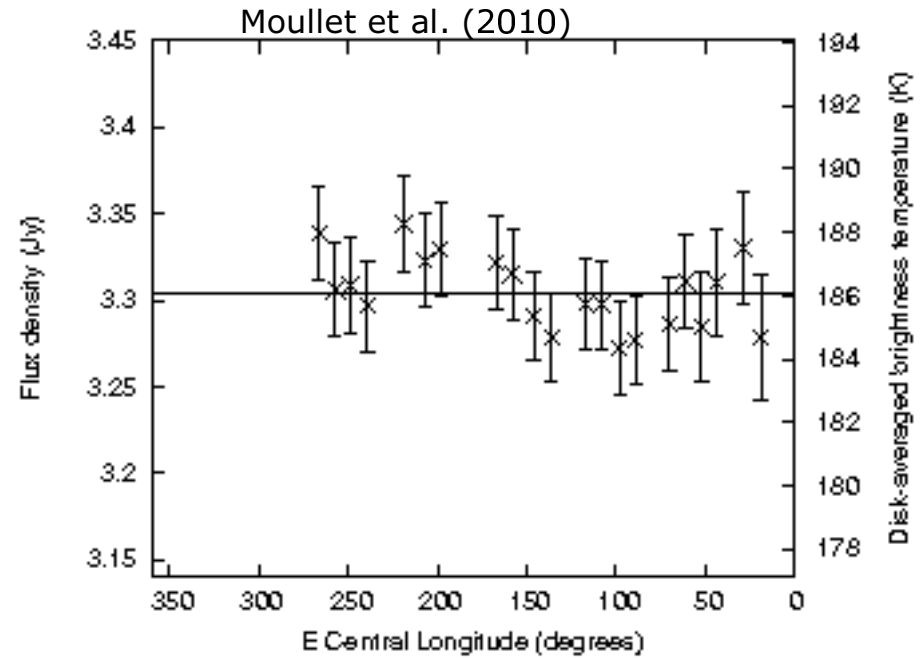
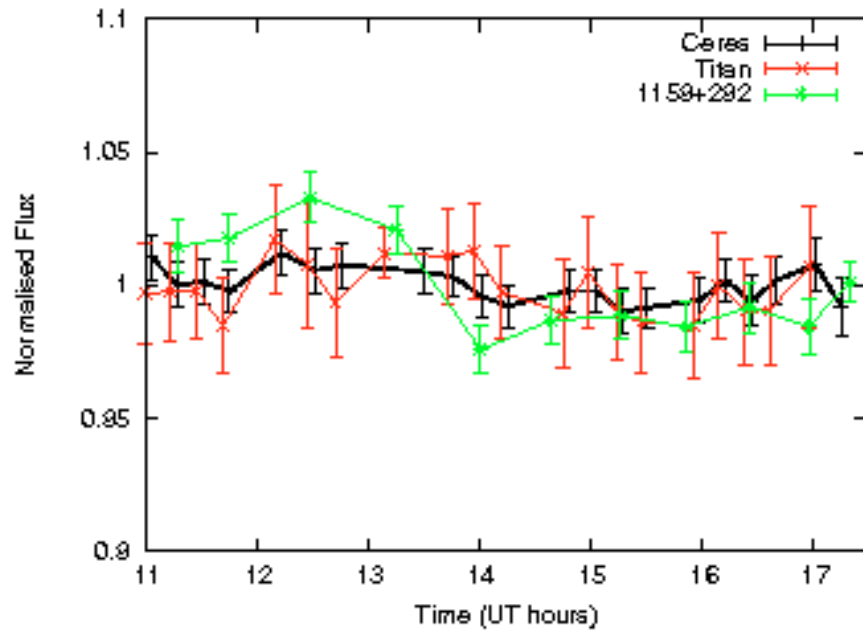


Elevation
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Flux Calibrators: Asteroids/Dwarf Planets

Dwarf

Ceres



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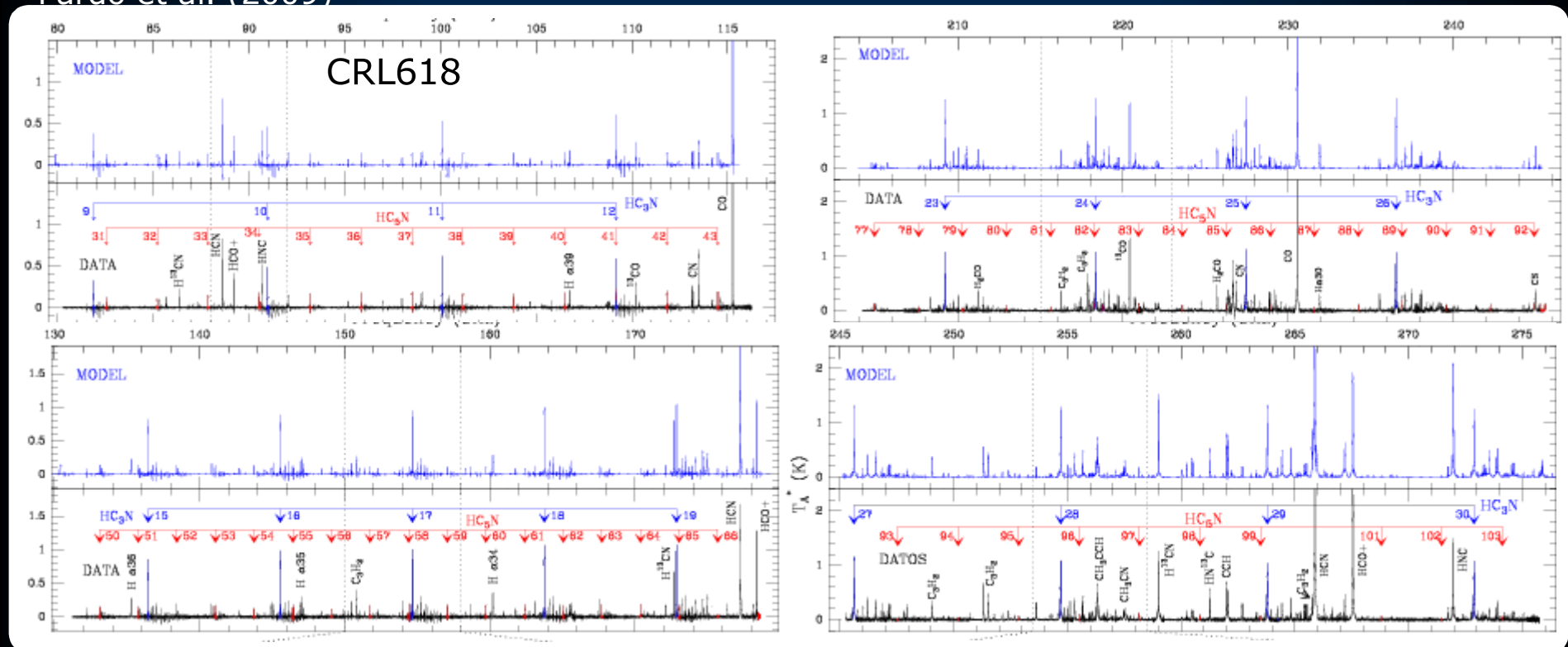
Flux Calibrators: Radio Stars

Number of radio bright stars:

- MWC349 (binary star)
- CRL618 (PPN)
- W3OH (HII region)
- NGC7072 (young PN)
- NGC7538 (HII region)
- K3-50A (HII-region)
-

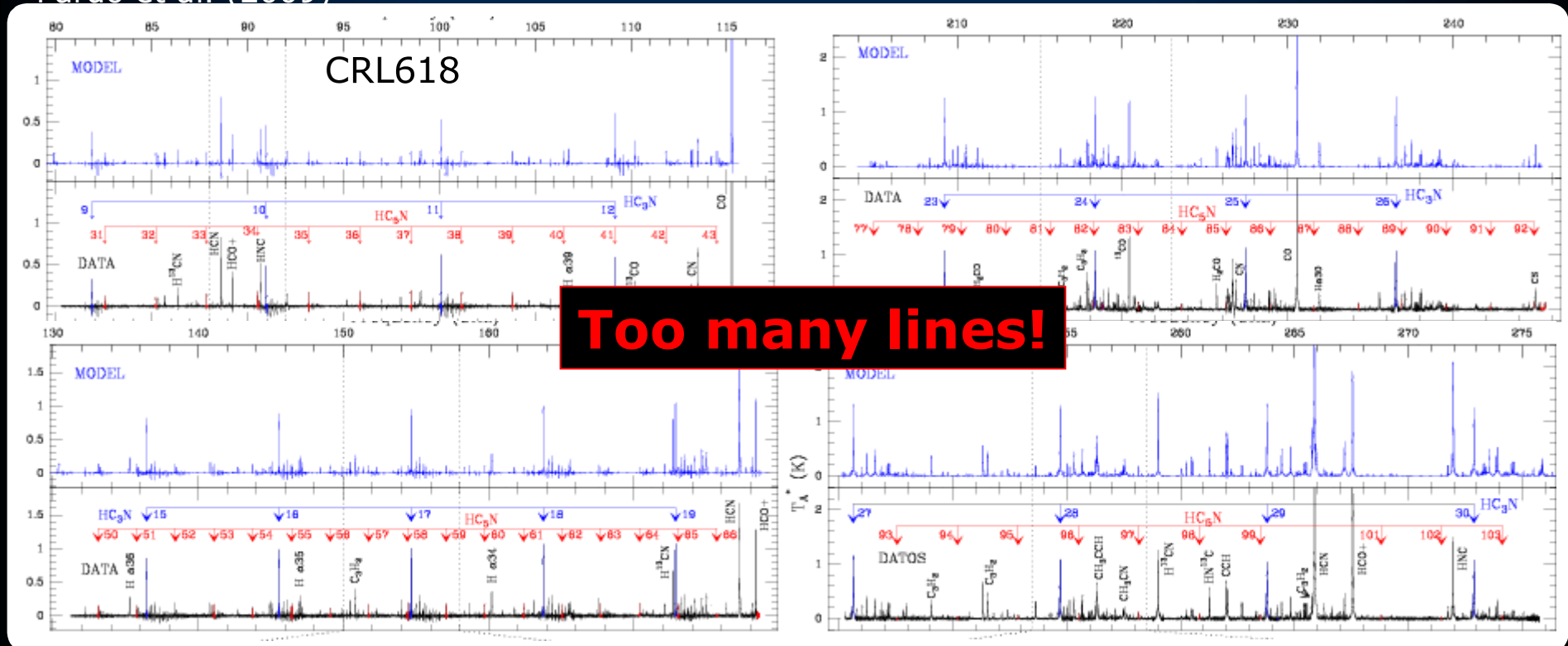
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Pardo et al. (2009)

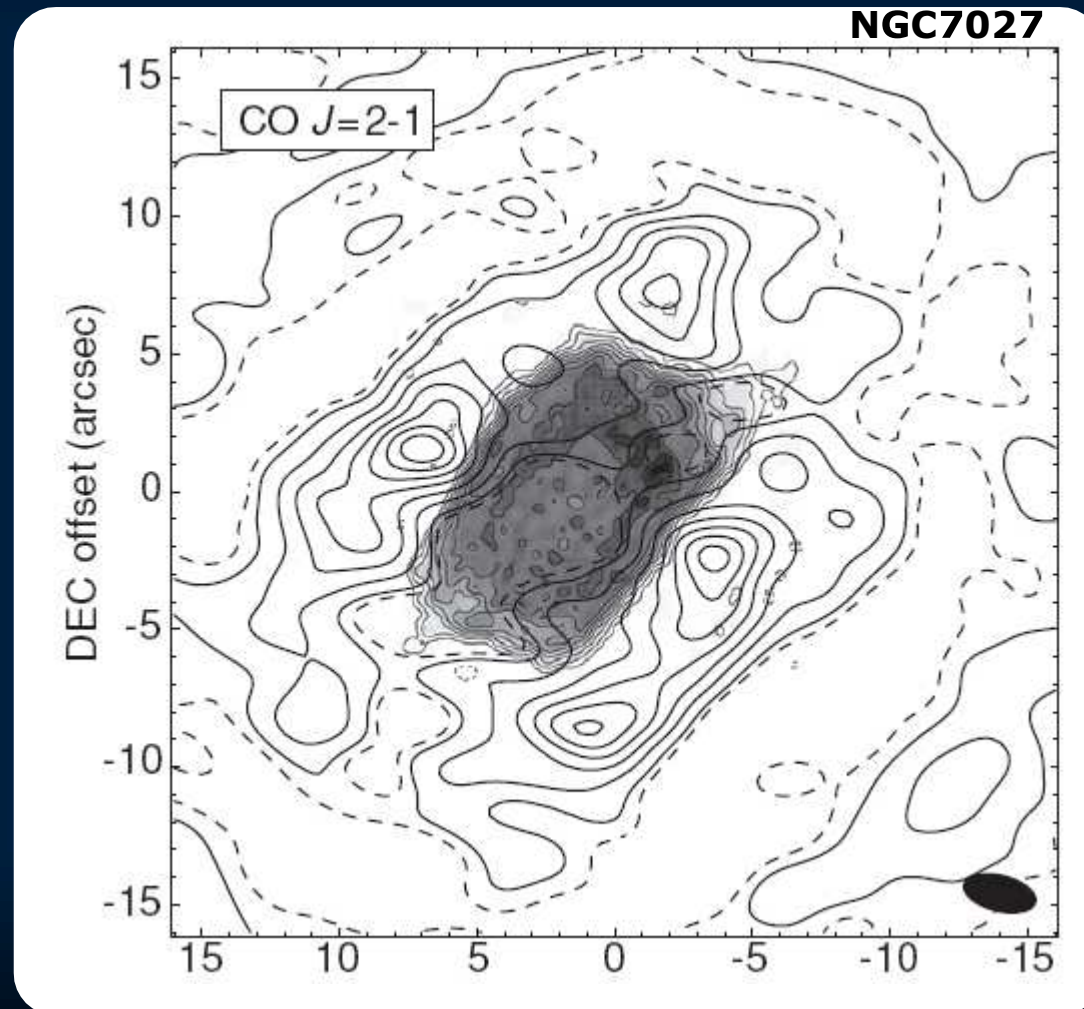


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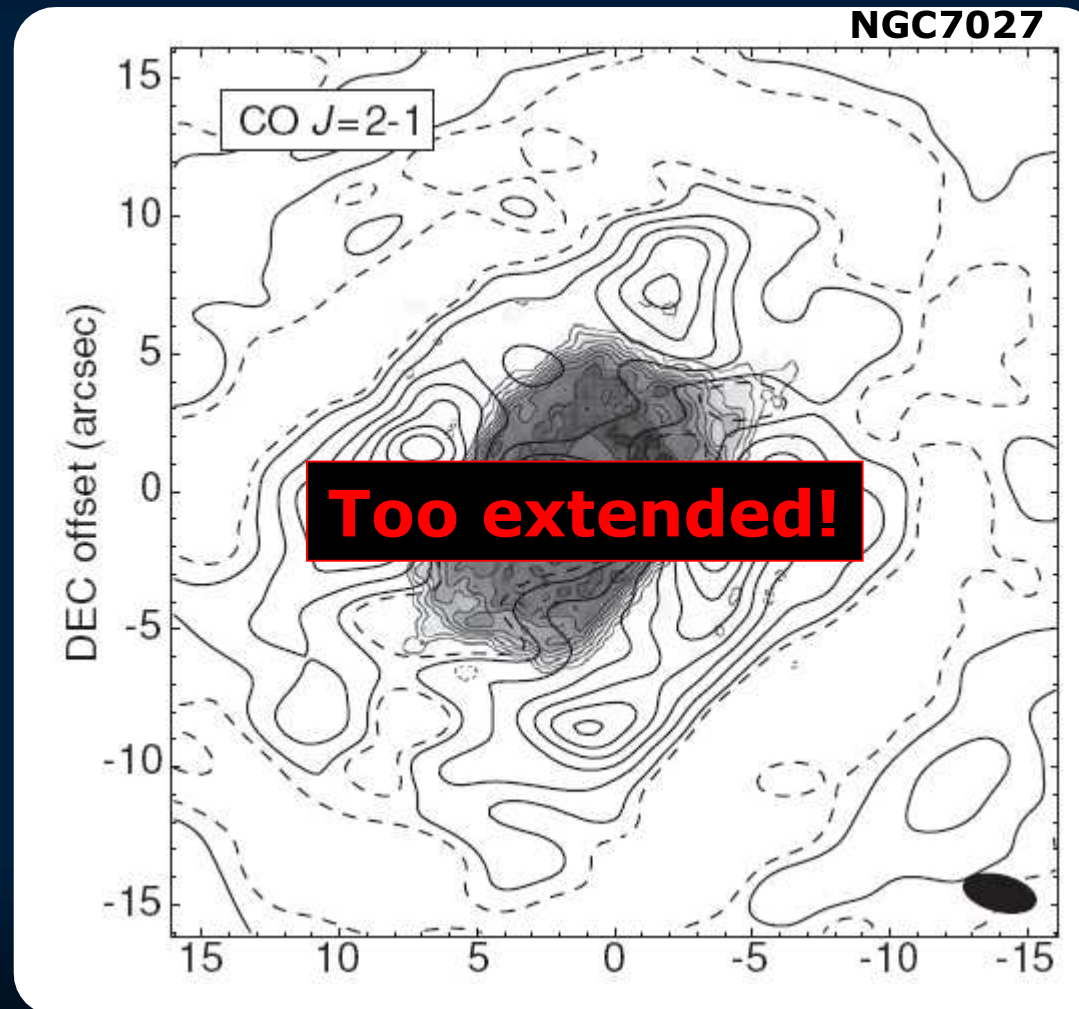


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Nakashima et al. (2010)

Flux Calibrators: Radio Stars



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Flux Calibrators: Radio Stars

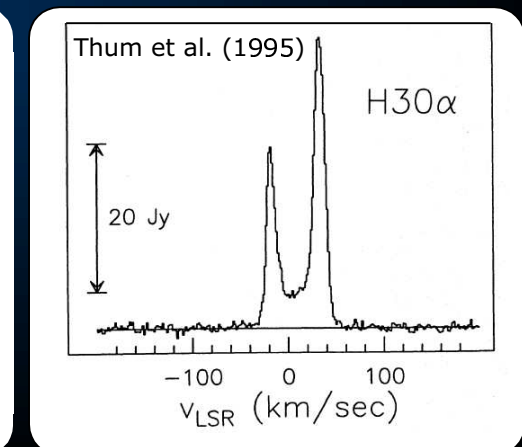
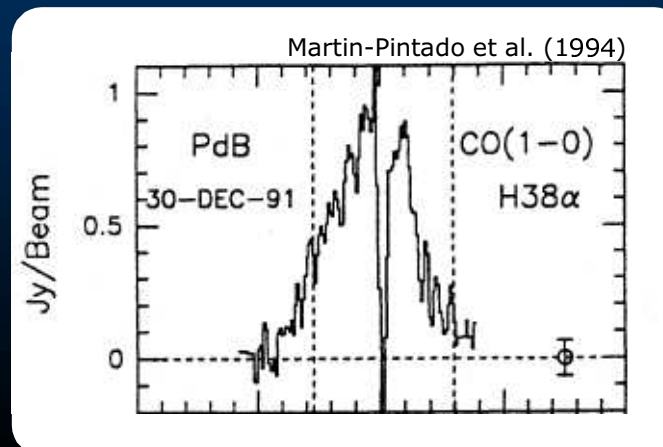
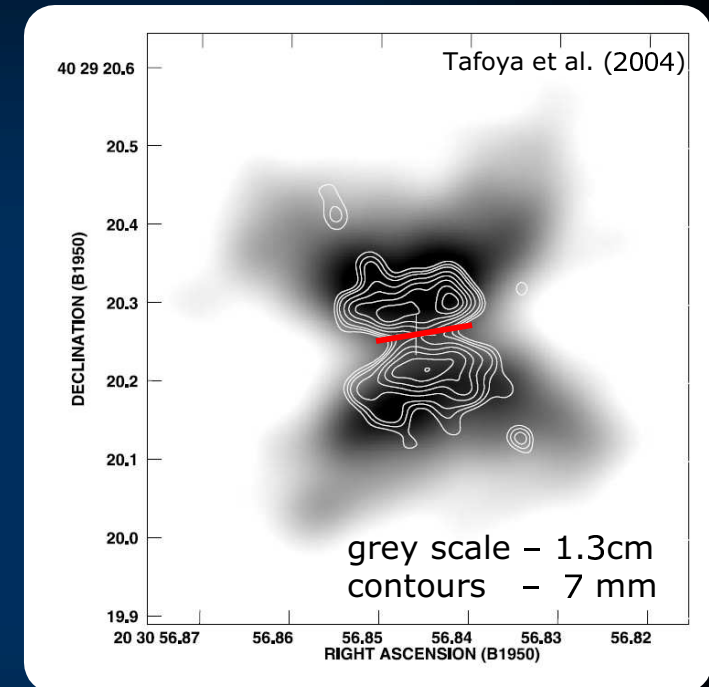
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Flux Calibrators: MWC349

Some facts:

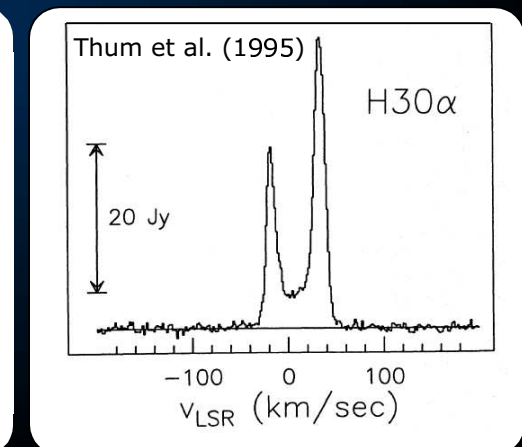
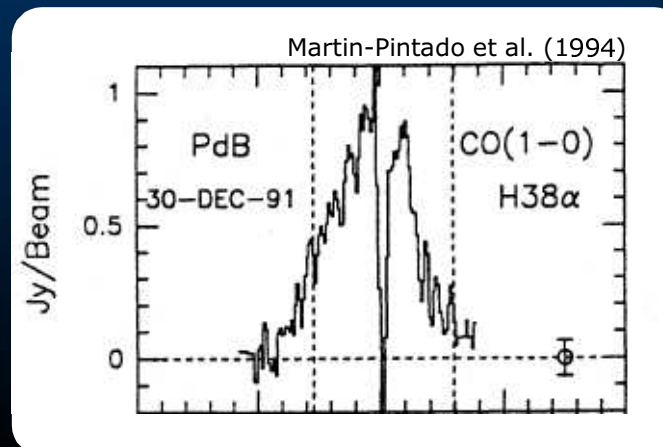
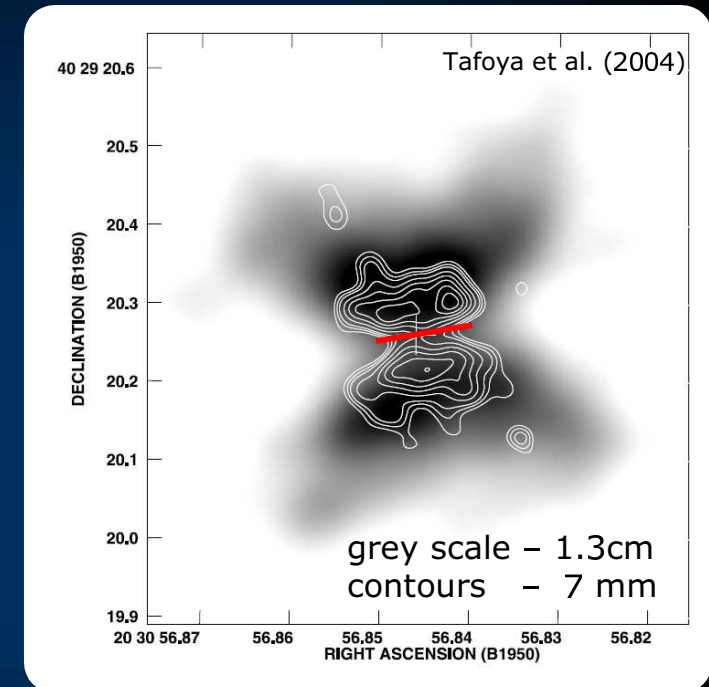
- binary stellar system:
MWC349A (Be) & MWC349B (B0 type III)
- the two stars are separated by $2.4'' \pm 0.1''$ and possibly interact
- MWC349A the brightest radio continuum star
- radio continuum produced by "ionised bipolar flow that photoevaporates from the surface of a neutral Keplerian disk"
- size of flow decreases with frequency
- strong but highly variable hydrogen maser emission (RRLs) from the near-edge-on disk ($\sim 0.065'' = 80\text{AU}@1.2\text{kpc}$)
- at declination of $>40\text{deg}$
-> visible for $\sim 13\text{h}$ per day



Flux Calibrators: MWC349

Some facts:

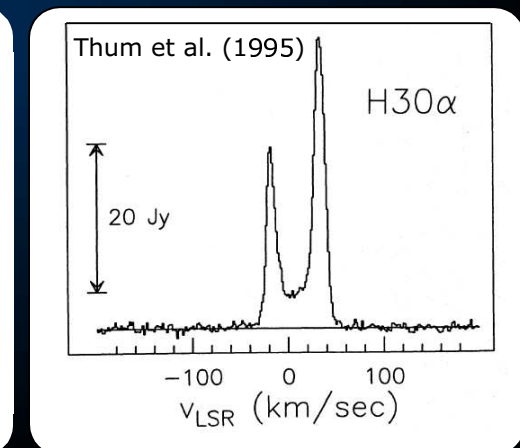
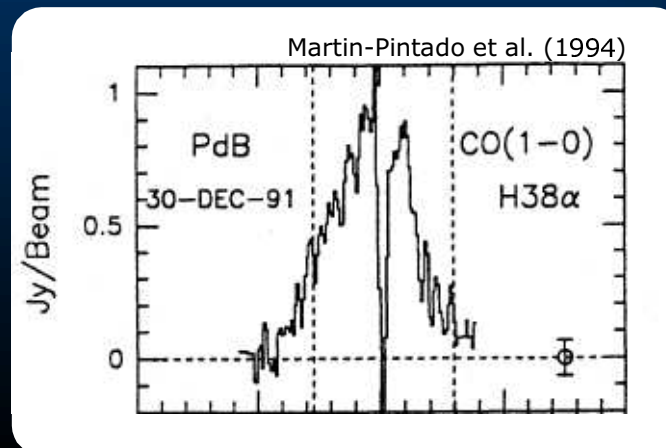
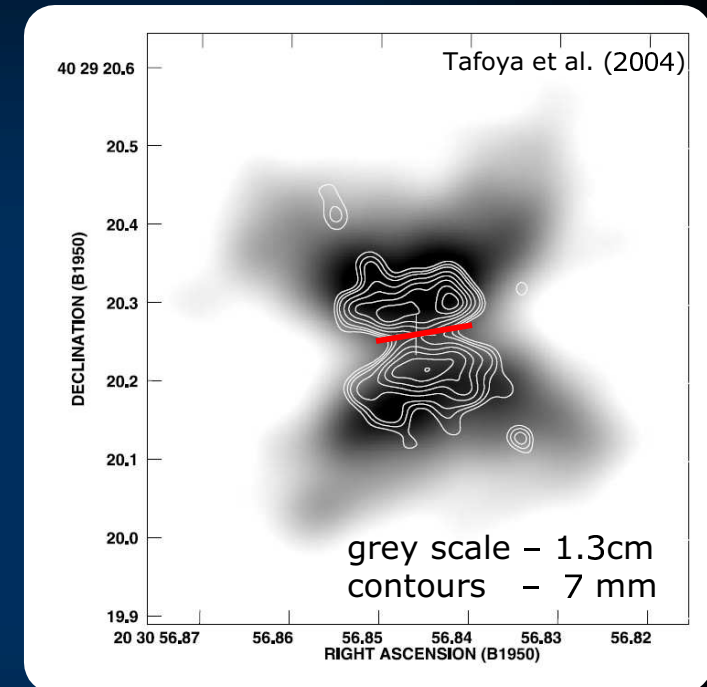
- binary stellar system:
MWC349A (Be) & MWC349B (B0 type III)
- the two stars are separated by $2.4'' \pm 0.1''$ and possibly interact
- MWC349A the brightest radio continuum star
- radio continuum produced by "ionised bipolar flow that photoevaporates from the surface of a neutral Keplerian disk"
- size of flow decreases with frequency
- strong but highly variable hydrogen maser emission (RRLs) from the near-edge-on disk ($\sim 0.065'' = 80\text{AU}@1.2\text{kpc}$)
- at declination of $>40\text{deg}$
-> visible for $\sim 13\text{h}$ per day



Flux Calibrators: MWC349

Some facts:

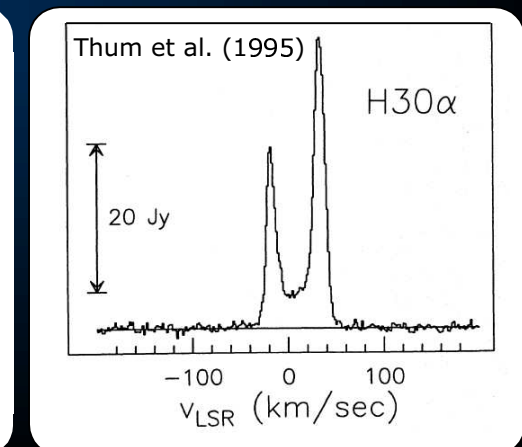
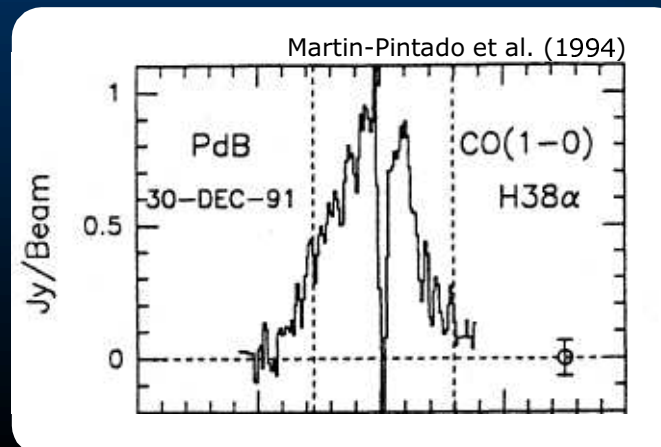
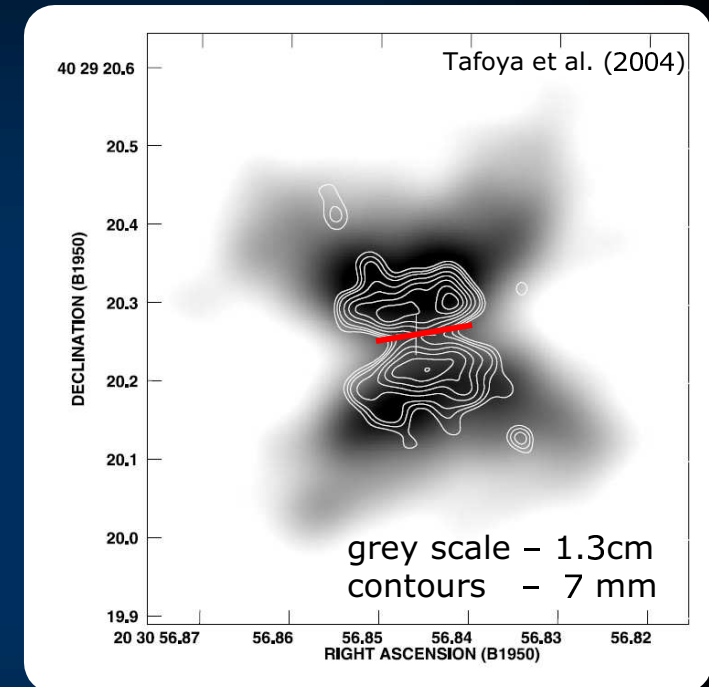
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Flux Calibrators: MWC349

Some facts:

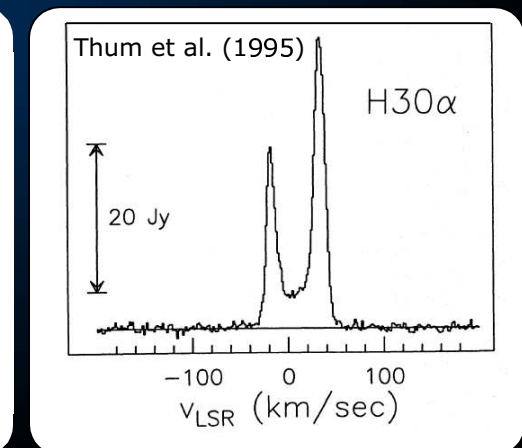
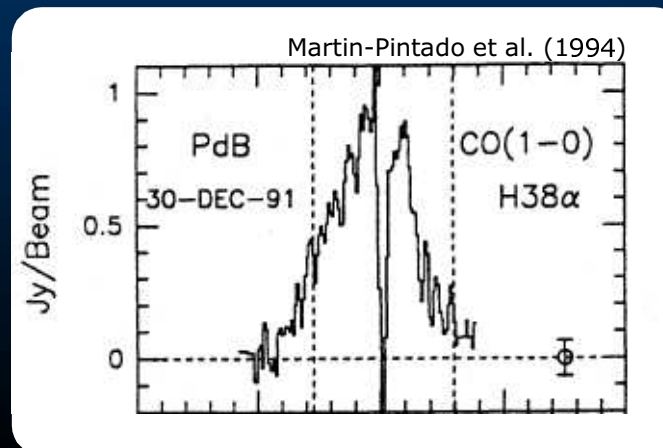
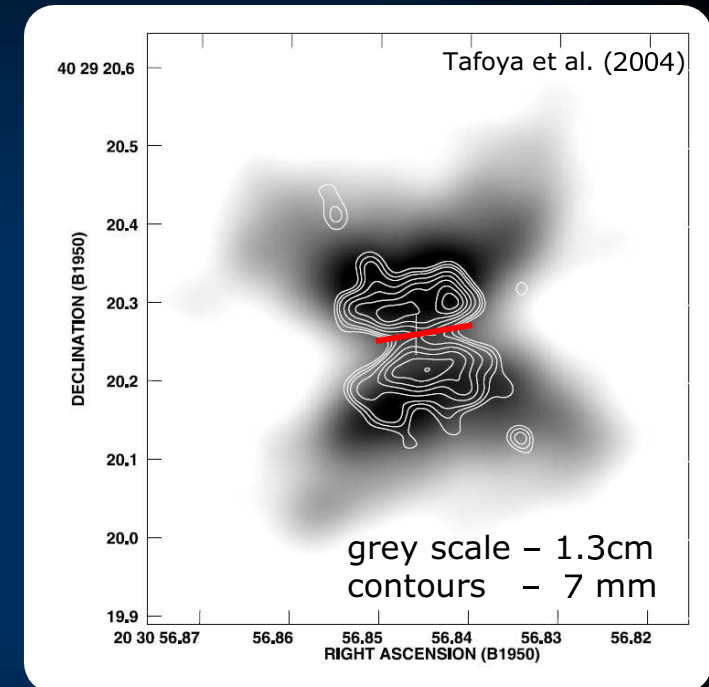
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Flux Calibrators: MWC349

Some facts:

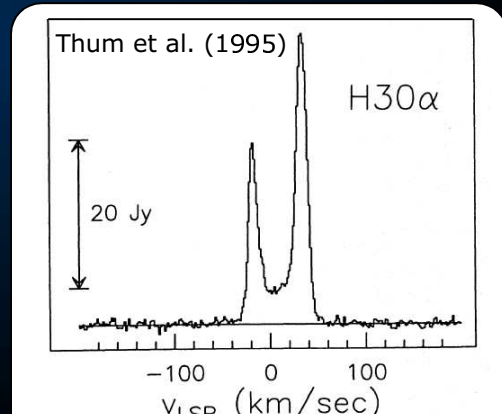
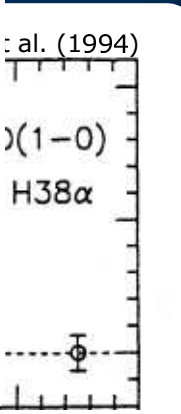
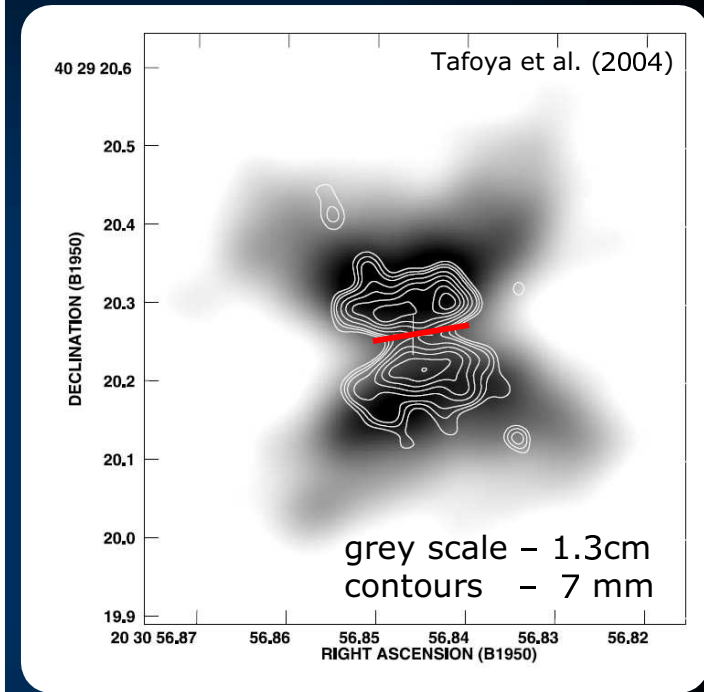
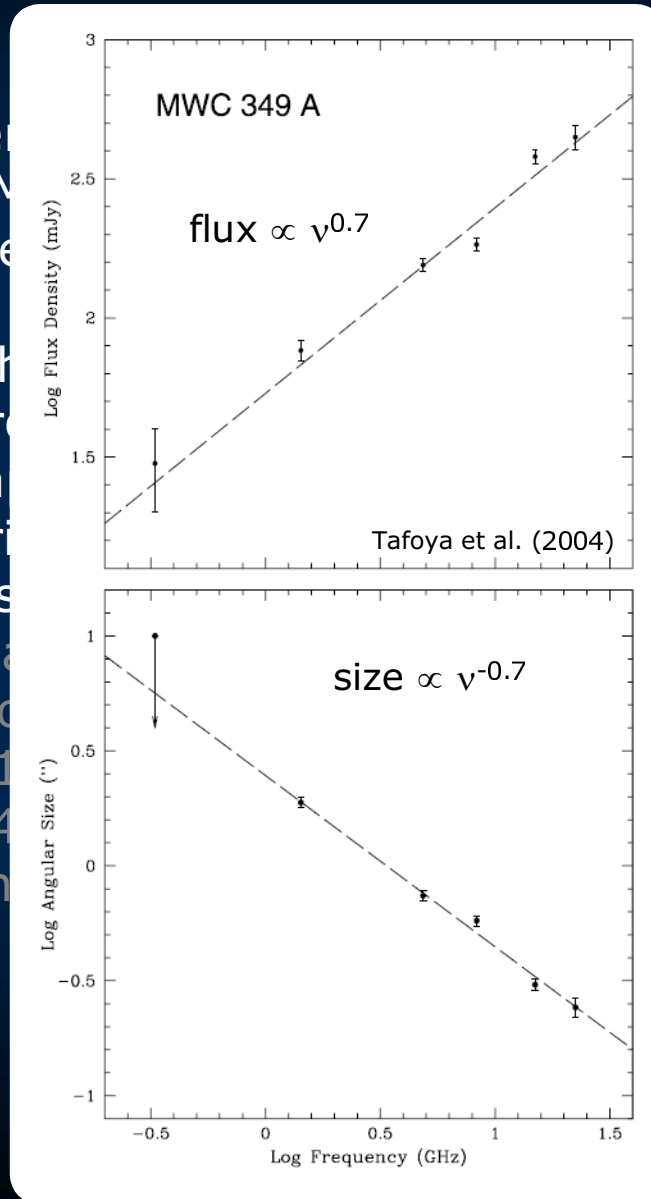
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Flux Calibrators: MWC349

Some facts:

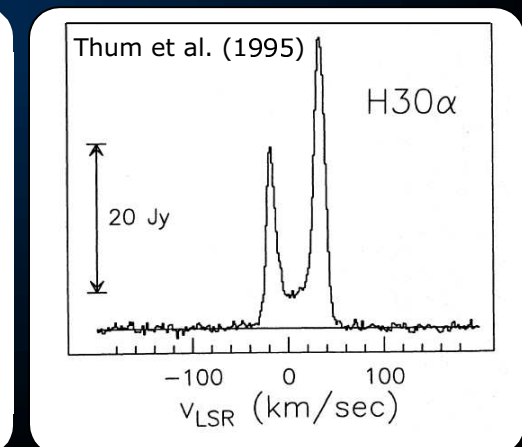
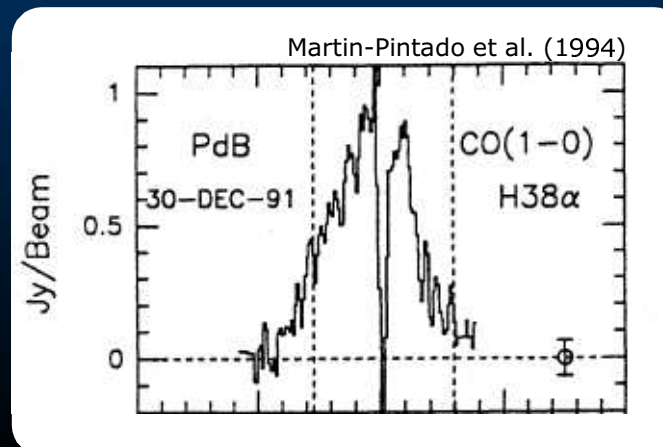
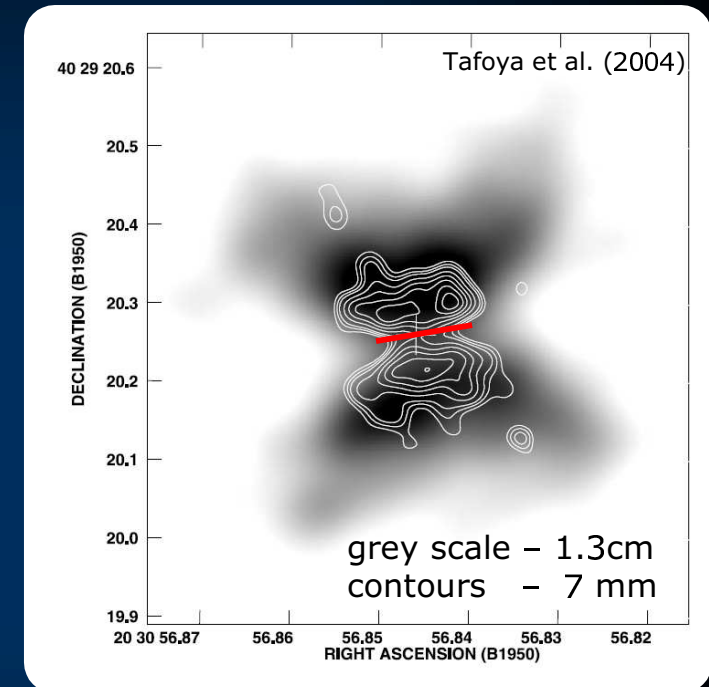
- binary stellar system MWC349A (Be) & MWC349B
- the two stars are seen to be possibly interact
- MWC349A the bright star
- radio continuum probe of flow that photoevaporates of a neutral Keplerian disk
- size of flow decreases with frequency
- strong but highly variable emission (RRLs) from MWC349A
- at declination of $>40^{\circ}$ -> visible for ~ 13 h per day



Flux Calibrators: MWC349

Some facts:

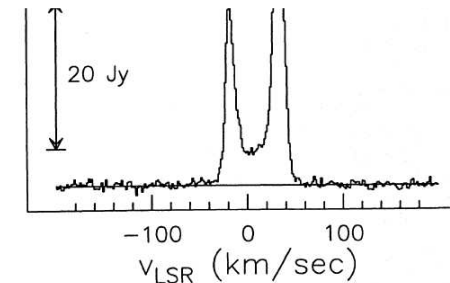
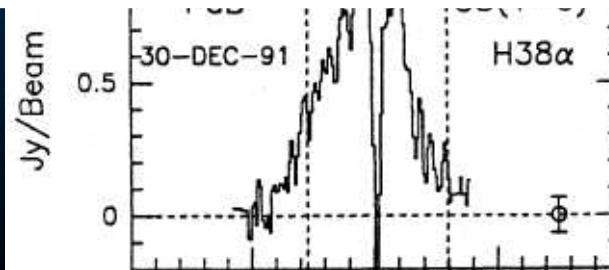
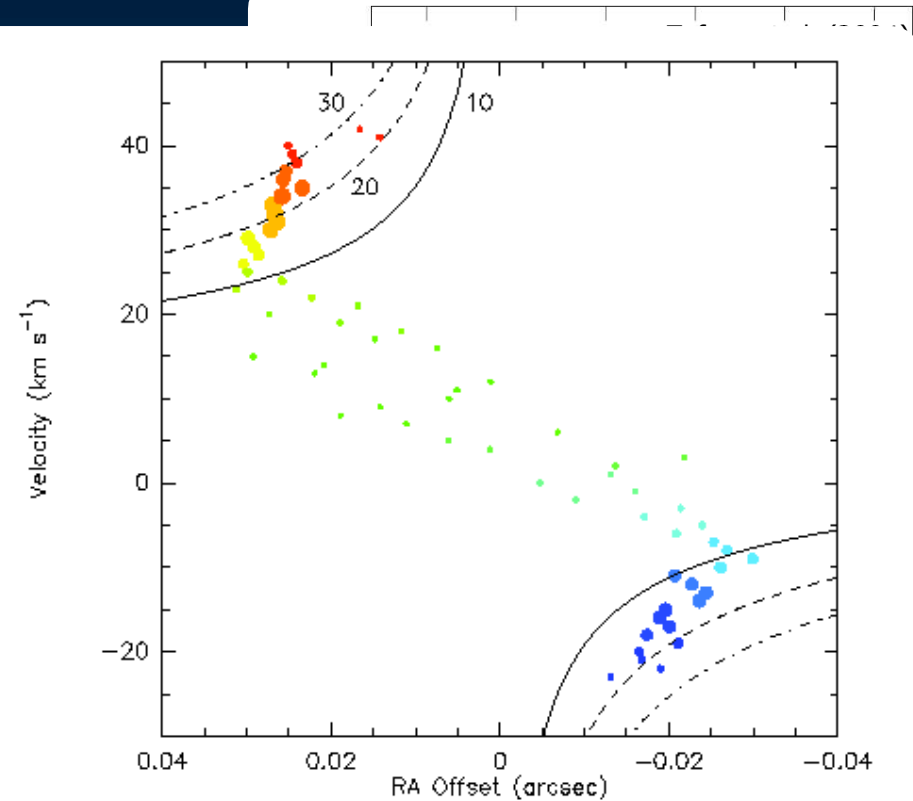
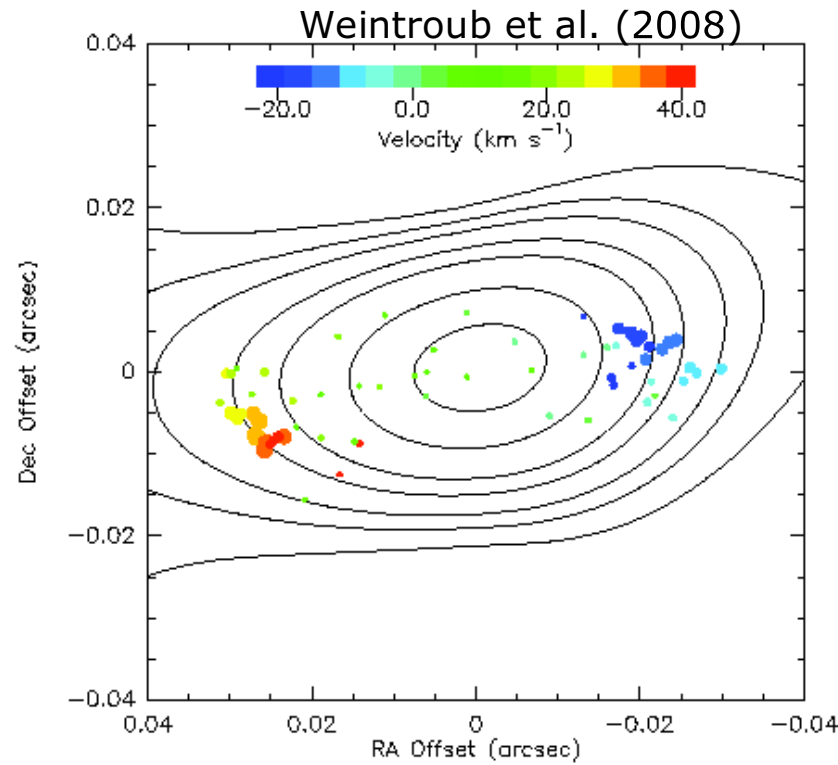
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-> visible for $\sim 13\text{h}$ per day



Flux Calibrators: MWC349

Some facts:

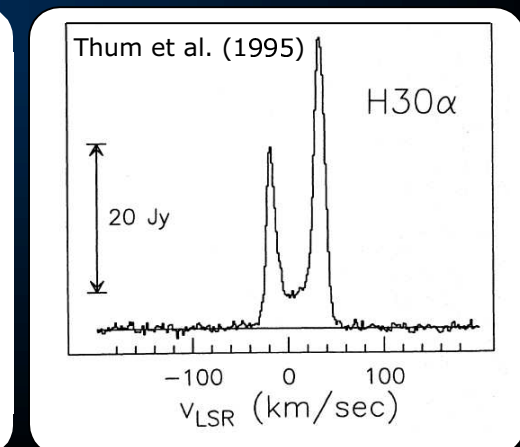
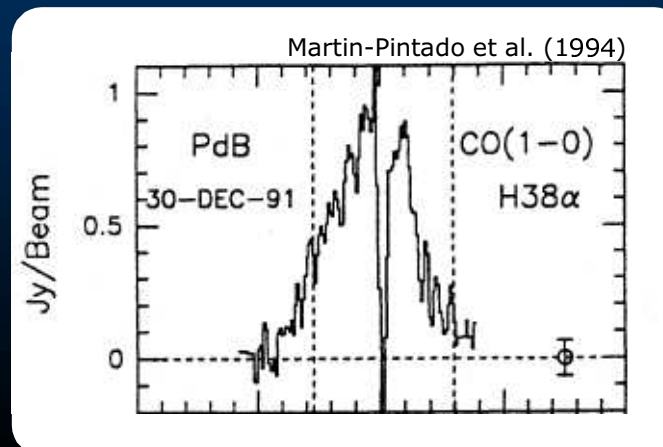
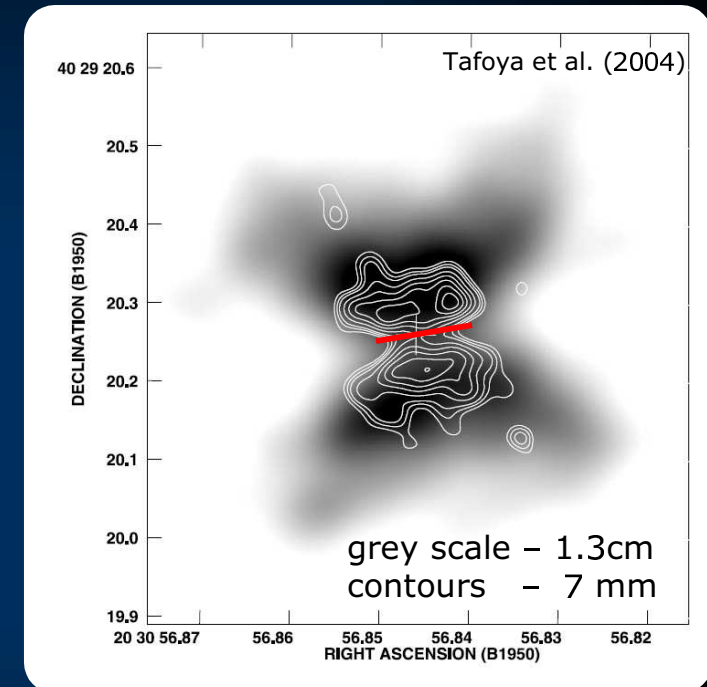
- binary stellar system:



Flux Calibrators: MWC349

Some facts:

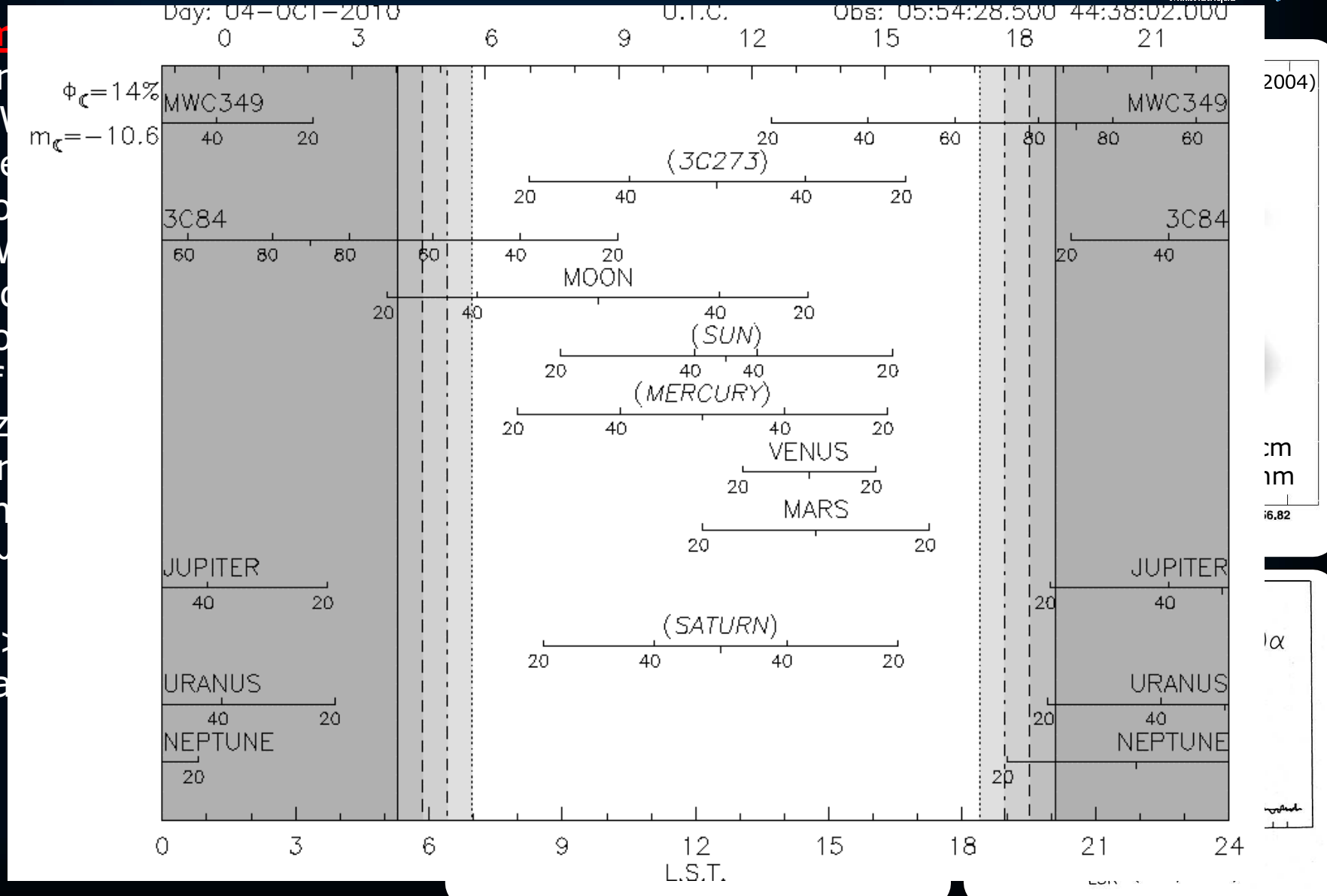
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=> visible for $\sim 13\text{h}$ per day



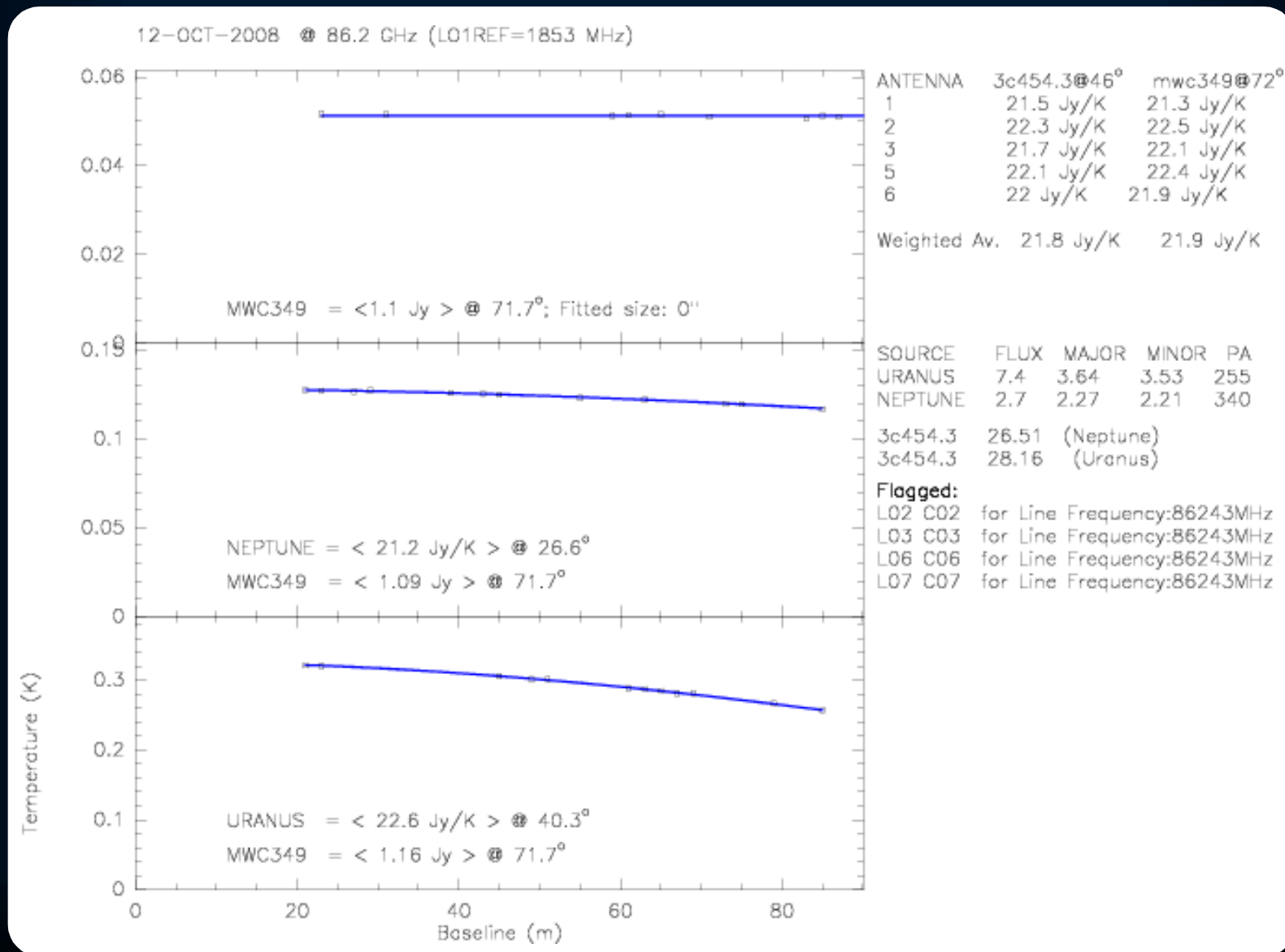
Flux Calibrators: MWC349

Som

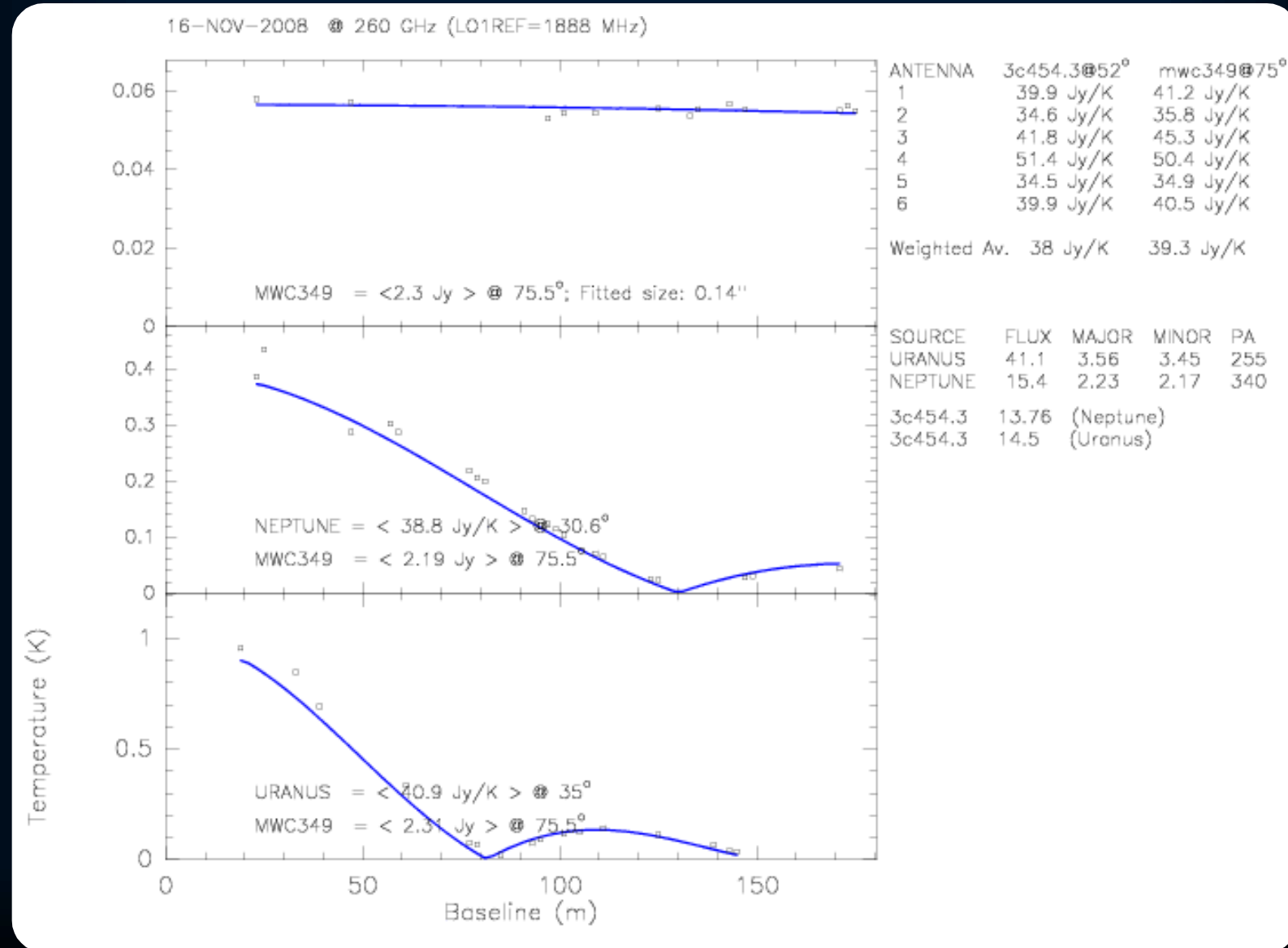
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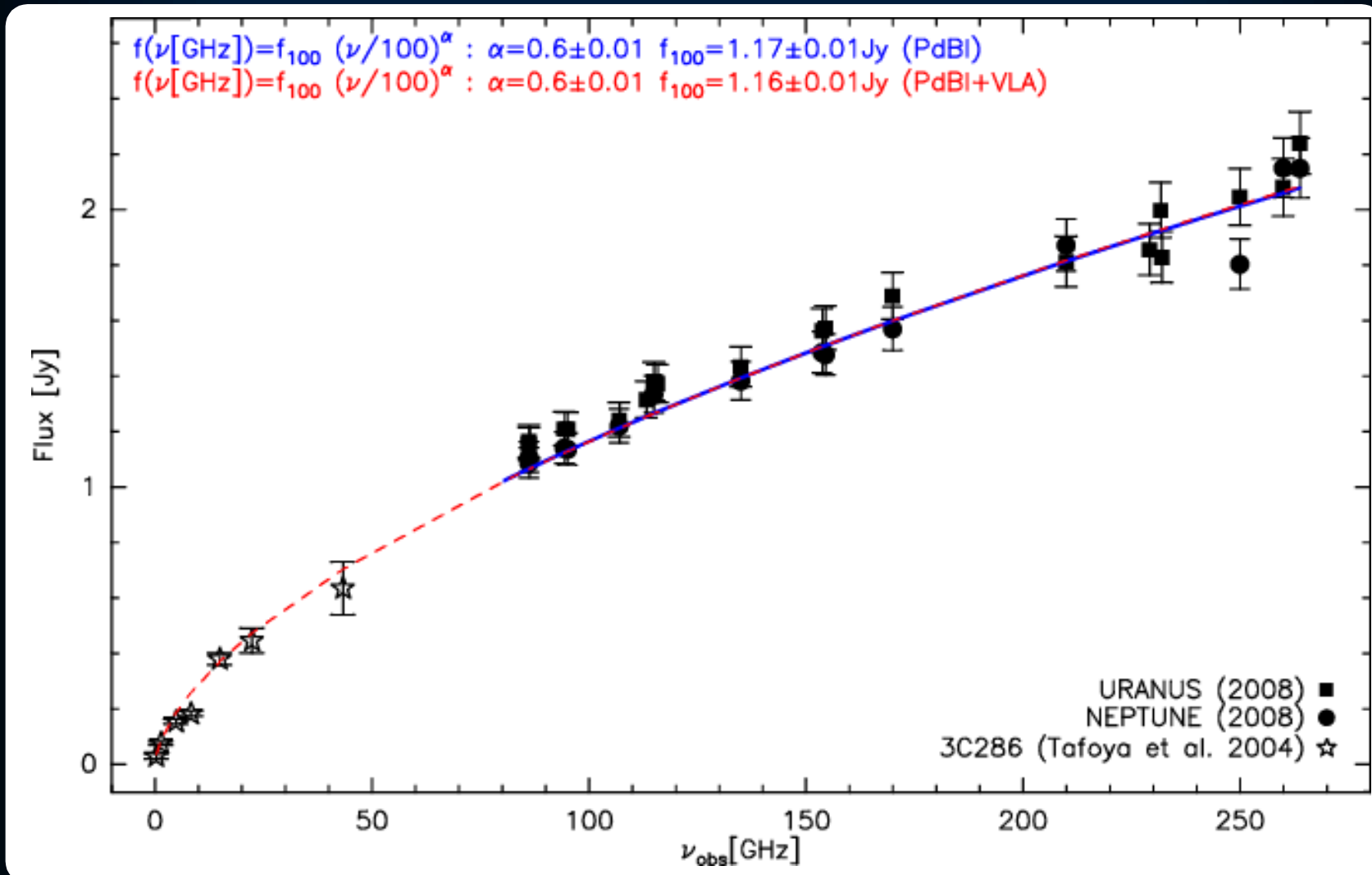
How to calibrate a calibrator?



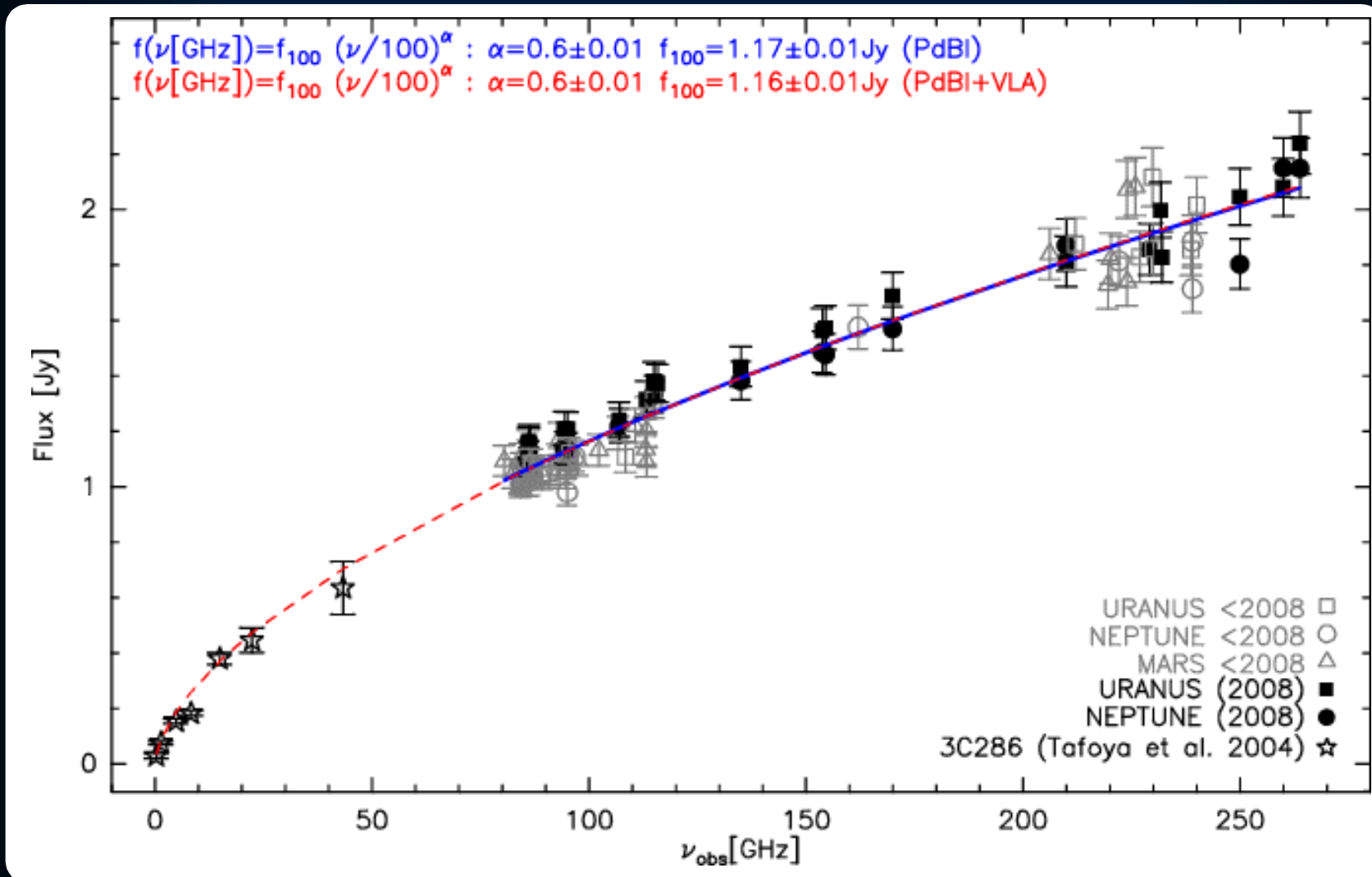
How to calibrate a calibrator?



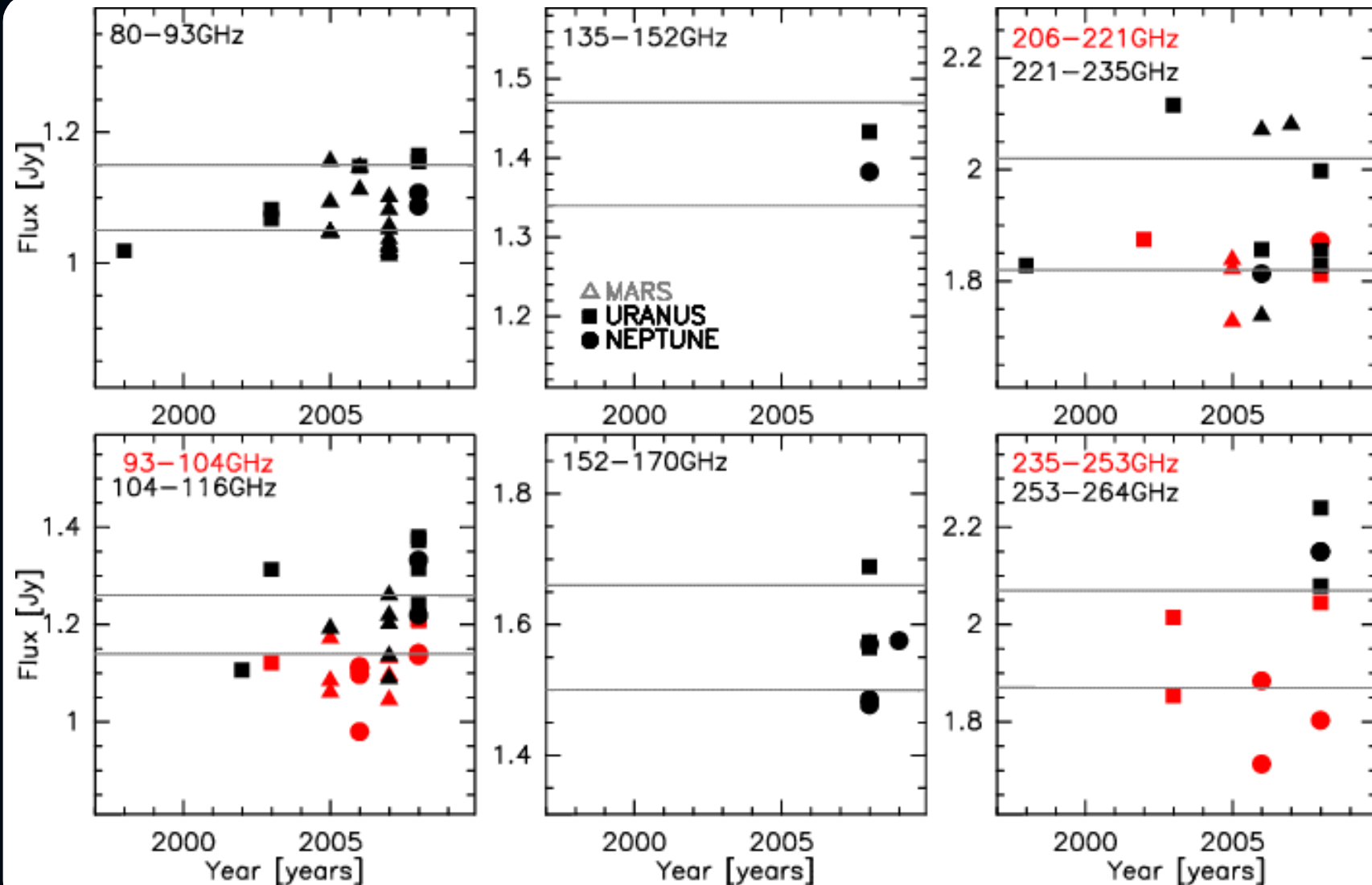
Flux of MWC348: SED



Flux of MWC348: SED

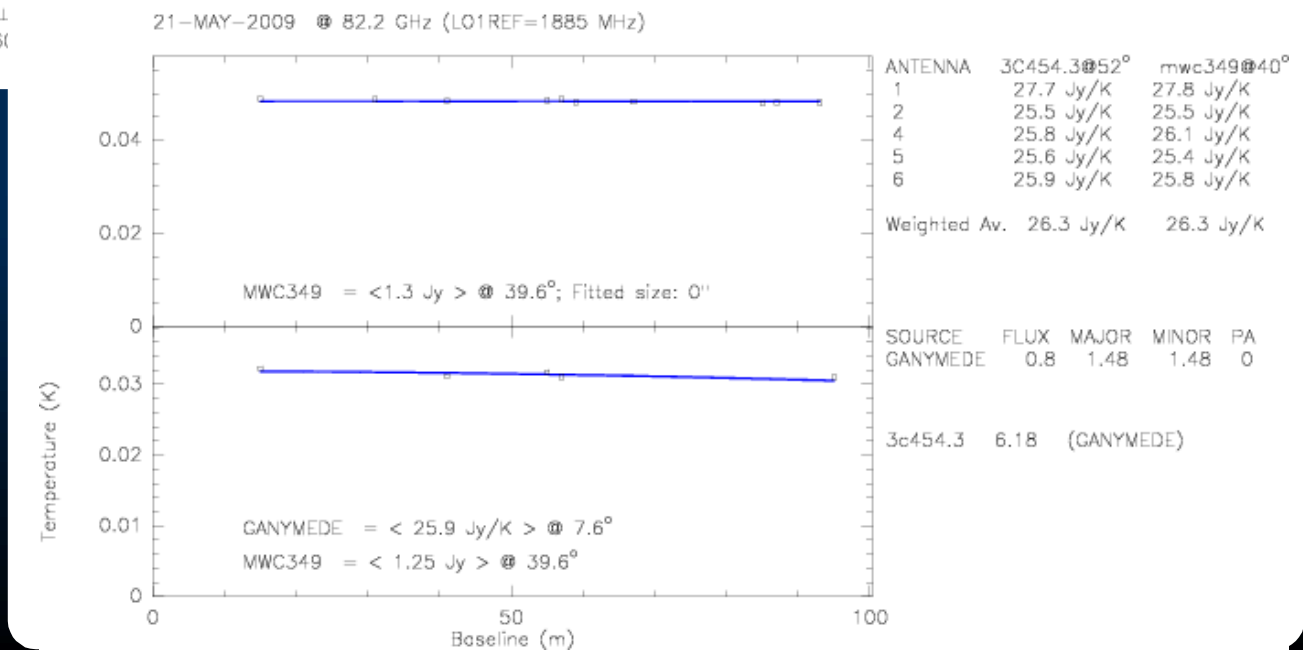
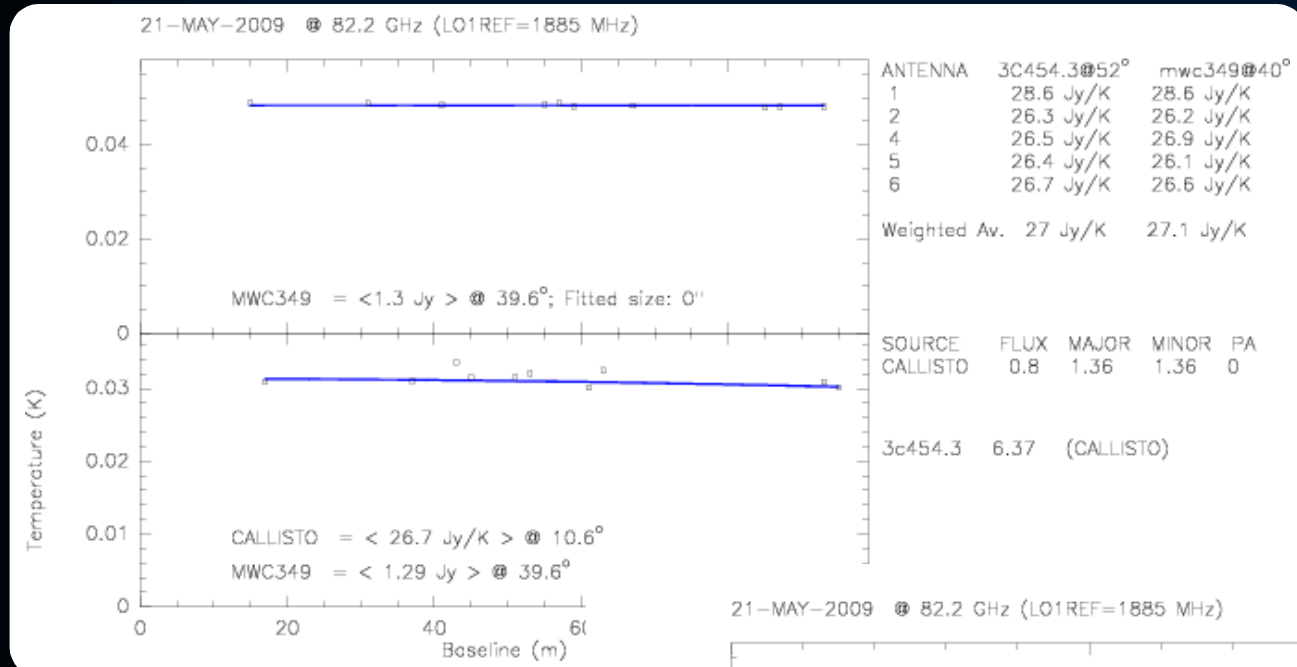


Flux of MWC348: Time variability?



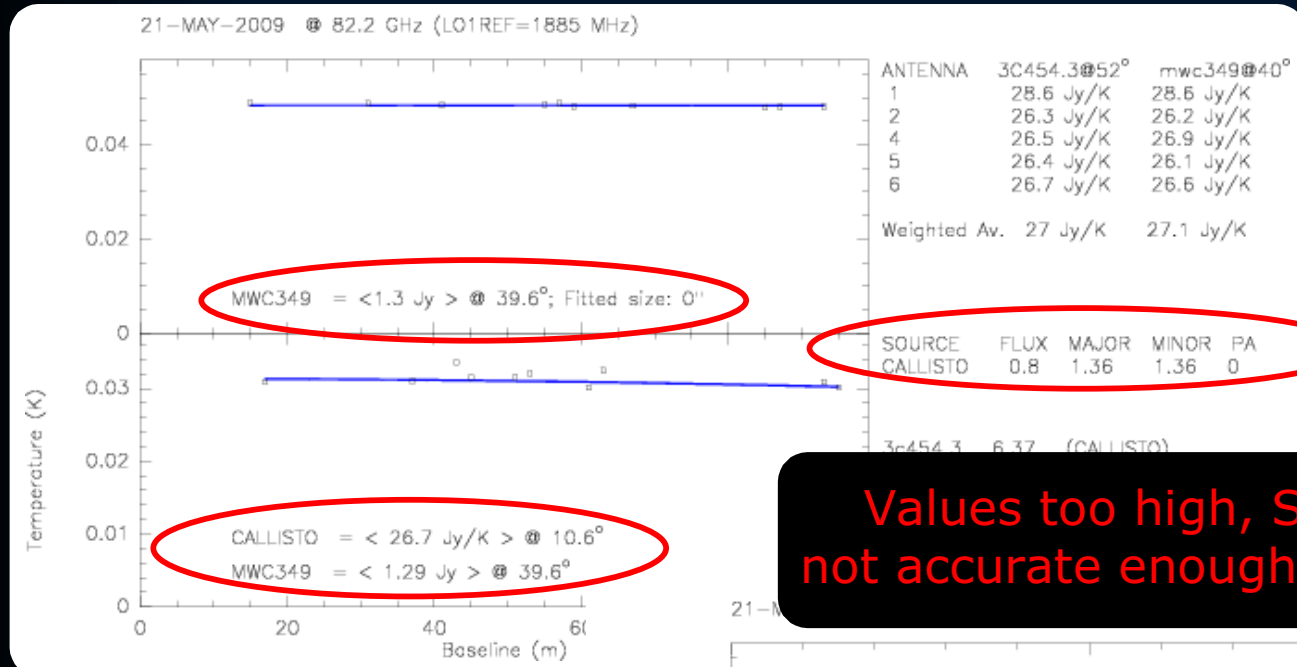
Flux of MWC348: Using satellites?

Using SMA model!

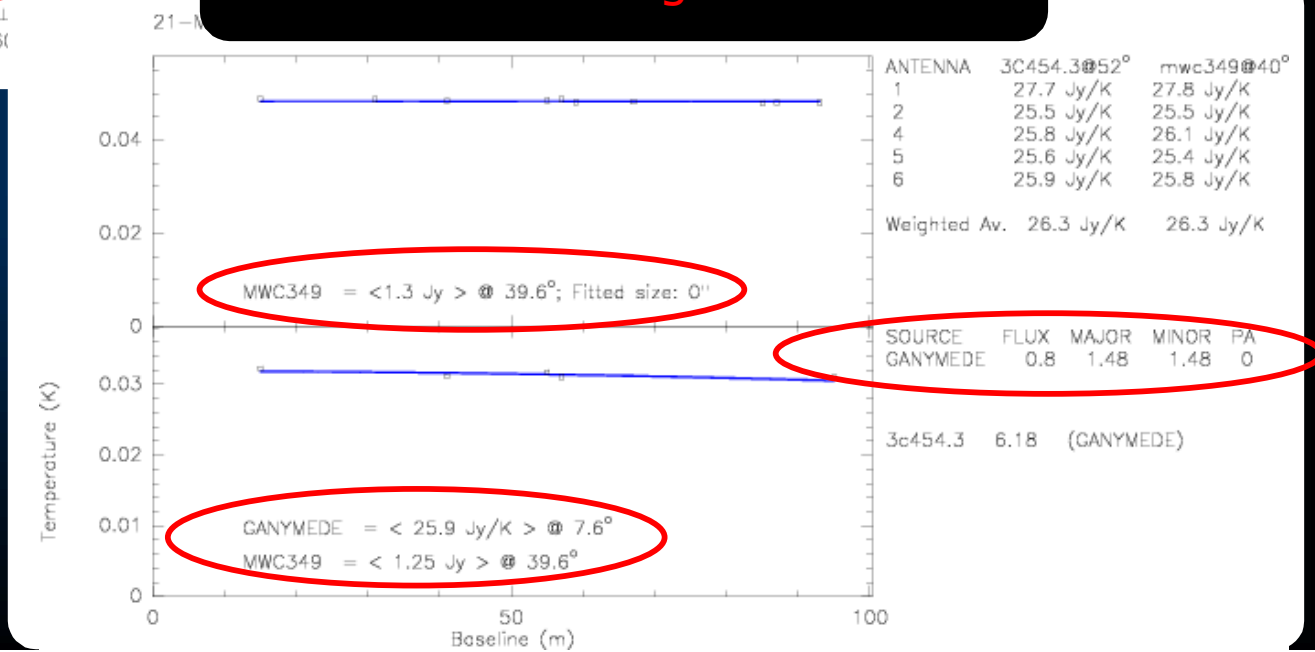


Flux of MWC348: Using satellites?

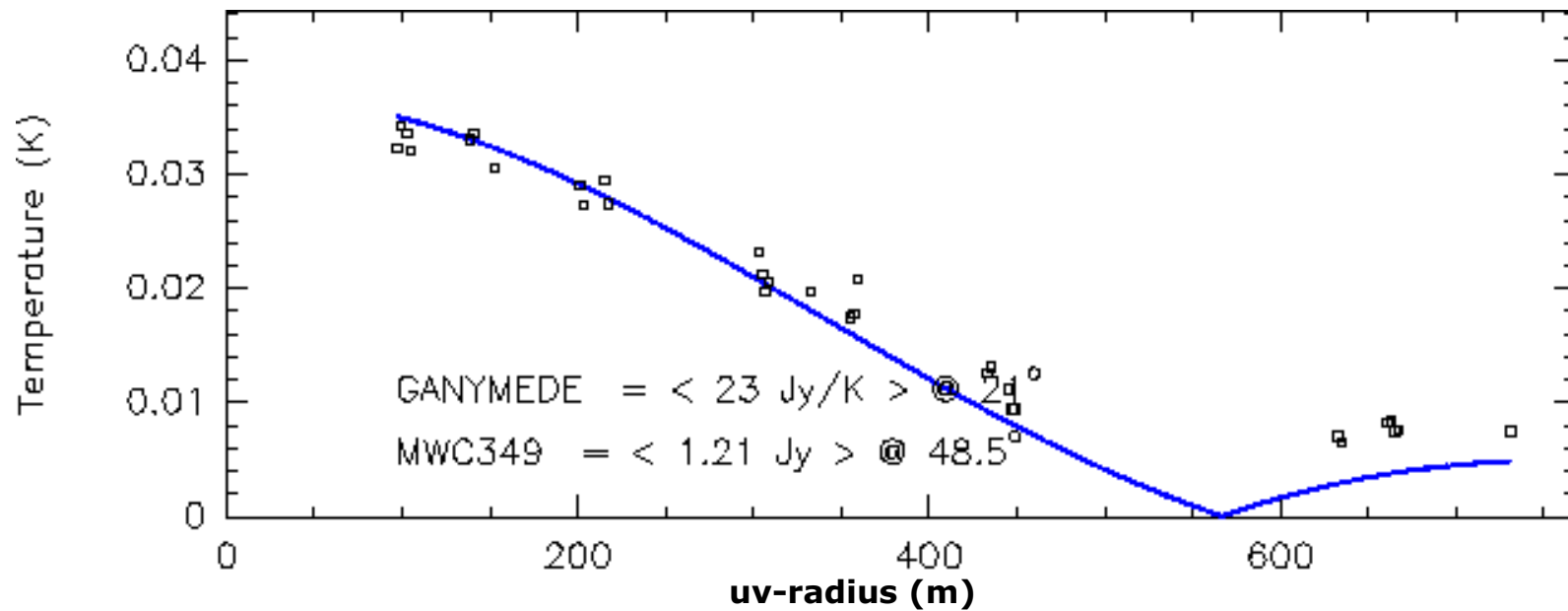
Using SMA model!



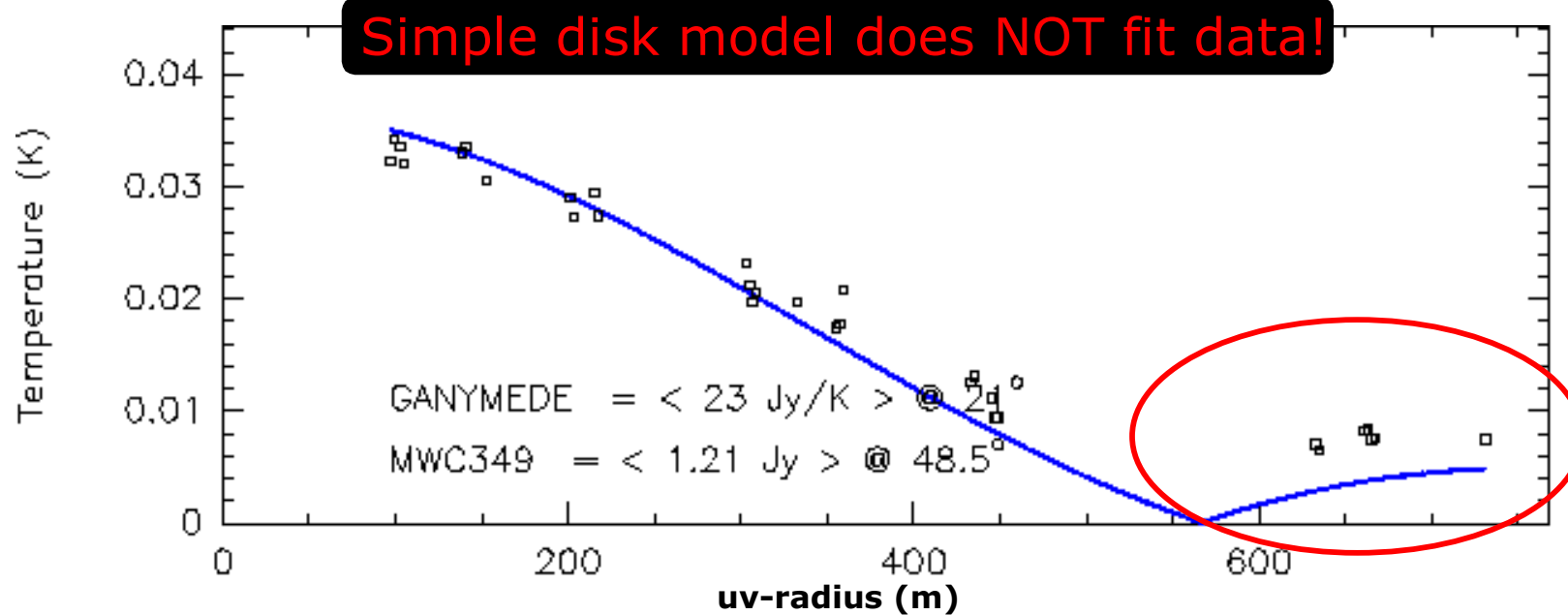
Values too high, SMA model not accurate enough for $\lambda > 1\text{mm}$!



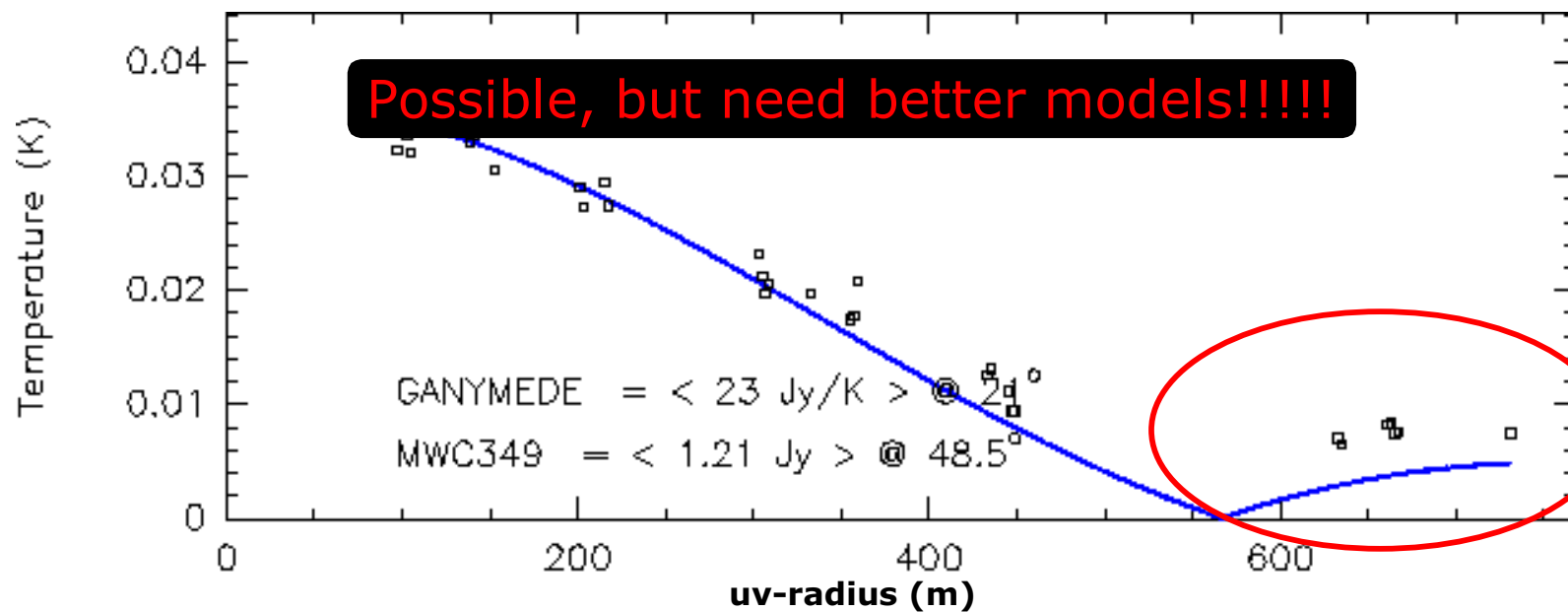
Flux of MWC348: Using satellites?



Flux of MWC348: Using satellites?

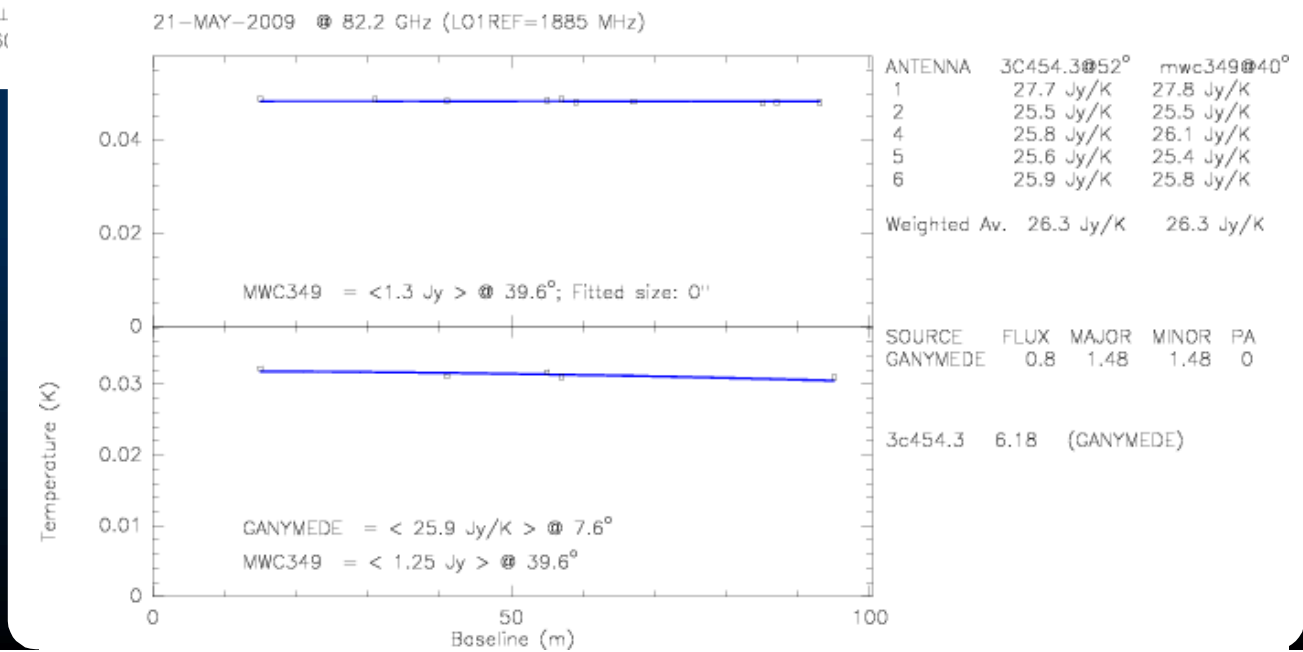
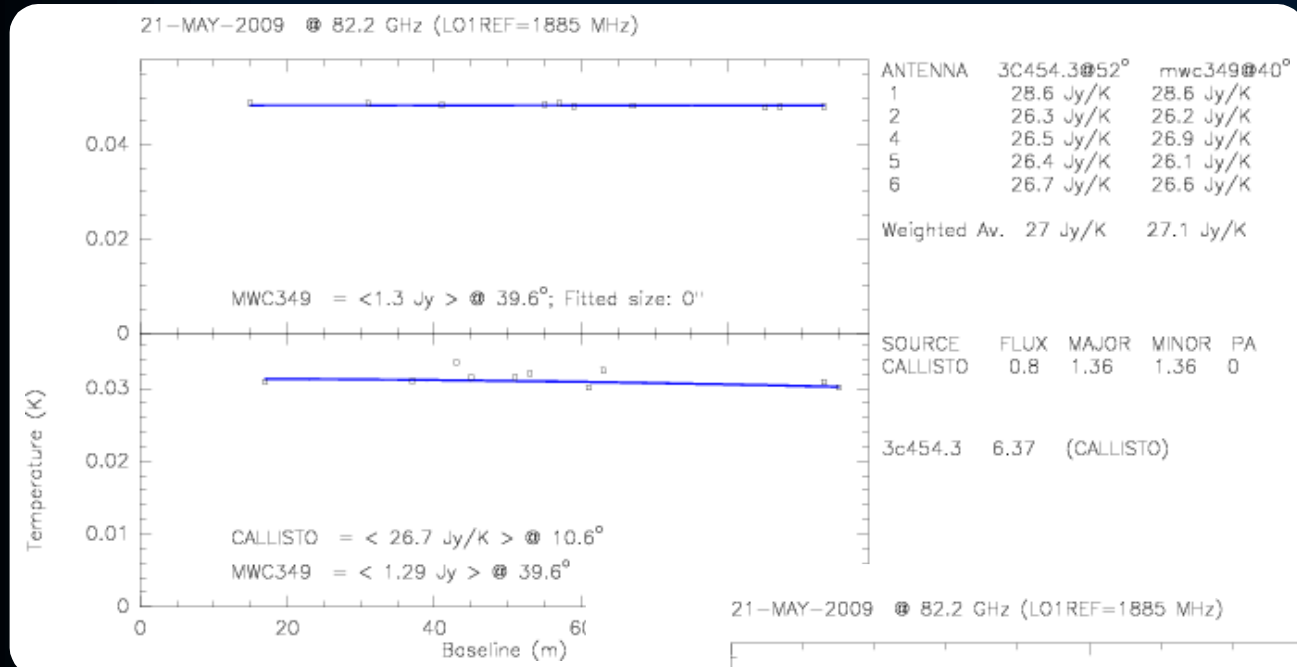


Flux of MWC348: Using satellites?

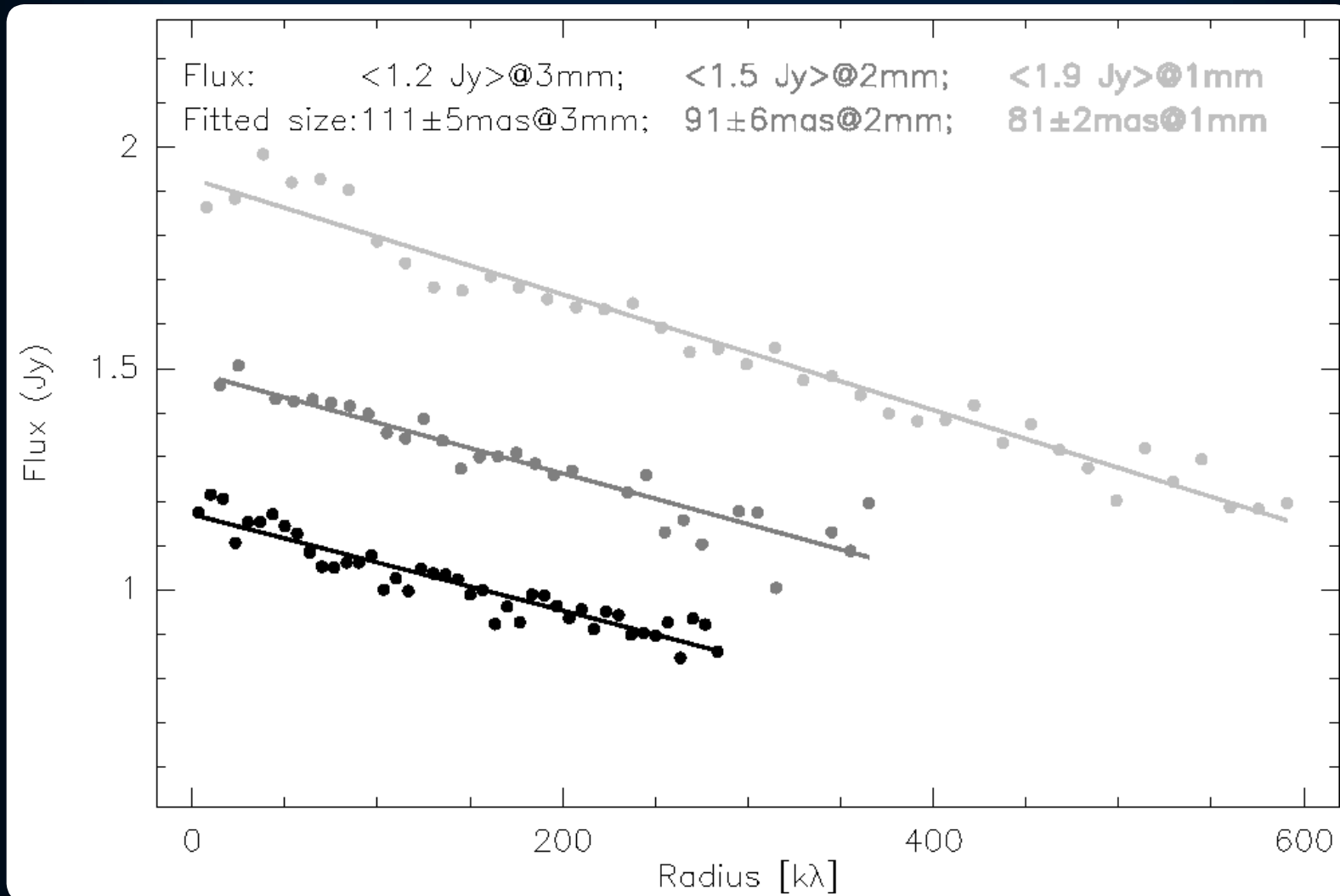


Flux of MWC348: Using satellites?

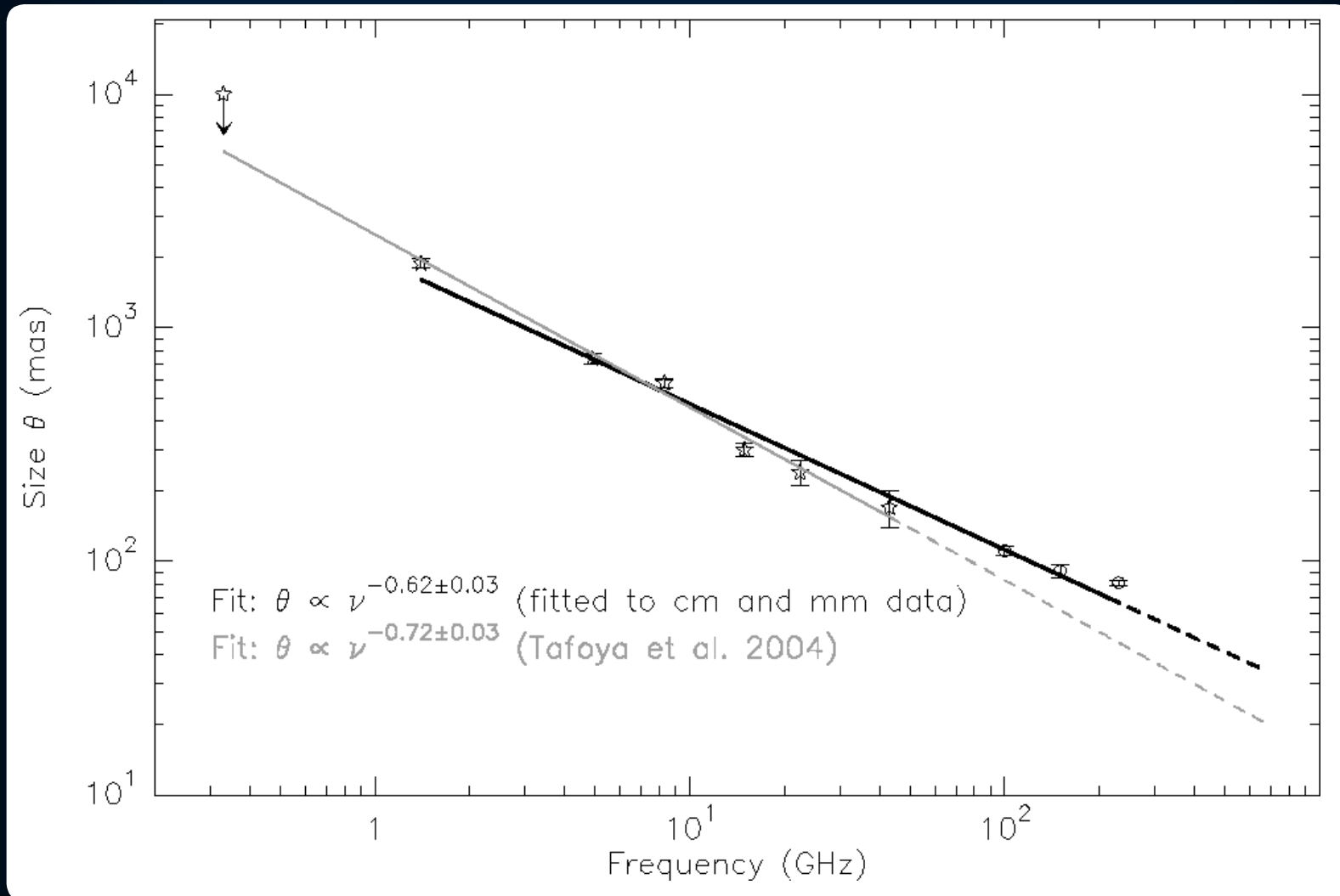
Using SMA model!



Size of MWC348



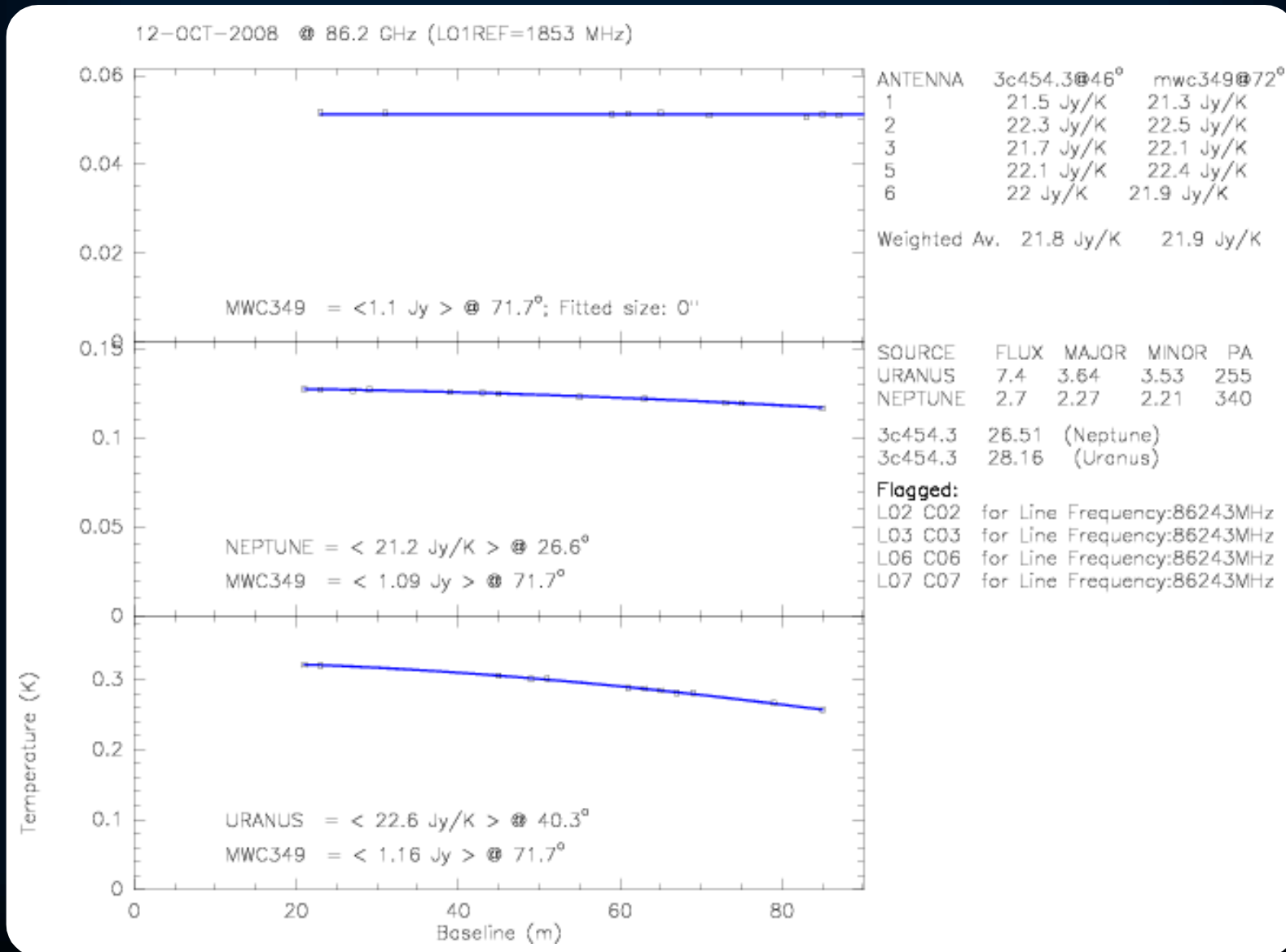
Size of MWC348



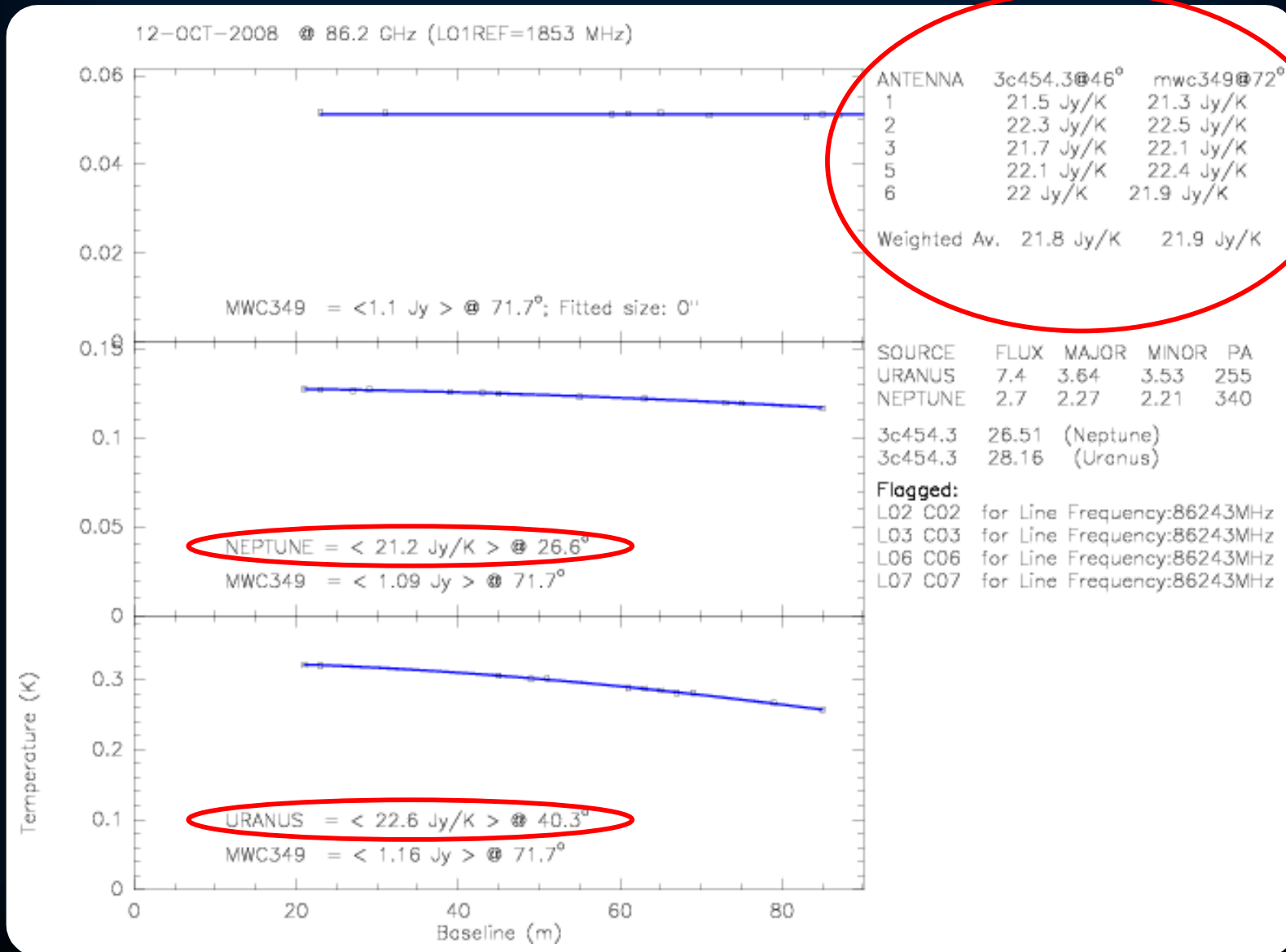
Primary Flux Calibrators

1. Quasars
2. Planets
3. Solar Bodies
(Satellites, Asteroids,
Dwarf Planets)
4. Radio Stars
5. Antenna Efficiencies?

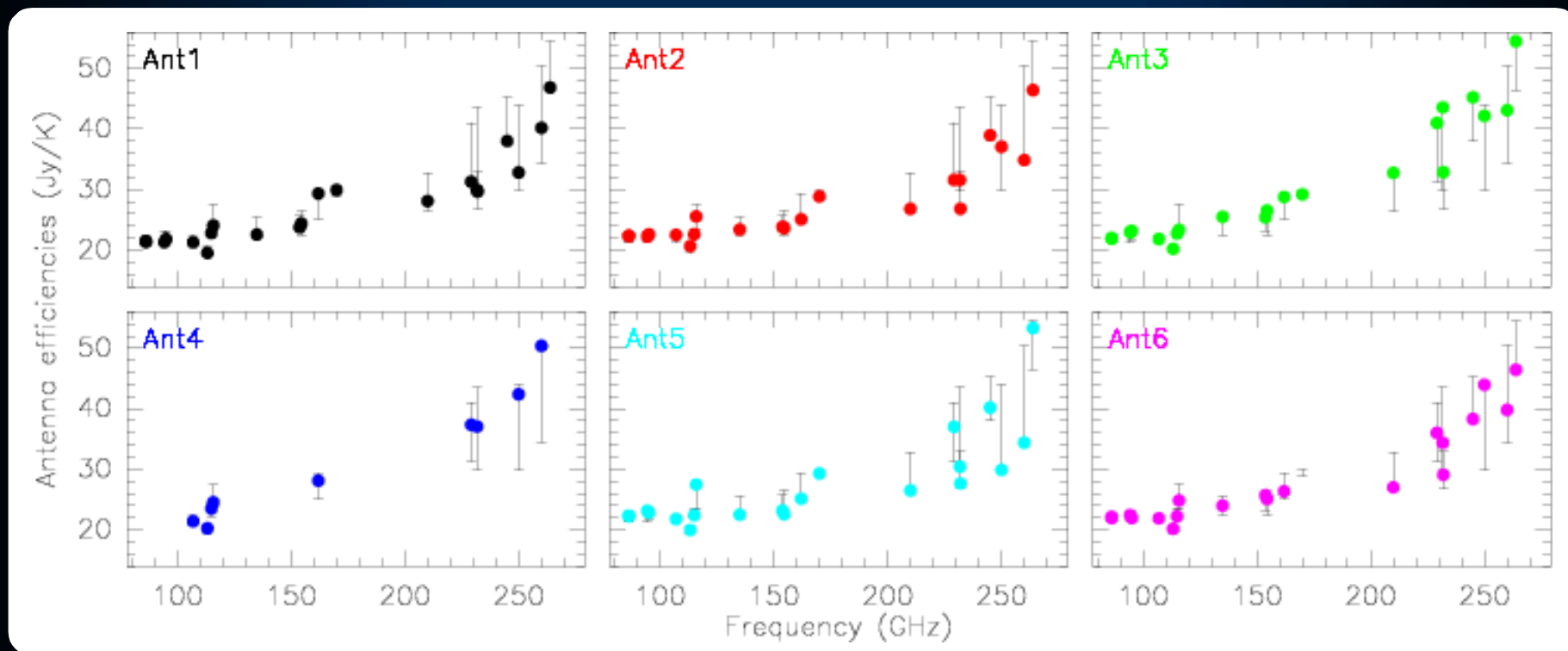
"By-product" of calibration



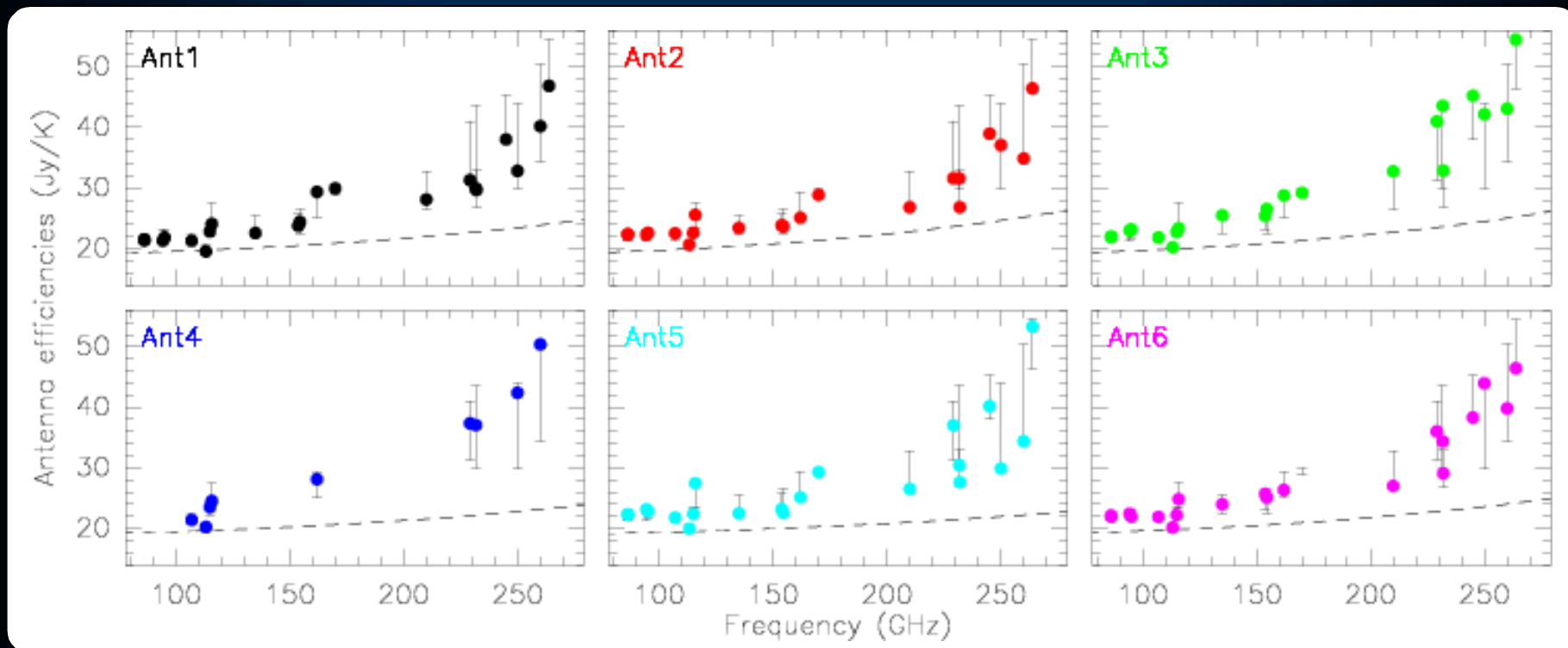
“By-product” of calibration: getting antenna efficiencies!



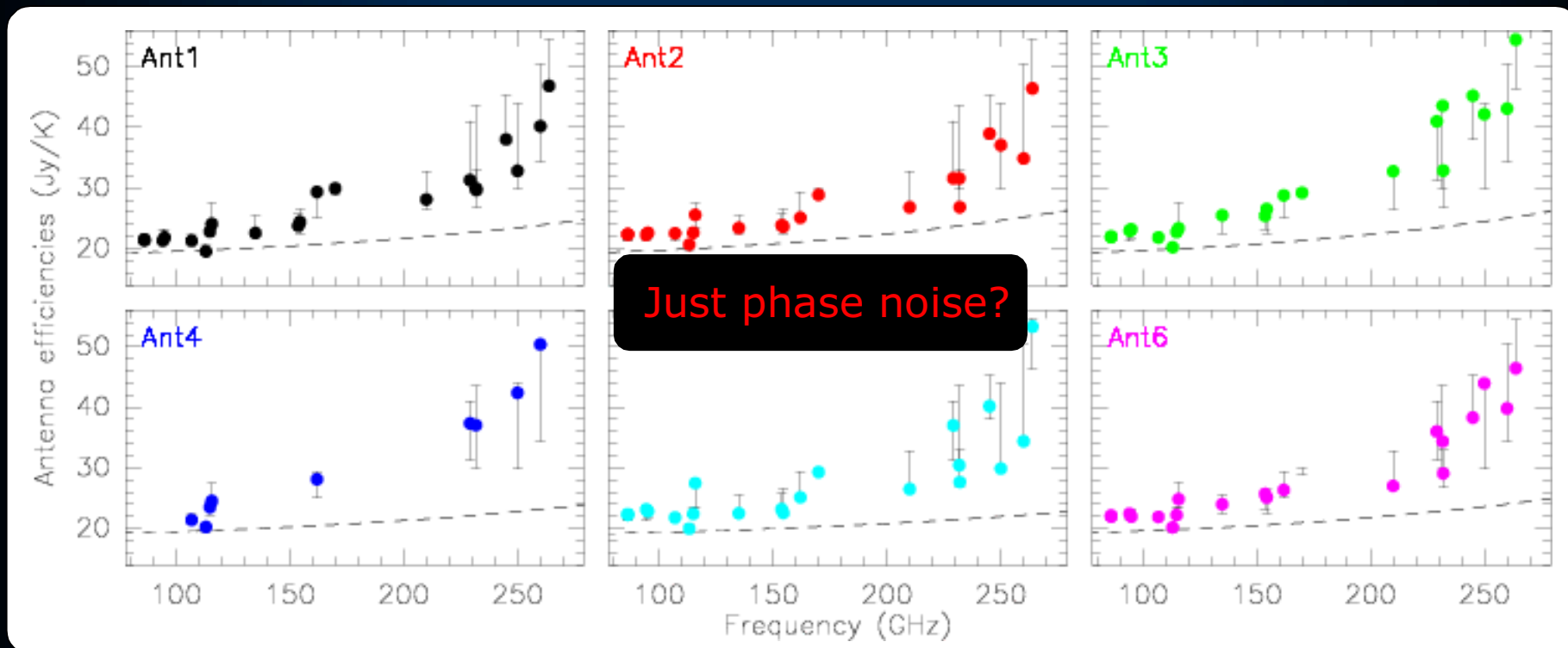
Antenna Efficiencies: Interferometrically



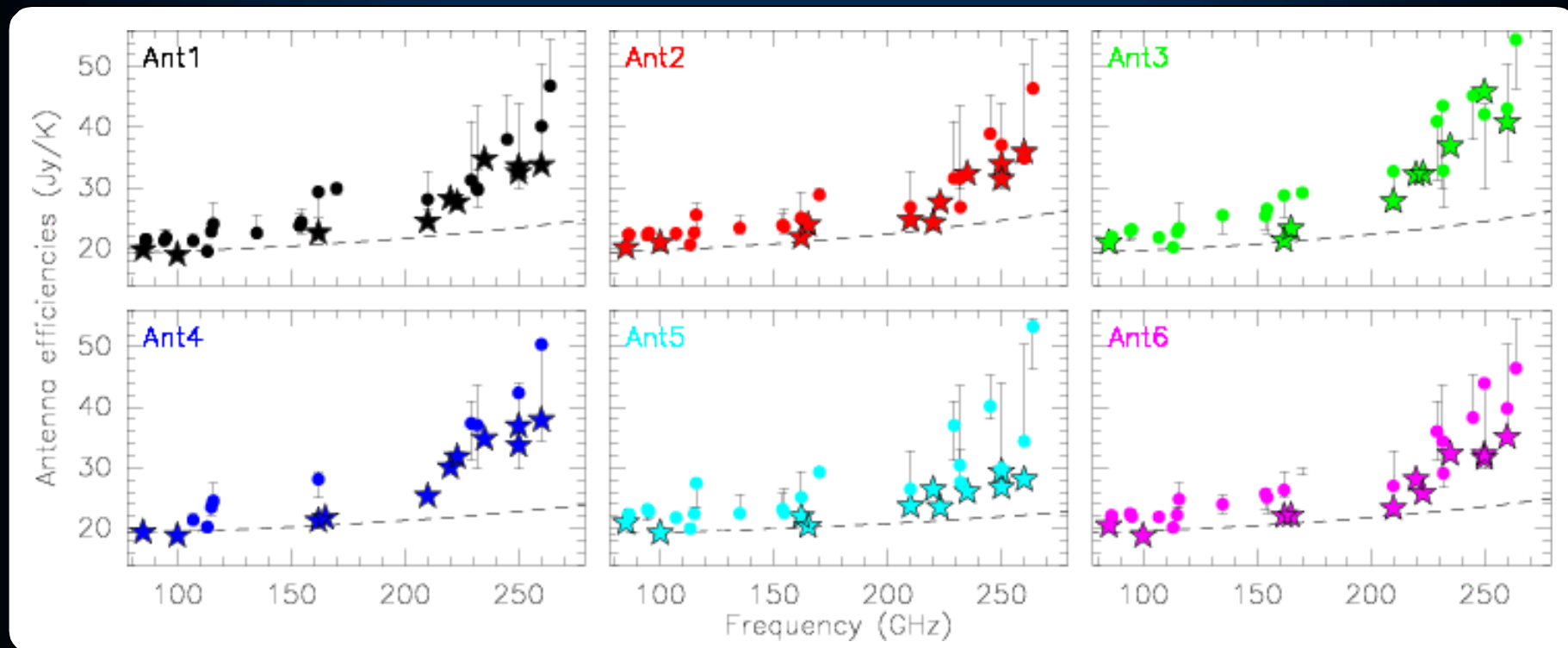
Antenna Efficiencies: Interferometrically + Holo



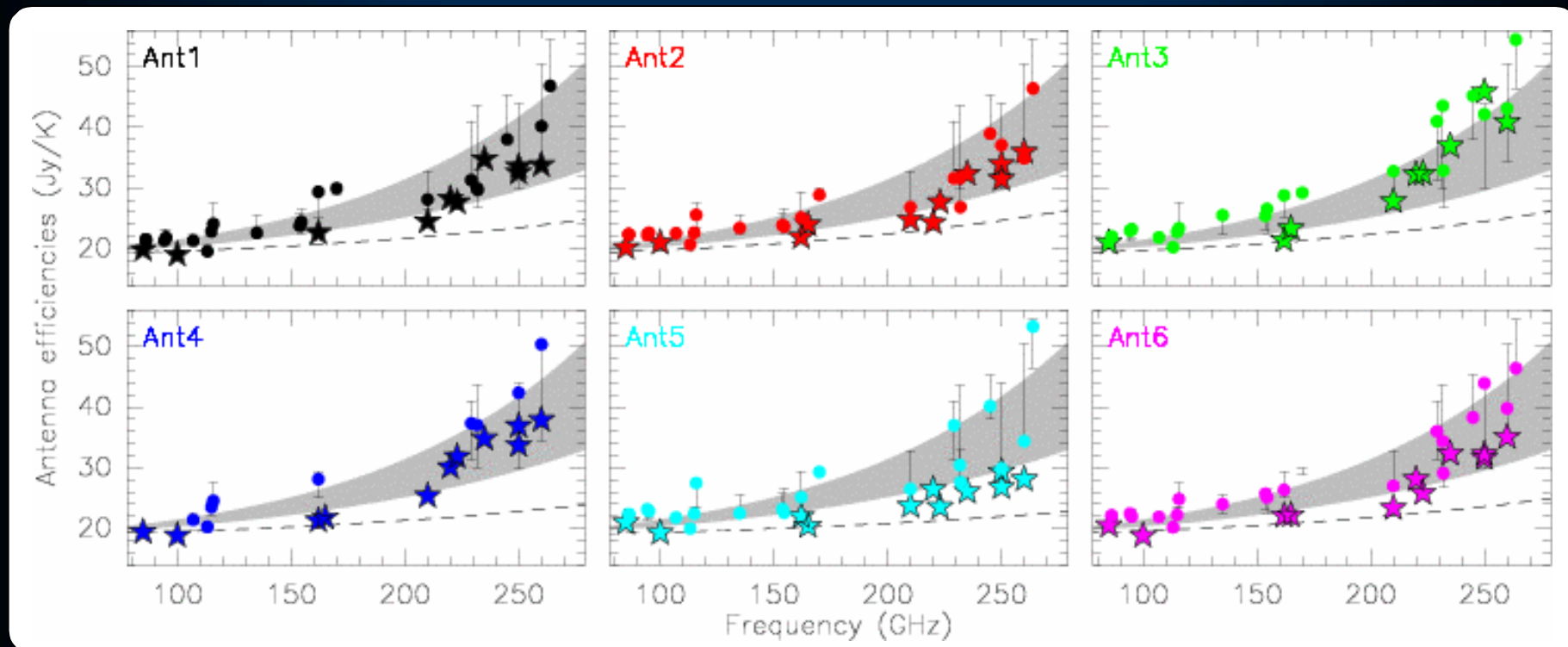
Antenna Efficiencies: Interferometrically + Holo



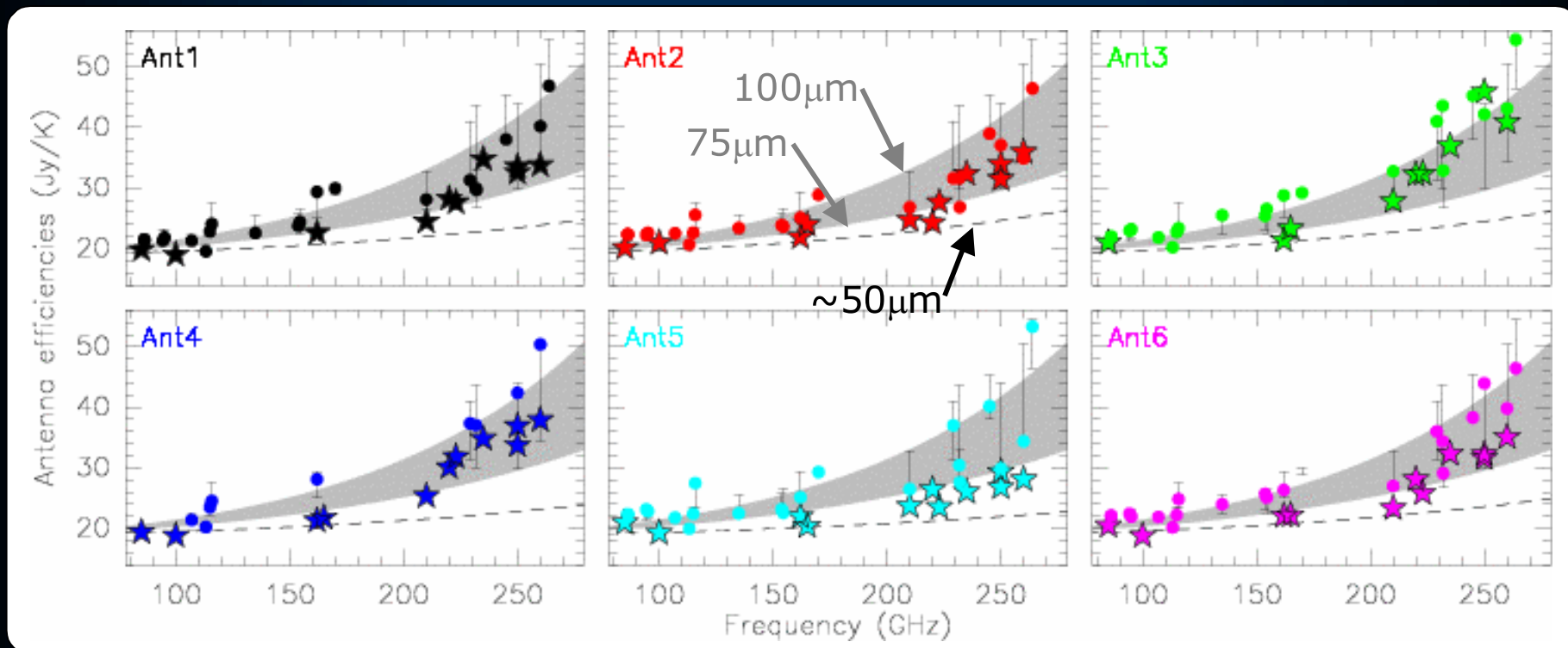
Antenna Efficiencies: Interferometrically + Holo + SD



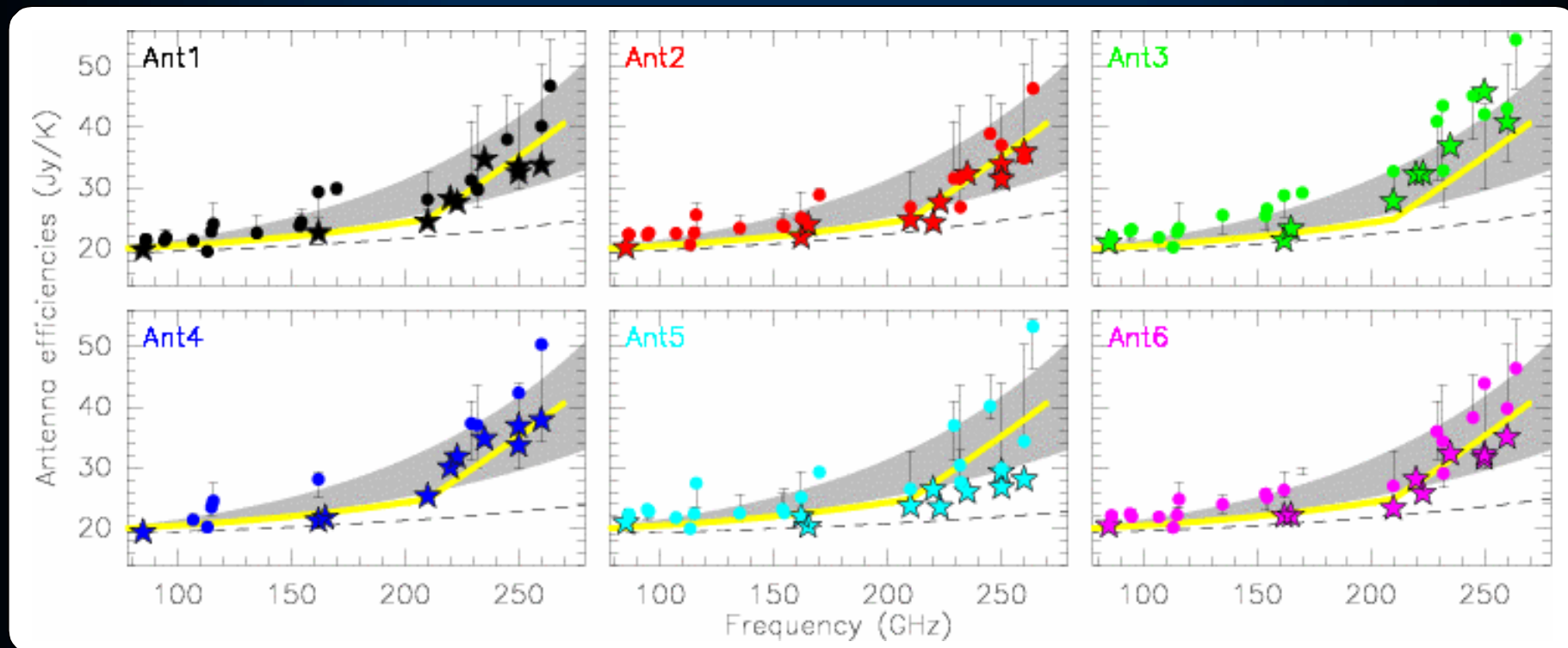
Antenna Efficiencies: Interferometrically + Holo + SD



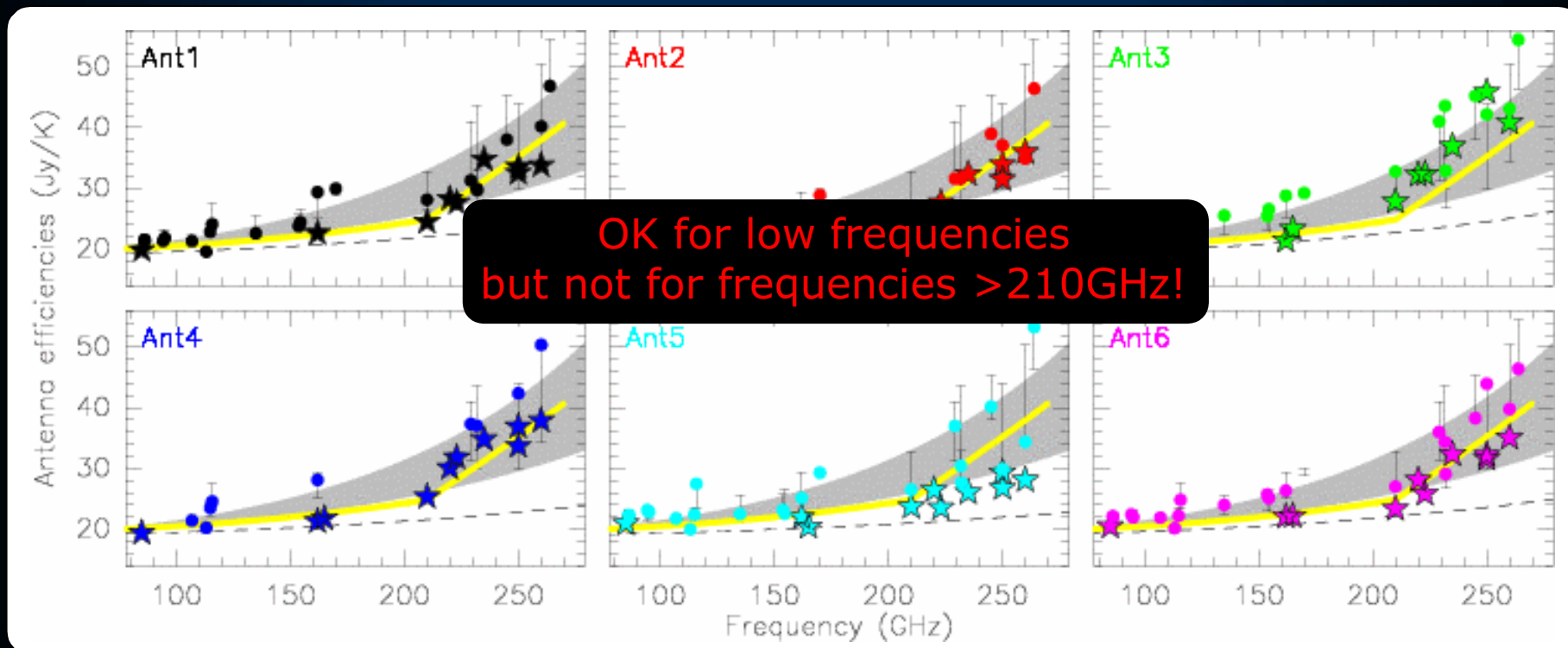
Antenna Efficiencies: Interferometrically + Holo + SD



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Antenna Efficiencies: Interferometrically + Holo + SD

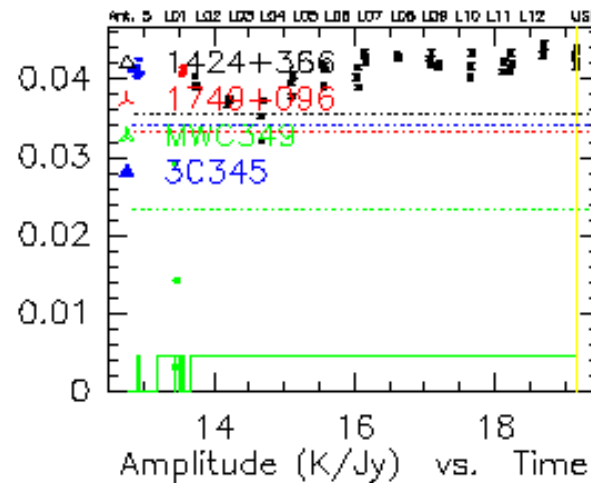
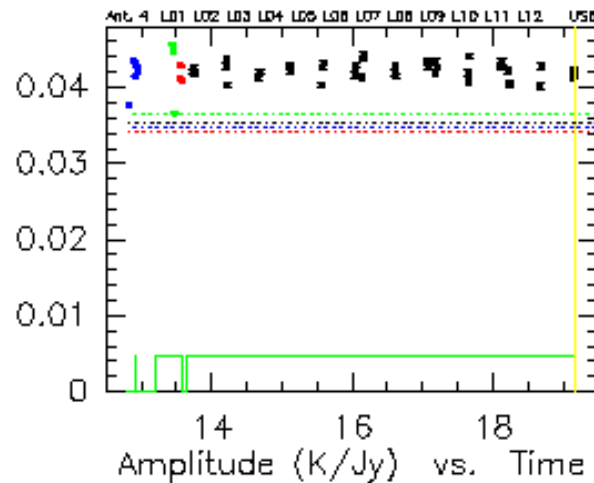
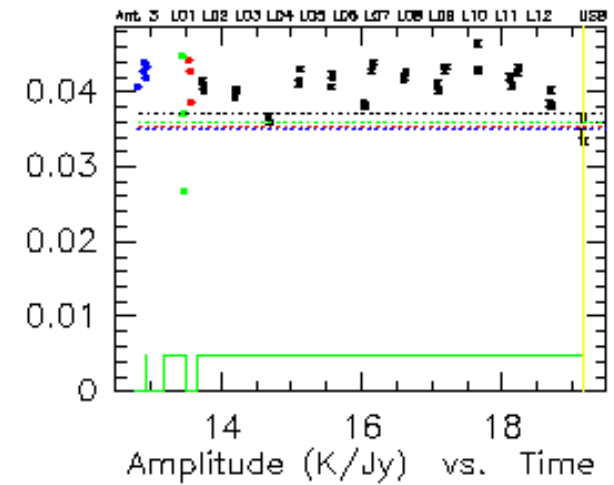
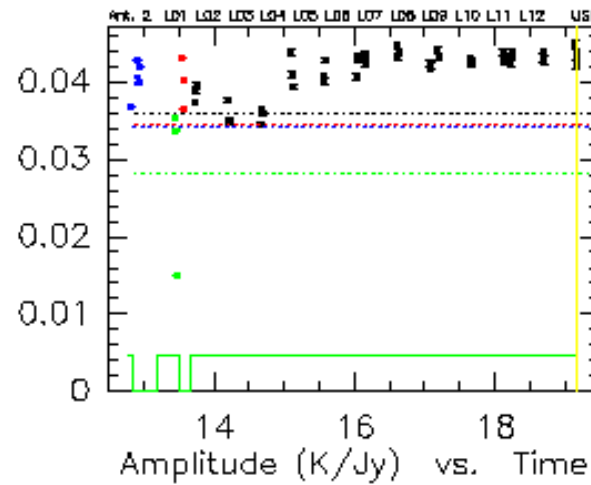
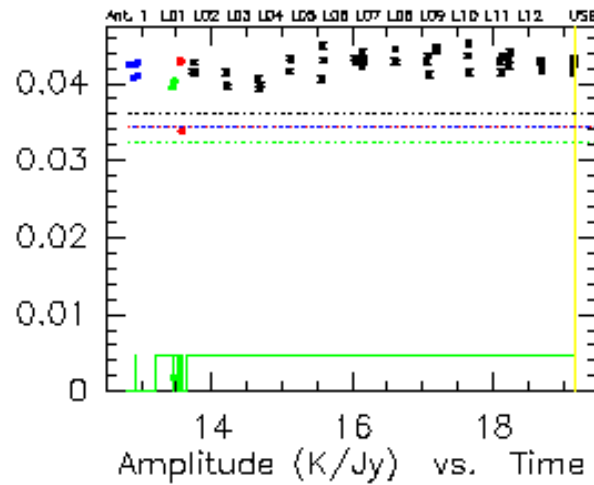


Practical Tips

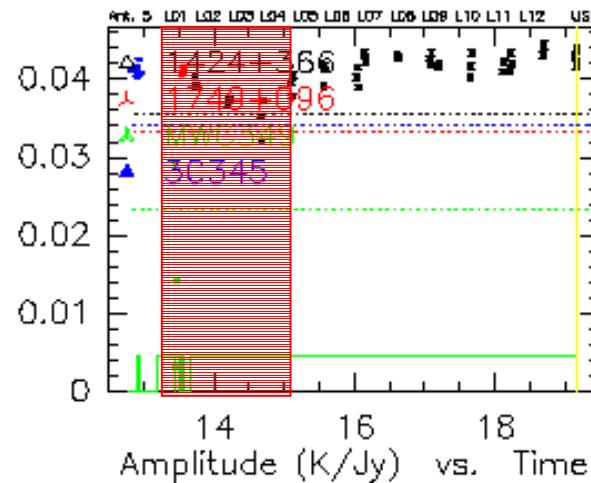
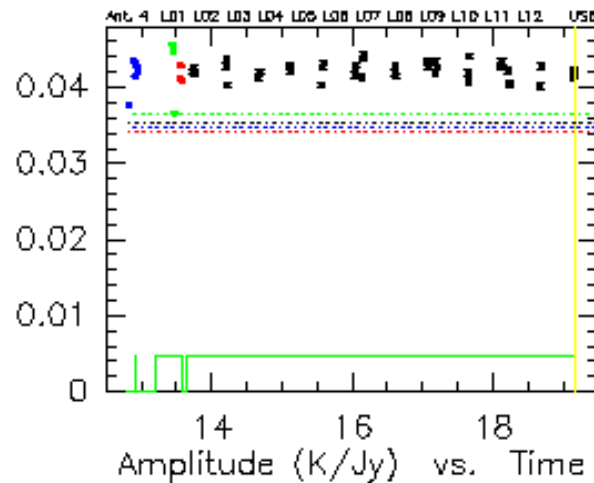
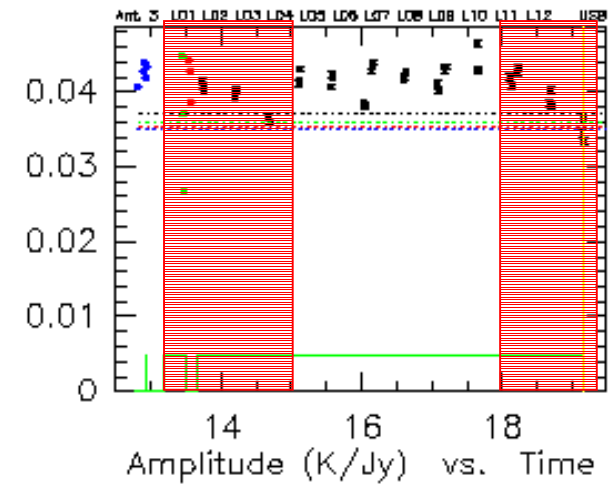
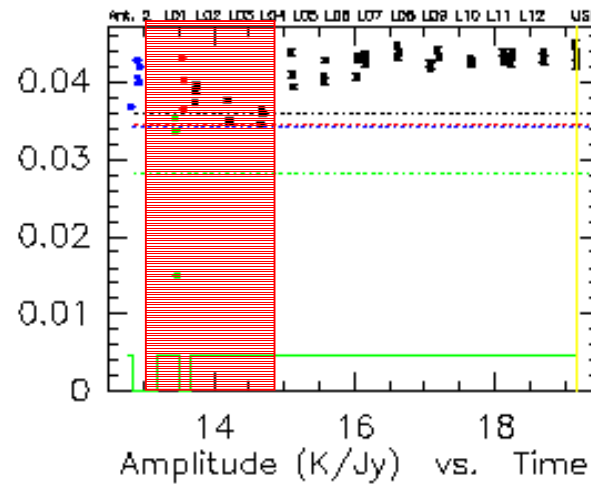
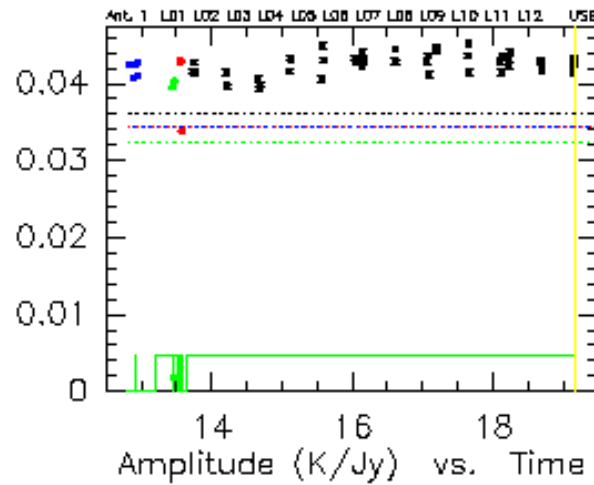
Checklist:

- Antenna Shadowing
- Pointing/Focus Problems
- Tracking Problems
- Do phases of different spectral windows overlap?
- Noisy data
- Has Flux Calibrator Lines?
- Is Flux Calibrator Extended?
- Check Elevation of your source
- Check whether source is polarised (only important when using NC with one polarisation)

Practical Tips



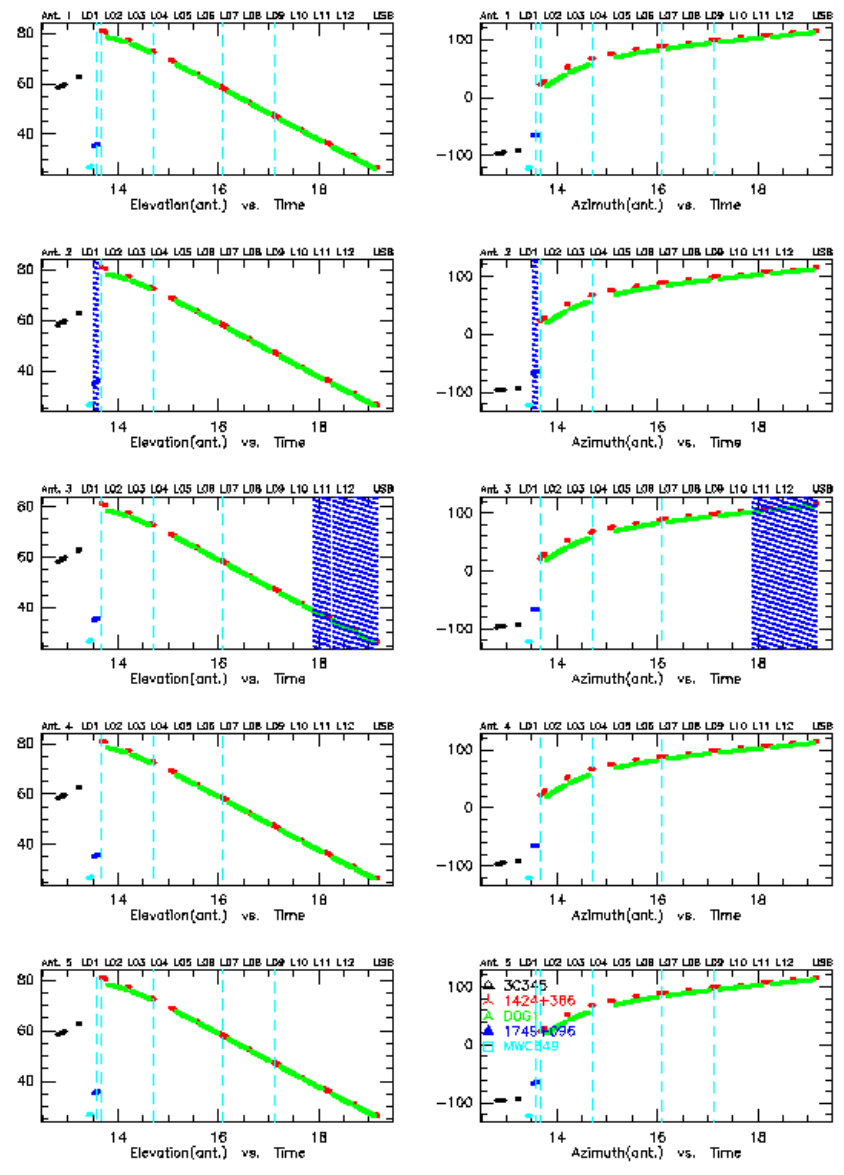
Practical Tips



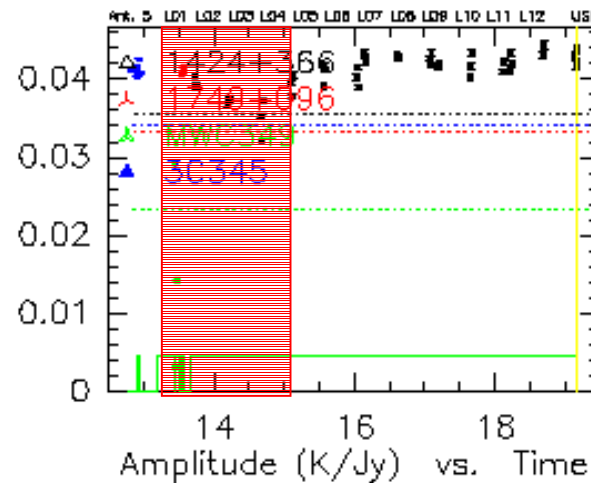
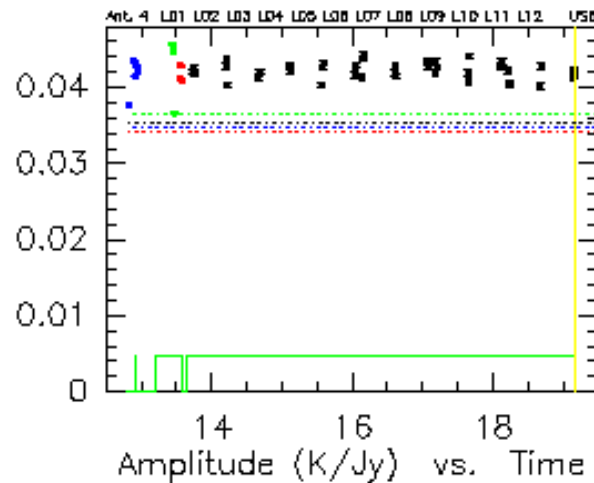
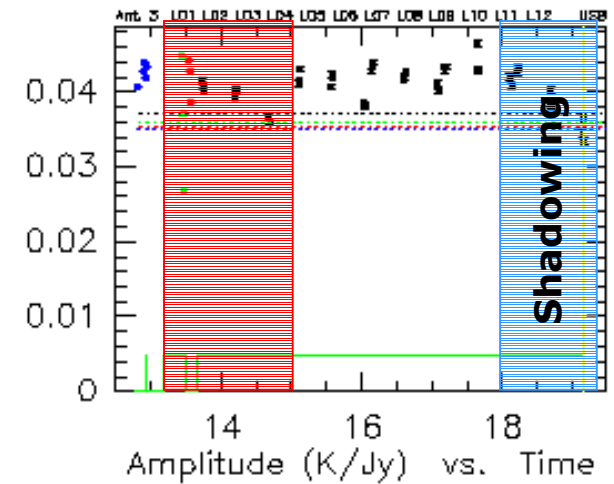
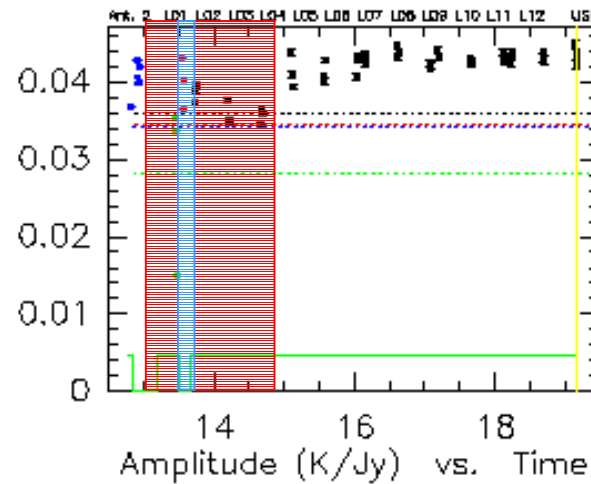
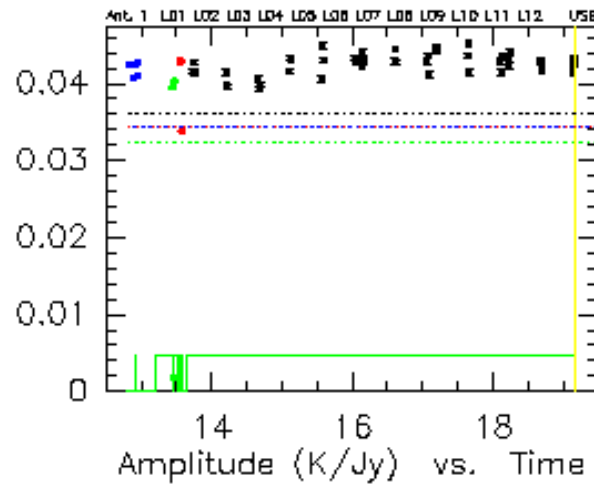
Practical Tips: Shadowing

First Look

ANT. FLAGS — SHADOW COI/LOI DATA/TRACK LOCK DOP/TIME TSY/POI/REDU

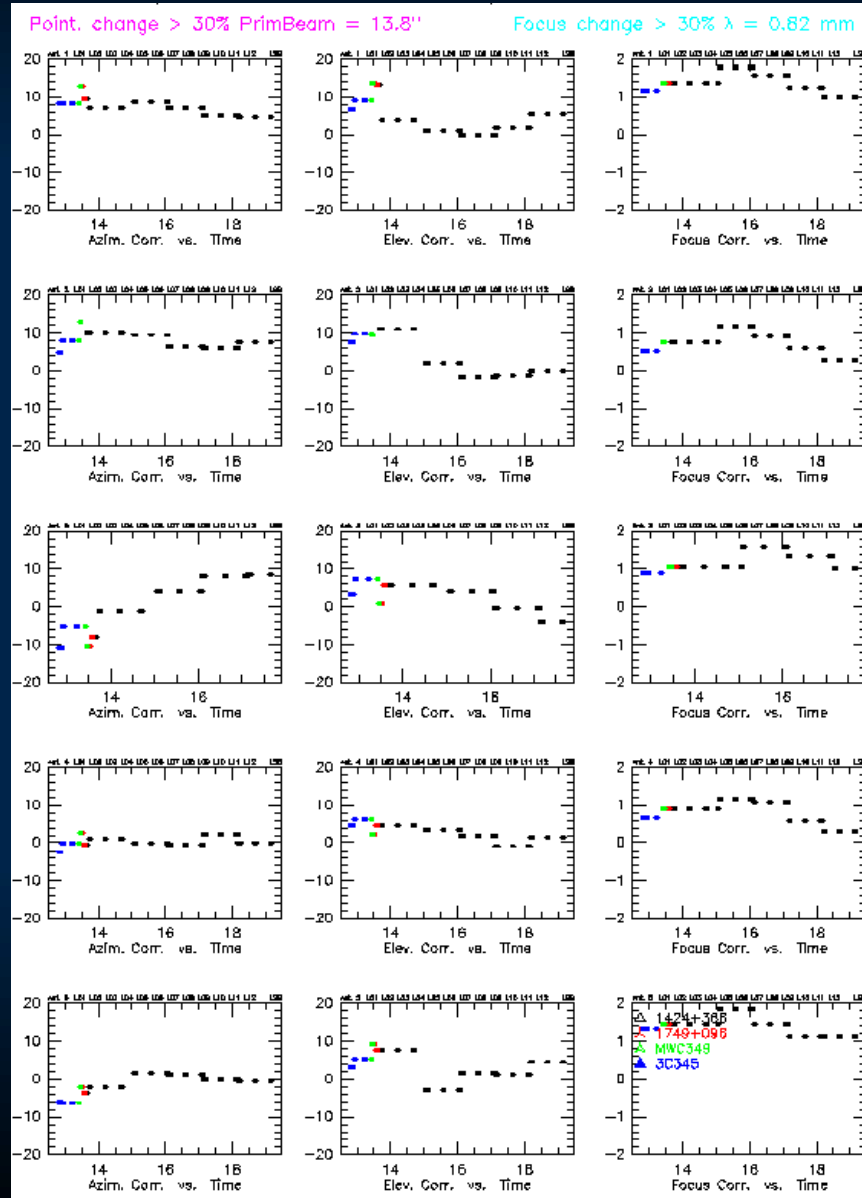


Practical Tips: Shadowing



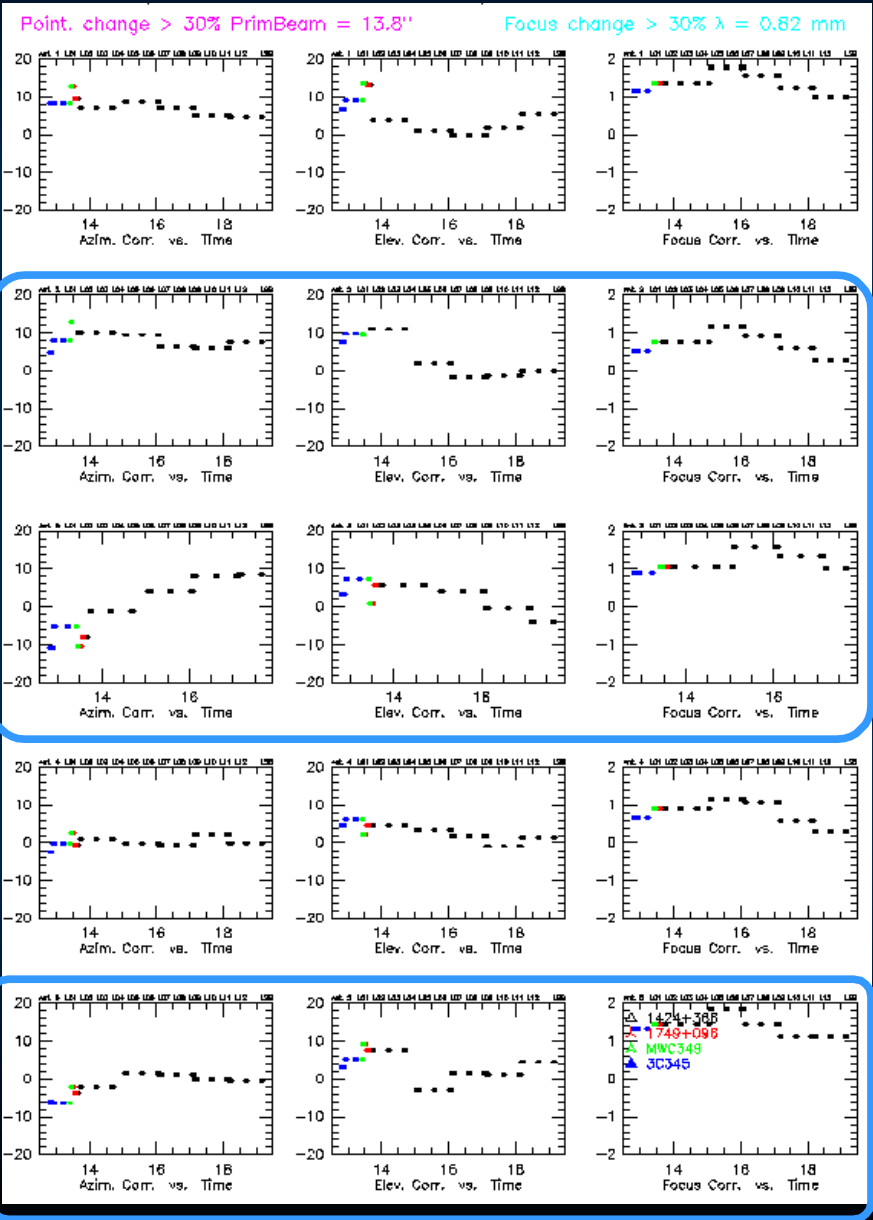
Practical Tips: Pointing/Focus

First Look



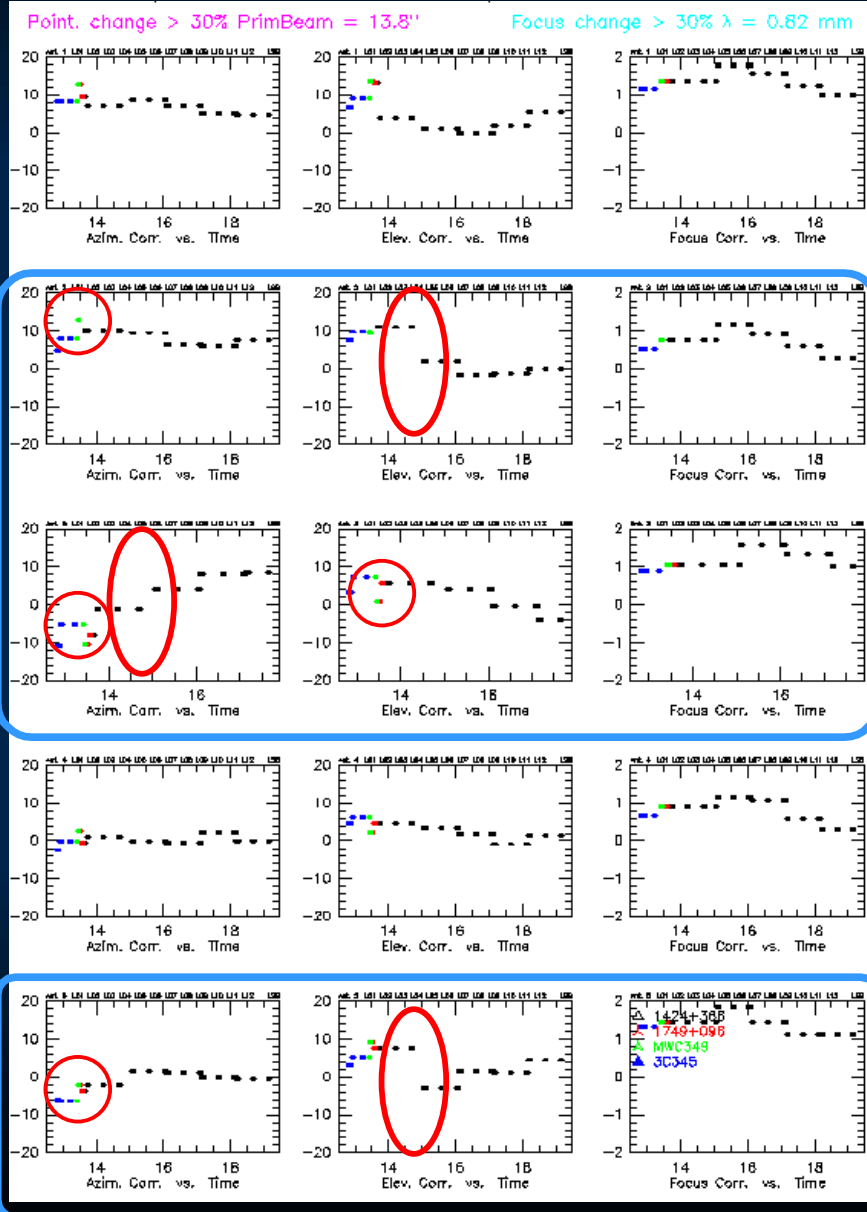
Practical Tips : Pointing/Focus

First Look



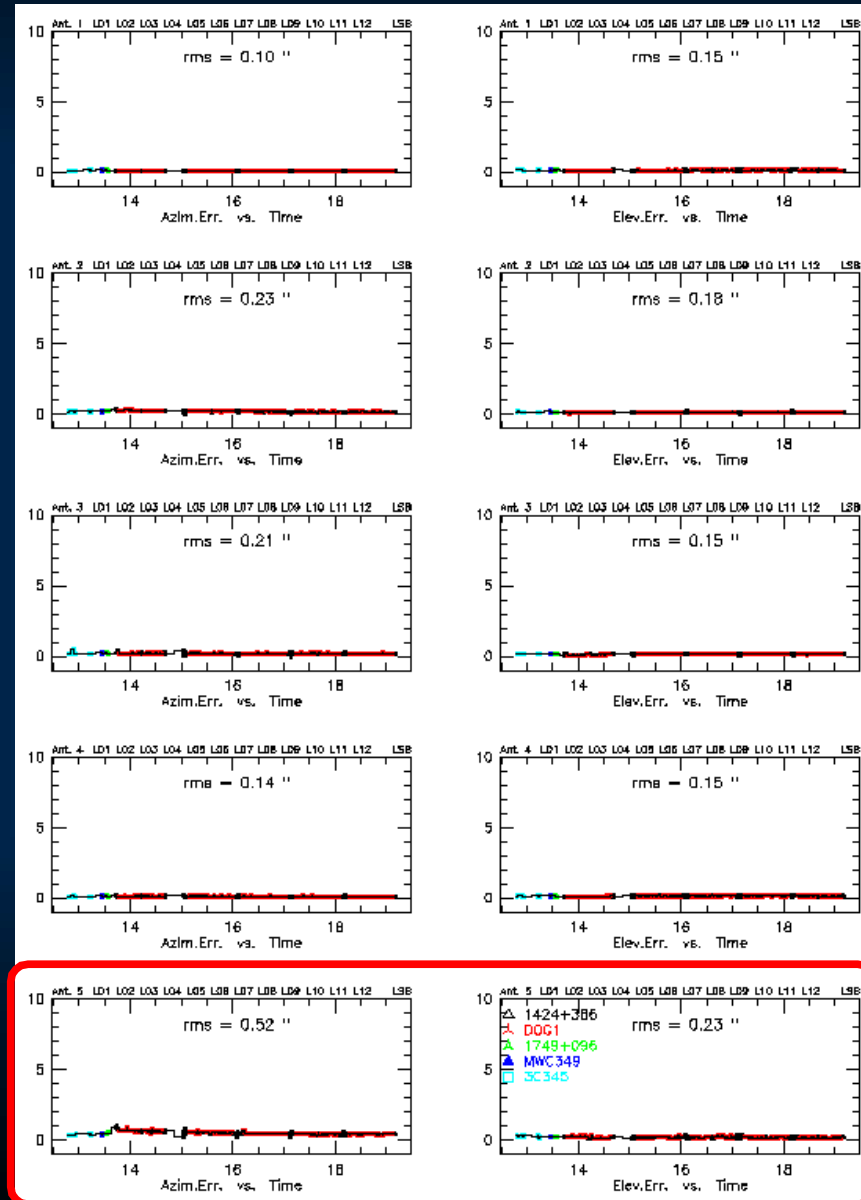
Practical Tips : Pointing/Focus

First Look

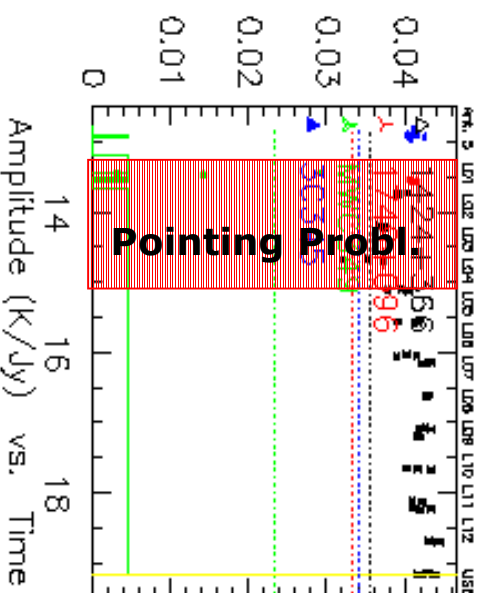
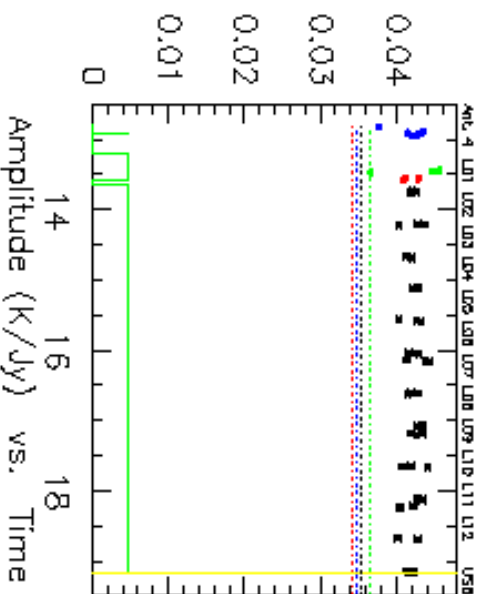
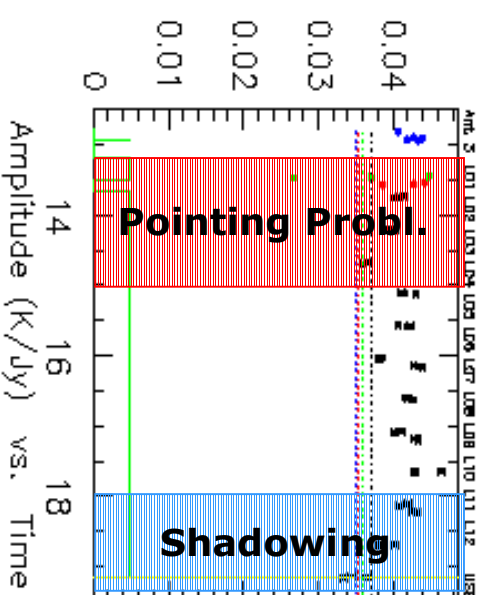
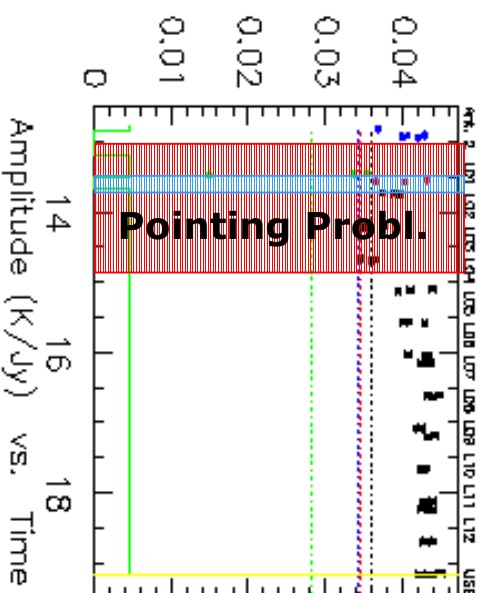
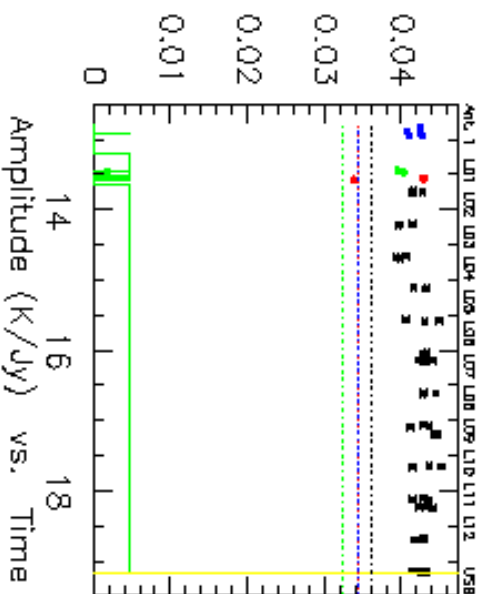


Practical Tips: Tracking

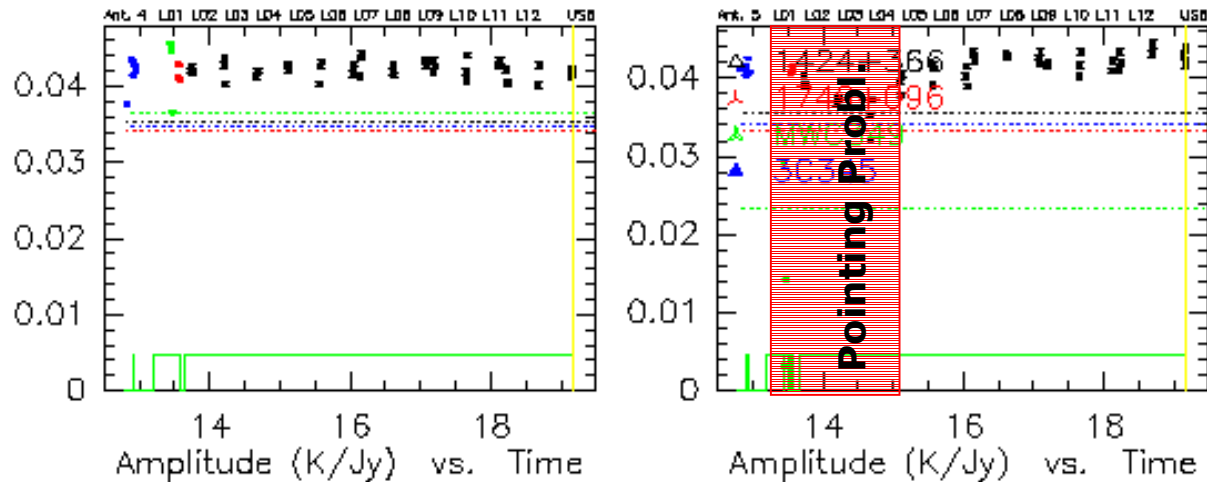
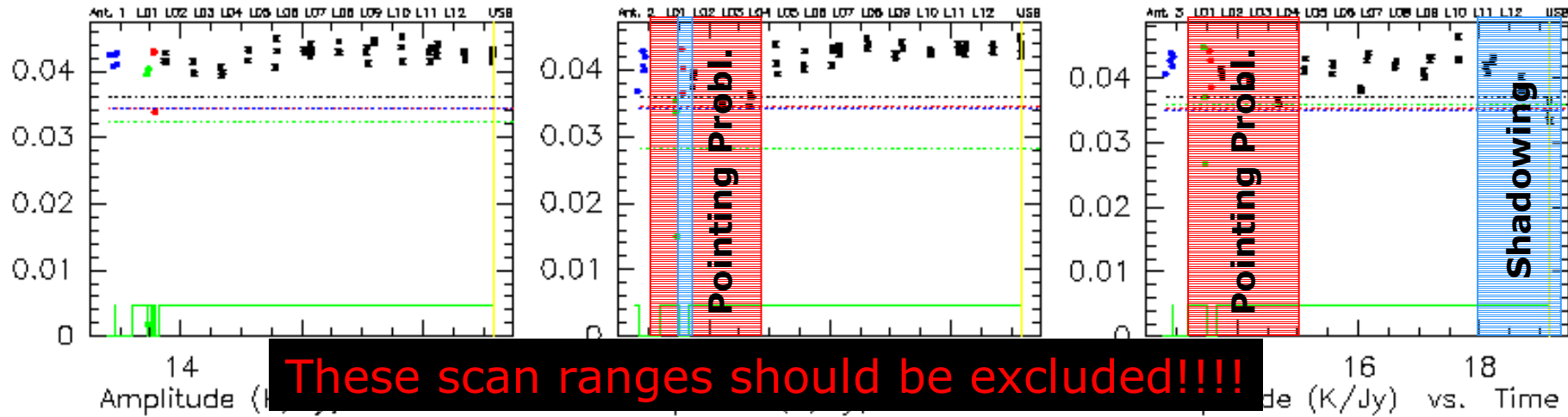
First Look



Practical Tips



Practical Tips



Practical Tips

Standard calibration package for NGR

GO ABORT HELP

SELECT AUTOFLAG PHCOR RF PHASE FLUX AMPL. PRINT

Use previous settings ? No

File name 01-oct-2010-ua36.hpb File

First and last scan 0 1000

RECEIVER BAND = 1

```
W-FIND,[8210] Nothing found
W-FIND,[8210] Nothing found
X axis  : Time           , = to =
Y axis  : Amplitude     , 0.00 to *
Amplitudes are absolute
Amplitude Calibration is antenna-based
Amplitudes are divided by assumed calibrator flux
Amplitudes are expressed in kelvins
I-CLIC_SET,[8210] Polarization mode: BOTH
All subbands
Subband group 1      : L01 L02 L03 L04 L05 L06 L07 L08 L09 L10
L11 L12
Ident  0.5950000
Y axis  : Atm.Corr.Val. , * to *
Plot type is HIST
Plot type is BARS
I-SET,[8634] Message display level set to          4
I-HARD, 01-oct-2010-ua36-eff-1.ps created
I-FIND,[8634] New generation receivers data
I-FIND,[8634]          57 observations found
W-FIND,[8634] Nothing found
W-FIND,[8634] Nothing found
Y axis  : Amplitude     , 0.00 to *
CLIC>
```

Practical Tips

Standard calibration package for NGR

GO ABORT HELP

SELECT AUTOFLAG PHCOR RF PHASE **FLUX** AMPL. PRINT

Use previous settings ? No

File name 01-oct-2010-ua36.hpt File

First and last scan 0 1000

RECEIVER BAND = 1

ogdr@iralx0: ~/project/ua36

```

W-FIND,[8210] Nothing found
W-FIND,[8210] Nothing found
X axis : Time           , = to =
Y axis : Amplitude      , 0.00 to *
Amplitudes are absolute
Amplitude Calibration is antenna-based
Amplitudes are divided by assumed calibrator flux
Amplitudes are expressed in kelvins
I-CLIC_SET,[8210] Polarization mode: BOTH
All subbands
Subband group 1      : L01 L02 L03 L04 L05 L06 L07 L08 L09 L10
L11 L12
Ident 0.5950000
Y axis : Atm.Corr.Val. , * to *
Plot type is HIST
Plot type is BARS
I-SET,[8634] Message display level set to 4
I-HARD, 01-oct-2010-ua36-eff-1.ps created
I-FIND,[8634] New generation receivers data
I-FIND,[8634] 57 observations found
W-FIND,[8634] Nothing found
W-FIND,[8634] Nothing found
Y axis : Amplitude      , 0.00 to *
CLIC>

```


Practical Tips

Standard calibration package for NGR

GO ABORT HELP

SELECT AUTOFLAG PHCOR RF PHASE **FLUX** AMPL. PRINT

Use previous settings? No

File name: 01-oct-2010-ua36.hpb File

First and last scan: 0 1000

RECEIVER BAND = 1

```

W-FIND,[8210] Nothing found
W-FIND,[8210] Nothing found
X axis : Time , = to =
Y axis : Amplitude , 0.00 to *
Amplitudes are absolute
Amplitude Calibration is antenna-based
Amplitudes are divided by assumed calibrator flux
Amplitudes are expressed in kelvins
I-CLIC_SET,[8210] Polarization mode: BOTH
All subbands
Subband group 1 : L01 L02 L03 L04 L05 L06
L11 L12
Ident 0.5950000
Y axis : Atm.Corr.Val. , * to *
Plot type is HIST
Plot type is BARS
I-SET,[8634] Message display level set to 4
I-HARD, 01-oct-2010-ua36-eff-1.ps created
I-FIND,[8634] New generation receivers data
I-FIND,[8634] 57 observations found
W-FIND,[8634] Nothing found
W-FIND,[8634] Nothing found
Y axis : Amplitude , 0.00 to *
CLIC>
    
```

Flux Receiver 1 (on iralx0)

GO ABORT HELP

CHECK SOLVE GET RESULT STORE PLOT >> CALIBRATE

Frequency 108.95 GHz

Efficiencies: 0 0 0 0 0

Scan list ? 8175 8634

Calibrator 3C345

Input Flux? 4.195

Fixed flux? No

Solved Flux: 0

Flux in File: 4.195

Source MWC349, Model Flux 1.26 Jy

Input Flux? 1.221

Fixed flux? Yes

Solved Flux: 0

Flux in File: 1.221

Calibrator 1749+096

Input Flux? 3.242

Fixed flux? No

Solved Flux: 0

Flux in File: 3.242

Calibrator 1424+366

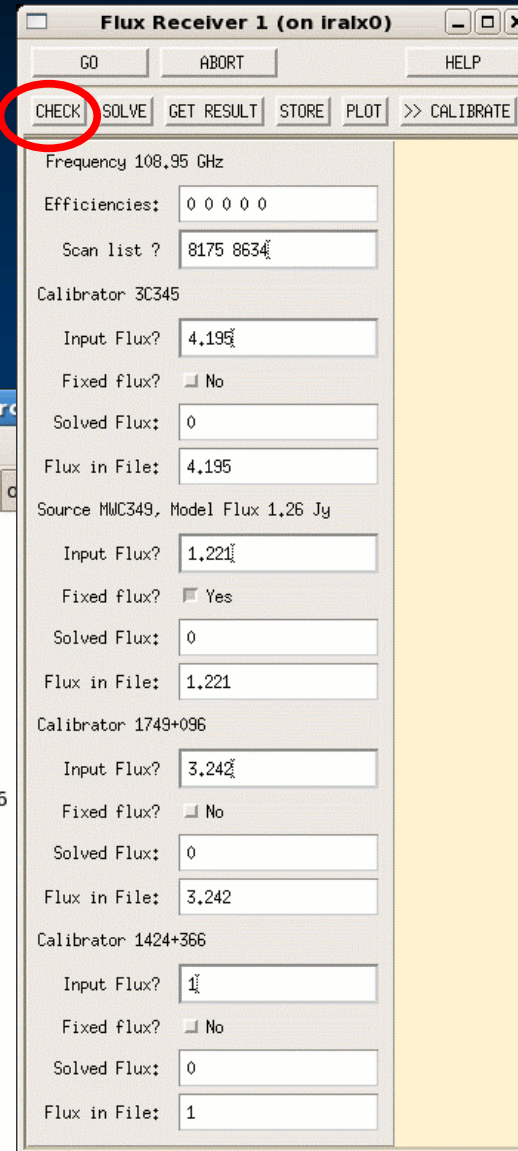
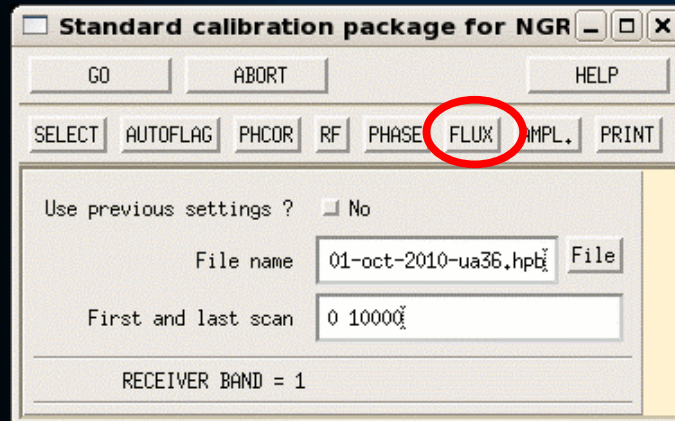
Input Flux? 1

Fixed flux? No

Solved Flux: 0

Flux in File: 1

Practical Tips



```

W-FIND,[8210] Nothing found
W-FIND,[8210] Nothing found
X axis : Time , = to =
Y axis : Amplitude , 0.00 to *
Amplitudes are absolute
Amplitude Calibration is antenna-based
Amplitudes are divided by assumed calibrator flux
Amplitudes are expressed in kelvins
I-CLIC_SET,[8210] Polarization mode: BOTH
All subbands
Subband group 1 : L01 L02 L03 L04 L05 L06
L11 L12
Ident 0.5950000
Y axis : Atm.Corr.Val. , * to *
Plot type is HIST
Plot type is BARS
I-SET,[8634] Message display level set to 4
I-HARD, 01-oct-2010-ua36-eff-1.ps created
I-FIND,[8634] New generation receivers data
I-FIND,[8634] 57 observations found
W-FIND,[8634] Nothing found
W-FIND,[8634] Nothing found
Y axis : Amplitude , 0.00 to *
CLIC>
    
```


Practical Tips

Standard calibration packa

GO ABORT

SELECT AUTOFLAG PHCOR RF PHASE

Use previous settings ? No

File name 01-oct-20

First and last scan 0 10000

RECEIVER BAND = 1

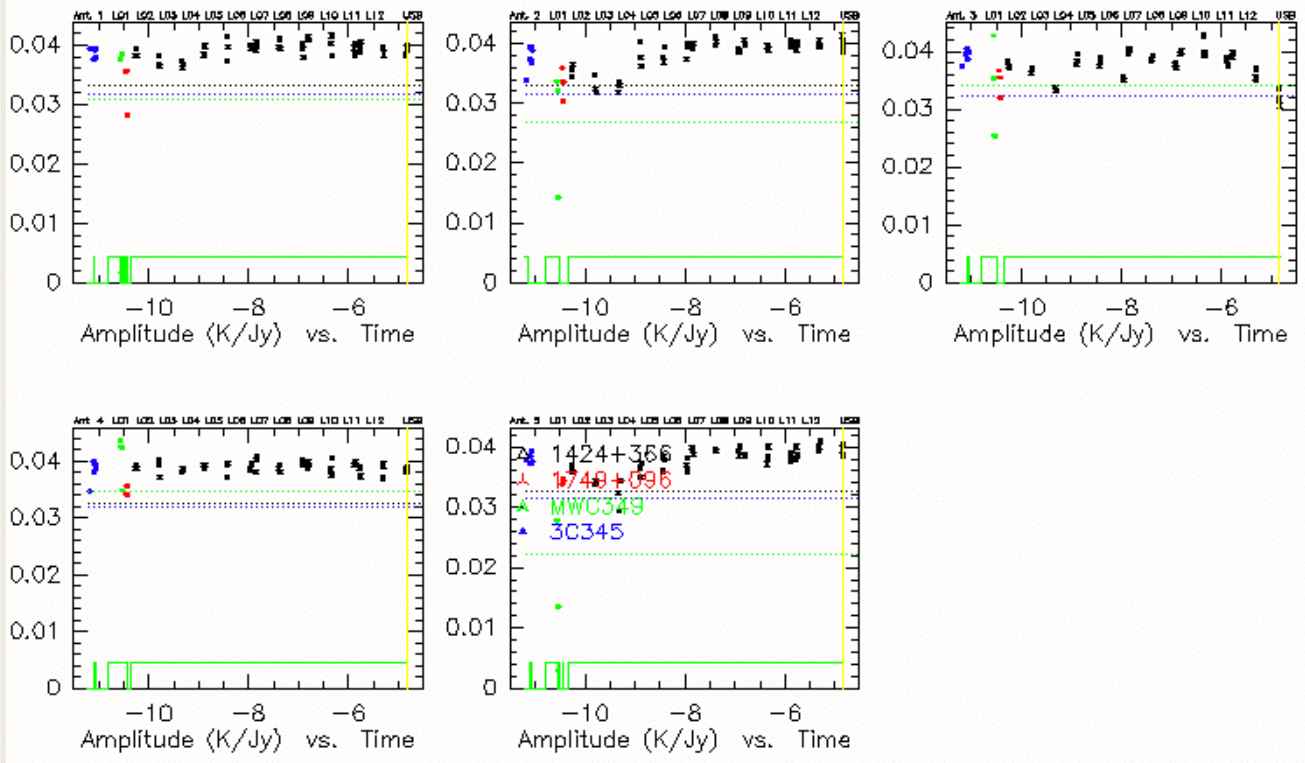
```

W-FIND,[8210] Nothing found
W-FIND,[8210] Nothing found
X axis : Time
Y axis : Amplitude
Amplitudes are absolute
Amplitude Calibration is a
Amplitudes are divided by
Amplitudes are expressed i
I-CLIC_SET,[8210] Polarizat
All subbands
Subband group 1 :
L11 L12
Ident 0.5950000
Y axis : Atm.Corr.Val.
Plot type is HIST
Plot type is BARS
I-SET,[8634] Message displa
I-HARD, 01-oct-2010-ua36-e
I-FIND,[8634] New generatio
I-FIND,[8634] 57 observations found
W-FIND,[8634] Nothing found
W-FIND,[8634] Nothing found
Y axis : Amplitude
CLIC> cursor
    
```

Flux Receiver 1 (on iralx0)

<GREG 0

RF: Fr.(A) CLIC - 04-OCT-2010 10:43:26 - ogdr@iralx0 N11W08W05N07E03 5Dq Scan Avg.
 Am: Scaled UA36 CO21R 108.950GHz B1 Q3(320,320,320,320)V Q3(320,320,320,320)H BOTH polarizations
 Ph: Rel.(A) Atm. (11 8176 P CORR)-(576 8634 P CORR) 01-OCT-2010 12:49-19:09



Amplitude (K/Jy) vs. Time

Amplitude (K/Jy) vs. Time

Amplitude (K/Jy) vs. Time

Amplitude (K/Jy) vs. Time

Solved Flux: 0

Flux in File: 1

Practical Tips

Standard calibration packa

GO ABORT

SELECT AUTOFLAG PHCOR RF PHASE

Use previous settings ? No

File name 01-oct-20

First and last scan 0 10000

RECEIVER BAND = 1

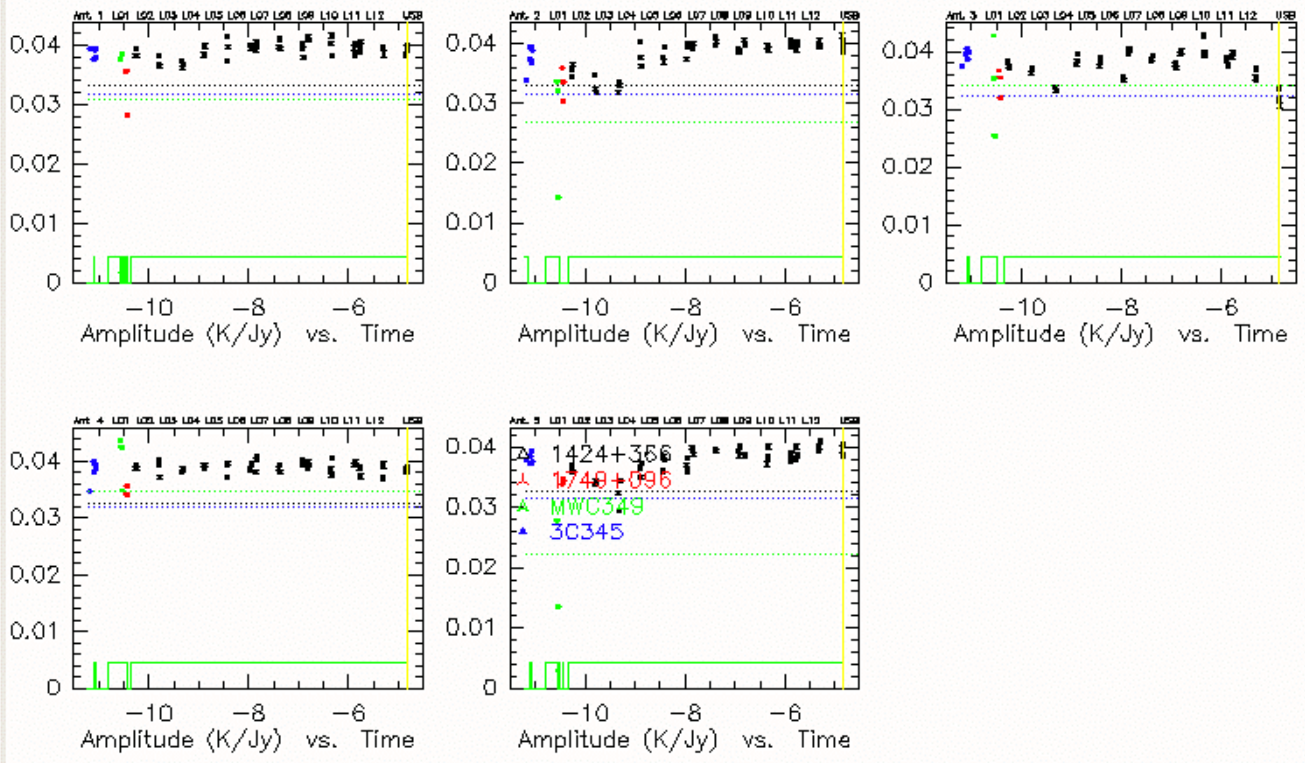
```

W-FIND,[8210] Nothing found
W-FIND,[8210] Nothing found
X axis : Time
Y axis : Amplitude
Amplitudes are absolute
Amplitude Calibration is a
Amplitudes are divided by
Amplitudes are expressed i
I-CLIC_SET,[8210] Polarizat
All subbands
Subband group 1 :
L11 L12
Ident 0.5950000
Y axis : Atm.Corr.Val.
Plot type is HIST
Plot type is BARS
I-SET,[8634] Message displa
I-HARD, 01-oct-2010-ua36-e
I-FIND,[8634] New generatio
I-FIND,[8634] 57 observations found
W-FIND,[8634] Nothing found
W-FIND,[8634] Nothing found
Y axis : Amplitude
CLIC cursor
    
```

Flux Receiver 1 (on iralx0)

<GREG 0

RF: Fr.(A) CLIC - 04-OCT-2010 10:43:26 - ogdr@iralx0 N11W08W05N07E03 5Dq Scan Avg.
 Am: Scaled UA36 CO21R 108.950GHz B1 Q3(320,320,320,320)V Q3(320,320,320,320)H BOTH polarizations
 Ph: Rel.(A) Atm. (11 8176 P CORR)-(576 8634 P CORR) 01-OCT-2010 12:49-19:09



Amplitude (K/Jy) vs. Time

Solved Flux: 0

Flux in File: 1

Practical Tips

Standard calibration packa

GO ABORT

SELECT AUTOFLAG PHCOR RF PHASE

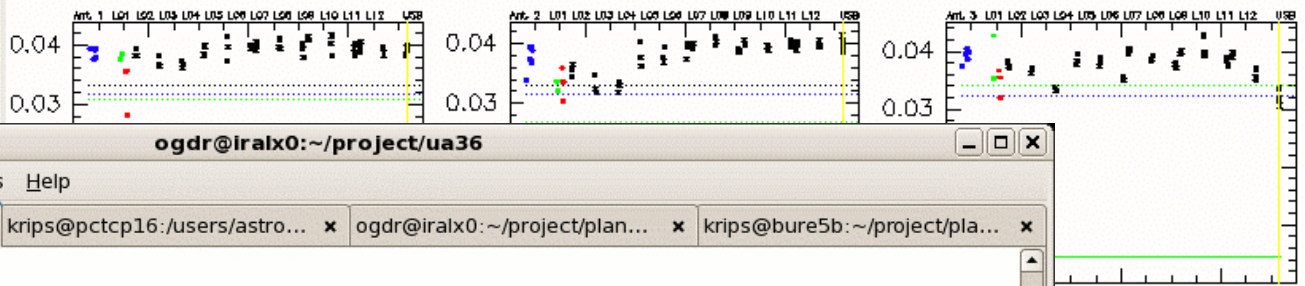
Use previous settings? No

File name 01-oct-20

First and last scan 0 10000

Flux Receiver 1 (on iralx0) <GREG 0

RF: Fr.(A) CLIC - 04-OCT-2010 10:43:26 - ogdr@iralx0 N11W08W05N07E03 5Dq Scan Avg.
 Am: Scaled UA36 C021R 108.950GHz B1 Q3(320,320,320,320)V Q3(320,320,320,320)H BOTH polarizations
 Ph: Rel.(A) Atm. (11 8176 P CORR)-(576 8634 P CORR) 01-OCT-2010 12:49-19:09



ogdr@iralx0:~/project/ua36

```

ogdr@iralx0:~/project/ua36 x krips@pctcp16:/users/astro... x ogdr@iralx0:~/project/plan... x krips@bure5b:~/project/pla... x
CLIC>
CLIC>
CLIC>
CLIC>
CLIC>
CLIC>
CLIC>
CLIC> cursor
I-CLIC_CURSOR,[8210] Use closest point in X
----- Cursor -----
Ant. 2      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12      USB
X: Time = -10.5448192      Y: Amplitude (K/Jy) = 3.357461229E-02
Scan: 8193 Obs: 51 Rec: 1 Weight = 74.0850220
----- Cursor -----
Ant. 2      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12      USB
X: Time = -9.00451594      Y: Amplitude (K/Jy) = 3.298940594E-02
Scan: 8296 Obs: 181 Rec: 1 Weight = 9.43385124
CLIC> cursor
I-CLIC_CURSOR,[8210] Use closest point in X
----- Cursor -----
Ant. 3      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12      USB
X: Time = -6.07560594      Y: Amplitude (K/Jy) = 3.440744862E-02
Scan: 8546 Obs: 472 Rec: 1 Weight = 6.44466686
CLIC>
                    
```

Practical Tips

Standard calibration packa

GO ABORT

SELECT AUTOFLAG PHCOR RF PHASE

Use previous settings? No

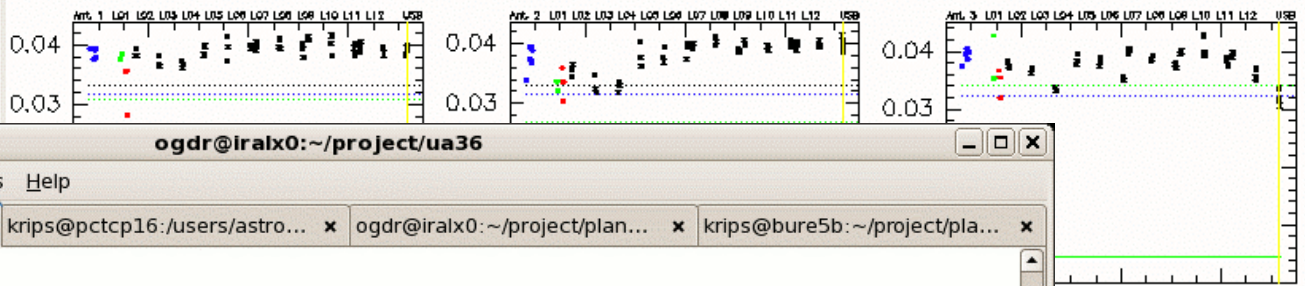
File name 01-oct-20

First and last scan 0 10000

Flux Receiver 1 (on iralx0)

<GREG 0

RF: Fr.(A) CLIC - 04-OCT-2010 10:43:26 - ogdr@iralx0 N11W08W05N07E03 5Dq Scan Avg.
 Am: Scaled UA36 C021R 108.950GHz B1 Q3(320,320,320,320)V Q3(320,320,320,320)H BOTH polarizations
 Ph: Rel.(A) Atm. (11 8176 P CORR)-(576 8634 P CORR) 01-OCT-2010 12:49-19:09



Ant. 1 L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12 USB

Ant. 2 L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12 USB

Ant. 3 L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12 USB

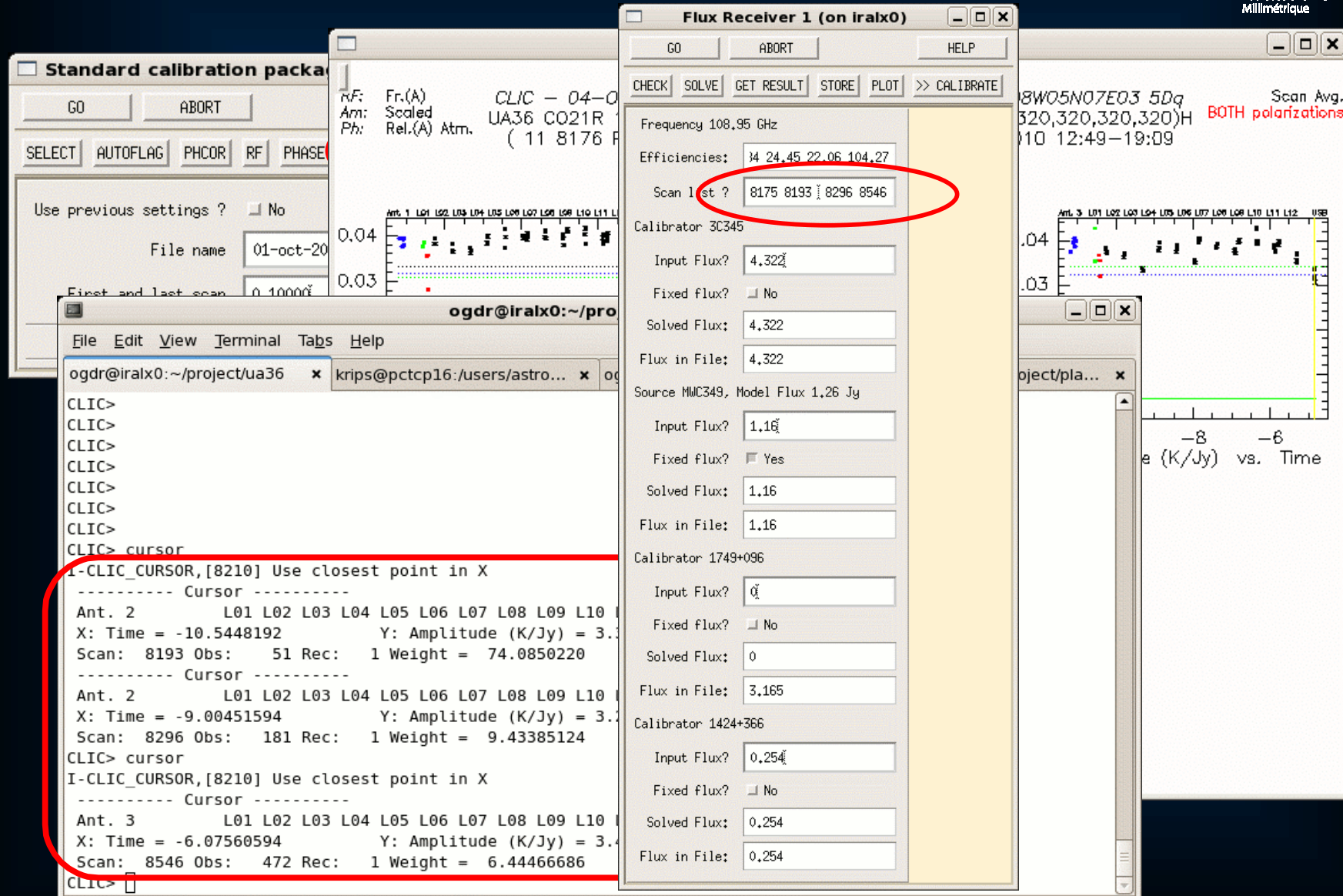
Amplitude (K/Jy) vs. Time

ogdr@iralx0:~/project/ua36

```

ogdr@iralx0:~/project/ua36 x krips@pctcp16:/users/astro... x ogdr@iralx0:~/project/plan... x krips@bure5b:~/project/pla... x
CLIC>
CLIC>
CLIC>
CLIC>
CLIC>
CLIC>
CLIC>
CLIC> cursor
I-CLIC_CURSOR,[8210] Use closest point in X
----- Cursor -----
Ant. 2      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12      USB
X: Time = -10.5448192      Y: Amplitude (K/Jy) = 3.357461229E-02
Scan: 8193 Obs: 51 Rec: 1 Weight = 74.0850220
----- Cursor -----
Ant. 2      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12      USB
X: Time = -9.00451594      Y: Amplitude (K/Jy) = 3.298940594E-02
Scan: 8296 Obs: 181 Rec: 1 Weight = 9.43385124
CLIC> cursor
I-CLIC_CURSOR,[8210] Use closest point in X
----- Cursor -----
Ant. 3      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12      USB
X: Time = -6.07560594      Y: Amplitude (K/Jy) = 3.440744862E-02
Scan: 8546 Obs: 472 Rec: 1 Weight = 6.44466686
CLIC>
                    
```


Practical Tips



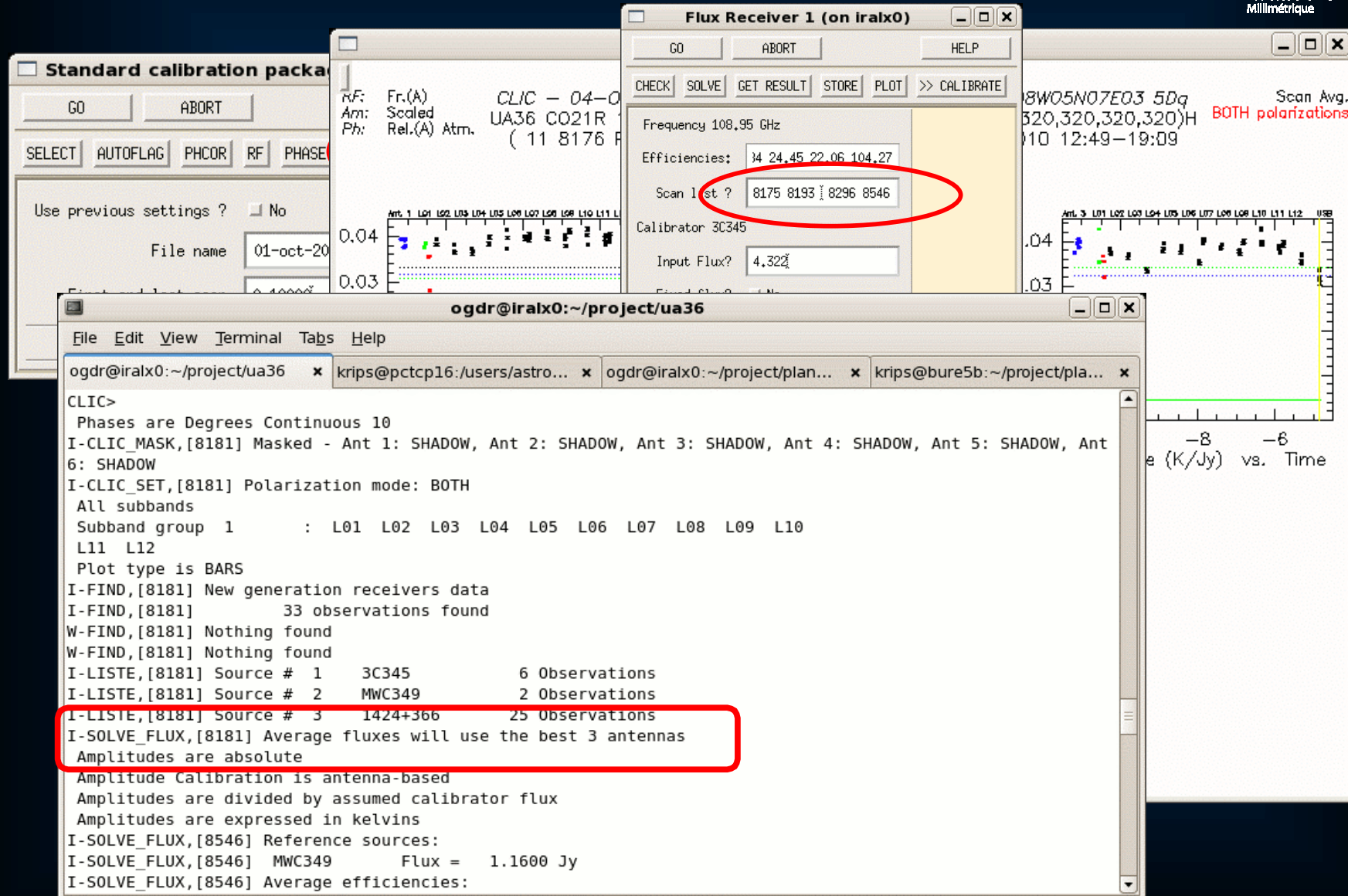
The screenshot displays the CLIC software interface for absolute flux calibration. It includes several windows:

- Standard calibration packa...:** A control window with buttons for GO, ABORT, SELECT, AUTOFLAG, PHCOR, RF, and PHASE. It also has fields for 'Use previous settings?', 'File name' (01-oct-20), and 'First and last scan' (0 10000).
- Flux Receiver 1 (on iralx0):** A central window with buttons for GO, ABORT, HELP, CHECK, SOLVE, GET RESULT, STORE, PLOT, and >> CALIBRATE. It shows:
 - Frequency: 108.95 GHz
 - Efficiencies: 34 24.45 22.06 104.27
 - Scan list: 8175 8193 8296 8546 (circled in red)
 - Calibrator: 3C345
 - Input Flux: 4.322
 - Solved Flux: 4.322
 - Flux in File: 4.322
 - Source: MMC349, Model Flux: 1.26 Jy
 - Input Flux: 1.16
 - Solved Flux: 1.16
 - Flux in File: 1.16
 - Calibrator: 1749+096
 - Input Flux: 0
 - Solved Flux: 0
 - Flux in File: 3.165
 - Calibrator: 1424+366
 - Input Flux: 0.254
 - Solved Flux: 0.254
 - Flux in File: 0.254
- Terminal:** A terminal window showing the CLIC command line interface. It displays the output of the 'cursor' command, which lists the closest point in X for three different scans. The scan 8296 is highlighted with a red box.


```

CLIC> cursor
I-CLIC_CURSOR,[8210] Use closest point in X
----- Cursor -----
Ant. 2      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10
X: Time = -10.5448192      Y: Amplitude (K/Jy) = 3.
Scan: 8193 Obs: 51 Rec: 1 Weight = 74.0850220
----- Cursor -----
Ant. 2      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10
X: Time = -9.00451594      Y: Amplitude (K/Jy) = 3.
Scan: 8296 Obs: 181 Rec: 1 Weight = 9.43385124
CLIC> cursor
I-CLIC_CURSOR,[8210] Use closest point in X
----- Cursor -----
Ant. 3      L01 L02 L03 L04 L05 L06 L07 L08 L09 L10
X: Time = -6.07560594      Y: Amplitude (K/Jy) = 3.
Scan: 8546 Obs: 472 Rec: 1 Weight = 6.44466686
CLIC>
            
```
- Plots:** Two plots showing amplitude vs. time for different antennas (Ant. 1 and Ant. 3). The x-axis is labeled 'Time (K/Jy) vs. Time' with values -8 and -6. The y-axis ranges from 0.03 to 0.04. A red box highlights the scan 8296 in the plot for Ant. 2.

Practical Tips



The screenshot displays a multi-windowed software interface for radio astronomy data processing. The windows include:

- Standard calibration packa...:** A control panel with buttons for GO, ABORT, SELECT, AUTOFLAG, PHCOR, RF, and PHASE. It also has a checkbox for "Use previous settings?" and a "File name" field.
- Flux Receiver 1 (on iralx0):** A window with buttons for GO, ABORT, HELP, CHECK, SOLVE, GET RESULT, STORE, PLOT, and >> CALIBRATE. It displays:
 - Frequency: 108.95 GHz
 - Efficiencies: 34 24.45 22.06 104.27
 - Scan list: 8175 8193 8296 8546 (circled in red)
 - Calibrator: 3C345
 - Input Flux: 4.322
- Terminal window (ogdr@iralx0):** Shows the execution of the CLIC software. The output includes:
 - CLIC>
 - Phases are Degrees Continuous 10
 - I-CLIC_MASK,[8181] Masked - Ant 1: SHADOW, Ant 2: SHADOW, Ant 3: SHADOW, Ant 4: SHADOW, Ant 5: SHADOW, Ant 6: SHADOW
 - I-CLIC_SET,[8181] Polarization mode: BOTH
 - All subbands
 - Subband group 1 : L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12
 - Plot type is BARS
 - I-FIND,[8181] New generation receivers data
 - I-FIND,[8181] 33 observations found
 - W-FIND,[8181] Nothing found
 - W-FIND,[8181] Nothing found
 - I-LISTE,[8181] Source # 1 3C345 6 Observations
 - I-LISTE,[8181] Source # 2 MWC349 2 Observations
 - I-LISTE,[8181] Source # 3 1424+366 25 Observations (circled in red)
 - I-SOLVE_FLUX,[8181] Average fluxes will use the best 3 antennas
 - Amplitudes are absolute
 - Amplitude Calibration is antenna-based
 - Amplitudes are divided by assumed calibrator flux
 - Amplitudes are expressed in kelvins
 - I-SOLVE_FLUX,[8181] Reference sources:
 - I-SOLVE_FLUX,[8181] MWC349 Flux = 1.1600 Jy
 - I-SOLVE_FLUX,[8181] Average efficiencies:
- Plot windows:** Two windows showing bar plots of flux density (K/Jy) versus Time for different antennas (Ant. 1, 3, 5). The plots show data points for various subbands (L01-L12) and a scan average line.

Practical Tips

Standard calibration package

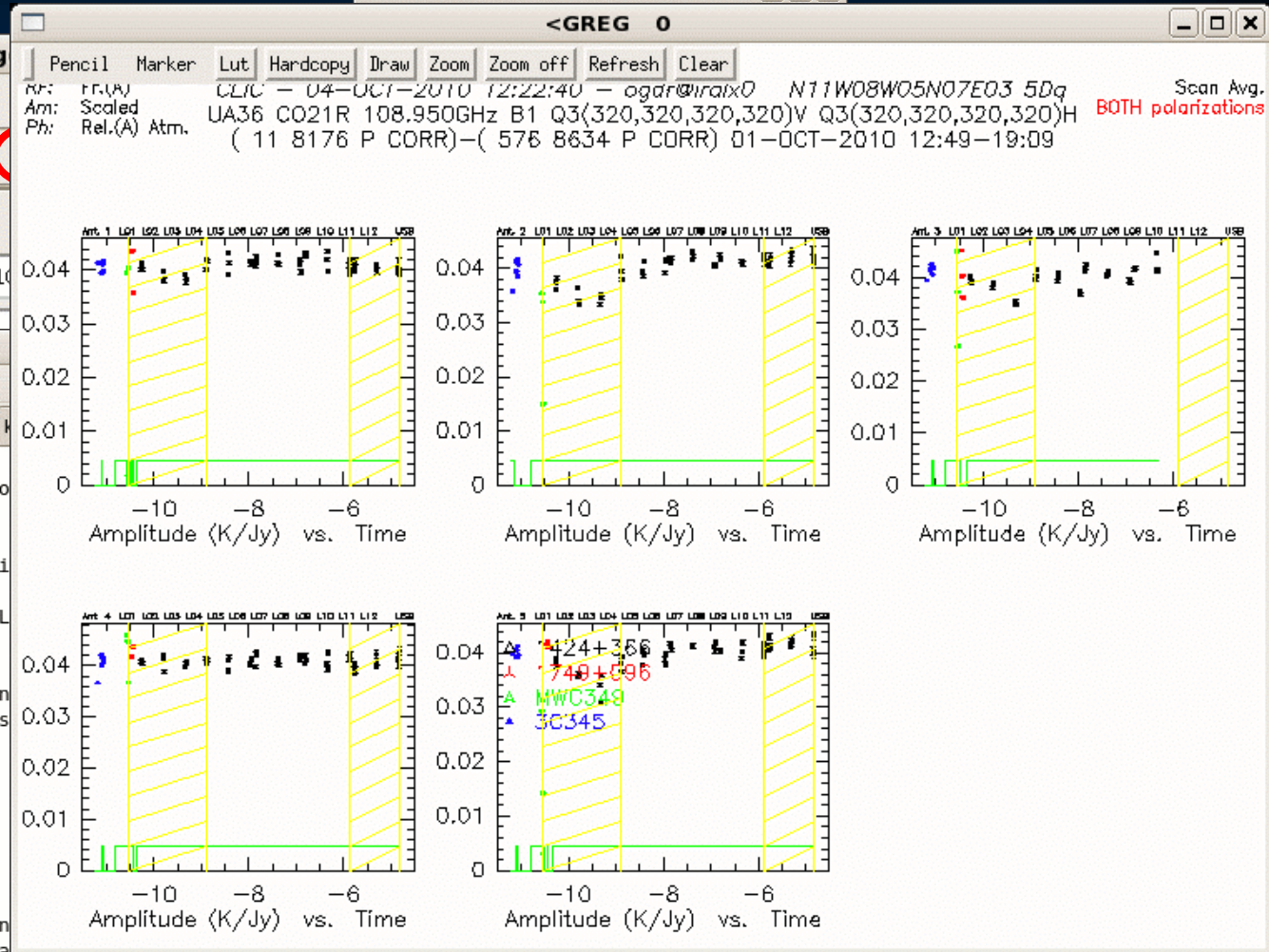
GO ABORT

SELECT AUTOFLAG PHCOR RF PHASE

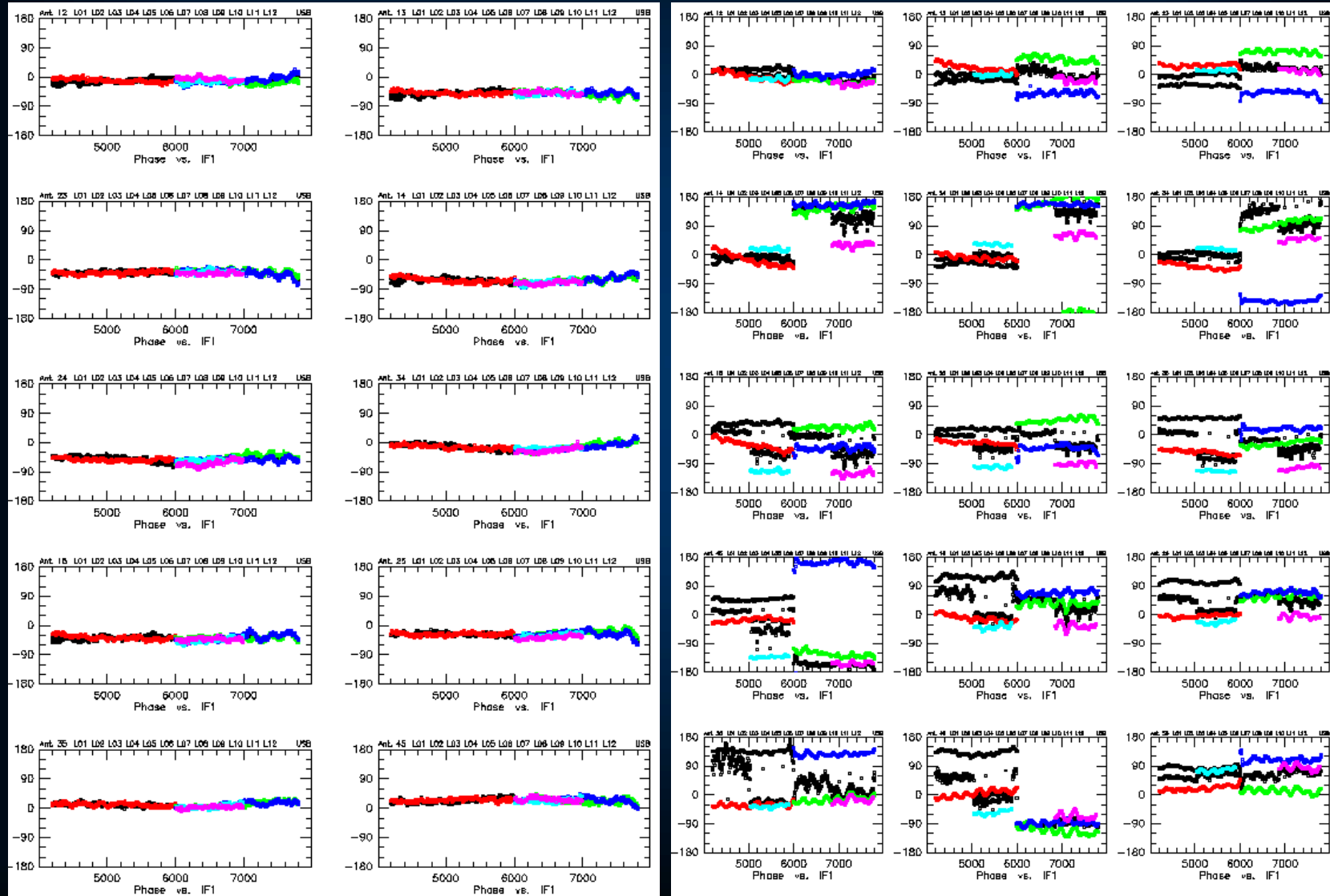
Use previous settings ? No

File name 01-oct-2010

```
ogdr@iralx0:~/project/ua36
CLIC>
Phases are Degrees Continuo
I-CLIC_MASK,[8181] Masked -
6: SHADOW
I-CLIC_SET,[8181] Polarizati
All subbands
Subband group 1      : L
L11 L12
Plot type is BARS
I-FIND,[8181] New generation
I-FIND,[8181]      33 obs
W-FIND,[8181] Nothing found
W-FIND,[8181] Nothing found
I-LISTE,[8181] Source # 1
I-LISTE,[8181] Source # 2
I-LISTE,[8181] Source # 3
I-SOLVE_FLUX,[8181] Average
Amplitudes are absolute
Amplitude Calibration is an
Amplitudes are divided by a
Amplitudes are expressed in kelvins
I-SOLVE_FLUX,[8546] Reference sources:
I-SOLVE_FLUX,[8546] MWC349      Flux = 1.1600 Jy
I-SOLVE_FLUX,[8546] Average efficiencies:
```



Practical Tips



Questions?

Summary

- SED of MWC349 follows $f \propto \nu^{0.6}$
- No time variability found above 10% during the past ~ 10 years
- Satellites can be used as flux calibrators as well but need better models
- Antenna efficiencies ok for 3mm & 2mm but quickly degrade for 1mm

Motivation

