



# SPIRE FTS ACCURACY AND REPEATABILITY (HIPE 8)

HERSCHEL CALIBRATION WORKSHOP 2  
JANUARY 2012, MADRID

THE SPIRE FTS TEAM

# FTS CALIBRATION PROGRAMME



## ROUTINE OBSERVATIONS: EACH FTS CYCLE

- Two line sources
- One asteroid
- Uranus/Neptune/Mars when visible
- Nominal mode Dark sky equal to length of longest science observation
- Bright mode 4 rep. Dark sky

## ROUTINE OBSERVATIONS: LESS OFTEN

### MONTHLY:

- Dark Load Curve

### EVERY TWO MONTHS:

- Phase Up
- Planet/Bright asteroid Load Curve

### EVERY FOUR MONTHS:

- Vss

### EVERY SIX MONTHS:

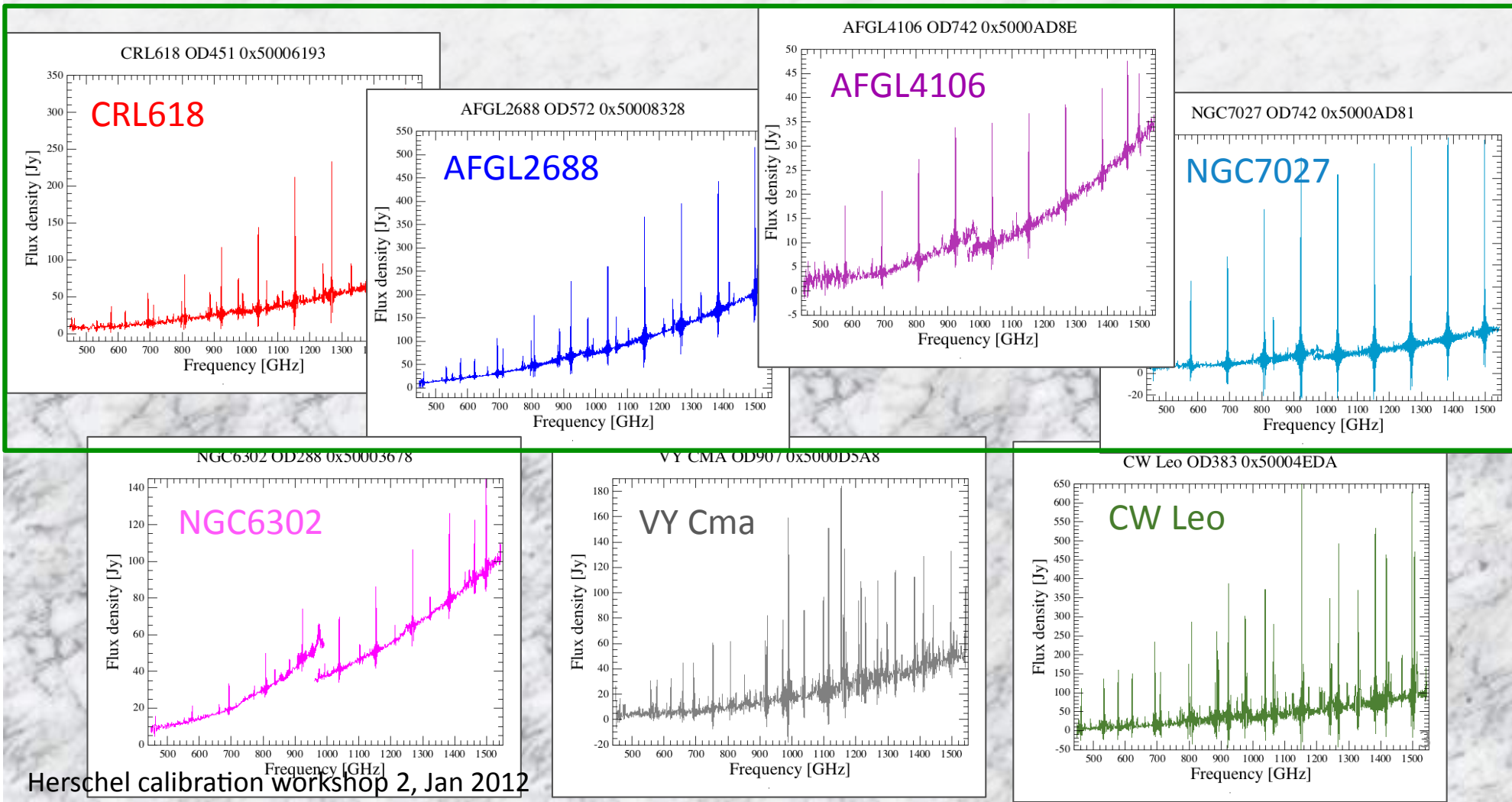
- BSM Angle
- SMEC Scanned Beam Profile
- Full Map on ORION Bar + Dark

# LINE SOURCES

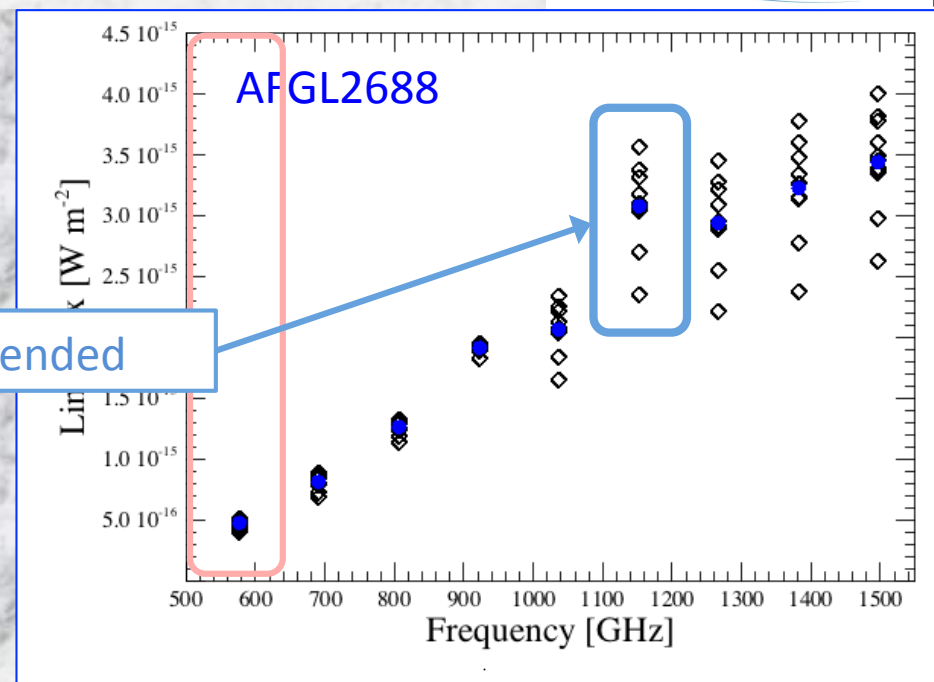
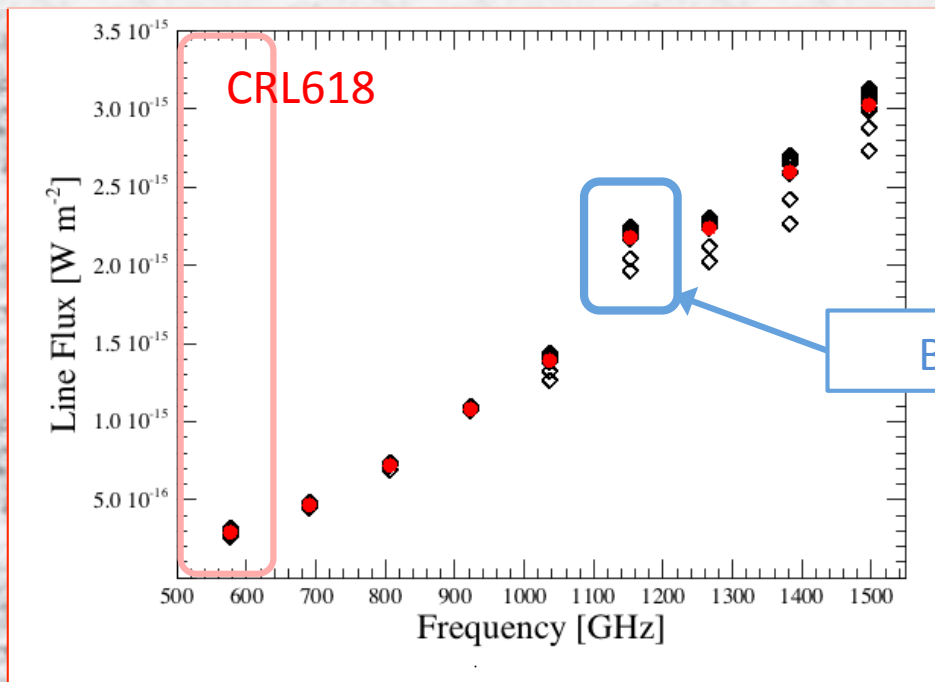


## MAIN POINT SOURCES (TWO OBSERVED PER CYCLE)

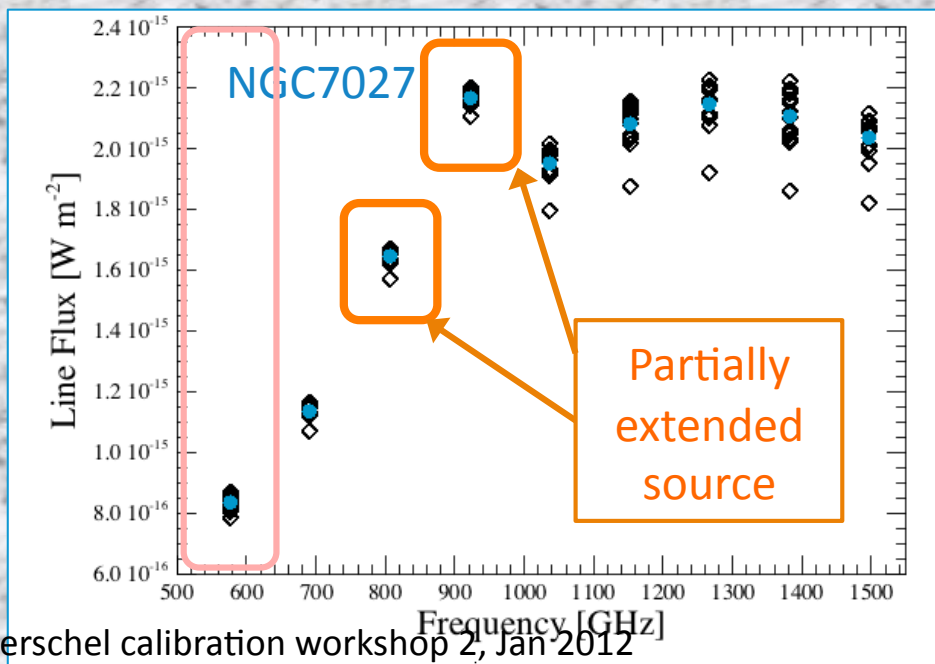
- CRL618 (13)    AFGL2688 (11)    AFGL4106 (13)    NGC7027 (marginally extended, 16)
  - NGC6302 (1)    VY CMa (2)    CW Leo (3)
- (number of observations after OD189 included)



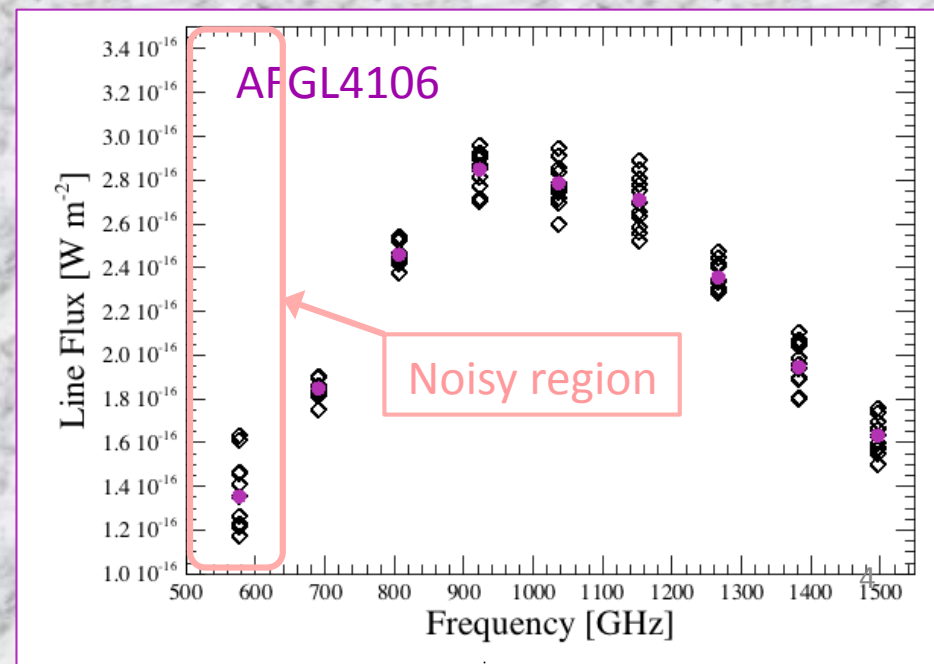
# REPEATABILITY: LINE FLUX



Blended



Partially extended source



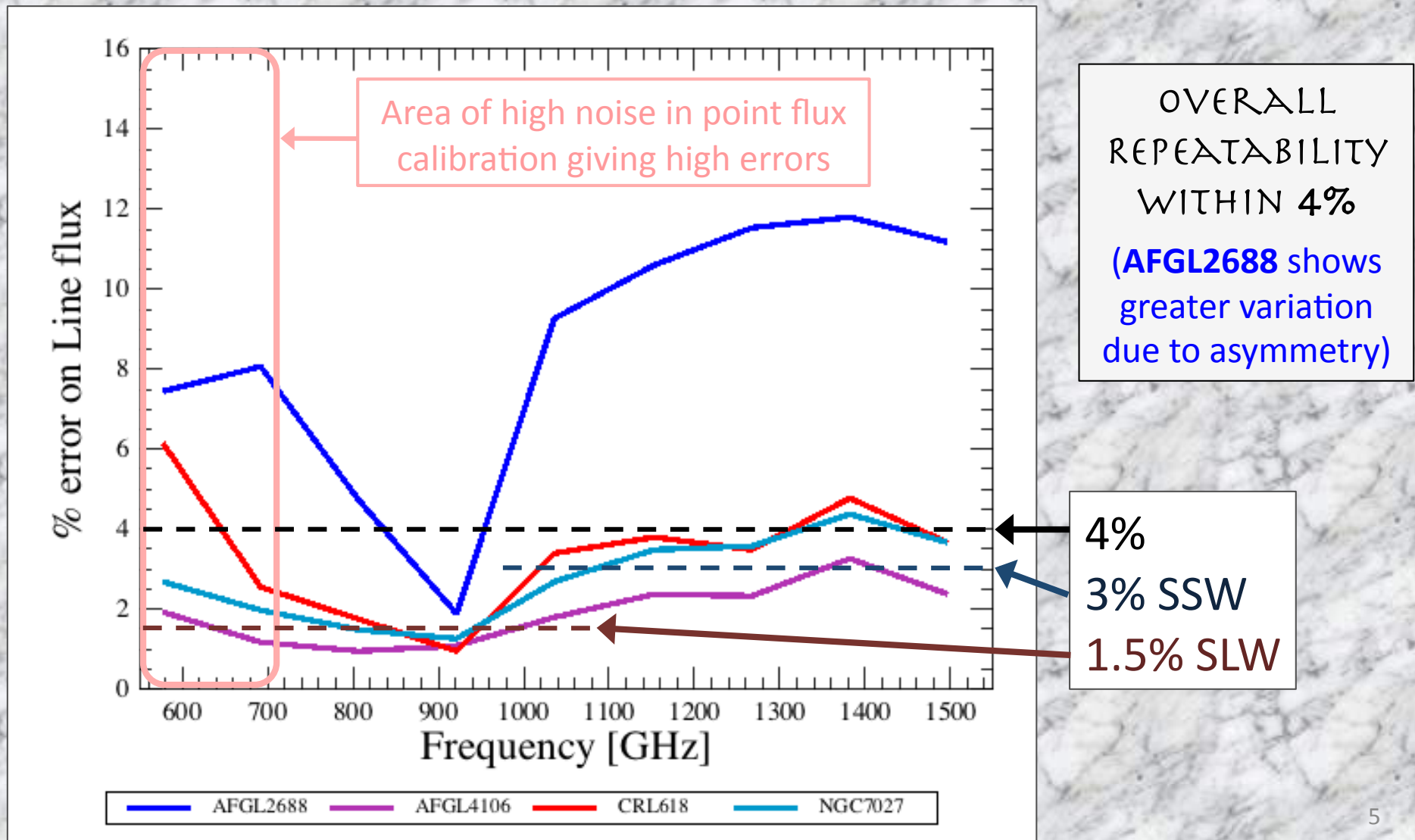
Noisy region



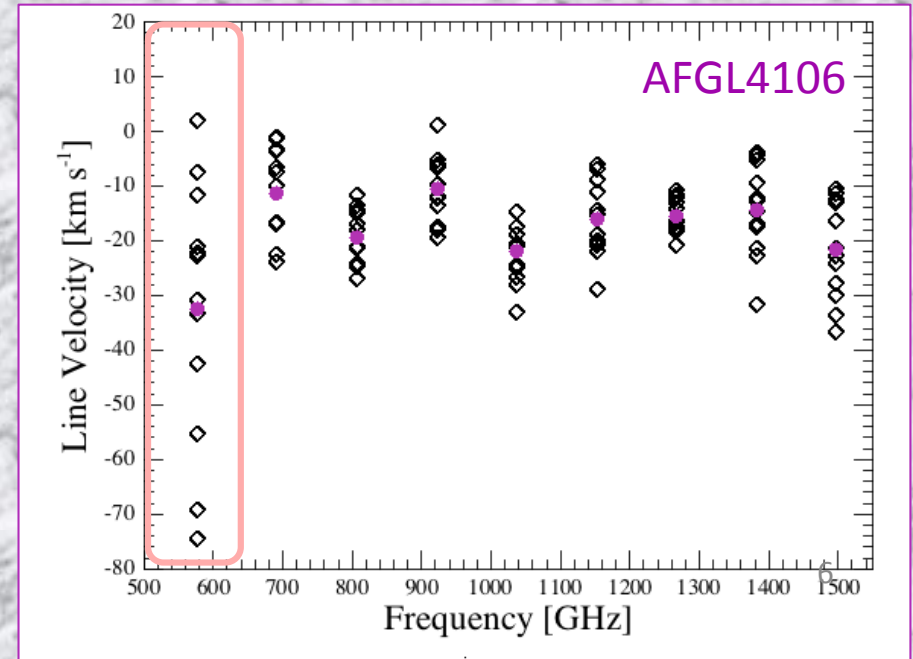
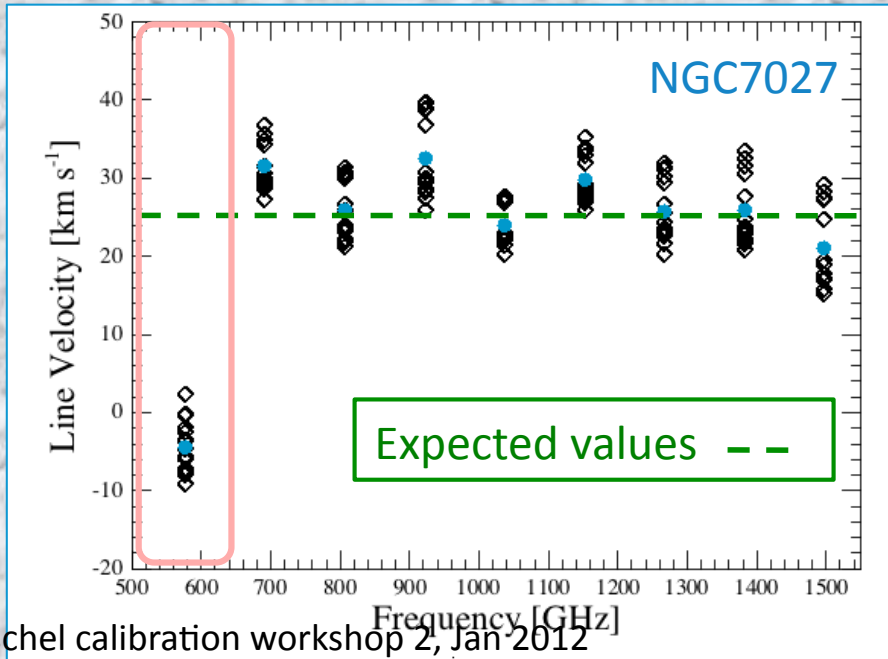
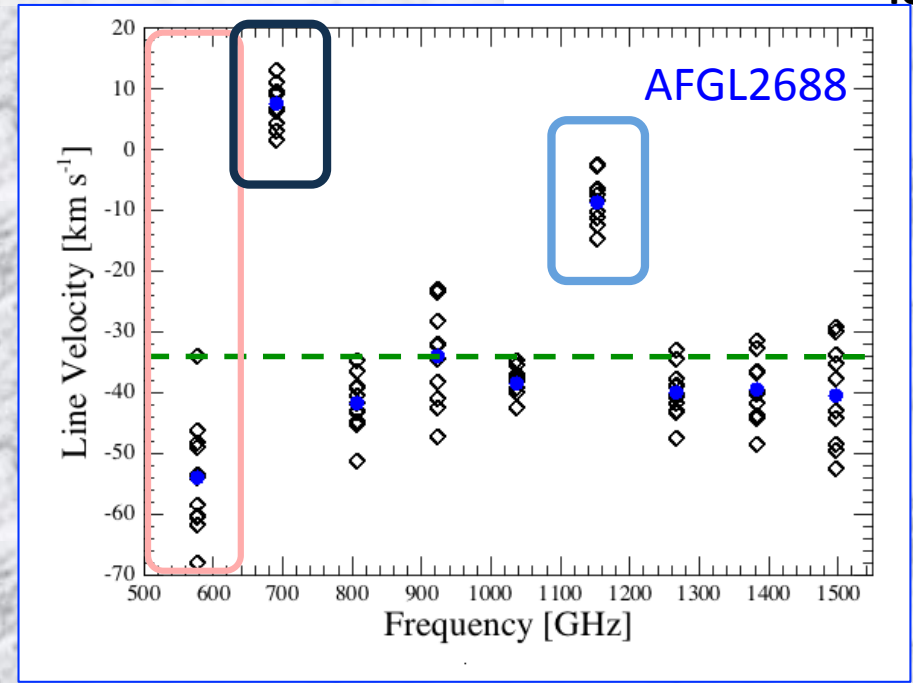
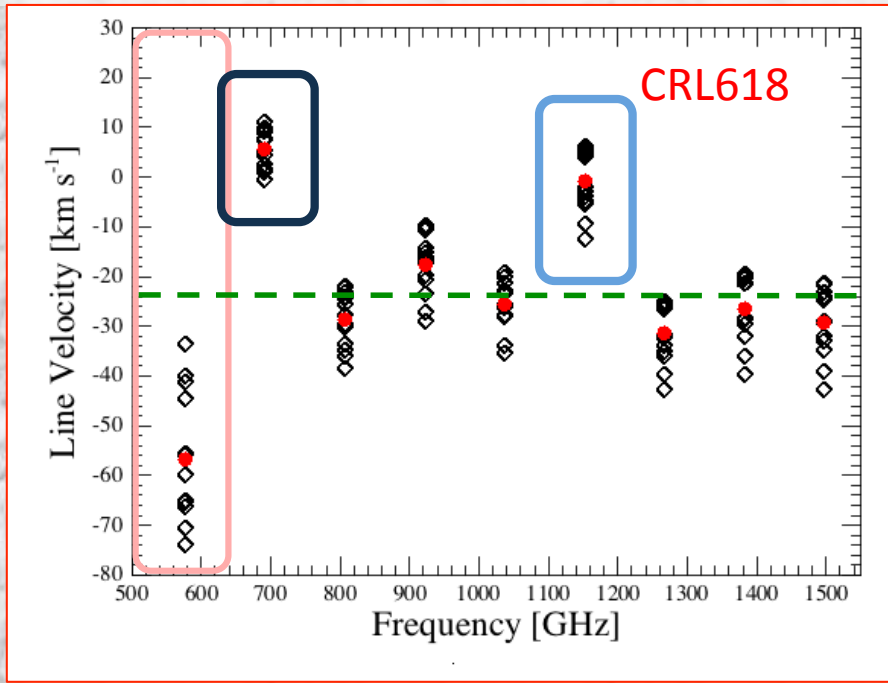
# REPEATABILITY: LINE FLUX



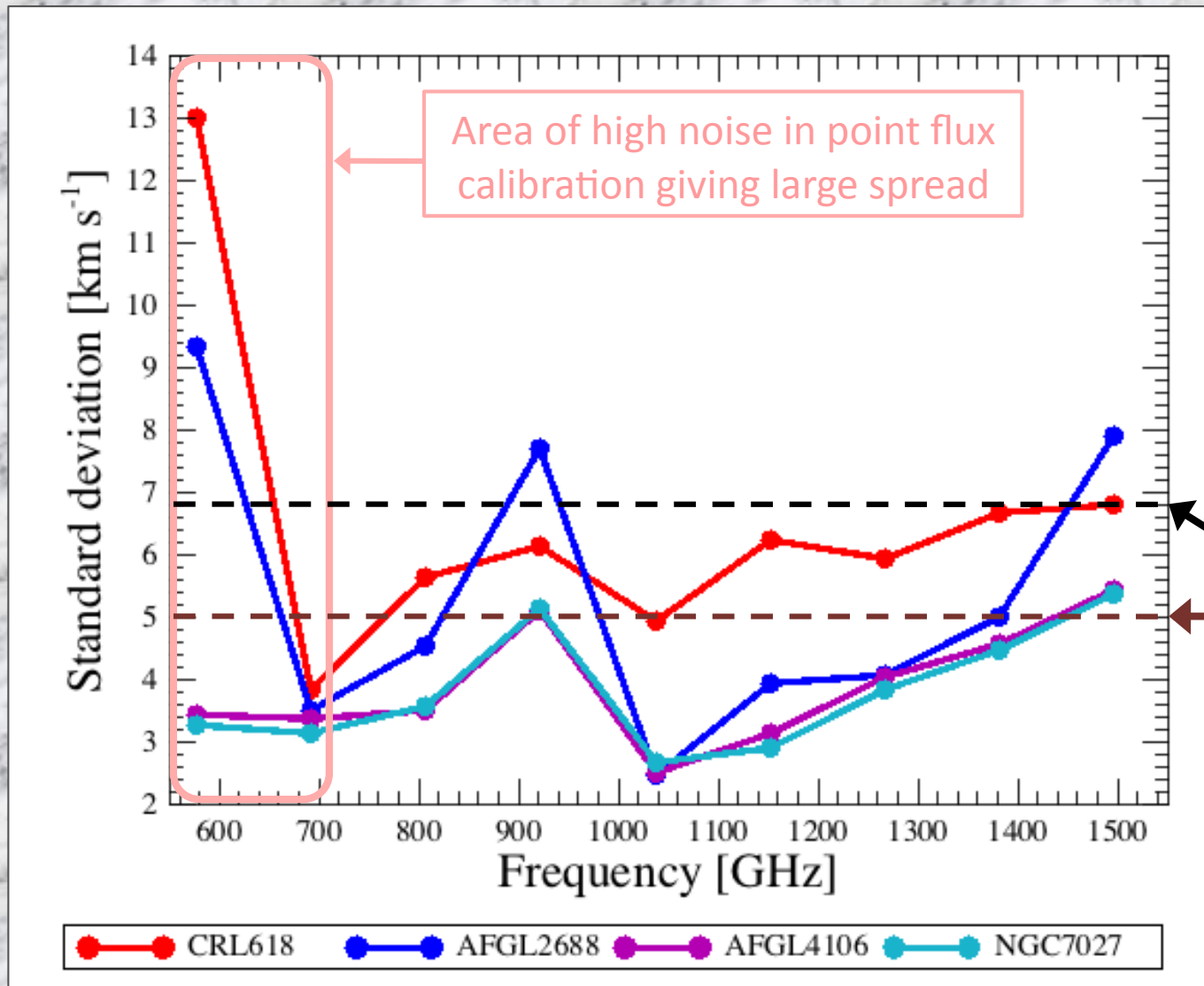
## RELATIVE SPREAD OF LINE FLUX



# LINE VELOCITY



## STANDARD DEVIATION

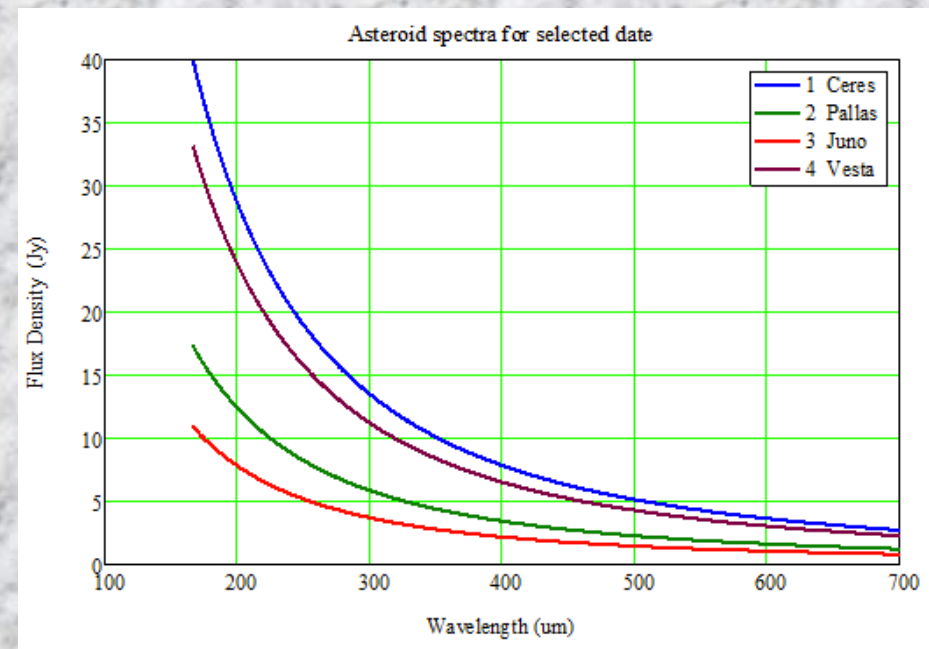
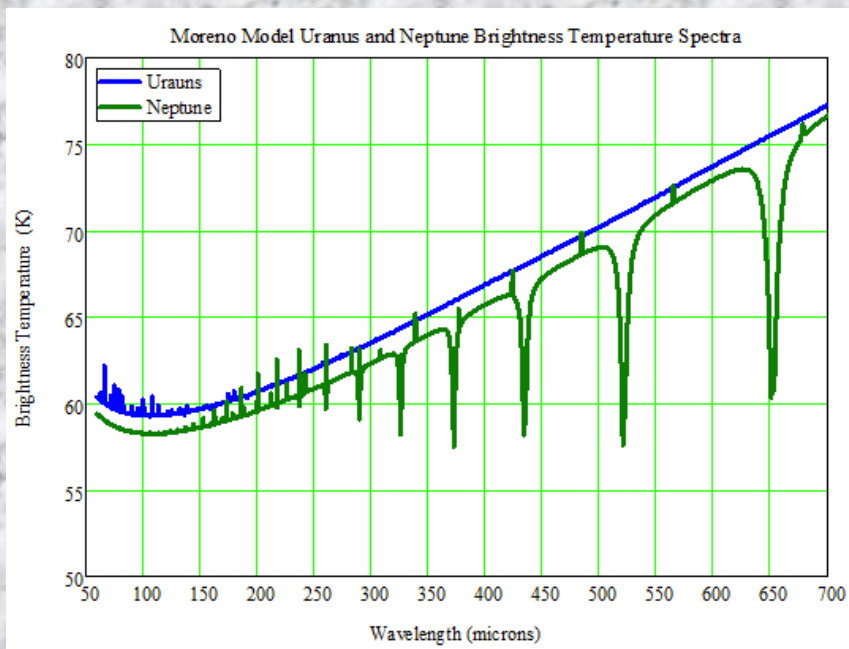


# PLANETS AND ASTEROIDS



MODELS ARE AVAILABLE FOR EACH OF THE FOLLOWING SOURCES:

- Uranus (7)      Neptune (10)
  - Ceres (5)      Pallas(2)      Vesta (7)
- (number of observations after OD189 included)



URANUS AND NEPTUNE  
MODELS (MORENO 2010, ESA2)

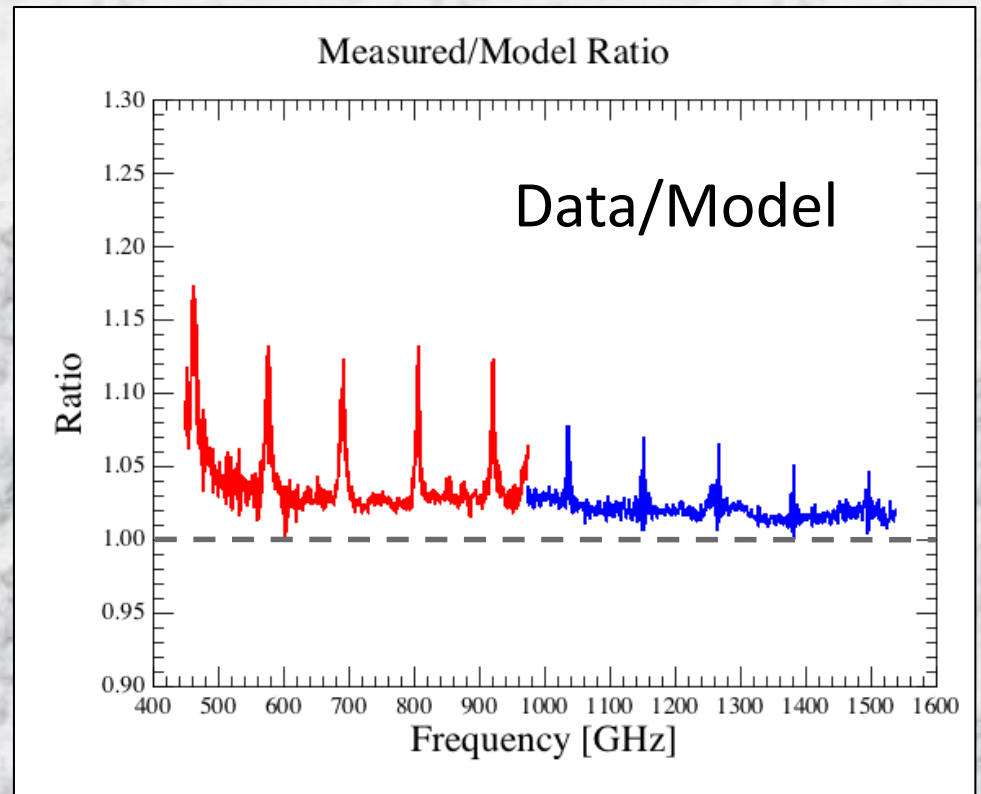
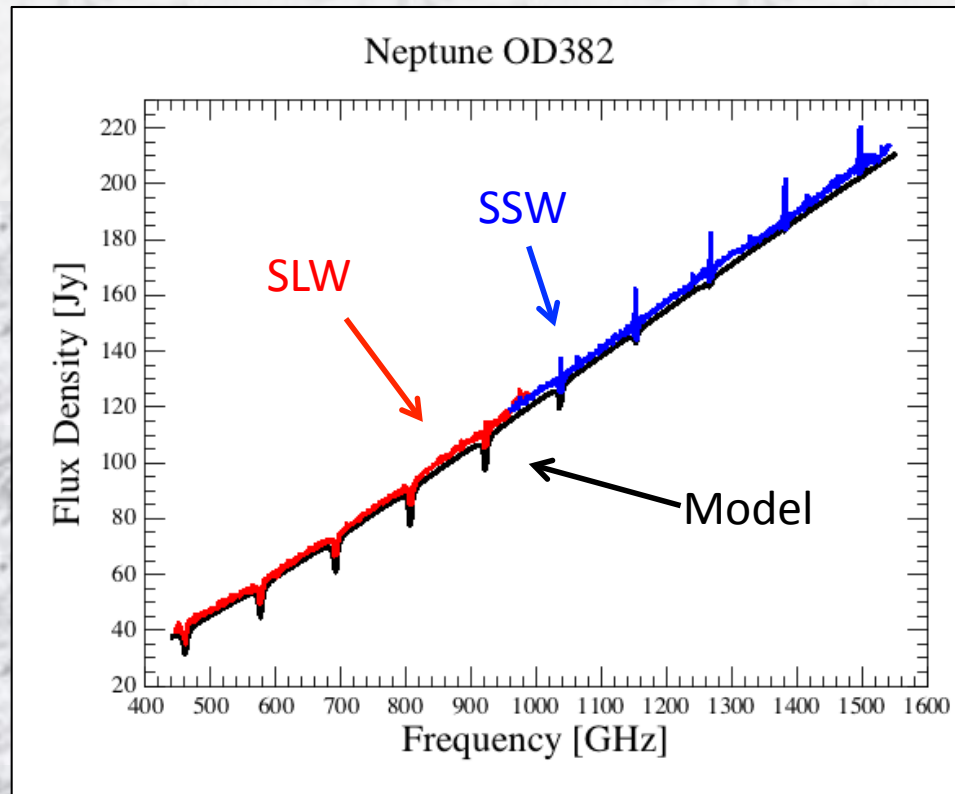
E.G. ASTEROID MODELS  
FOR DATA TAKEN 9<sup>TH</sup> DEC  
2009 (THOMAS MULLER)



# PLANETS AND ASTEROIDS



## COMPARISON WITH MODELS



## COMPARISON WITH MODELS

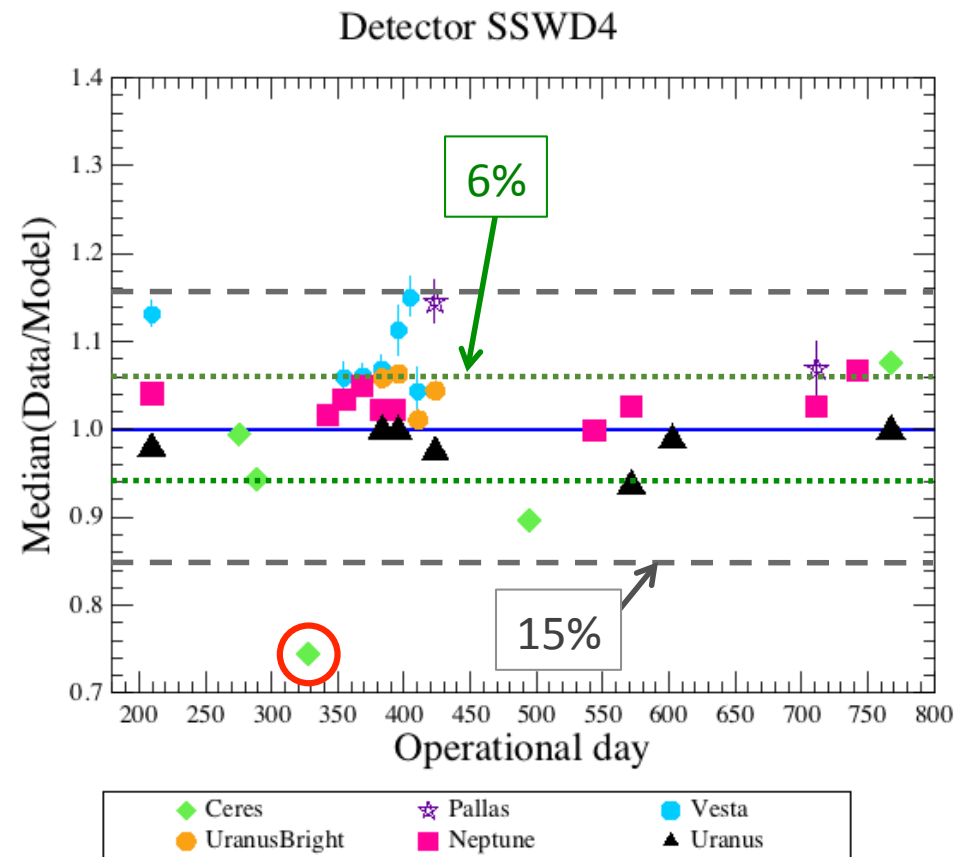
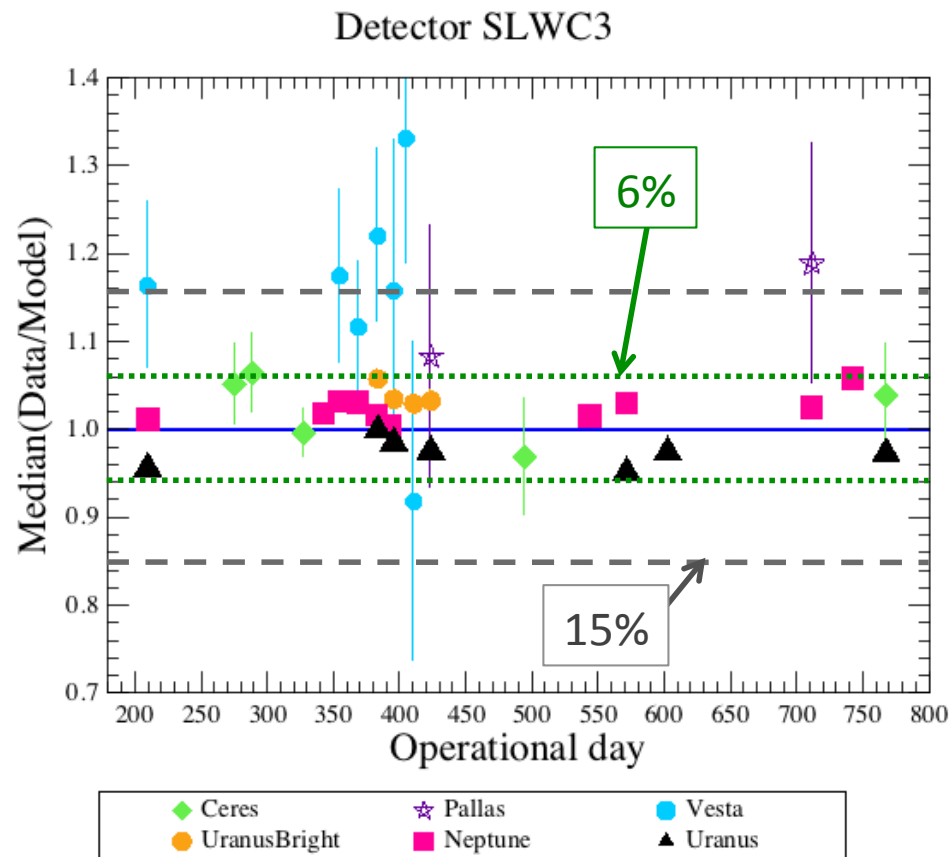
- Compute the **ratio** of the **measured spectra** and **models**
- Compare the **median** of the measured/model ratio for each band
- **Standard deviation** of 'difference ratio' is assigned as the error

# PLANETS AND ASTEROIDS



## COMPARISON WITH MODELS

- COMPARISON OF THE DATA/MODEL RATIOS FOR ALL SOURCES
- PLANETS GIVE BETTER RESULTS THAN ASTEROIDS
- WITHIN ~ 6% FOR PLANETS AND ~ 15% FOR ASTEROIDS

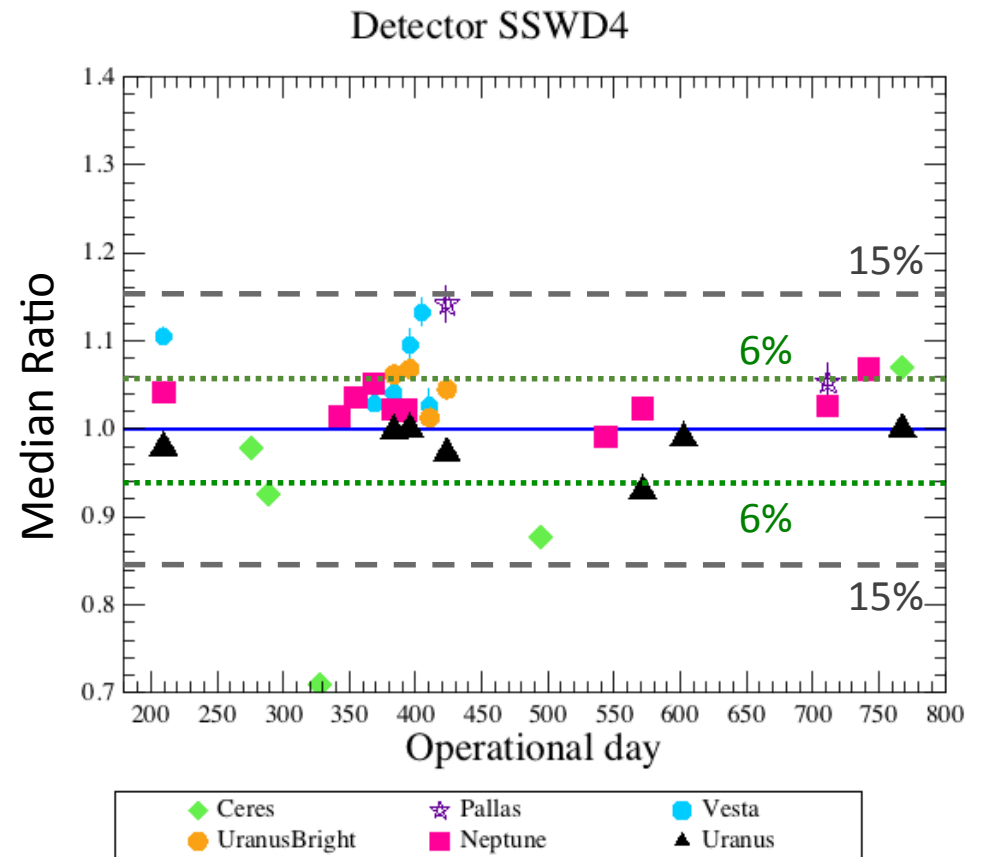


# PLANETS AND ASTEROIDS



## COMPARISON WITH MODELS

- Repeat of previous plot over the **PACS/SPIRE overlap region** 1430-1550 GHz
- **STILL** within  $\sim 6\%$  for planets and  $\sim 15\%$  for asteroids



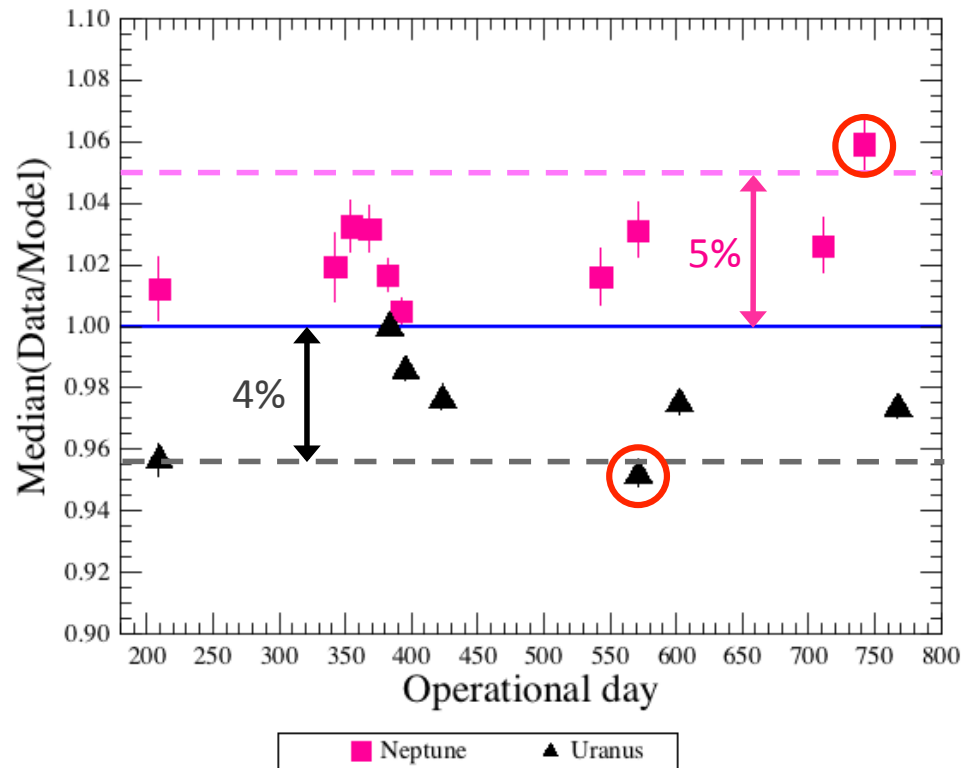
# PLANETS AND ASTEROIDS



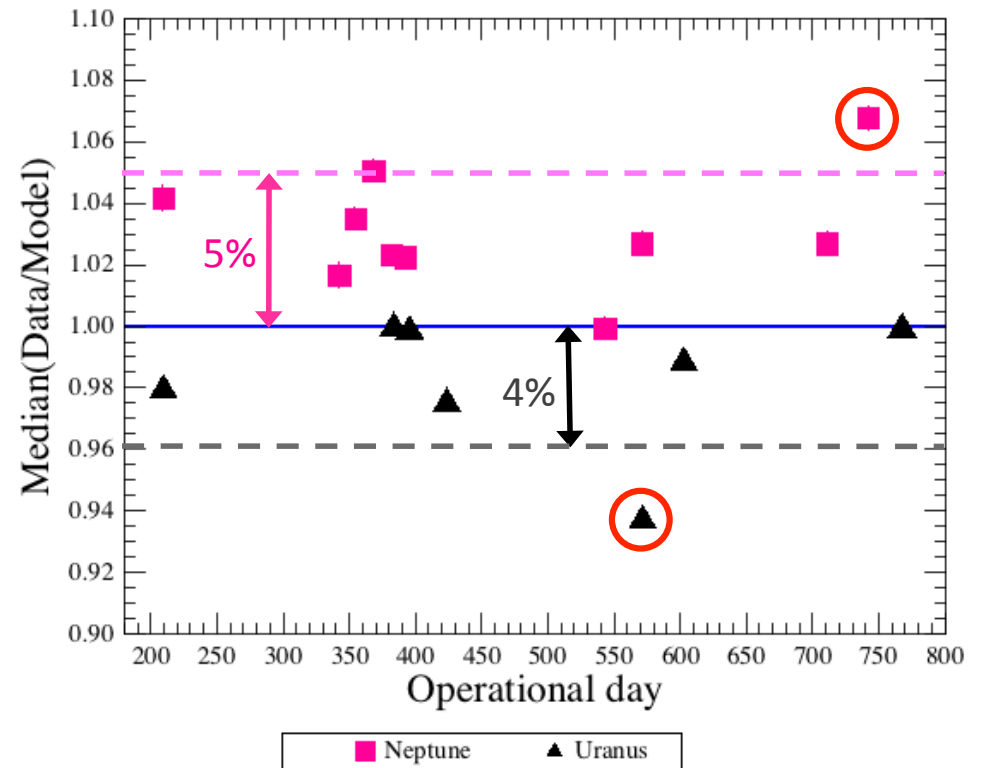
## COMPARISON WITH MODELS

- Neptune ratios > 1
- Uranus ratios < 1
- Overall the ratios lie within a 4-5% range

Detector SLWC3



Detector SSWD4





- CALIBRATION ACCURACY:
  - **4-6%** compared to **planet** models
  - higher for **asteroid**/model comparison
- REPEATABILITY
  - **1.5-4%** for **line flux**
  - **5-7 km s<sup>-1</sup>** for **line velocity**