

# Towards a Comprehensive Sensitivity Calibration for the STIS Echelle Modes

**Alessandra Aloisi**  
(ESA/STScI)

- Description of the issues involved
- Data analysis and results
- Pipeline tools implemented for corrections
- What still remains to be done

# Outstanding Issues

- Updated Absolute Flux Calibration for Primary Settings
- Time Dependent Sensitivity
  - ▶ Counts vs.  $t$
- Blaze Function Characterization
  - ▶ Shifts vs. location  $(x,y)$  &  $t$
  - ▶ Shape vs. location  $(x,y)$  &  $t$
- Flux Calibration for Secondary Settings

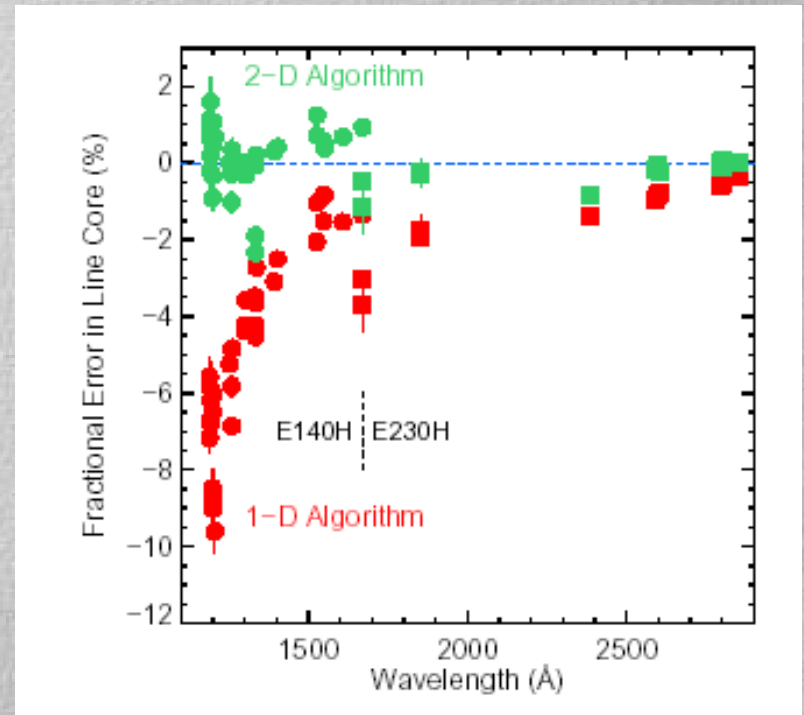
# Updated Absolute Flux Calibration for Primary Settings

- 2D algorithm for **Scattered Light** implemented into the pipeline

**Lindler & Bowers (2002)**

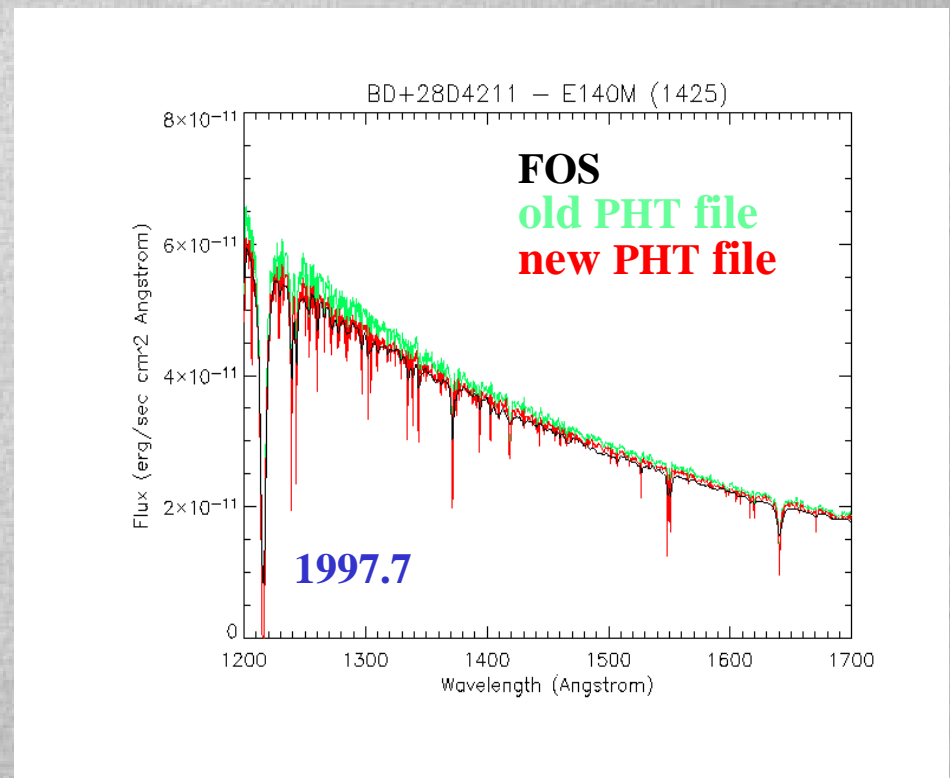
- ▶ CALSTIS 2.9 (Dec. 2000)
- ▶ F uncertainty  $< 2\%$  (absorption lines)

**ISR STIS 02-01**



# Updated Absolute Flux Calibration for Primary Settings

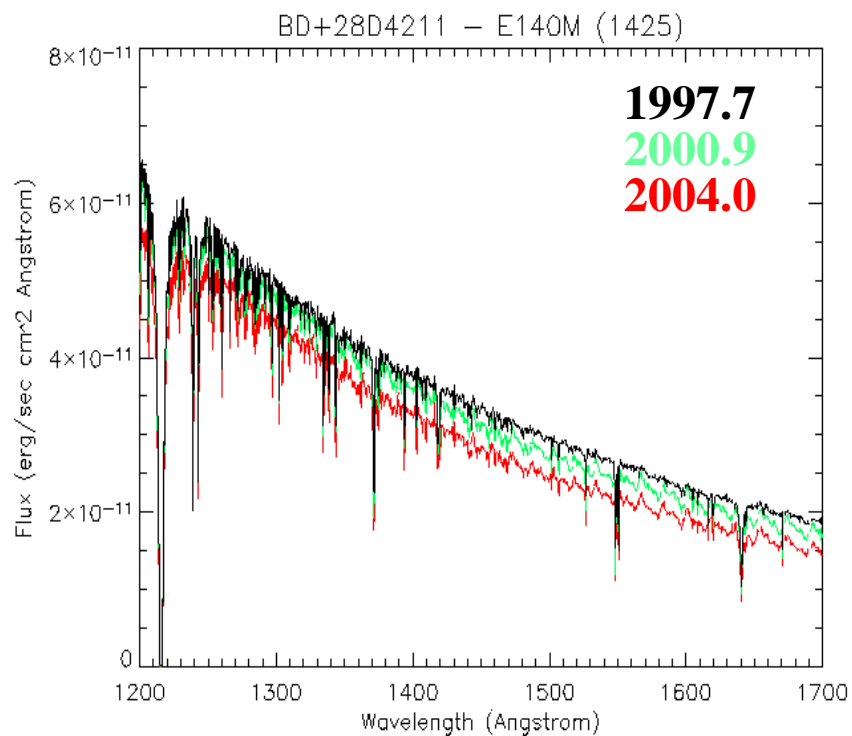
- Re-determination of Echelle flux calibration for self-consistency
  - ▶ no changes for SL
  - ▶ 2-7 % due to other
- New PHT files delivered to the pipeline
  - ▶ Apr. 2005
  - ▶ BZS & TDS backed out
  - ▶ F uncertainty < few%



# Time Dependent Sensitivity (TDS)

- Sensitivity of MAMAs decreases with time (contaminants)

▶ F errors < 15%



# Time Dependent Sensitivity (TDS)

- Analysis of Spectra with same MO & different t

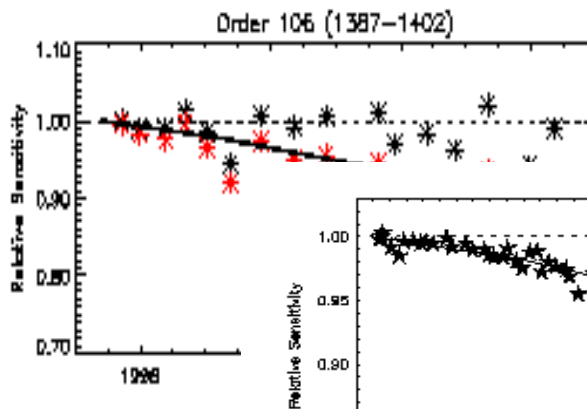
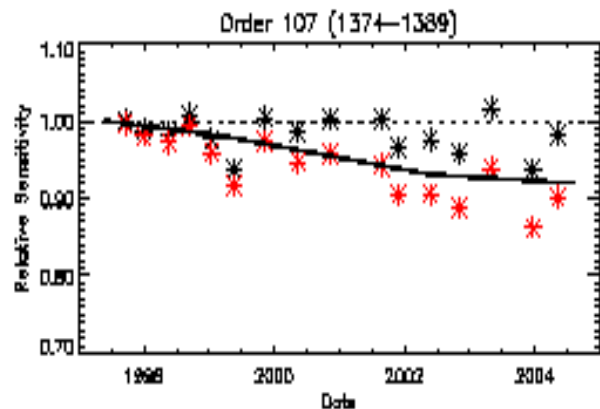
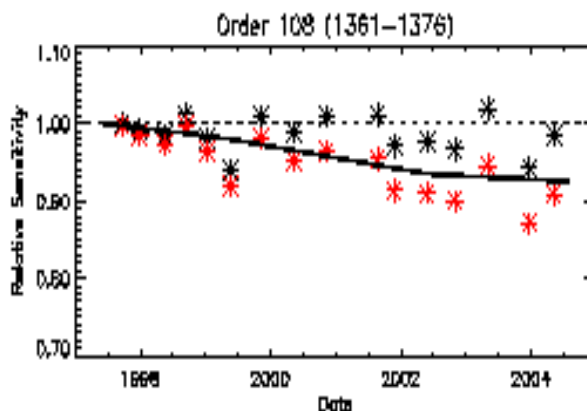
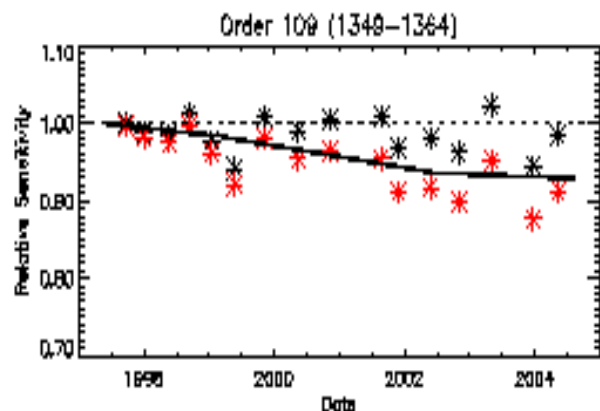
★ = **BD+28D4211**    **MO = (0,0)**    **t = 1997.7–2004**

**Primary Settings**    **E140H (1416)**    **E140M (1425)**  
                                 **E230H (2263)**    **E230M (1978, 2707)**

- ▶ **Results**

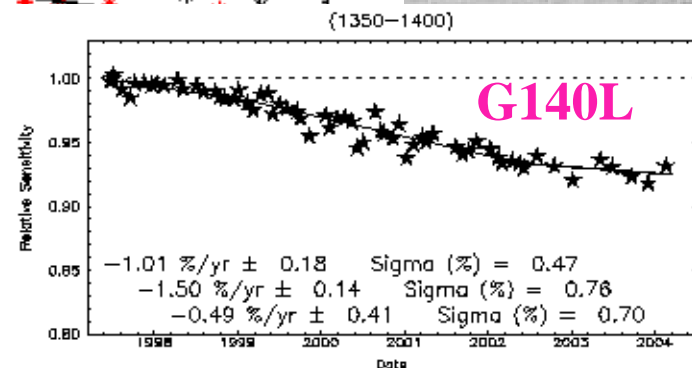
- \* **Similar trend as first order modes**

# Time Dependent Sensitivity (TDS)



different t  
2004  
(2707)

E140M (1425)



# Time Dependent Sensitivity (TDS)

- Analysis of Spectra with same MO & different t

★ = **BD+28D4211** MO = **(0,0)** t = **1997.7–2004**

<b>Primary Settings</b>	<b>E140H (1416)</b>	<b>E140M (1425)</b>
	<b>E230H (2263)</b>	<b>E230M (1978, 2707)</b>

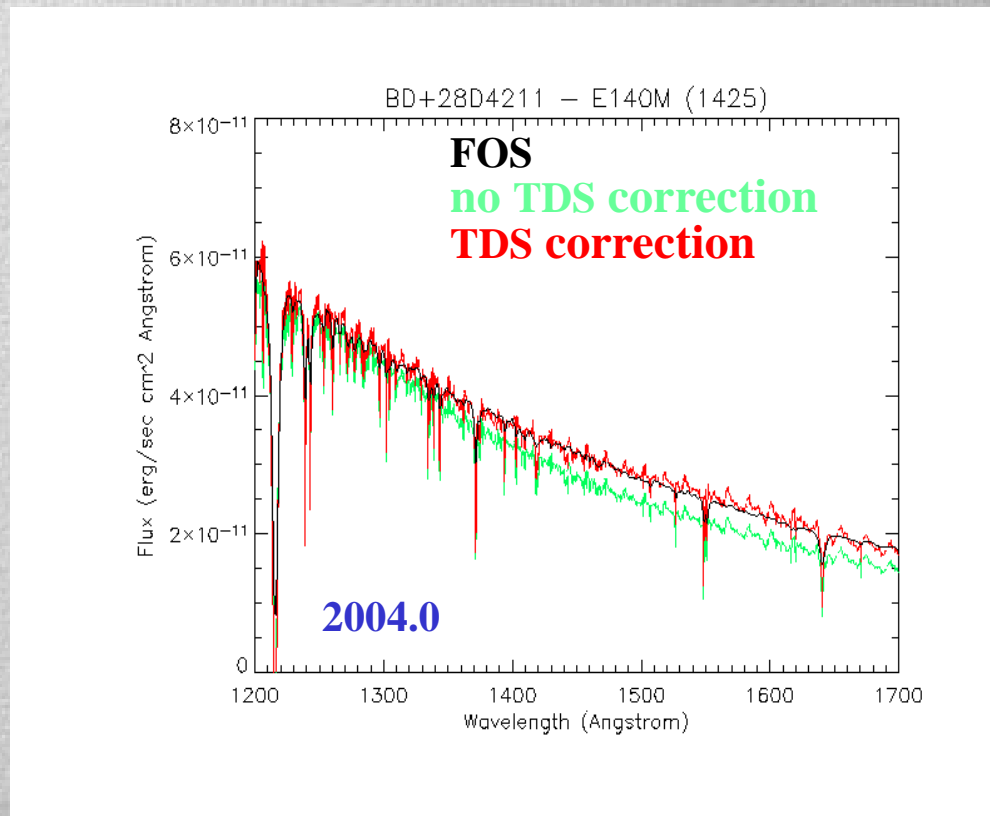
## ▶ Results

- \* Similar trend as first order modes
- \* Some scatter due to:
  - temperature ?
  - miscentering in small aperture ?
  - BF with t ?



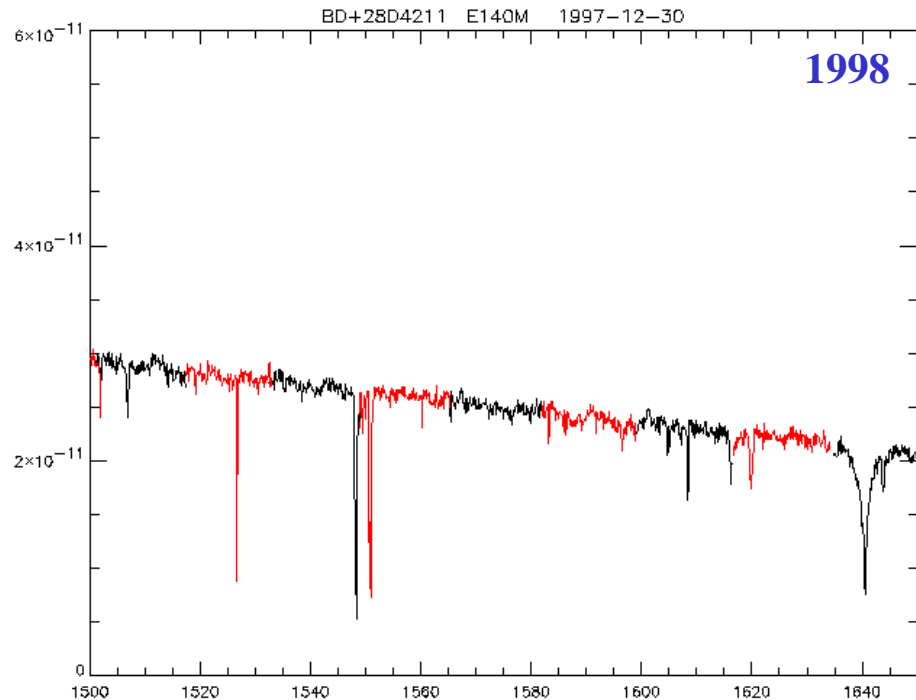
# Time Dependent Sensitivity (TDS)

- TDS correction from first-order modes
- New TDS files delivered to the pipeline
  - ▶ Apr. 2005
  - ▶ F uncertainty < few %



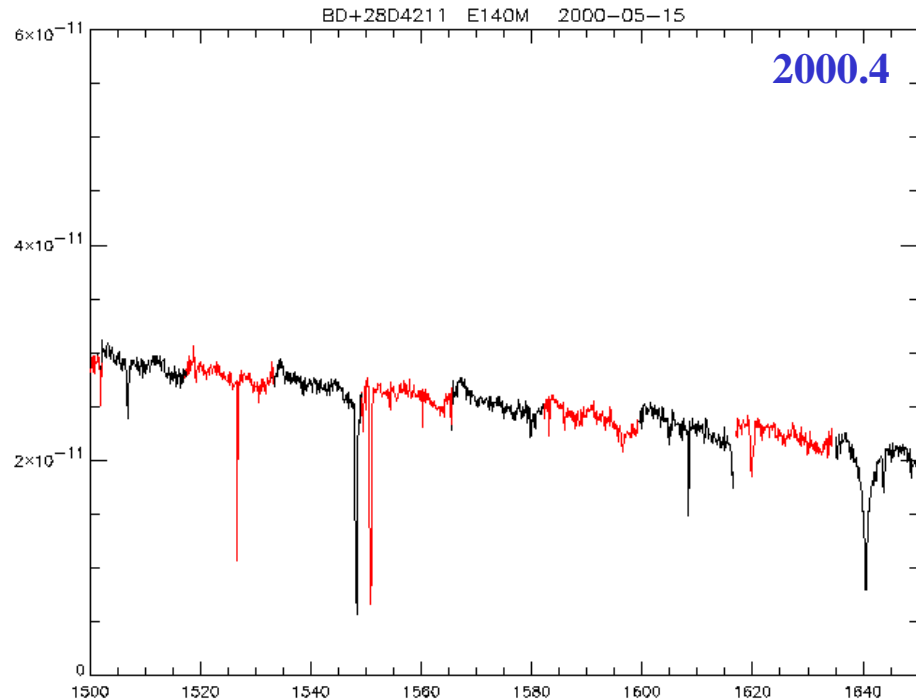
# Blaze Function (BF)

- BF leads to ripples in calibrated spectra
  - ▶ saw-tooth F calibration errors < 20%



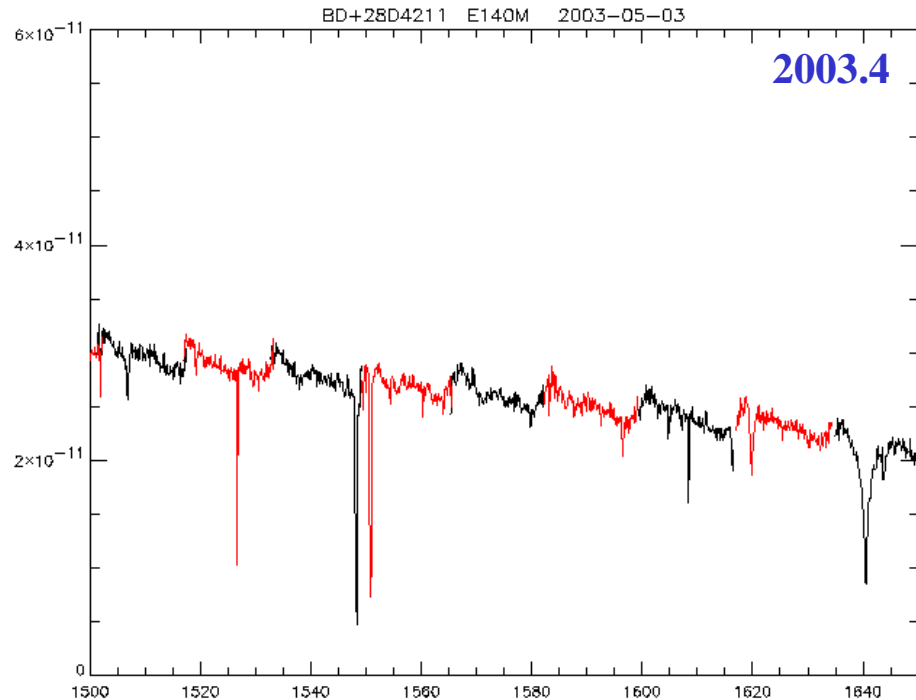
# Blaze Function (BF)

- BF leads to ripples in calibrated spectra
  - ▶ saw-tooth F calibration errors < 20%



# Blaze Function (BF)

- BF leads to ripples in calibrated spectra
  - ▶ saw-tooth F calibration errors < 20%



# BF Variations

- Changes with **time** (contaminants & optics) & **location** on the detector (MOs)
  - ▶ What type of changes ?
    - \* BF Shift
    - \* BF Shape
  - ▶ What causes the changes ?
    - \* Effects due to location (x,y)
    - \* Effects due to time (t)

# BF Shift

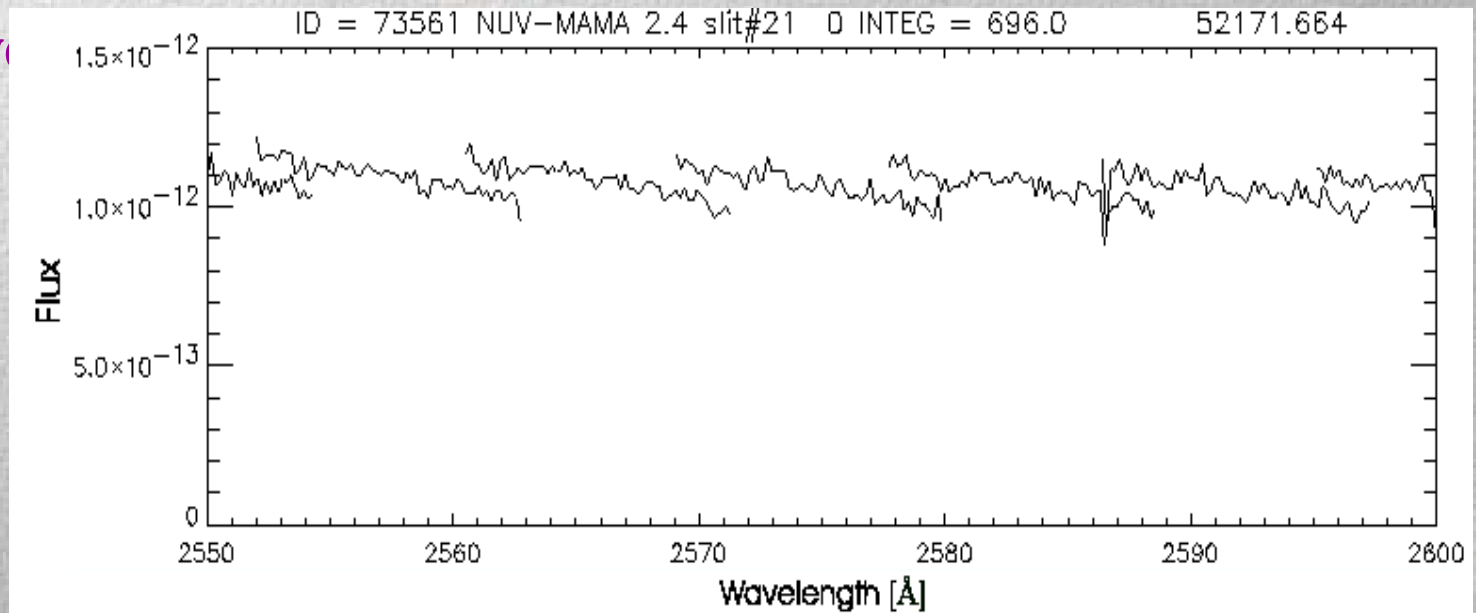
- MO produces BF shift
- Algorithm already implemented into pipeline

**Bowers & Lindler (2002)**

# BF Shift

- MO produces BF shift
- Algorithm already implemented into pipeline

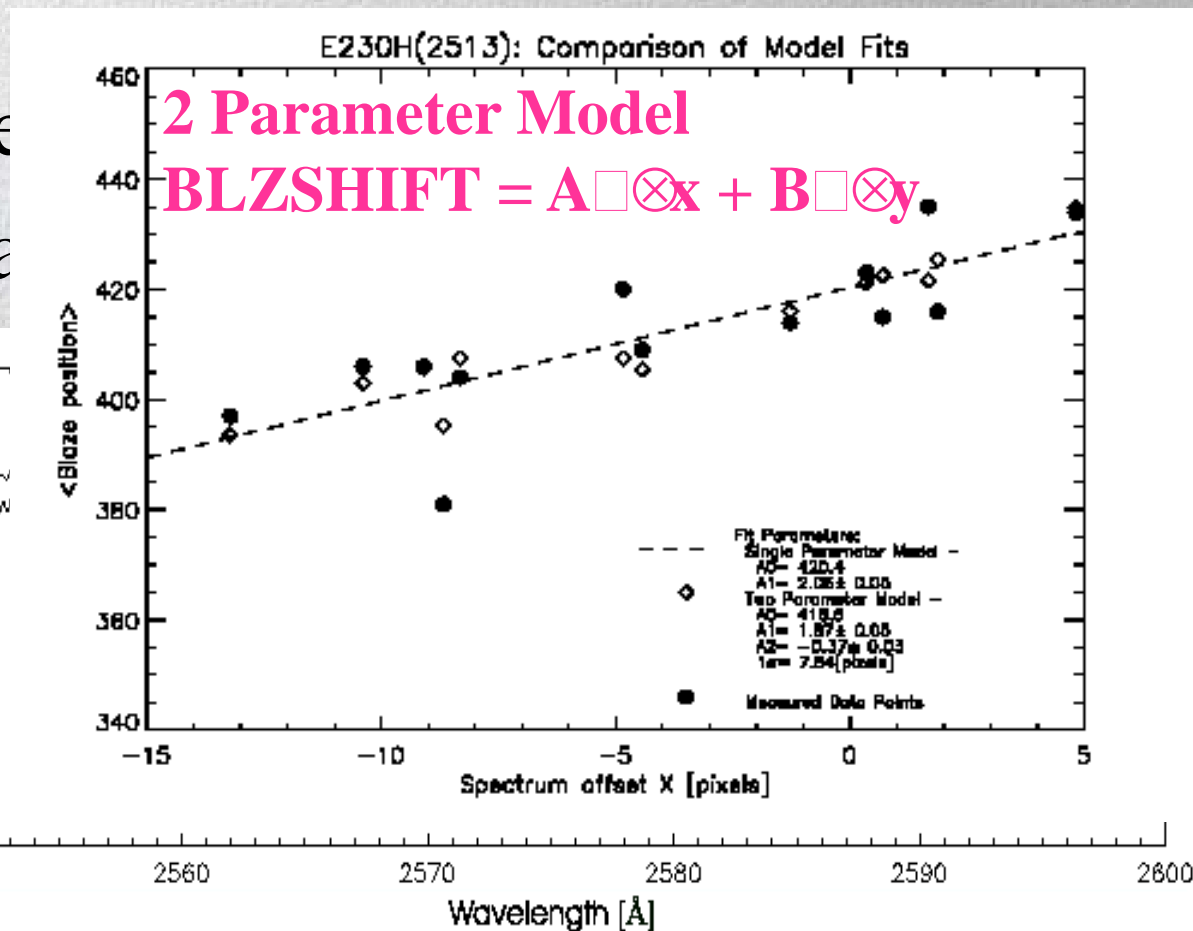
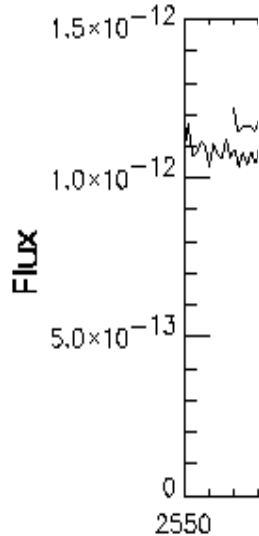
Bow



# BF Shift

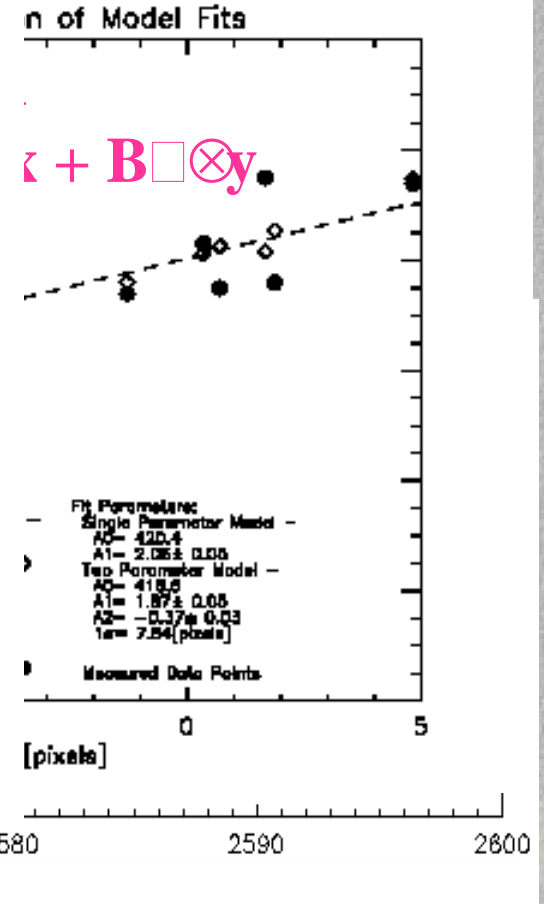
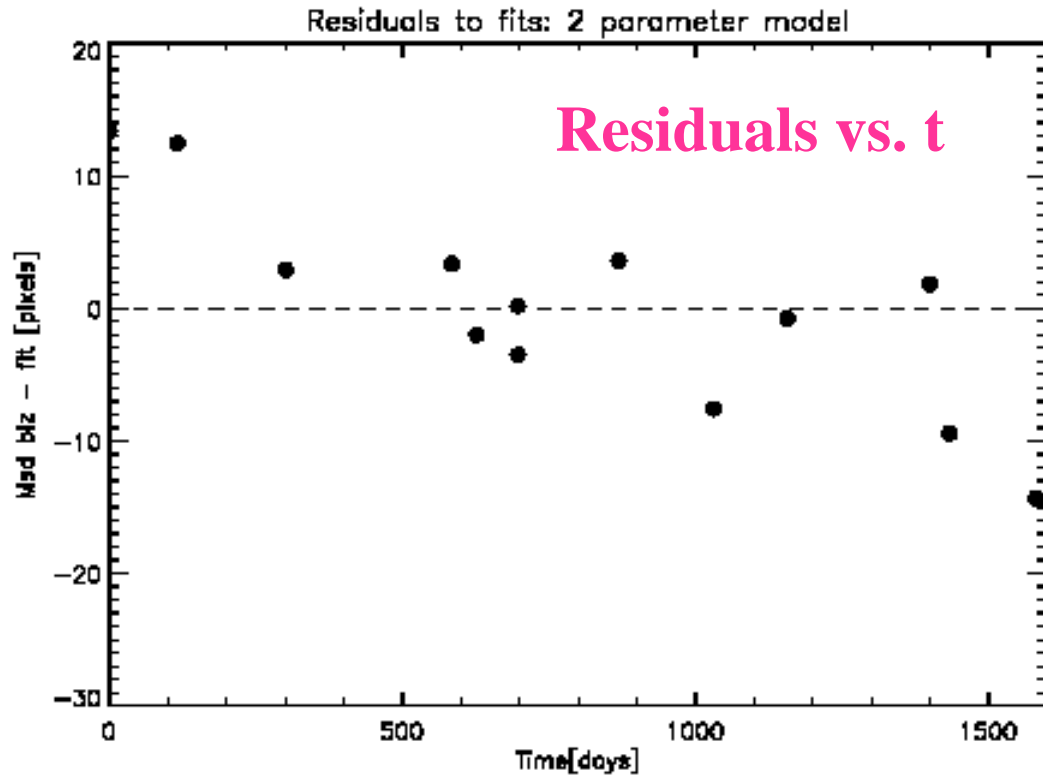
- MO produced
- Algorithm a

Bow

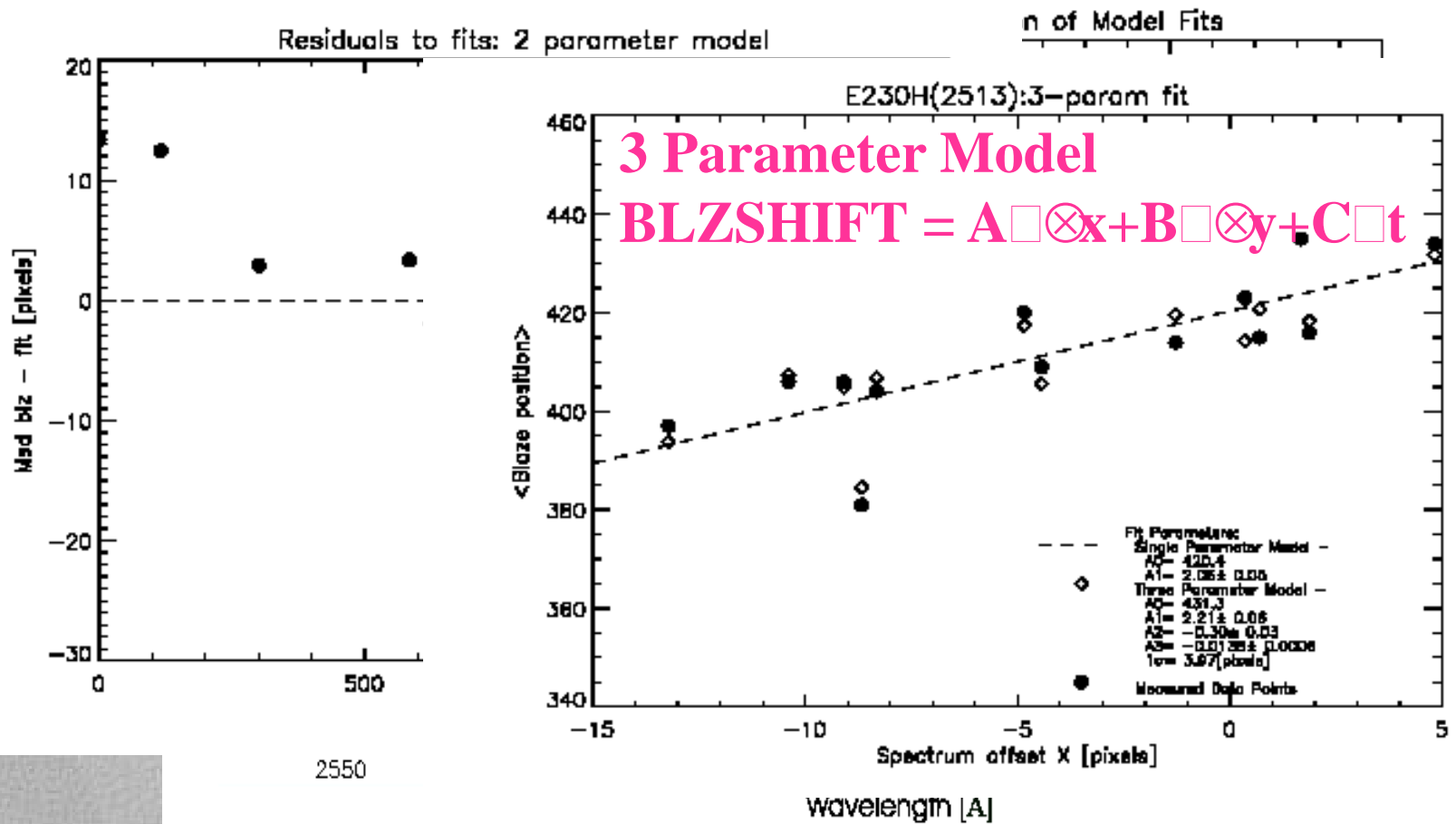




# BF Shift



# BF Shift



# BF Shift

- MO produces BF shift
- Algorithm already implemented into pipeline

## Bowers & Lindler (2002)

- ▶ CALSTIS 2.13b (Sep. 2002)
- ▶  $BLZSHIFT = A \otimes x + B \otimes y + C \otimes t$   
 $\otimes x$  &  $\otimes y$  from wavecals  
A, B, & C from fit of data (1997-2001)
- MO switched off in Aug 2002

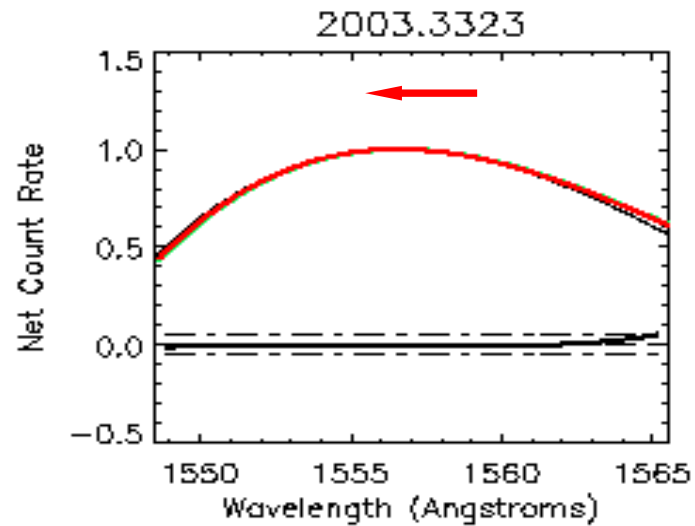
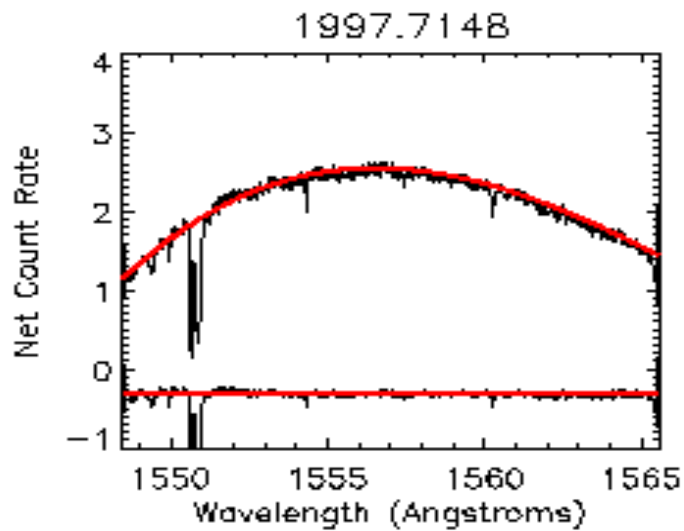
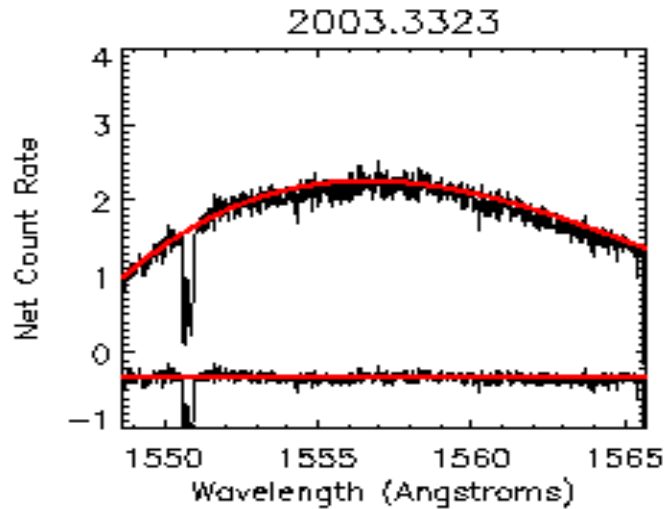
# BF with Time

- Analysis of Spectra with same MO & different t  
**Same datasets used for TDS**

# BF with Time

with same MO & different t

FDS



E140M (1425) – order 95

# BF with Time

- Analysis of Spectra with same MO & different t

**Same datasets used for TDS**

- ▶ **Results**

- \* **No change in BF shape with time**
- \* **BF shift linear (?) with order**

# BF with Time

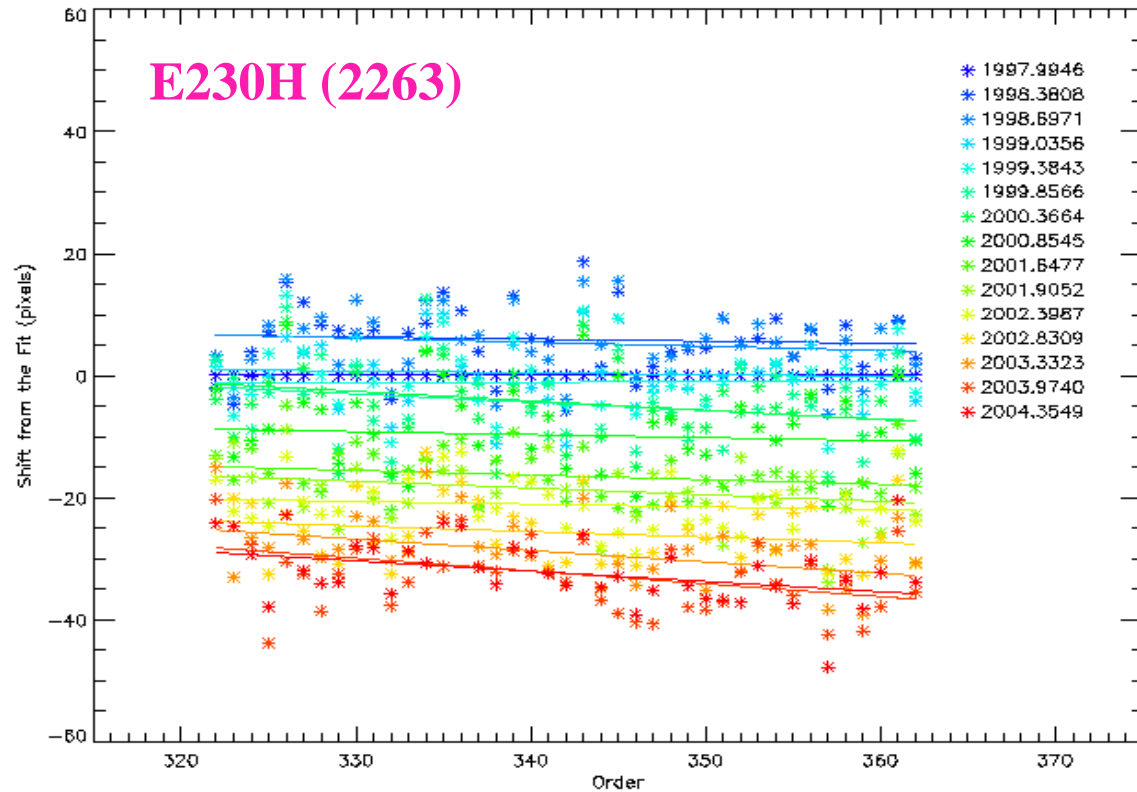
- Analy

San

▶ R

\*

\*



# BF with Time

- Analysis of Spectra with same MO & different t

## Same datasets used for TDS

### ▶ Results

- \* No change in BF shape with time
- \* BF shift linear (?) with order
- \* Slope and normalization linear with t for **E140H**, **E140M** & **E230H** but large differences at latest t  
→ average BF shift not correct



# BF with Time

- Analy

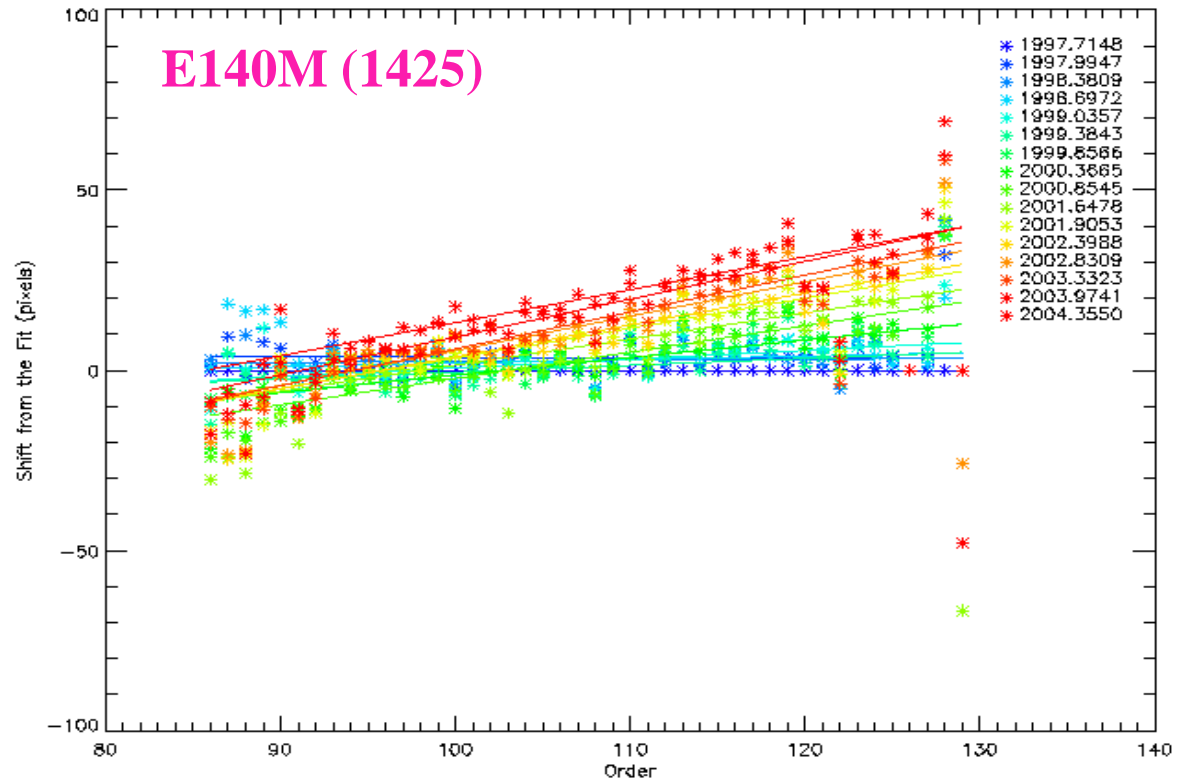
San

▶ R

\*

\*

\*



# BF with Time

- Analysis of Spectra with same MO & different t

## Same datasets used for TDS

### ► Results

- \* No change in BF shape with time
- \* BF shift linear (?) with order
- \* Slope and normalization linear with t for **E140H**, **E140M** & **E230H** but large differences at latest t
  - average BF shift not correct
- \* Normalization non monotonic with t for **E230M**
  - linear extrapolation of pipeline wrong

# BF with Time

- Analy

San

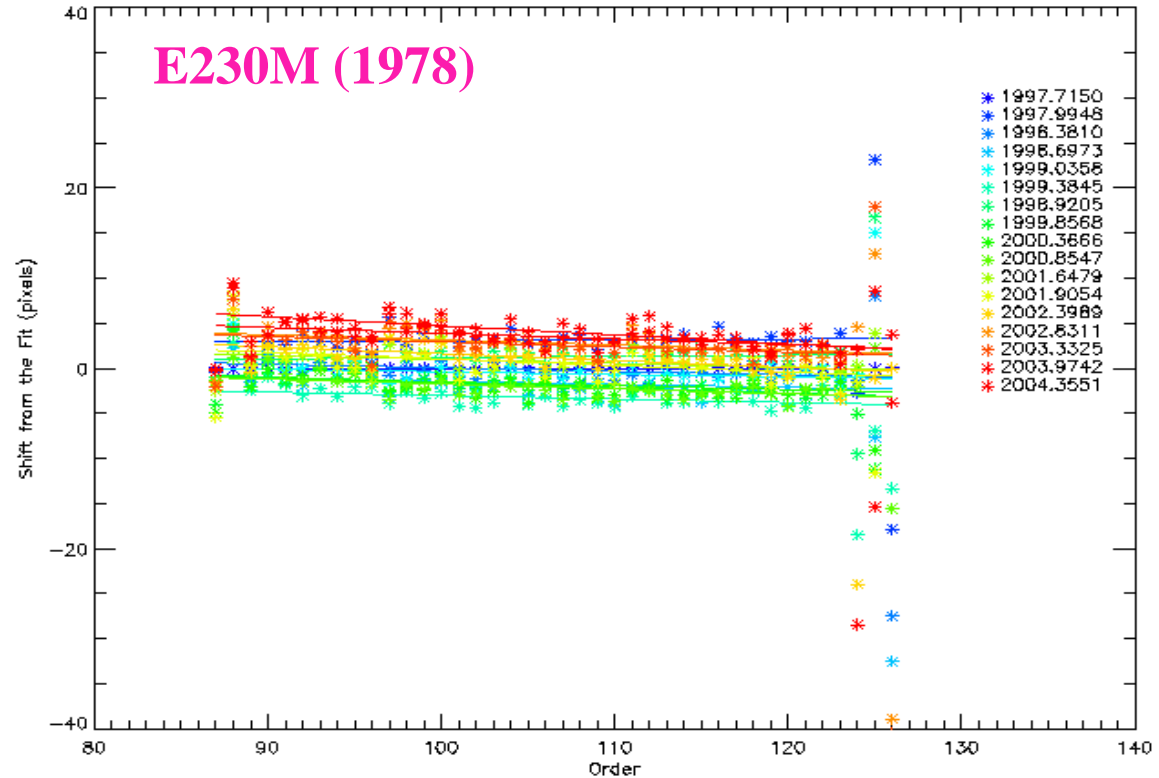
► R

\*

\*

\*

\*



# BF with Time

- Analysis of Spectra with same MO & different t

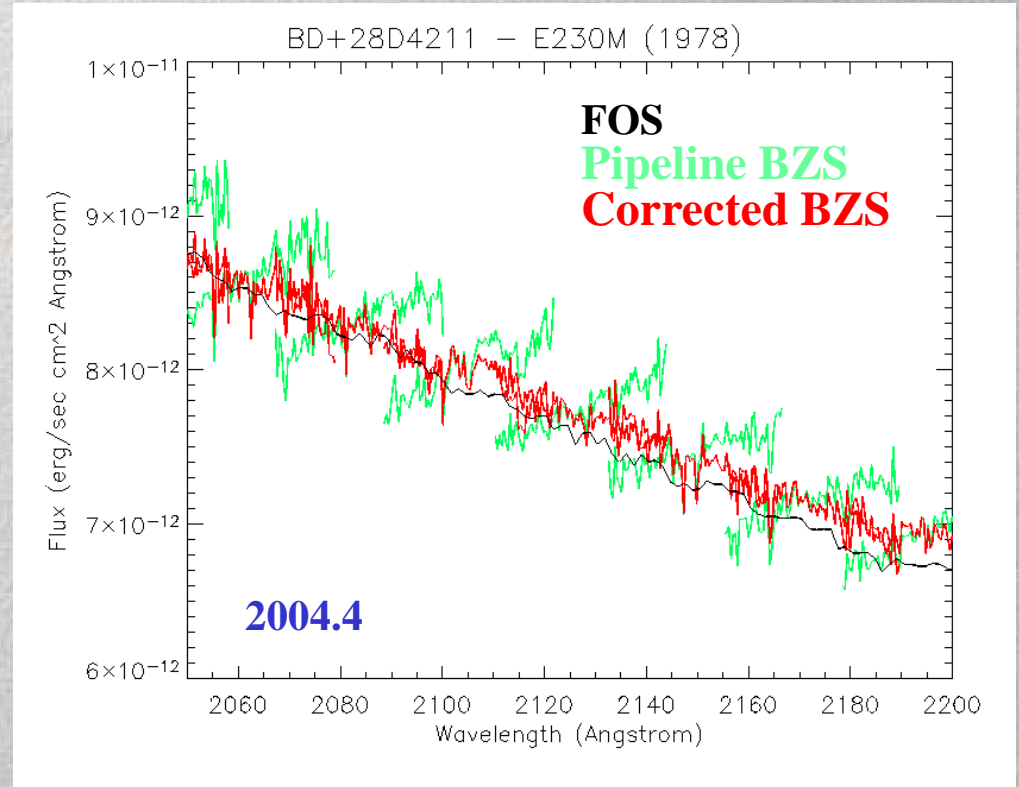
## Same datasets used for TDS

### ► Results

- \* No change in BF shape with time
- \* BF shift linear (?) with order
- \* Slope and normalization linear with t for **E140H**, **E140M** & **E230H** but large differences at latest t
  - average BF shift not correct
- \* Normalization non monotonic with t for **E230M**
  - linear extrapolation of pipeline wrong
- \* Same behavior of **E230M (1978)** & **E230M(2707)**
  - change in grating

# BF with Time

- Implementation of t-dependent BFS with order
- New PHT files will be delivered to the pipeline
  - ▶ F uncertainty < few %



# BF with Location

- Analysis of Spectra with different MO & same t

★ = BD+28D4211      5 MOs      t = Jul 2002

Primary Setting    E230H (2513)

## ▶ Results

- \* No change in BF shape with location
- \* Average BF shift similar to BLZSHIFT once MO = (0,0) taken as reference
- \* No strong dependence with the order

# BF with Location

- Analysis

★ = BL

Primary

► Res

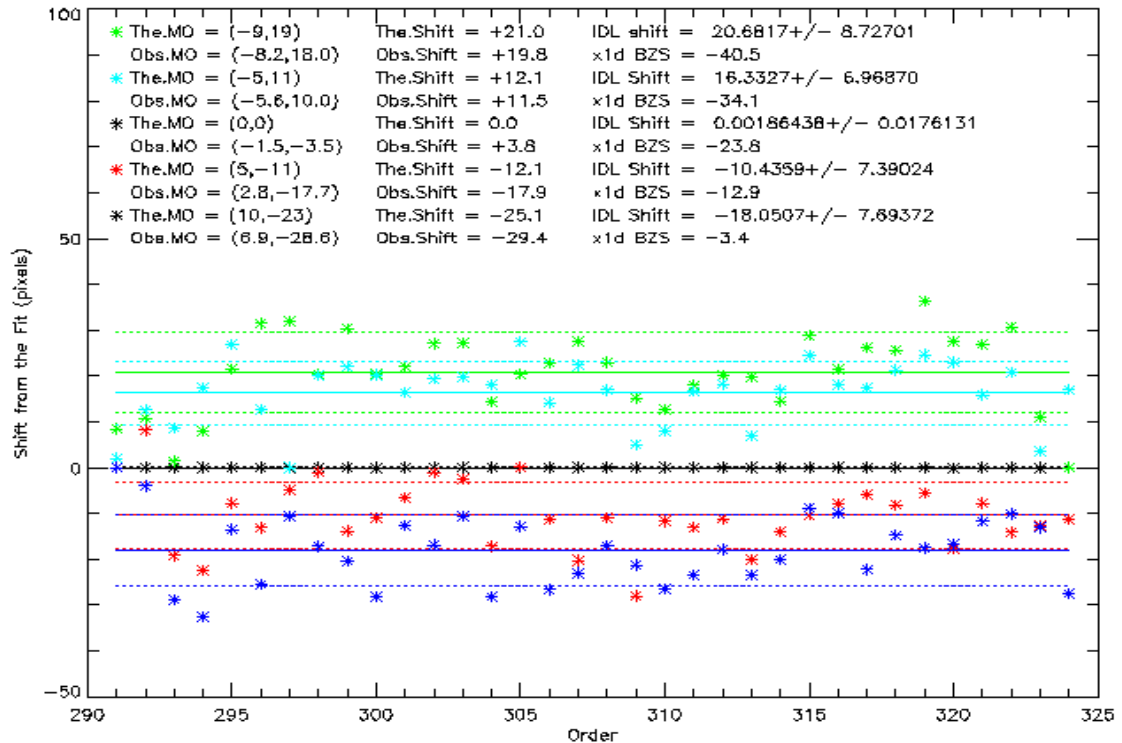
\* N

\* A

0

\* N

## E230H (2513)



# Flux Calibration for Secondary Settings

- Secondary Settings almost used as often as Primary Settings
- Absolute flux calibration of Secondary Settings still based on pre-launch data
- TDS but not BF shift correction applied
- On-board data collected **G191B2B**  
**All Primary & Secondary Settings (Sep. 2001)**
- Analysis to be performed



# Summary

- Updated Absolute Flux Calibration for Primary Settings → PIPELINE
- Time Dependent Sensitivity → PIPELINE
- Blaze Function → IMPLEMENTATION
- Flux Calibration for Secondary Settings → DATA ANALYSIS