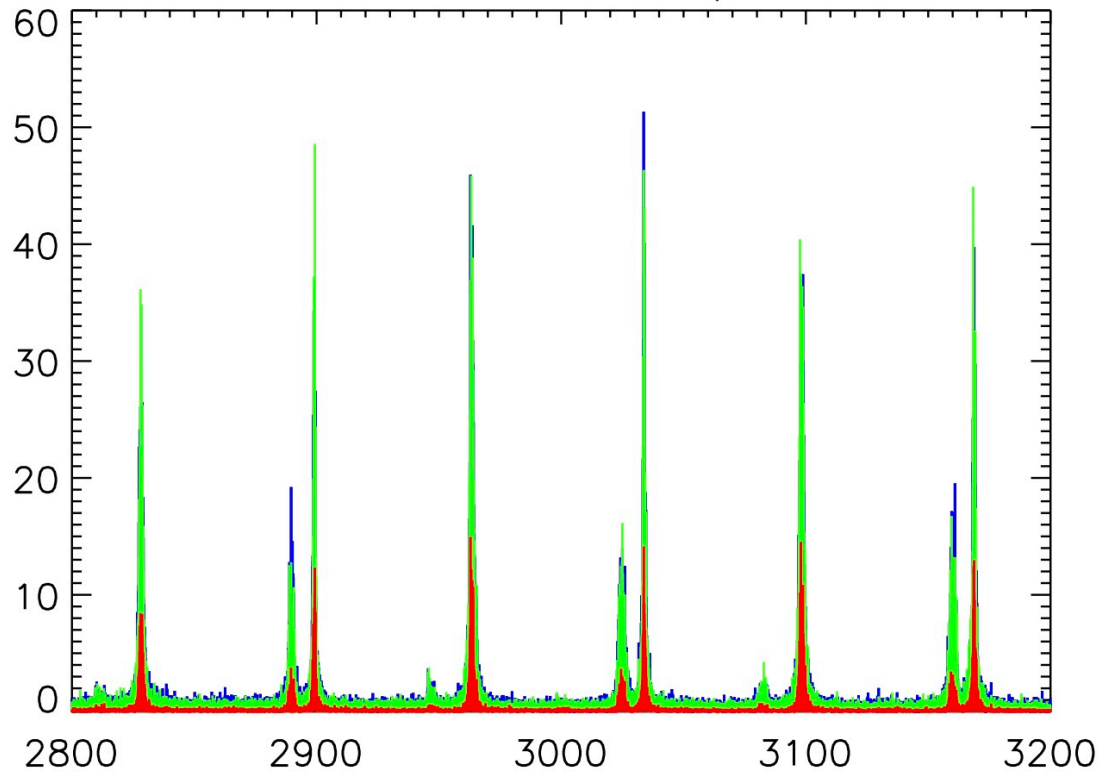


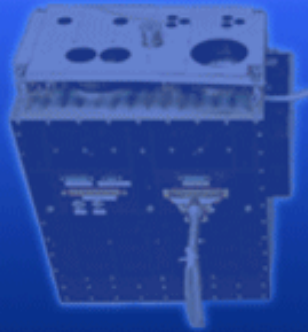
SOHO 29: 22 Years of GOLF and VIRGO: 2 Sunspot cycles seen by seismology

Antonio Jiménez. Nice, France 27-29 Nov 2018

22 Years of VIRGO/SPM

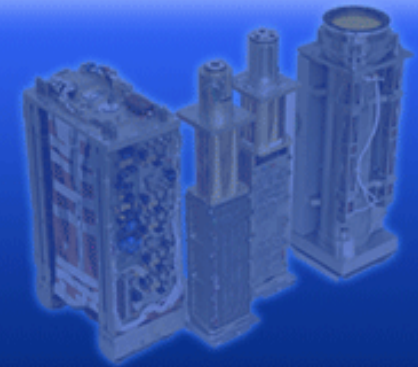


1. VIRGO(SOHO) SunPhotometer (SPM)
 - 1.1 Degradation
 - 1.2 Data Acquisition System (DAS) and spikes
 - 1.3 Attractors .
2. P-modes Analysis
3. High n p-modes and pseudo modes analysis.
4. Things to do ...(for which I had no time ..)



VIRGO

Variability of solar IRadiance and Gravity Oscillations
on the ESA/NASA SOLar and Heliospheric Observatory



- 2 Types of Radiometers: DIARAD and PMO
- 1 Luminosity Oscillation Imager (12 pixels)
- 3 channels SunPhotometer SPM:

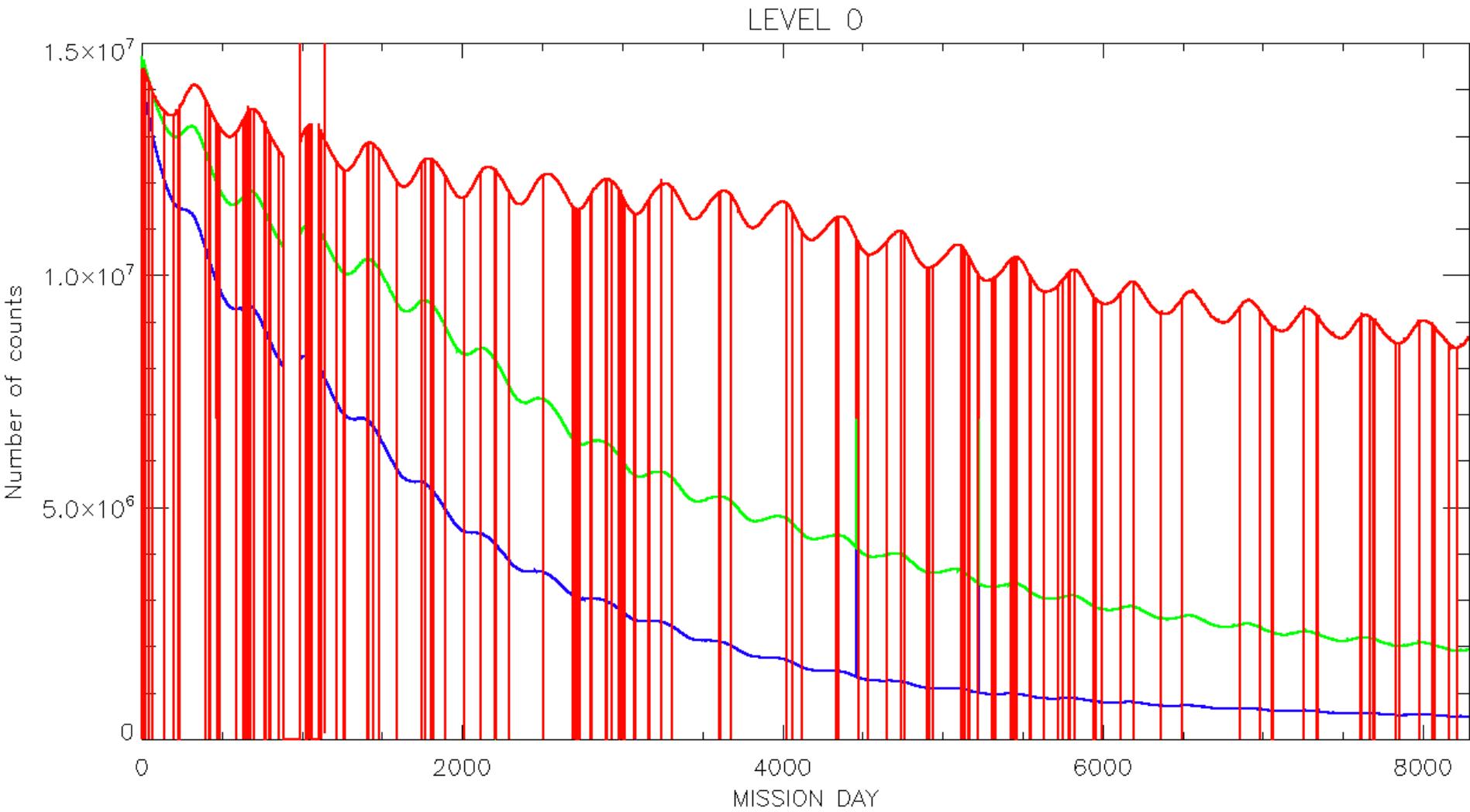
BLUE: 450nm , 5nm Bandwidth

GREEN: 500 nm , 5 nm Bandwidth

RED: 862 nm , 5 nm Bandwidth

1. VIRGO(SOHO) SunPhotometer (SPM)

1.1 Degradation



Degradation factor : B \approx 30, G \approx 7.5, RED \approx 1.8

1.2 Data Acquisition System (DAS) and spikes.

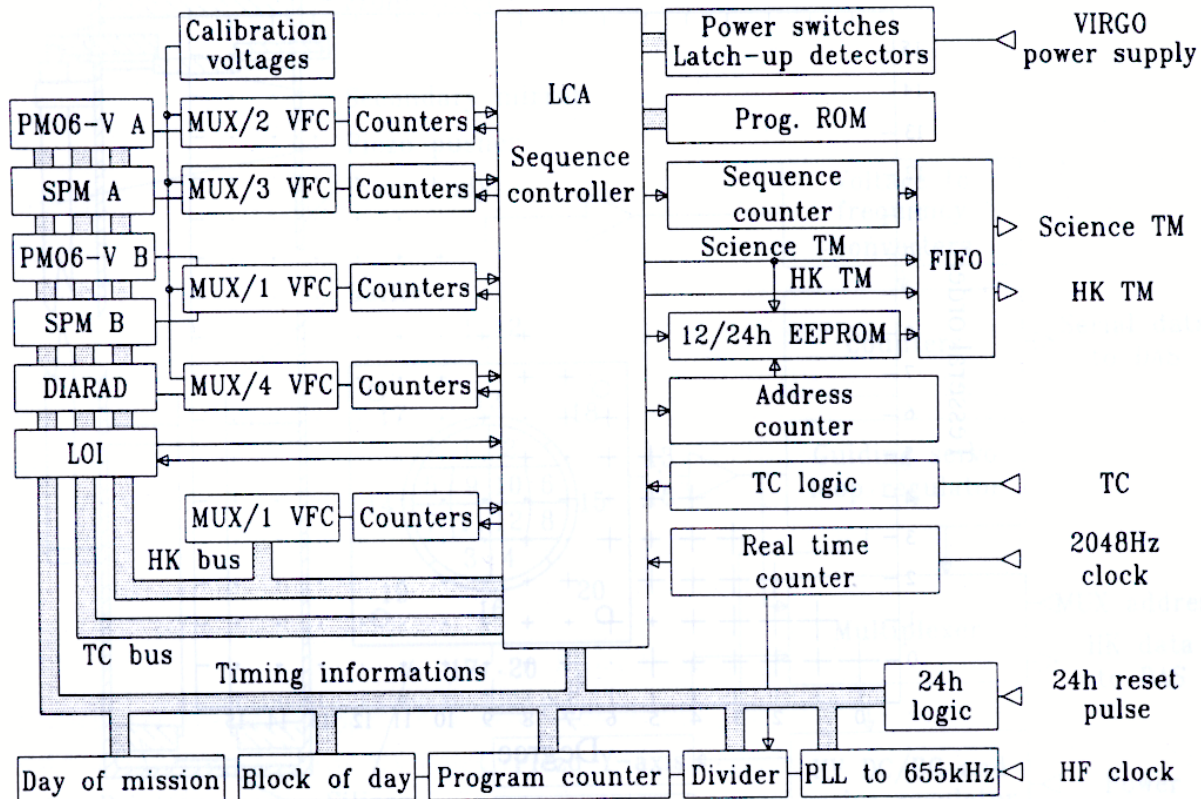


Fig. 9. Block diagram of the data acquisition and control system (DAS).

DAS cycle= 3m (1 integration per minute for SPM)
 VFC and or Counters blocked randomly for a while

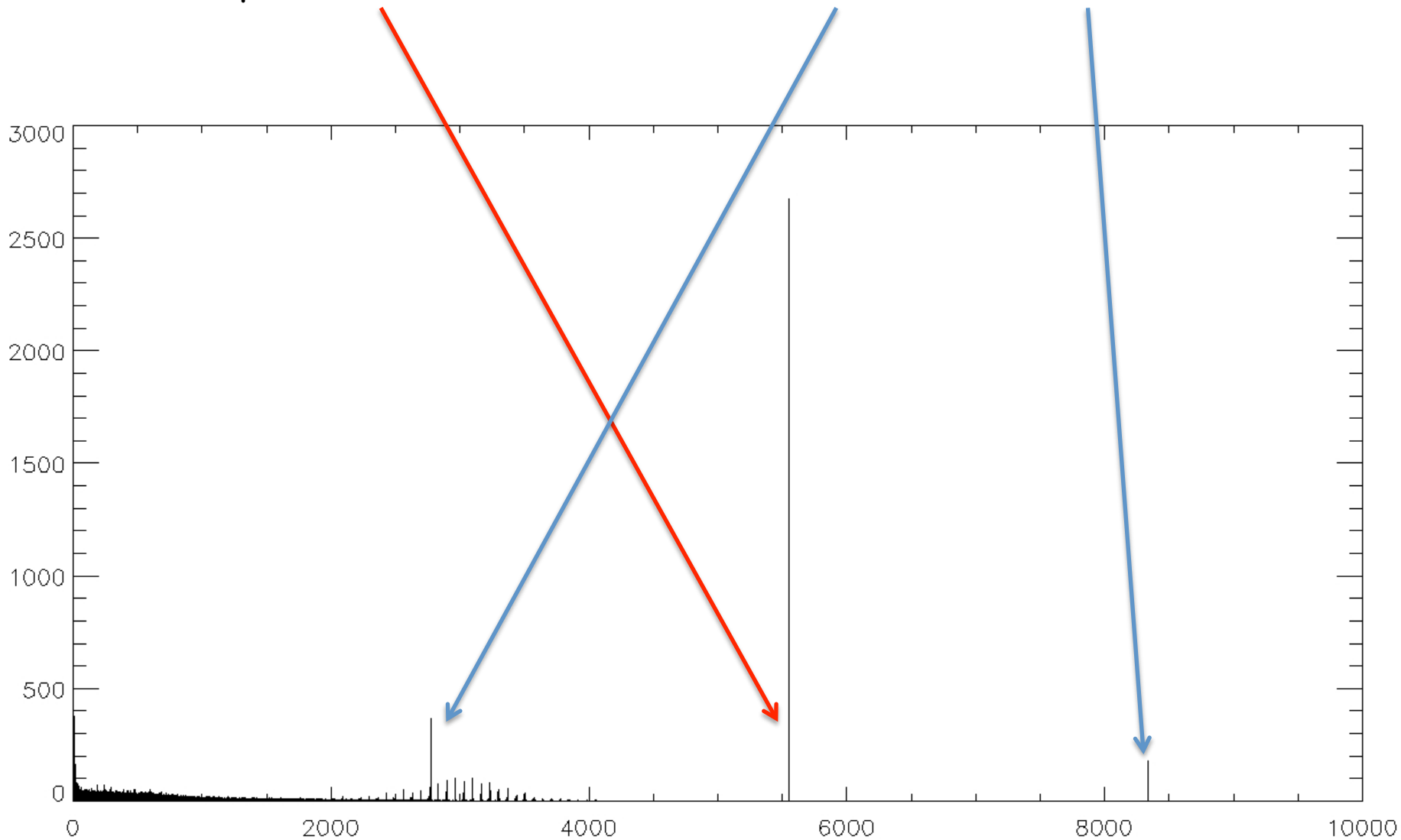


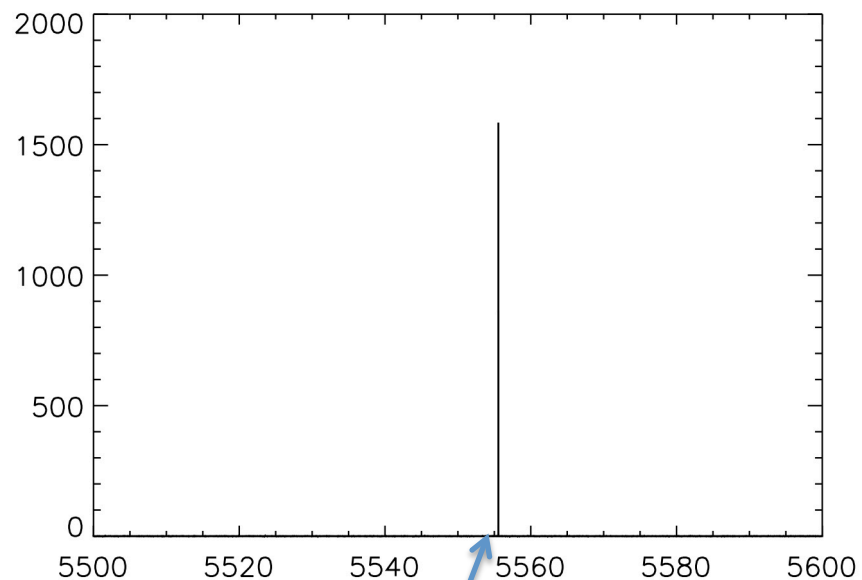
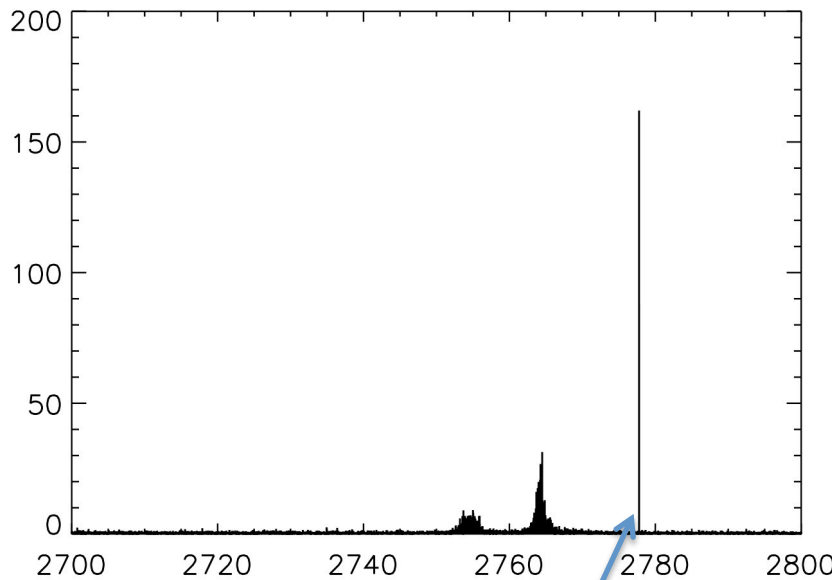
Spikes



Attractors

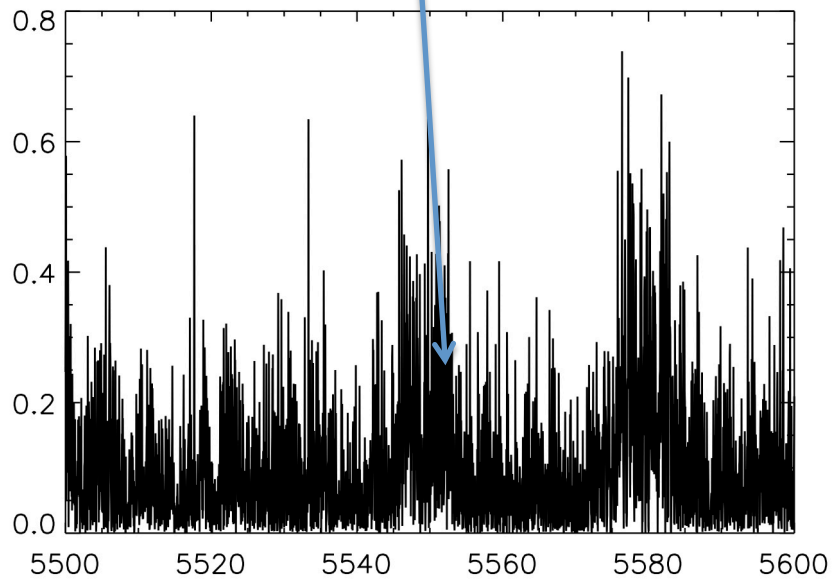
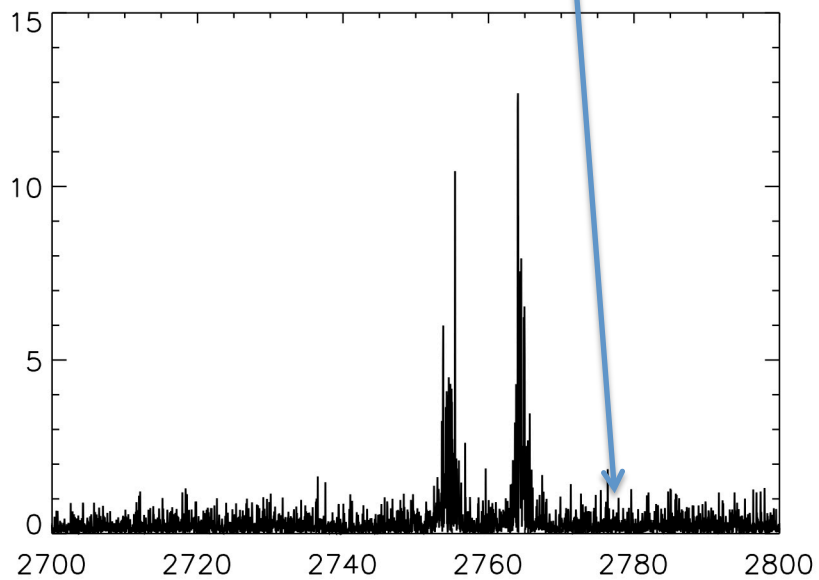
Spikes: 5555.55 μHz (3 minutes), 2777.77 μHz , 8333.3 μHz

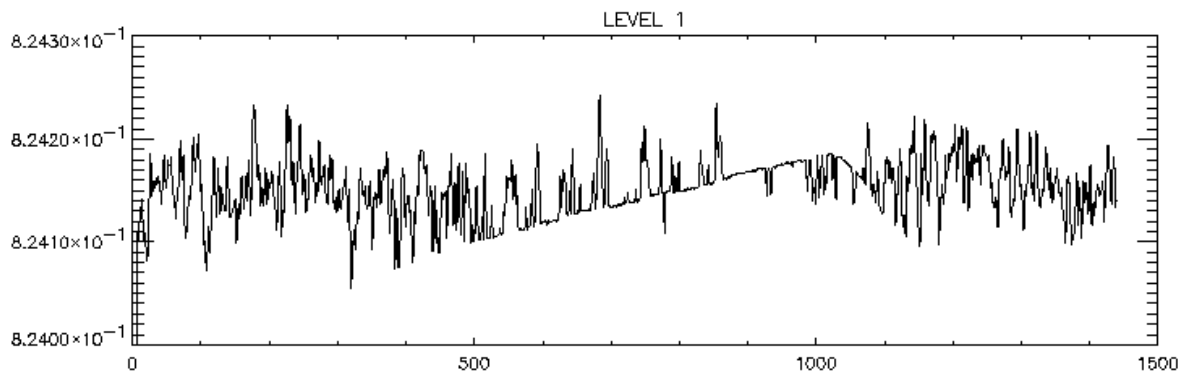
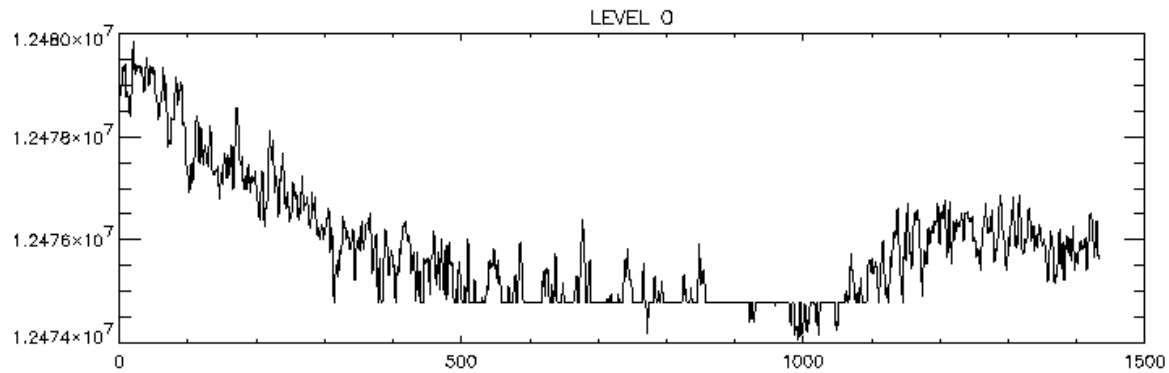




does not participate in the fits but it is suppressed

Contaminates one pseudomodes .
It is suppressed

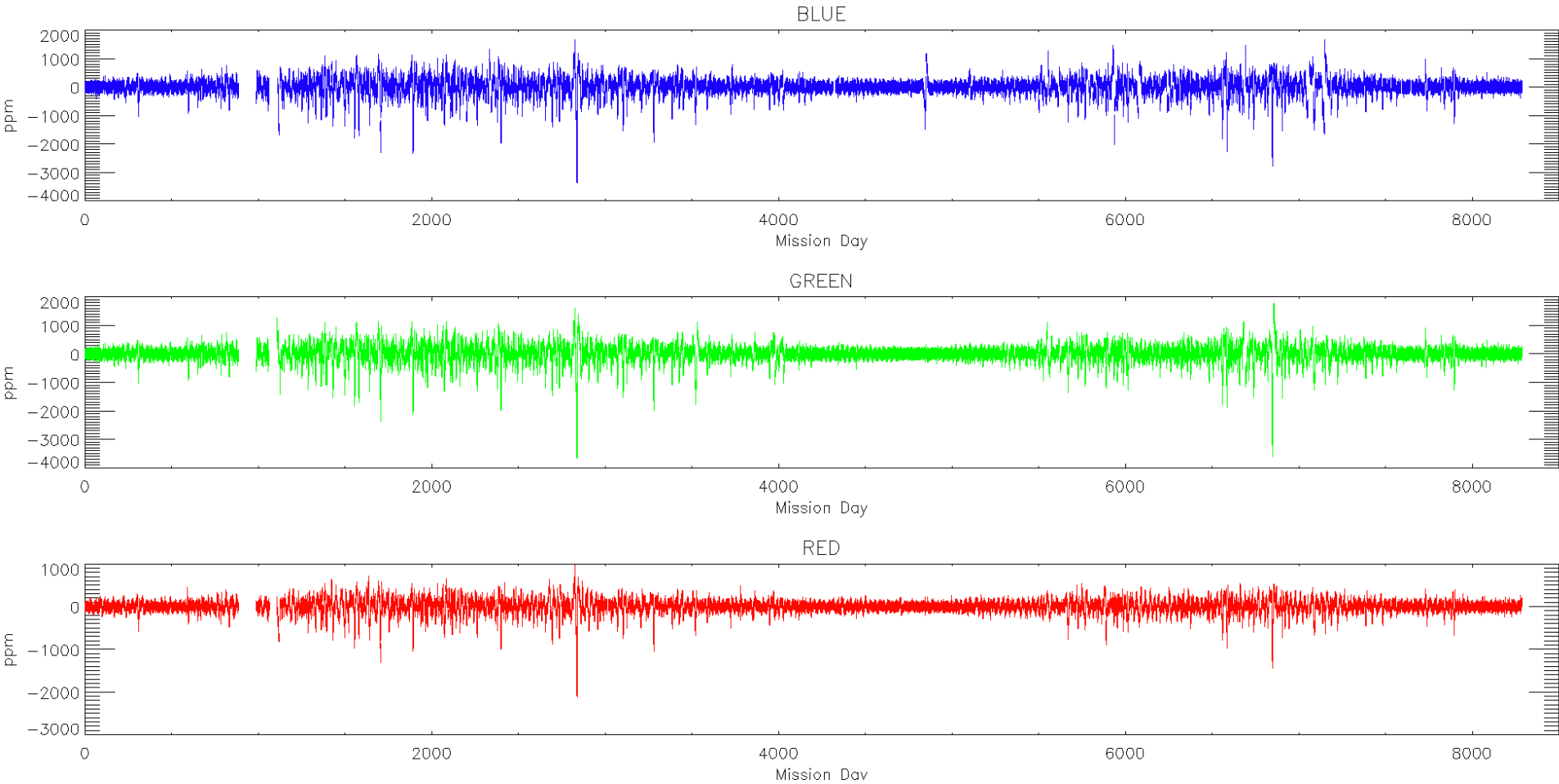




Attractors are fully identified and directly removed out

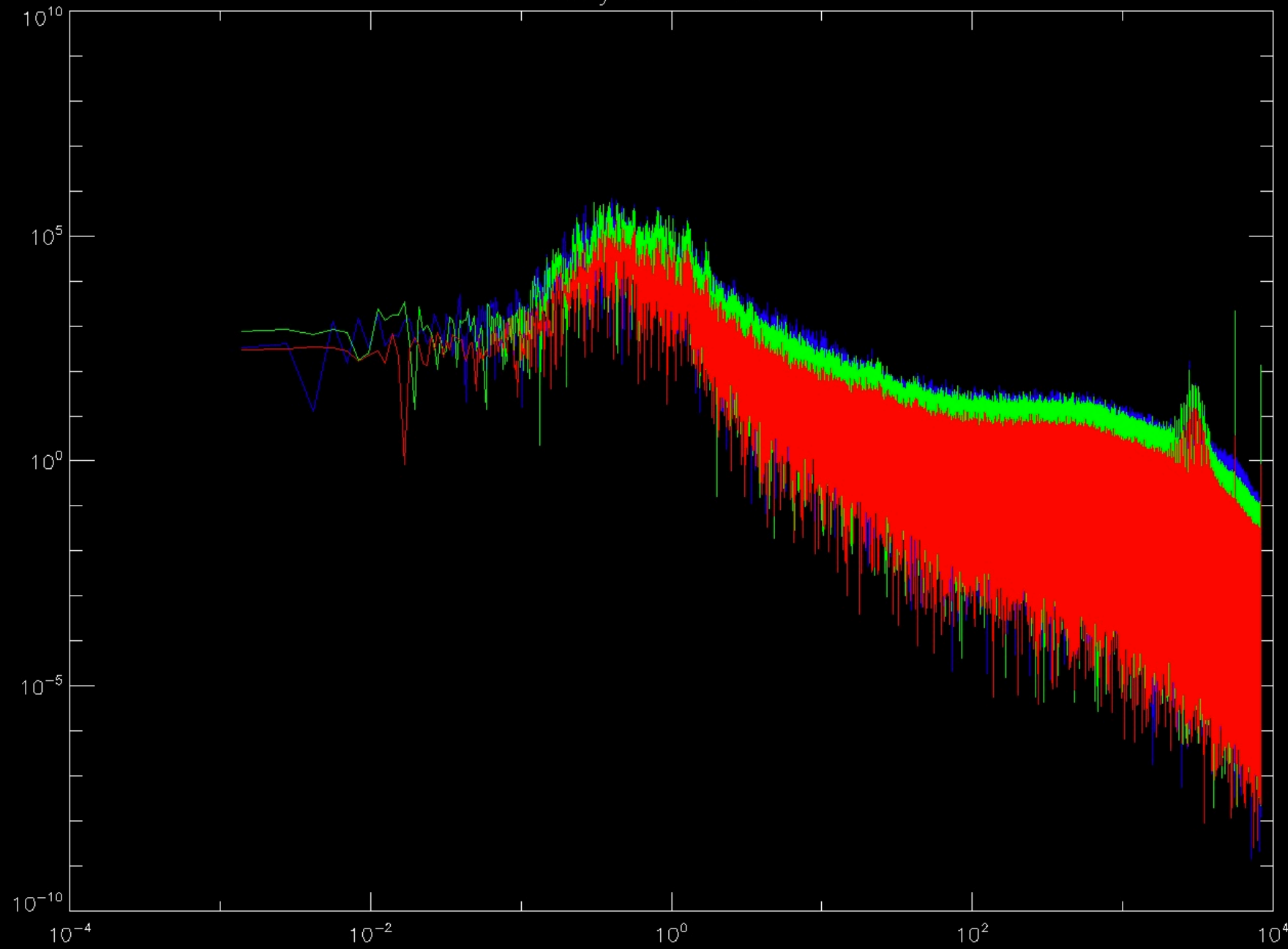
	RED (%)	GREEN (%)	BLUE (%)
Initial zeros	1.41	1.41	1.41
Final zeros	3.41	4.12	5.92
Attractors removed	2.00	2.79	4.52

LEVEL_1 Time Series, cleaned and fitted and filtered by around 70 days filter using A2z pipeline (S. Mathur 2010) and KADACS Software (RA. García et al 2011 (Kepler soft based on GOLF calibration))



From 1996-01-23 (MD=53) to 2018-09-30 (MD=8339).
Time series of 8287 days

22 years of SOHO



These datasets were split into contiguous 365-day subseries, with a one-fourth overlap (91.25 days).

Total number of time series =87.

Power spectra analyzed with A2z pipeline and KADACS.

Background fitted and built the guess model

The whole spectra fitted at once:

For each group $l=2(n), 0(n+1), 1(n+1), 3(n+1)$

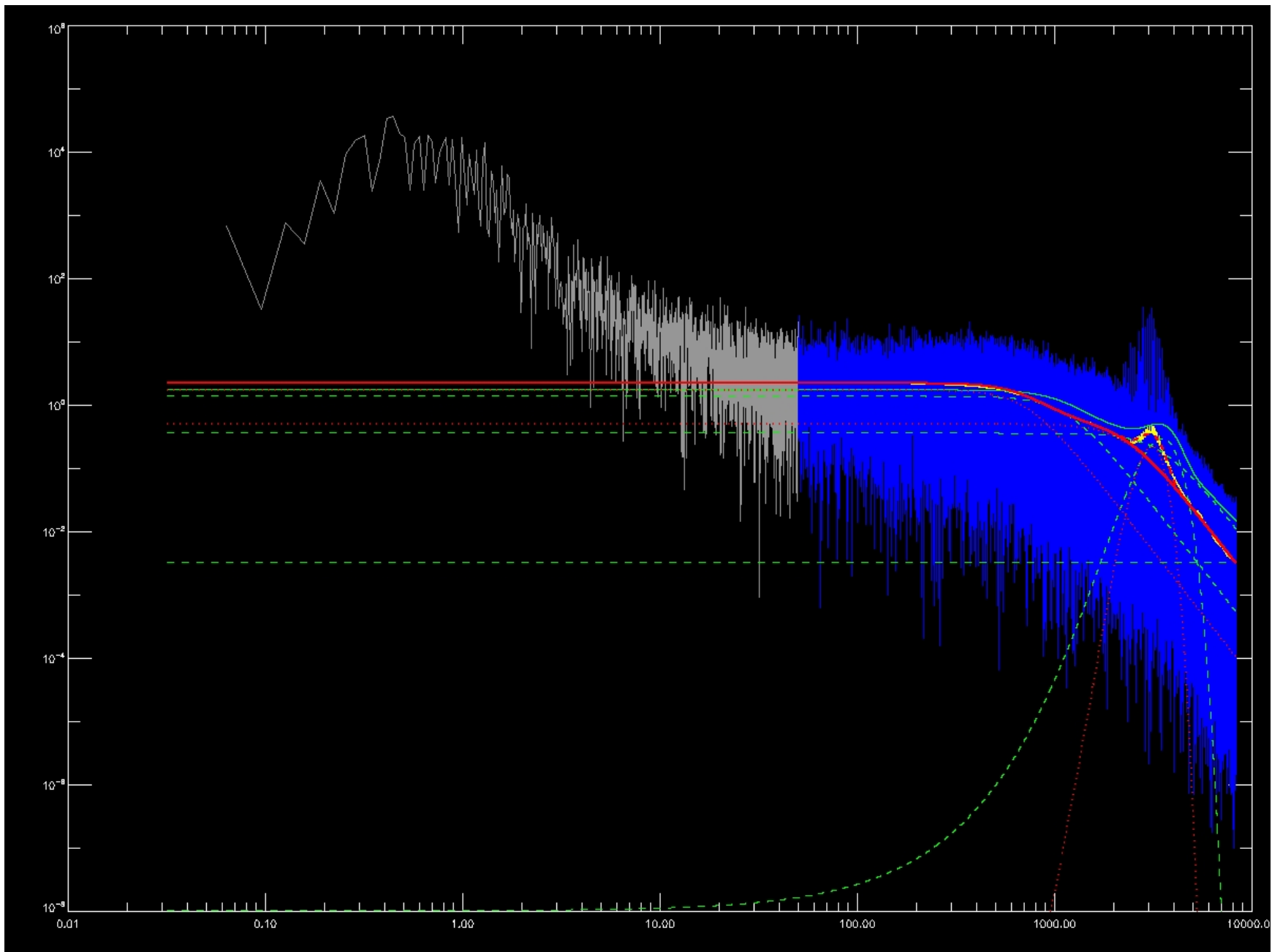
-Same width

-Fix Amplitud ratios, $l_0 = 1, l_1 = 1.5l_0, l_2 = 0.5 l_0, l_3 = 0.1l_0$

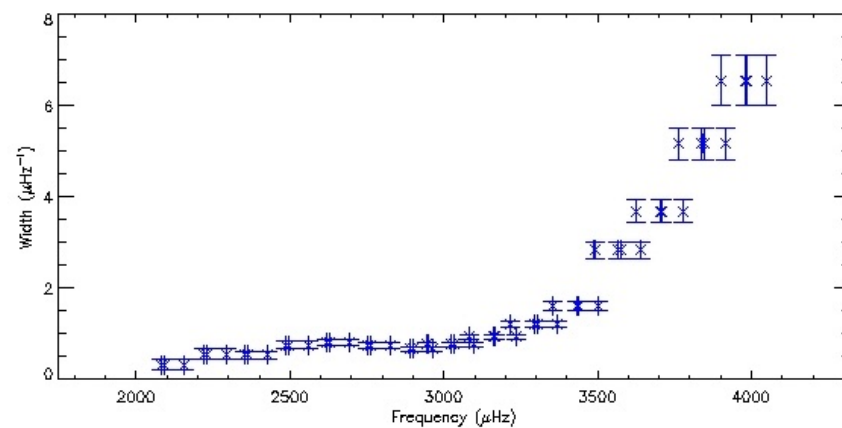
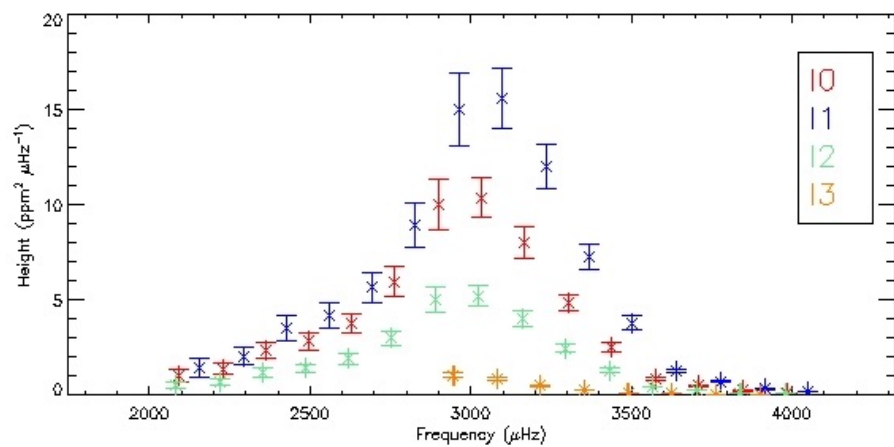
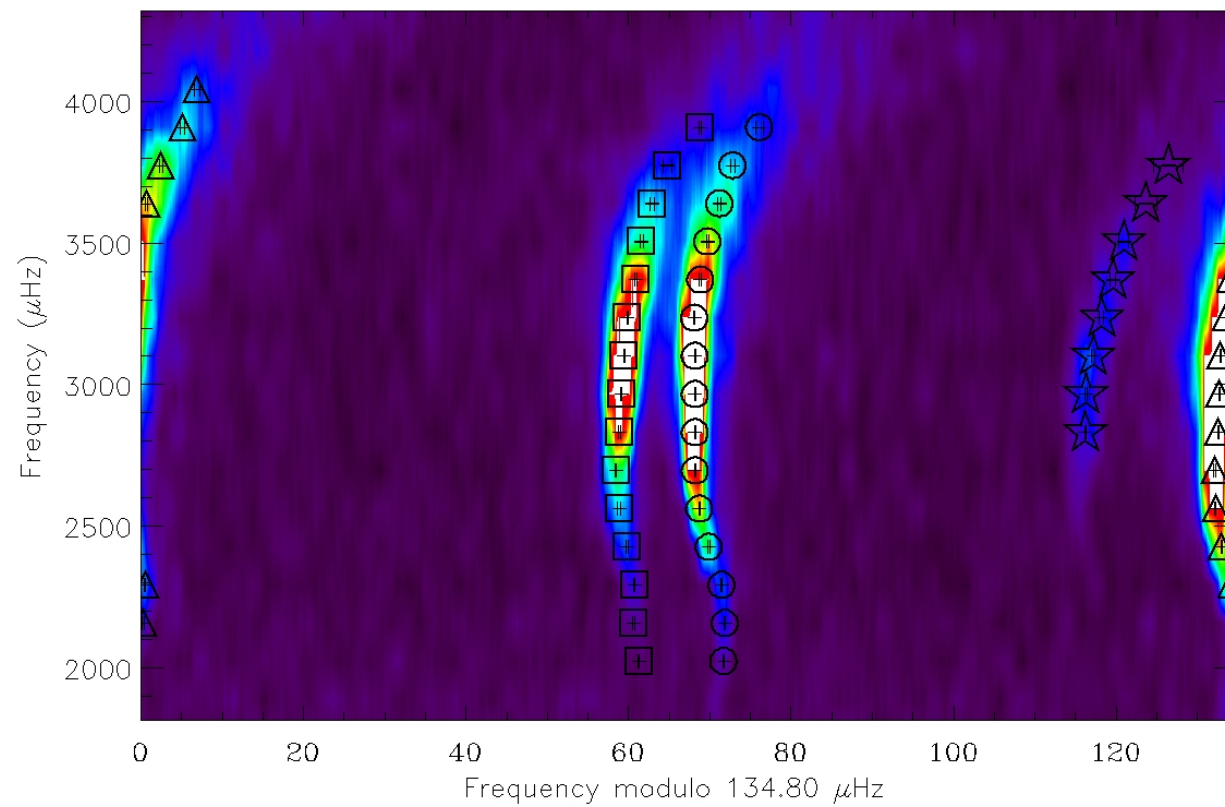
Angle=90° (fix)

1 splitting per spectrum

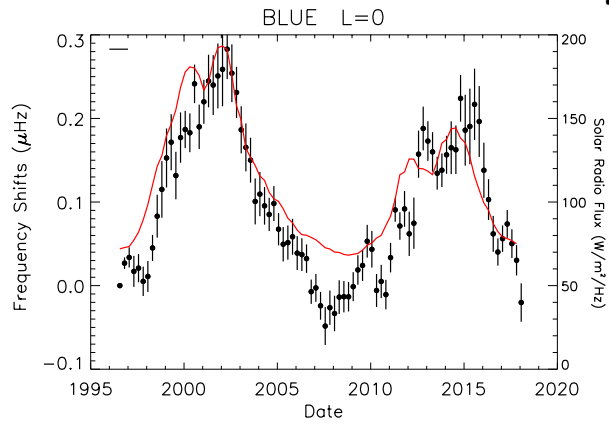
1 Time serie as Reference:
Middle point in the middle of 1997
(minimun activity)



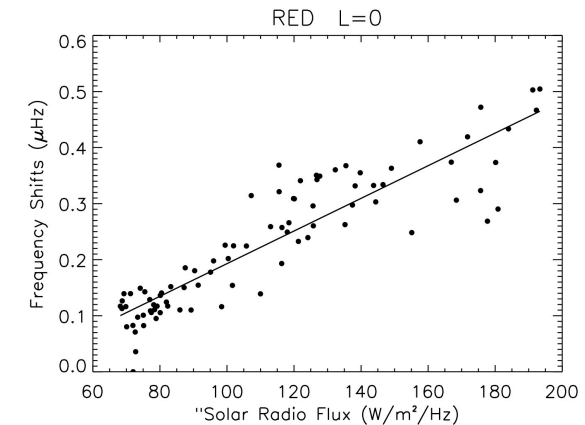
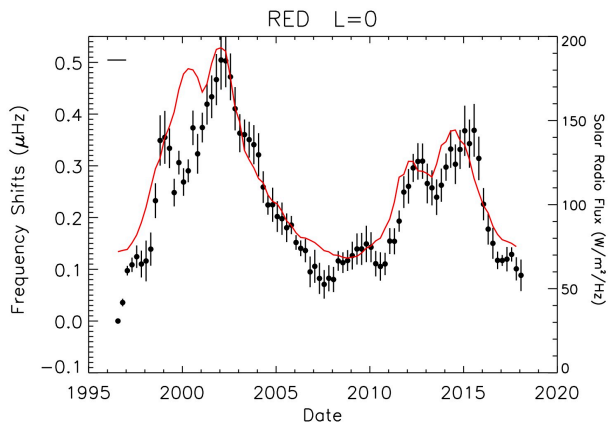
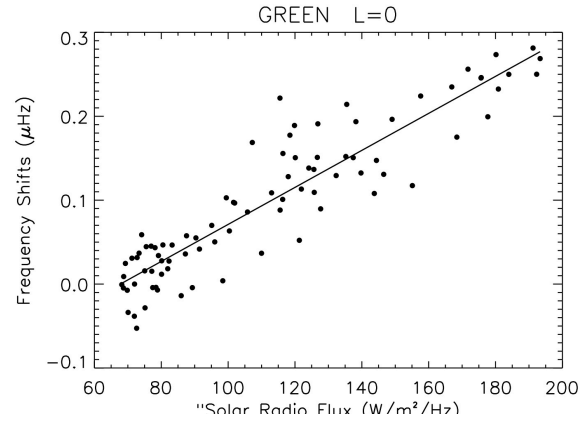
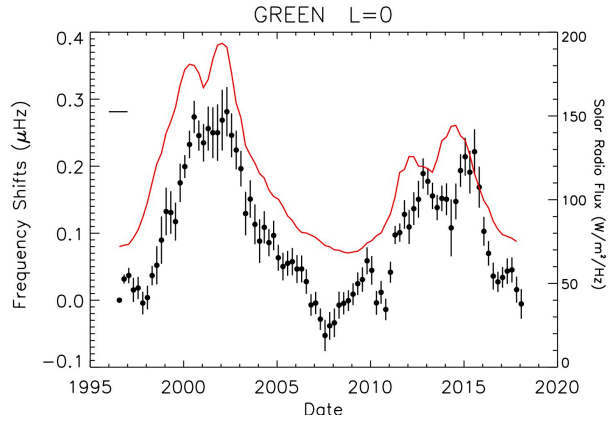
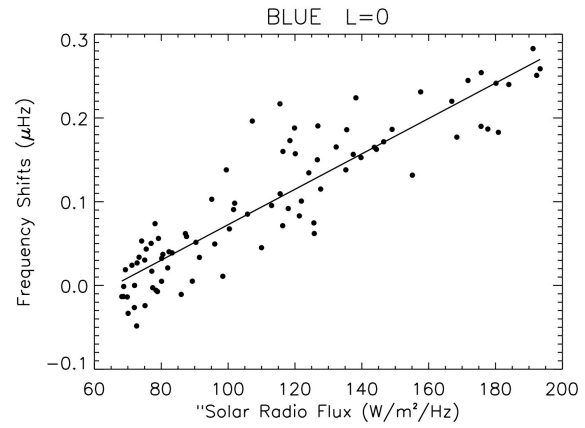
Fitted 1

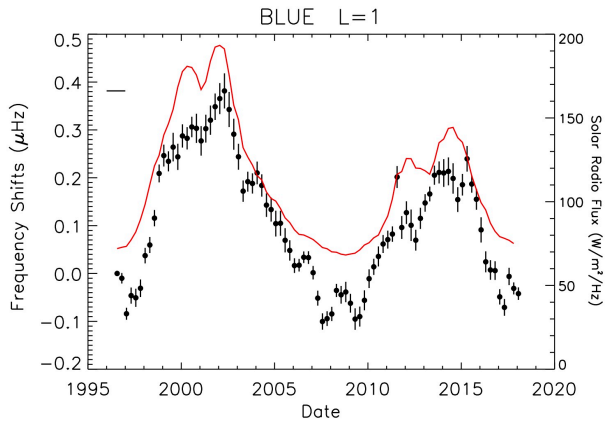


Frequency Shifts

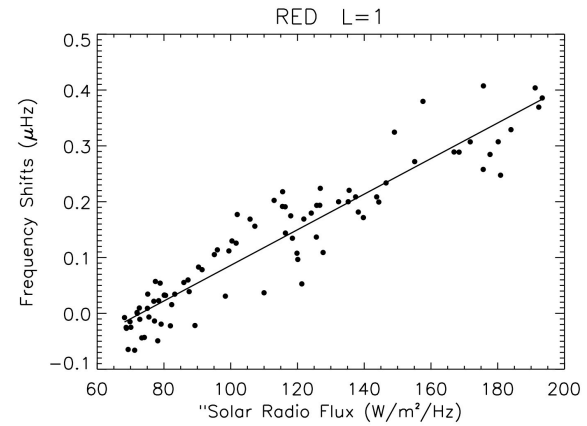
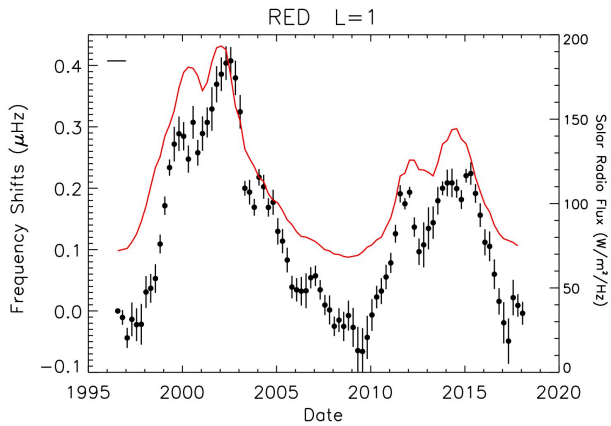
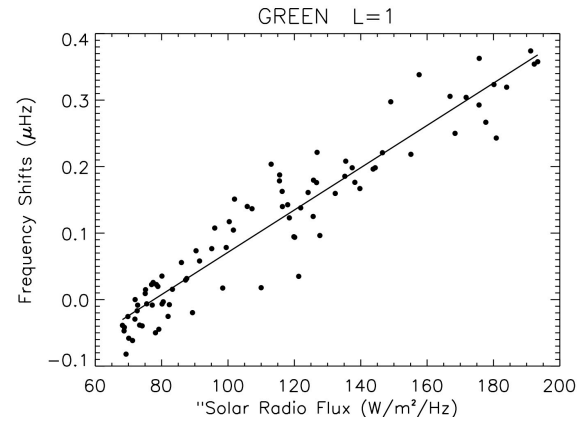
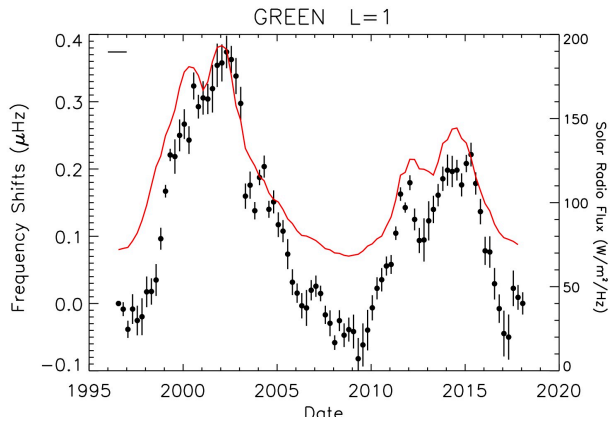
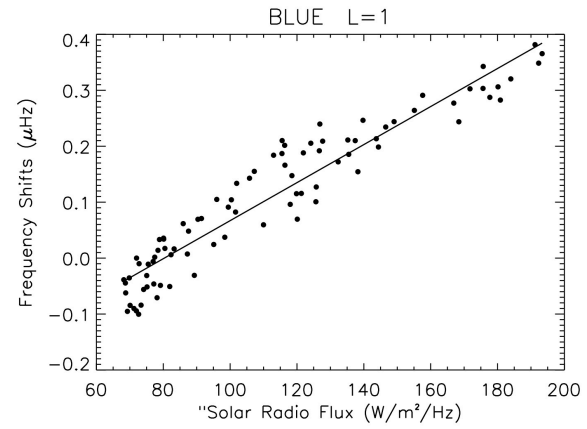


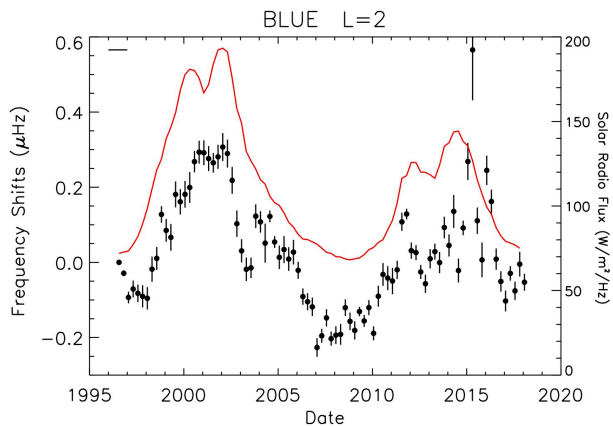
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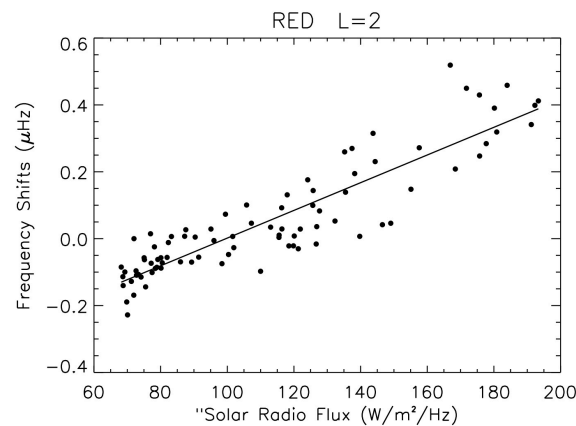
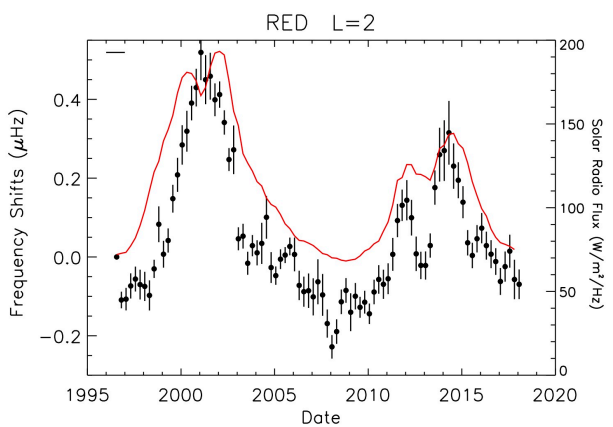
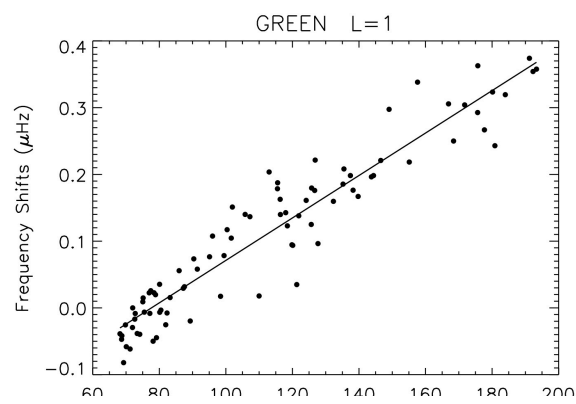
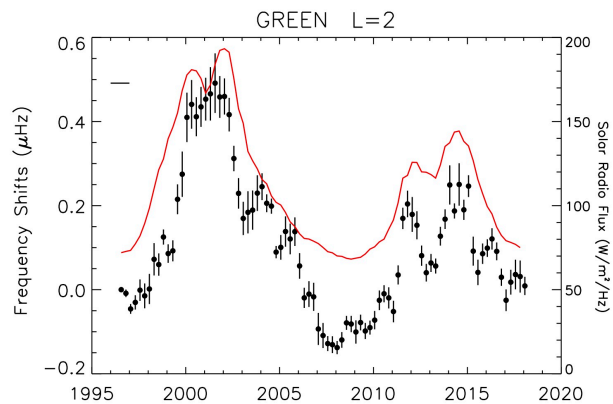
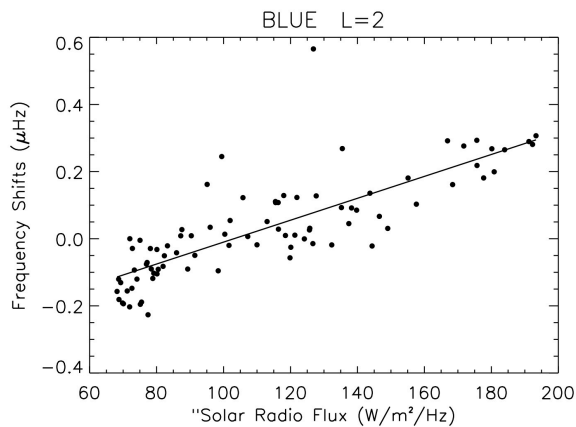


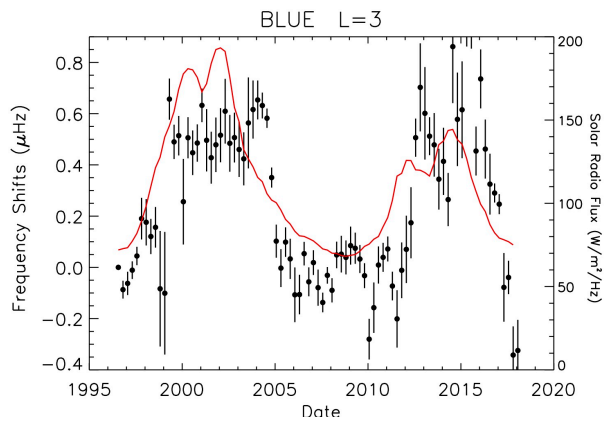
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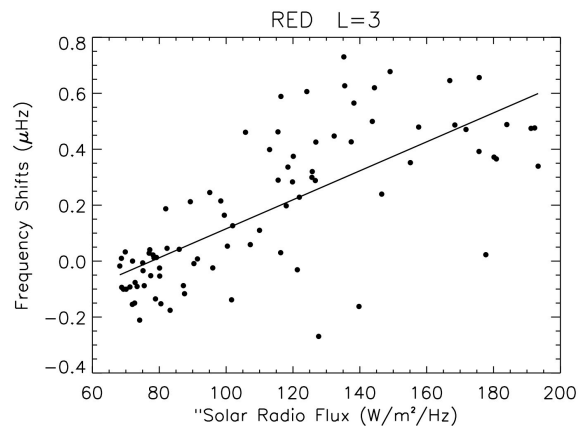
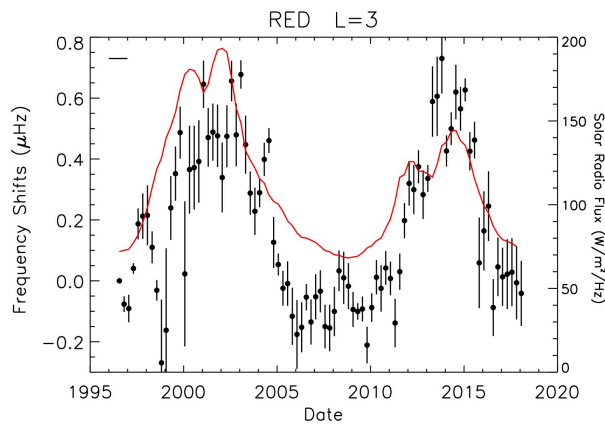
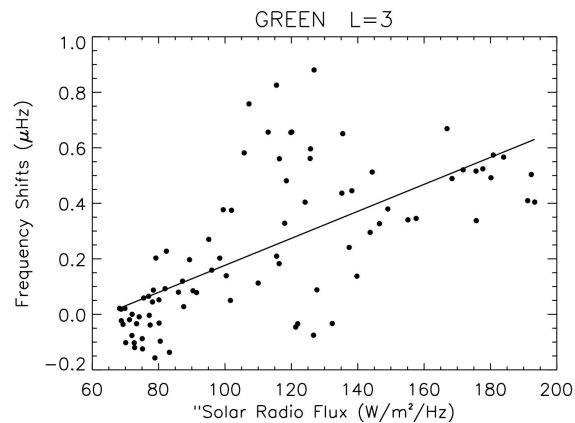
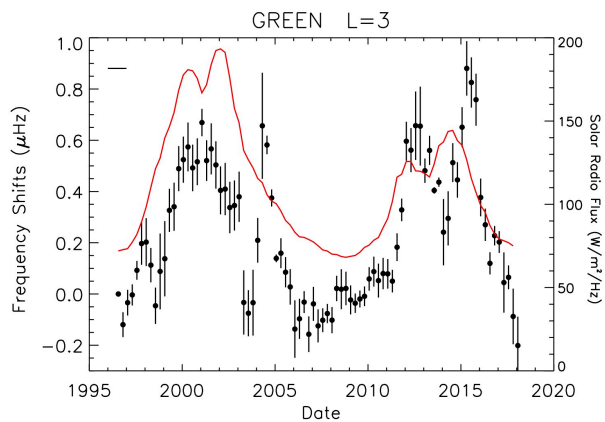
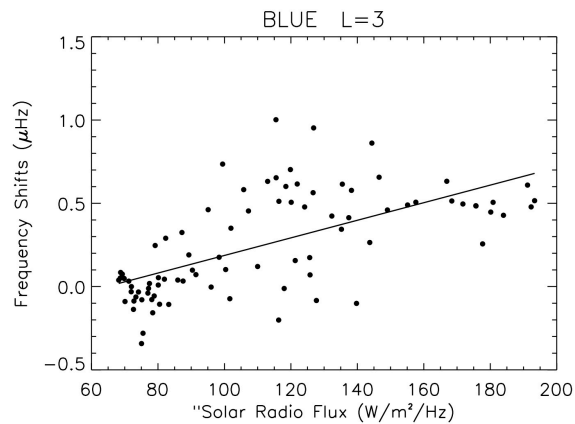


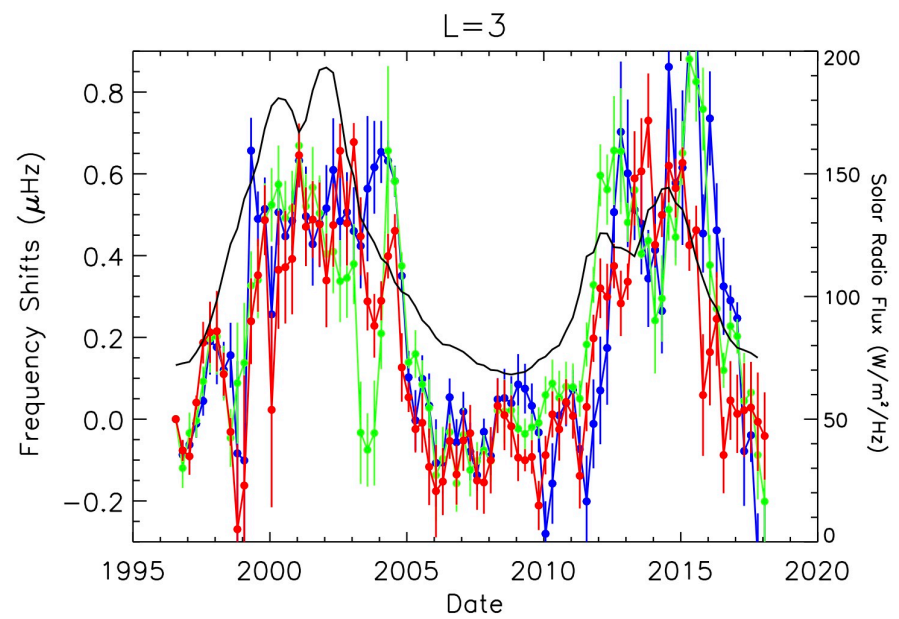
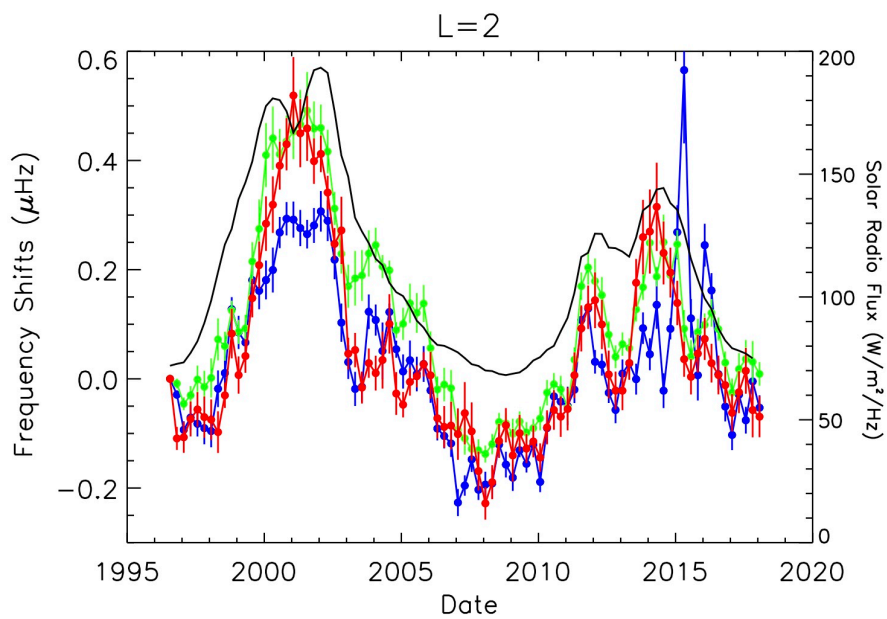
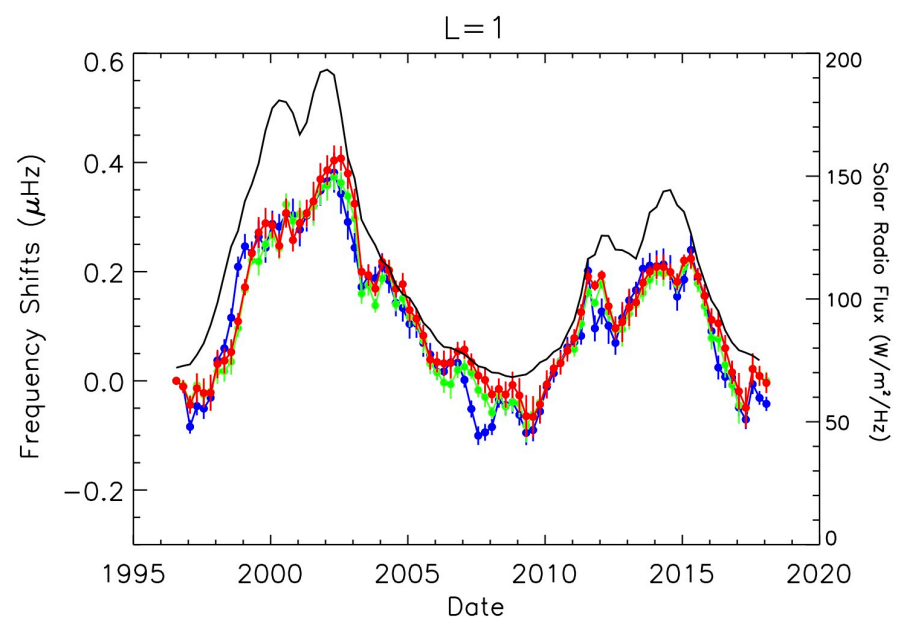
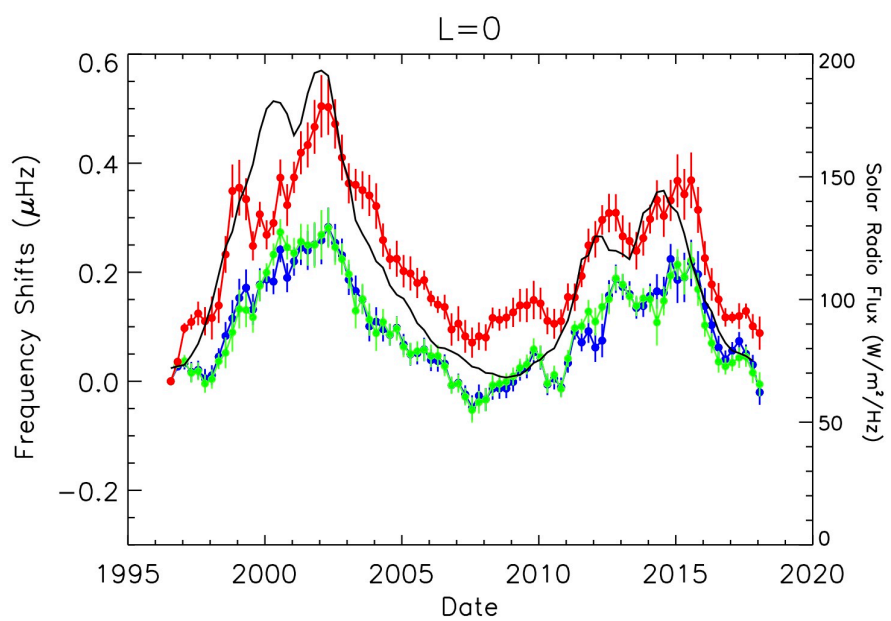
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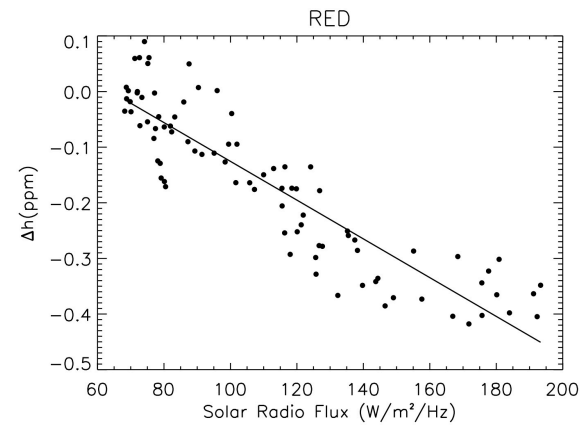
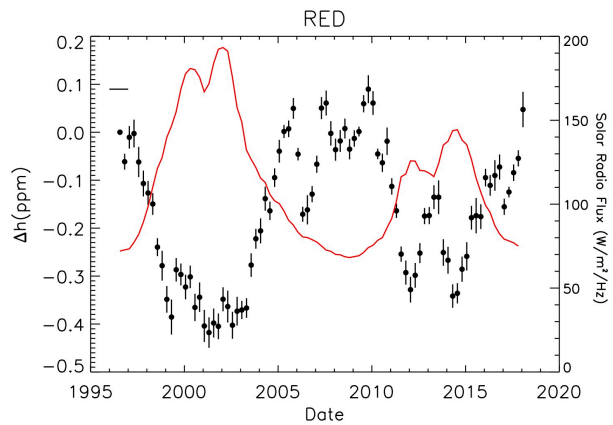
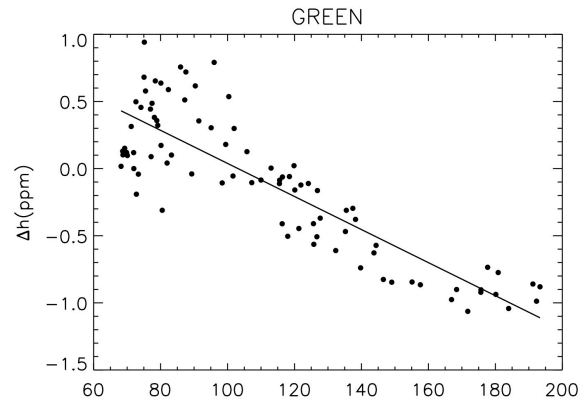
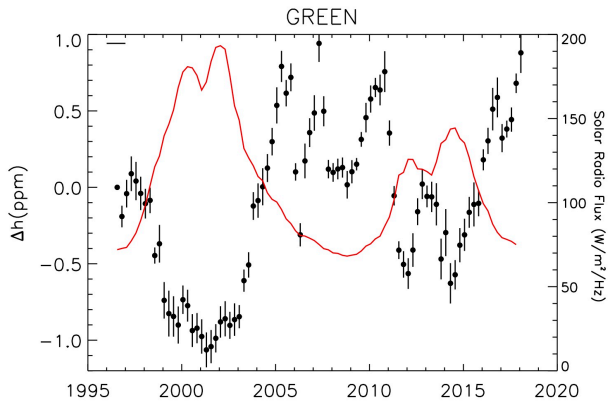
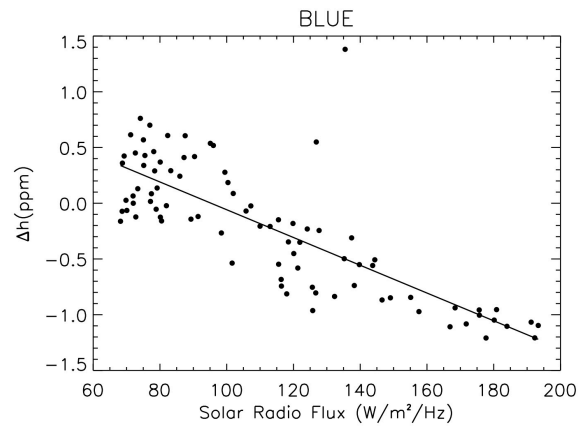
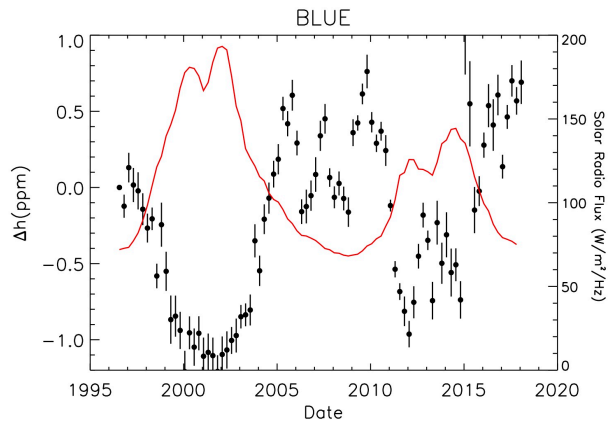


L=3

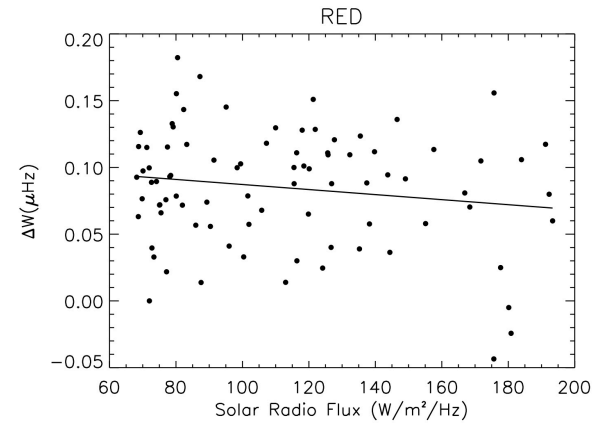
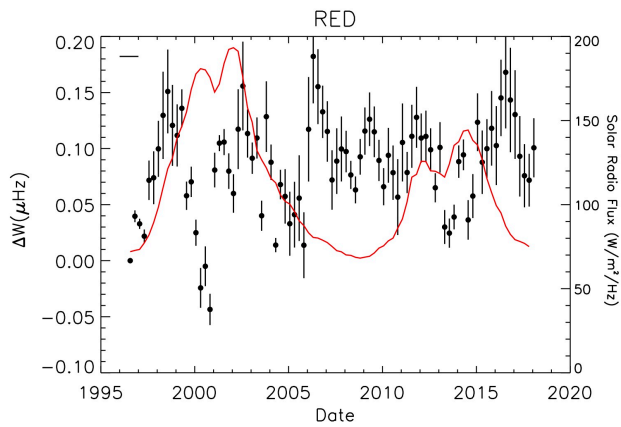
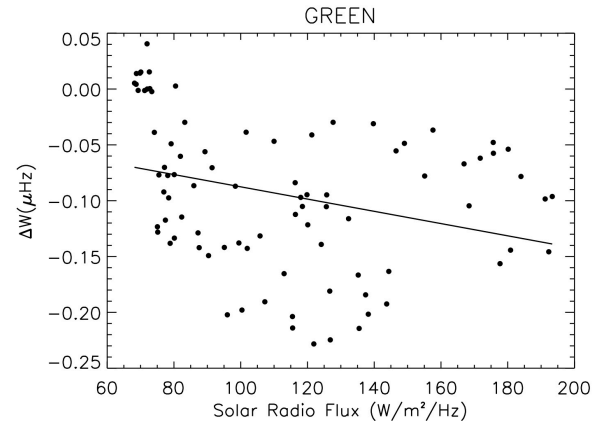
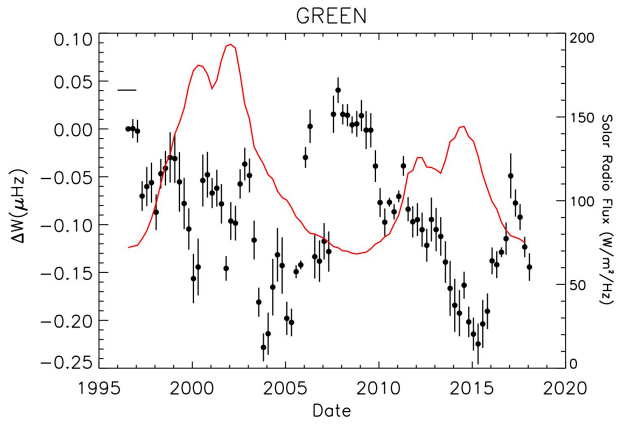
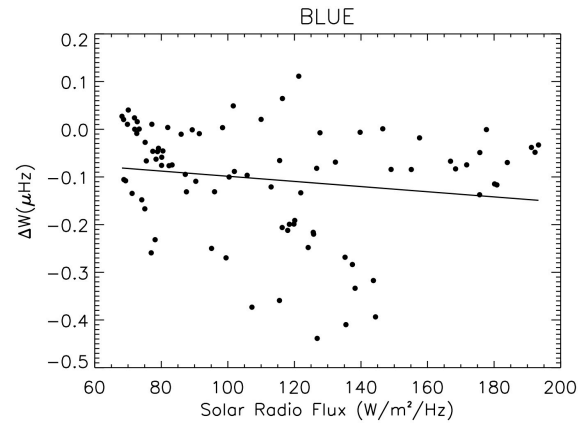
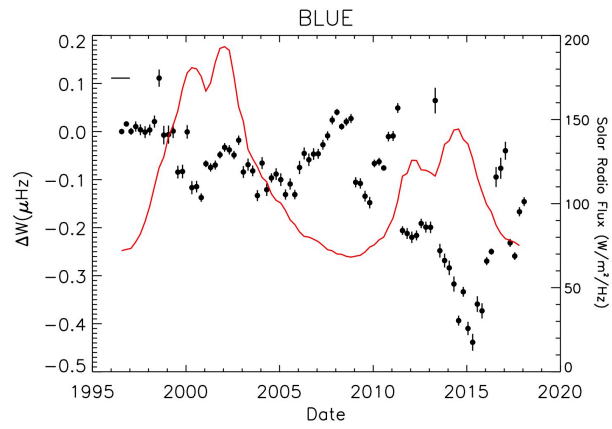




Heights

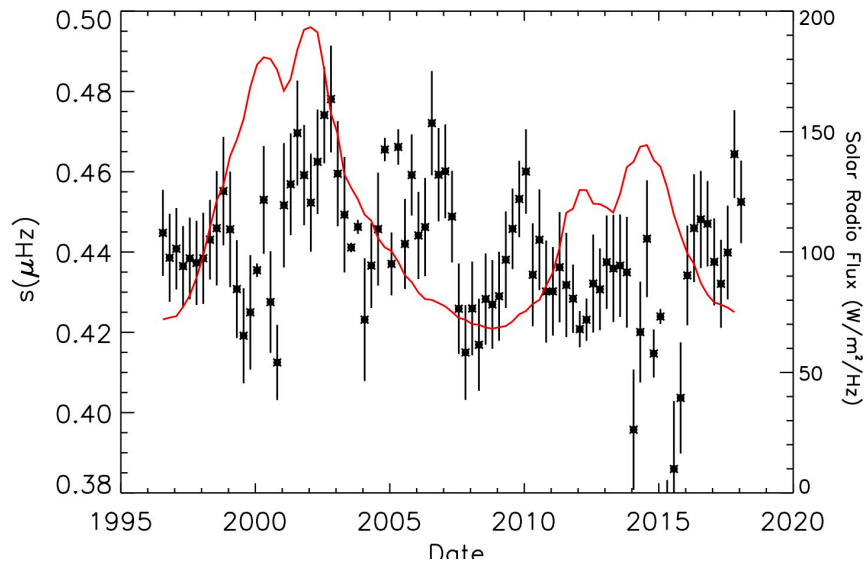


Widths

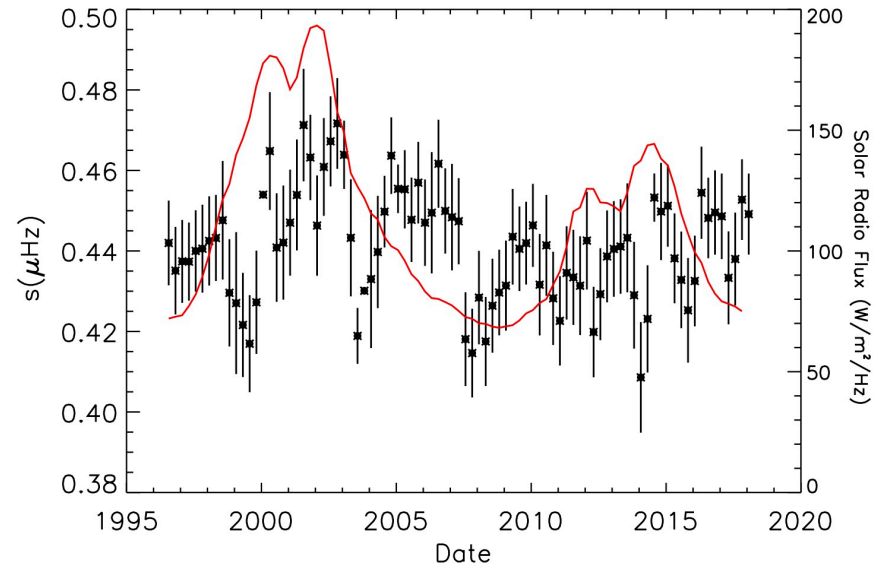


Splitting

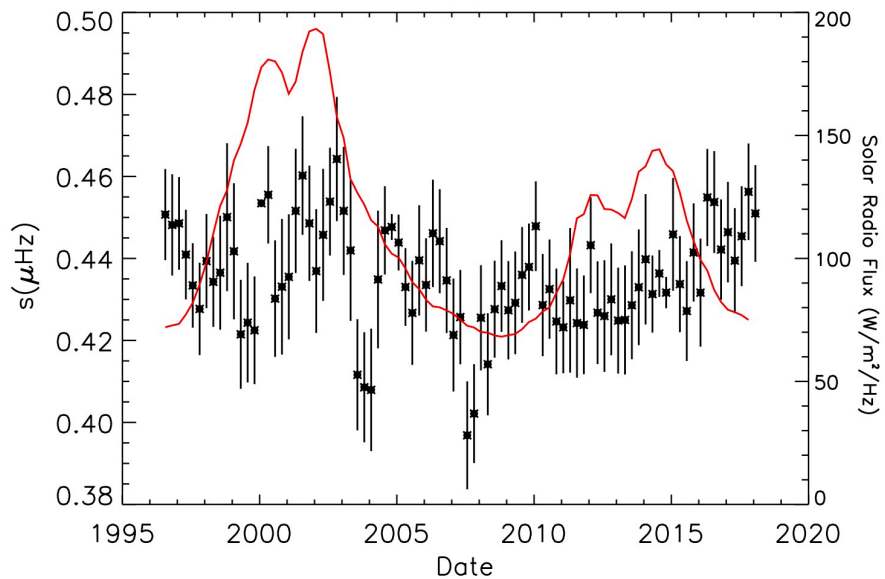
BLUE

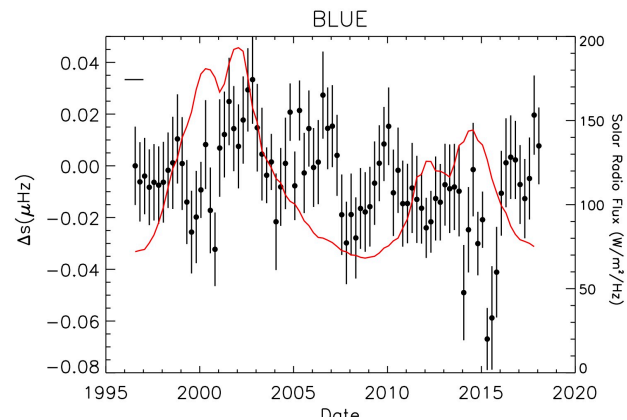


GREEN

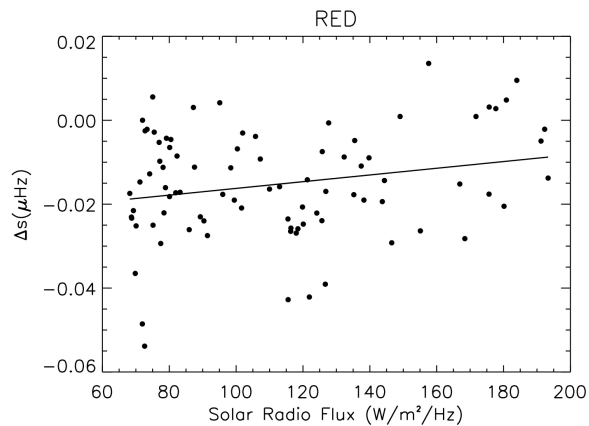
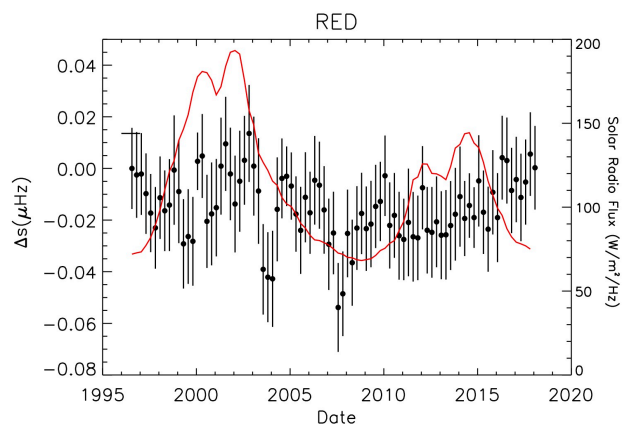
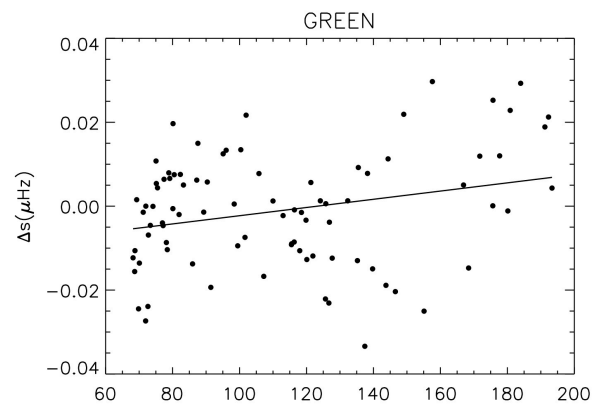
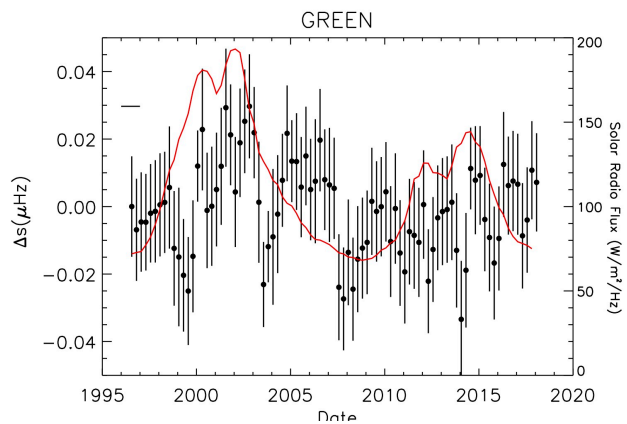
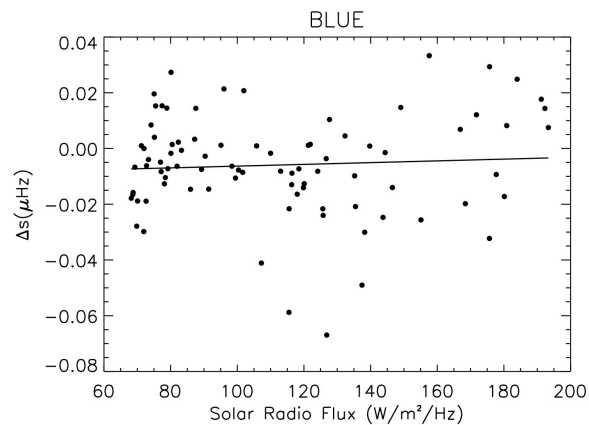


RED

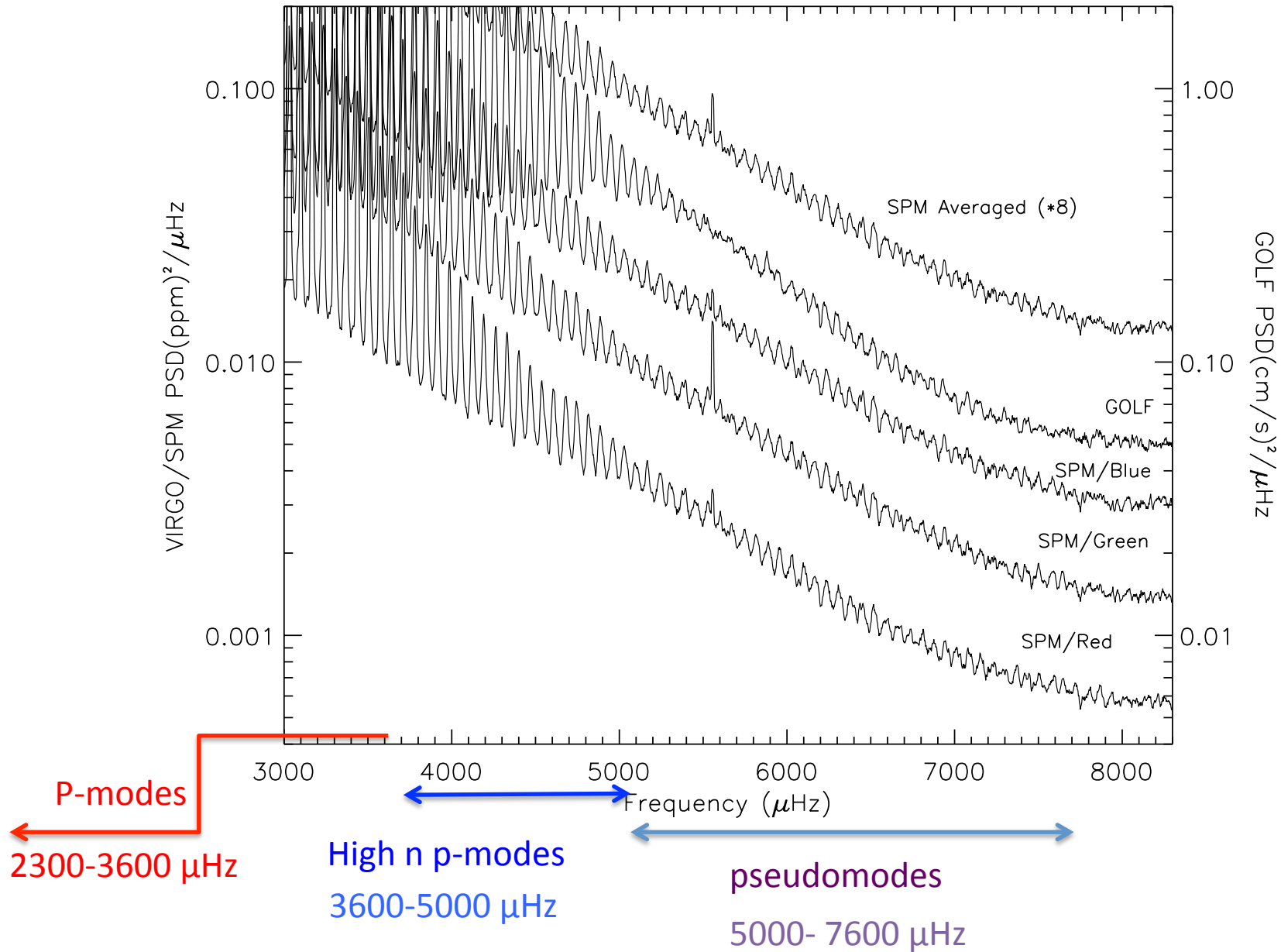




Splitting
variation



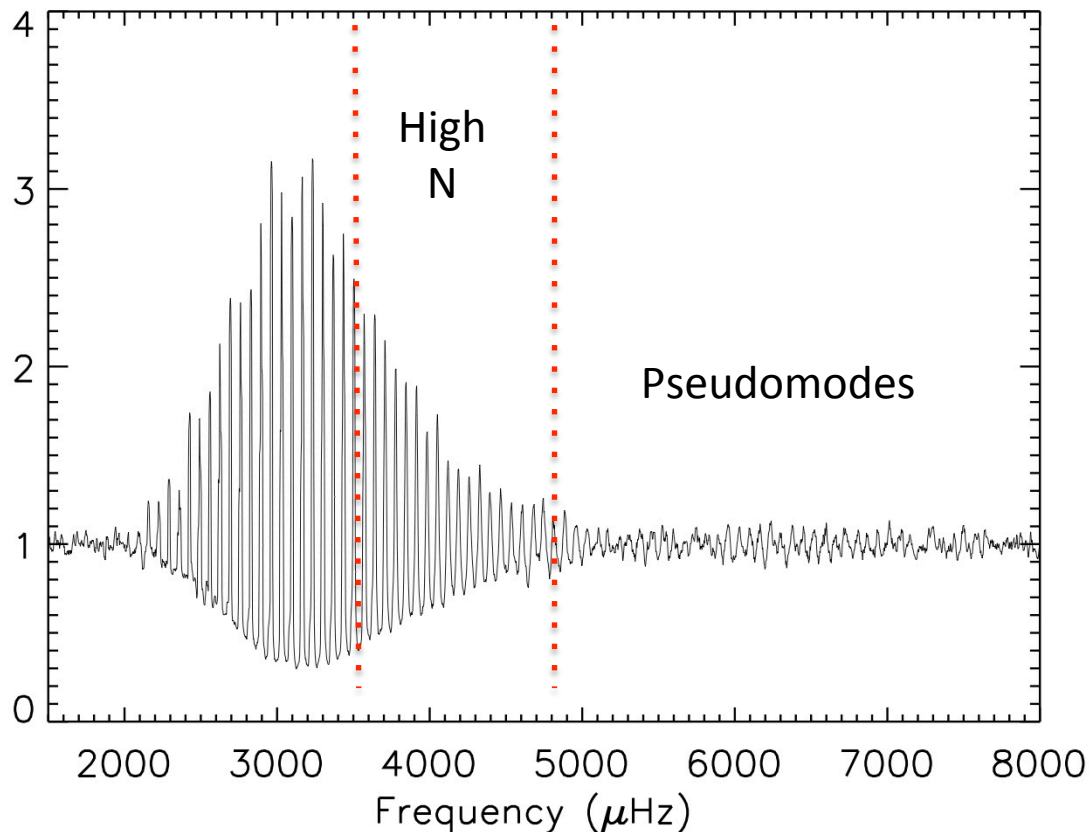
2. High n p-modes and pseudo modes analysis. Averaged spectra



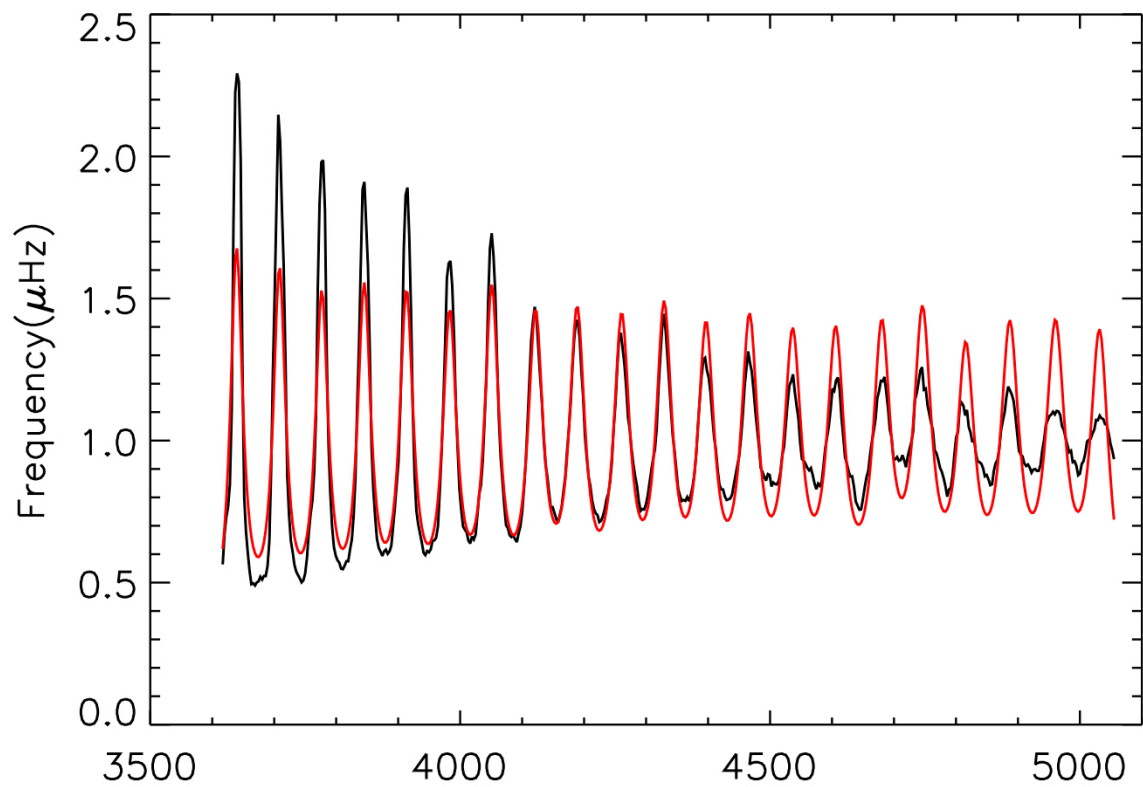
200 four days time series (800 days) , averaged the
200 PSD and shift 50 days → 150 spectra

(PSD with a short smooth)/(PSD with big smooth)
and fitted with MLH with an offset close to 1

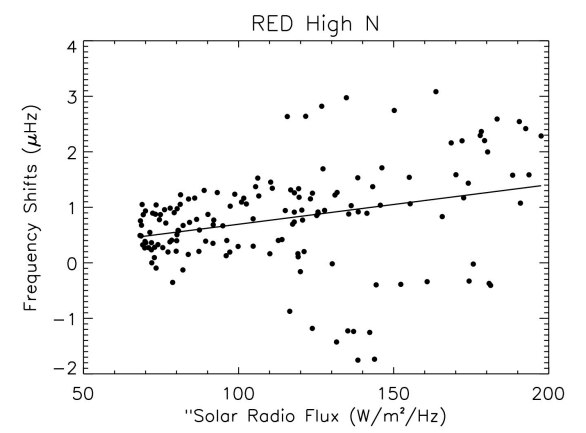
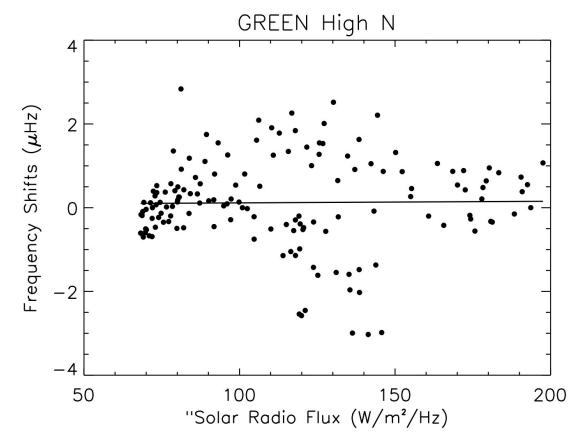
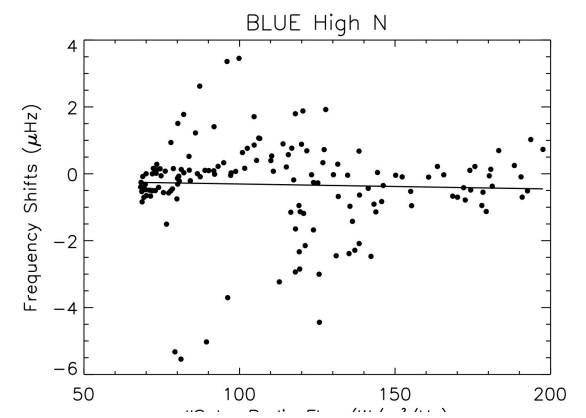
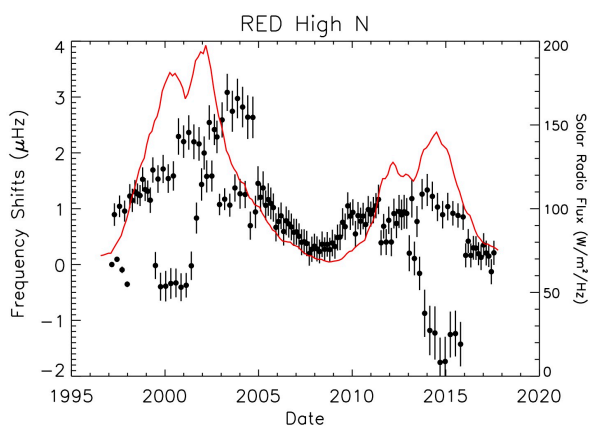
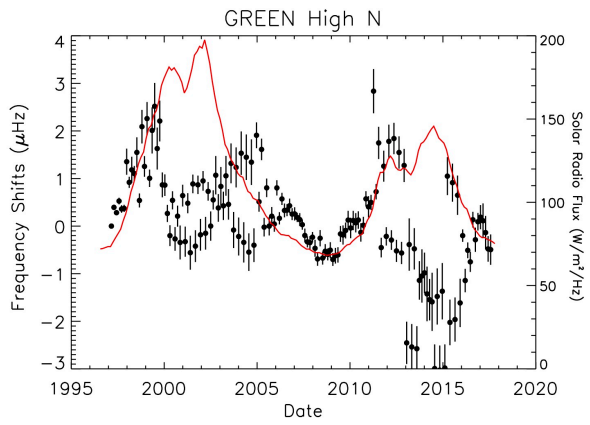
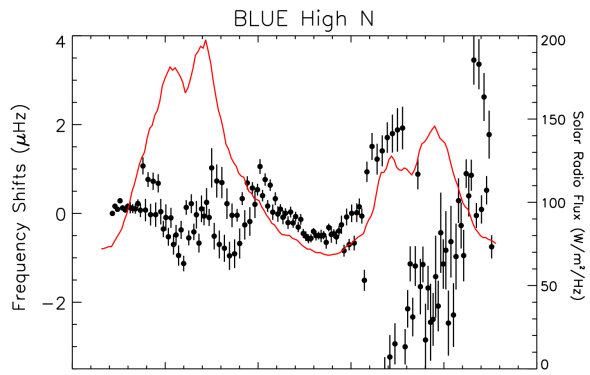
Jiménez et al 2015



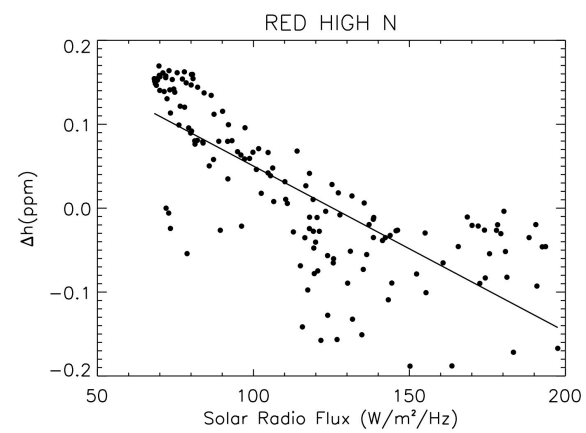
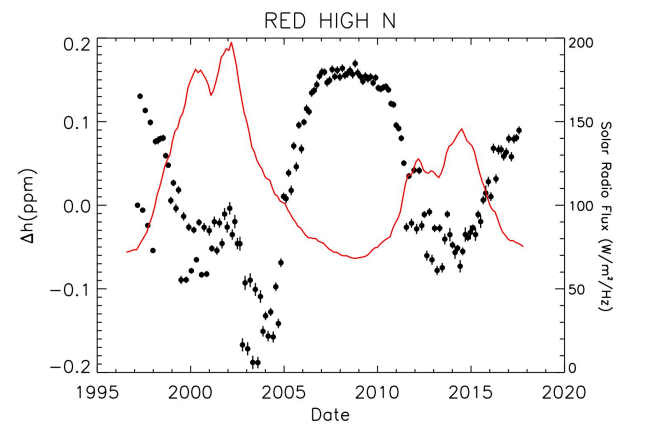
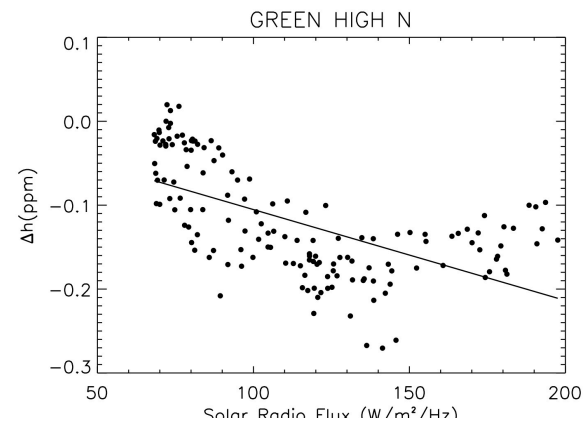
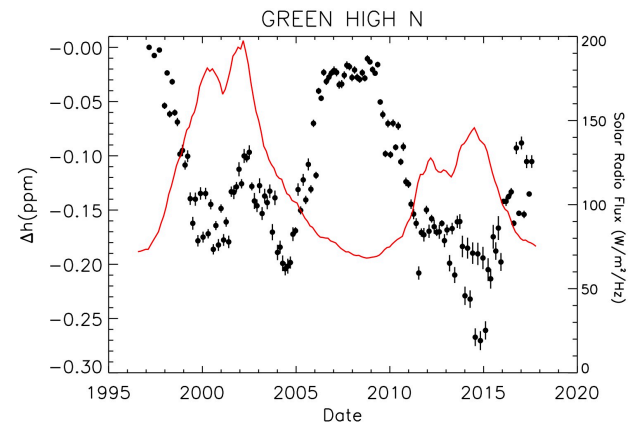
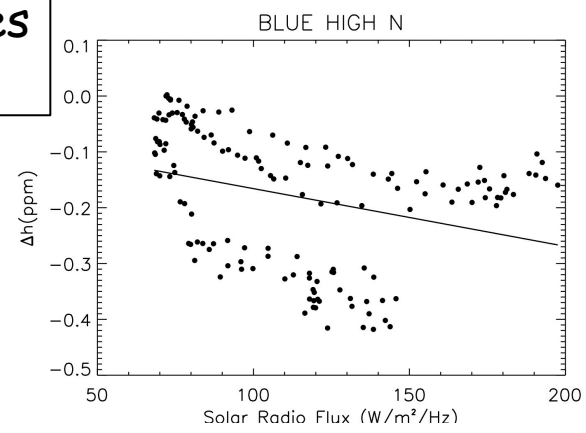
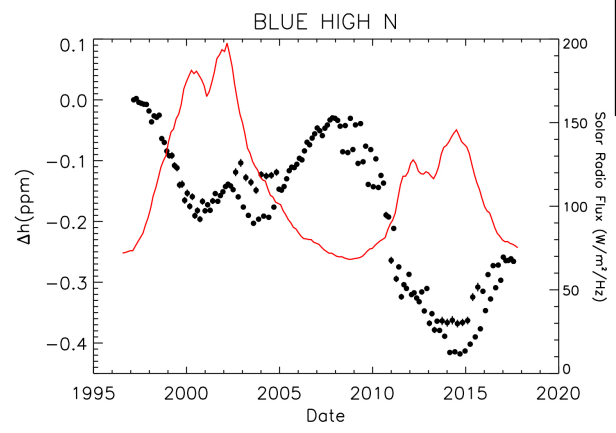
High n p-modes



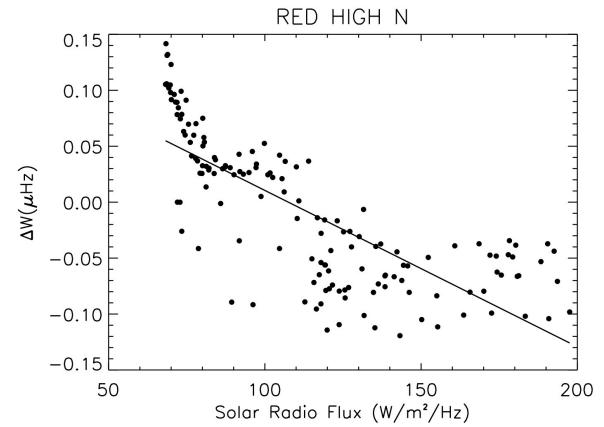
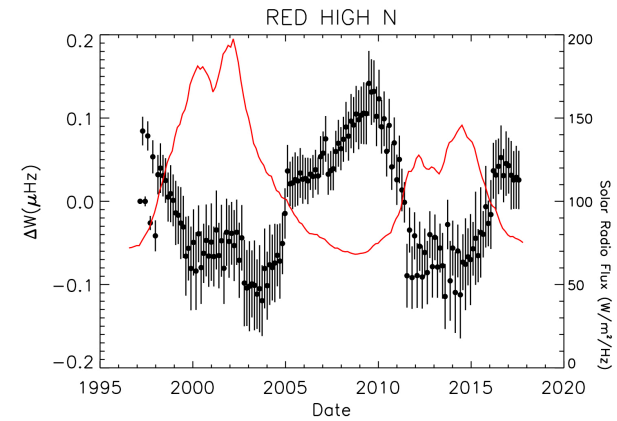
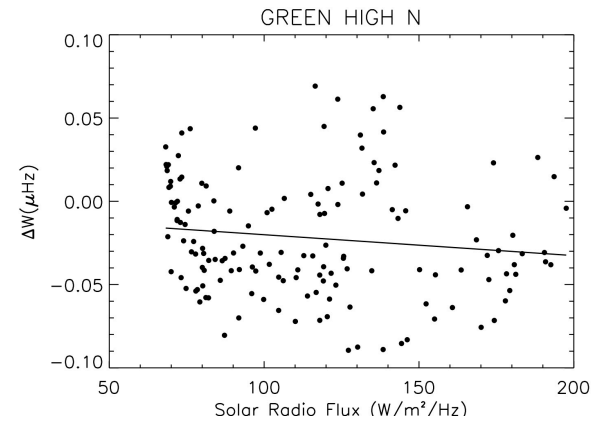
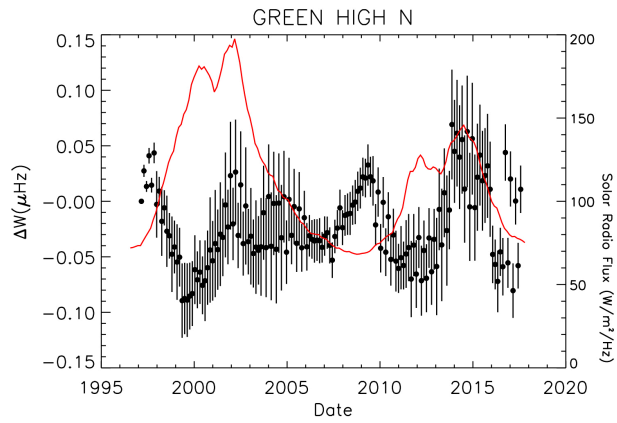
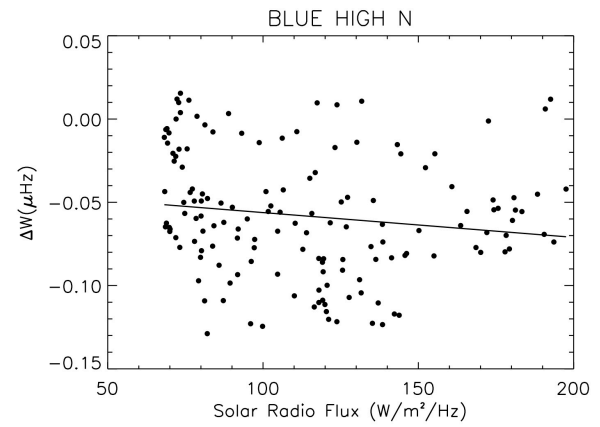
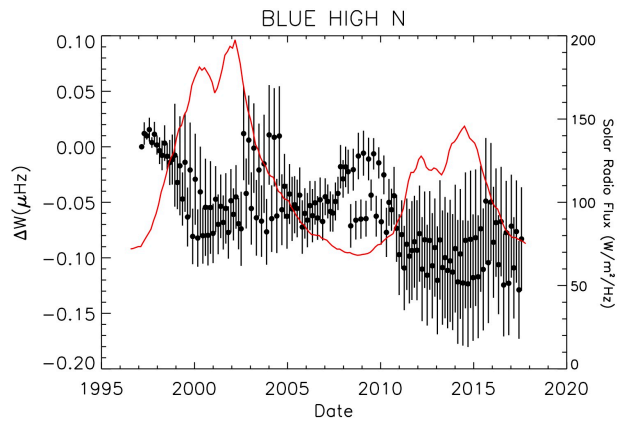
High n p-modes Frequency Shifts



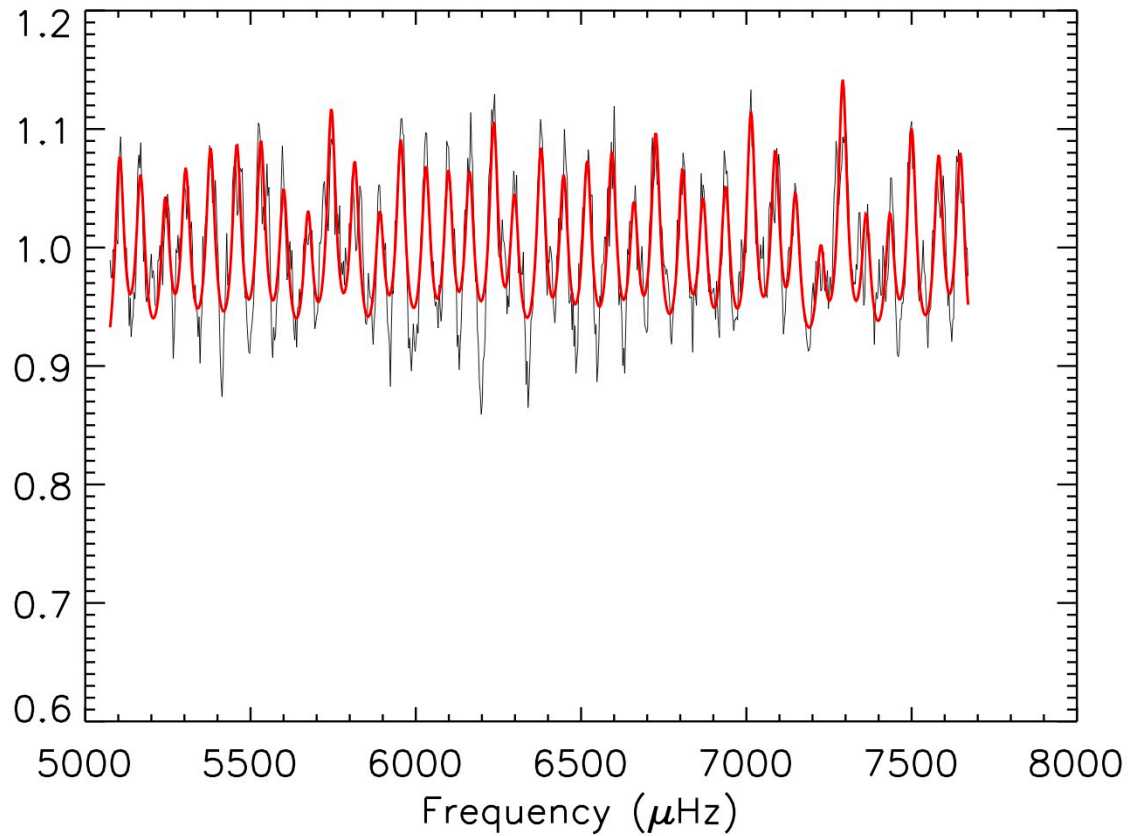
High n p-modes Heights



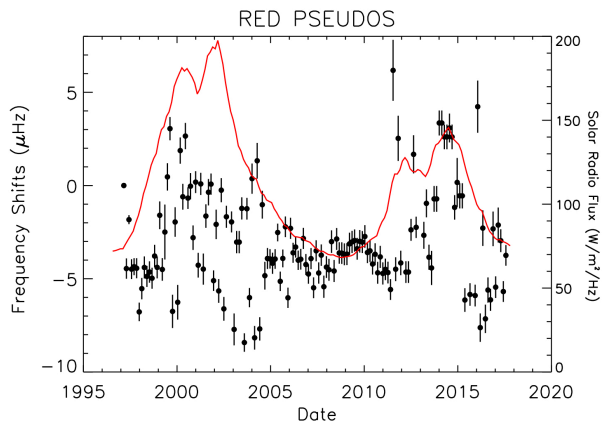
High n p-modes Widths



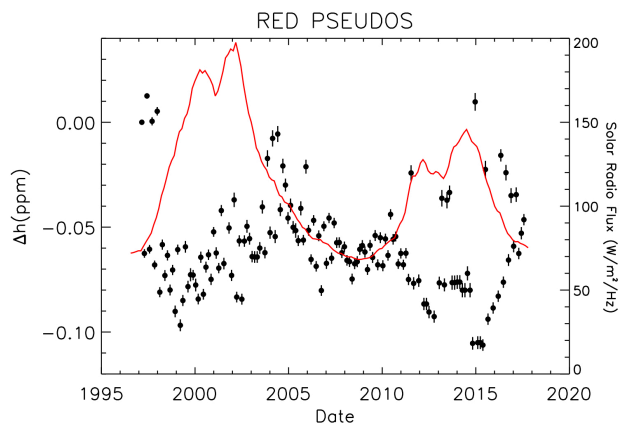
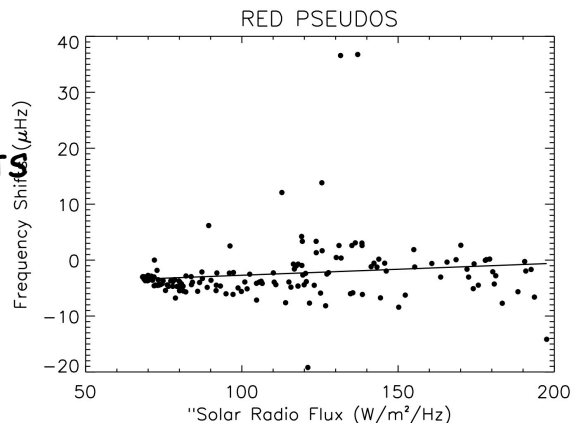
Pseudomodes



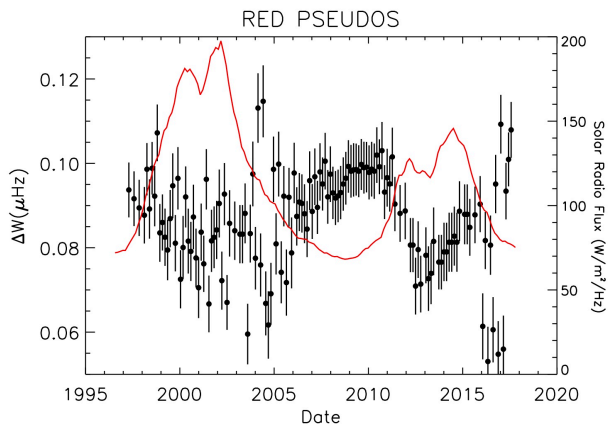
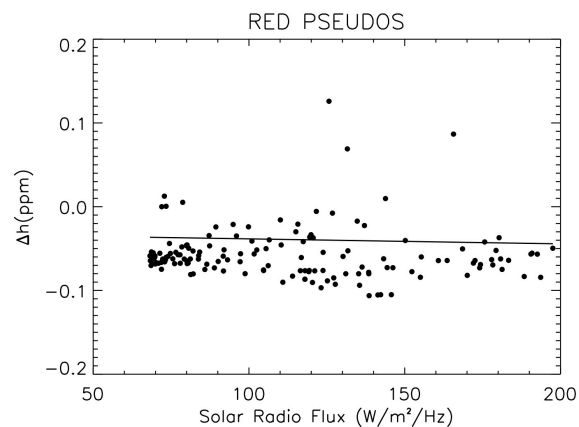
Pseudomodes in Blue and Green gave too much NaN, not used at this time.
Only Red channel pseudomodes used.



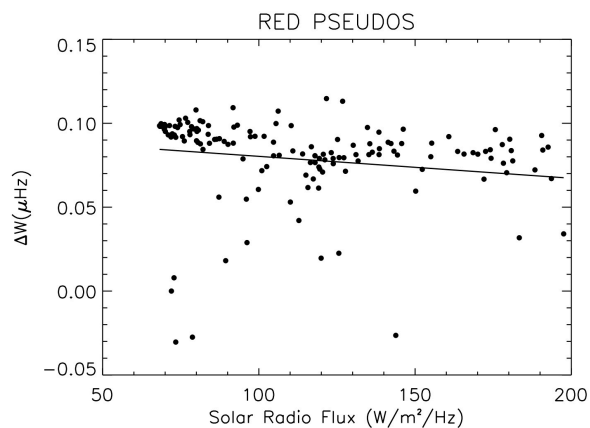
Frequency shifts



Heights



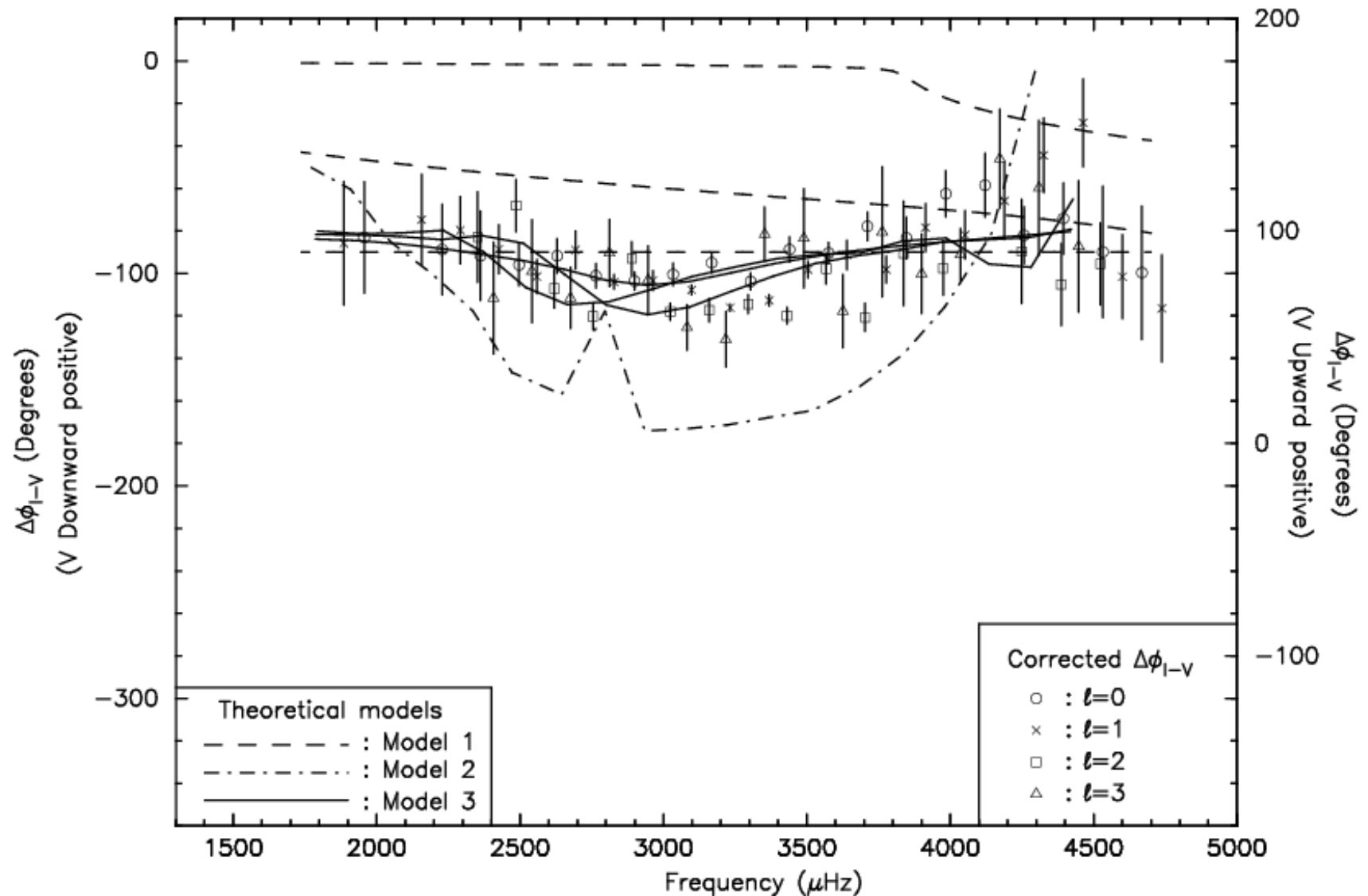
Widths

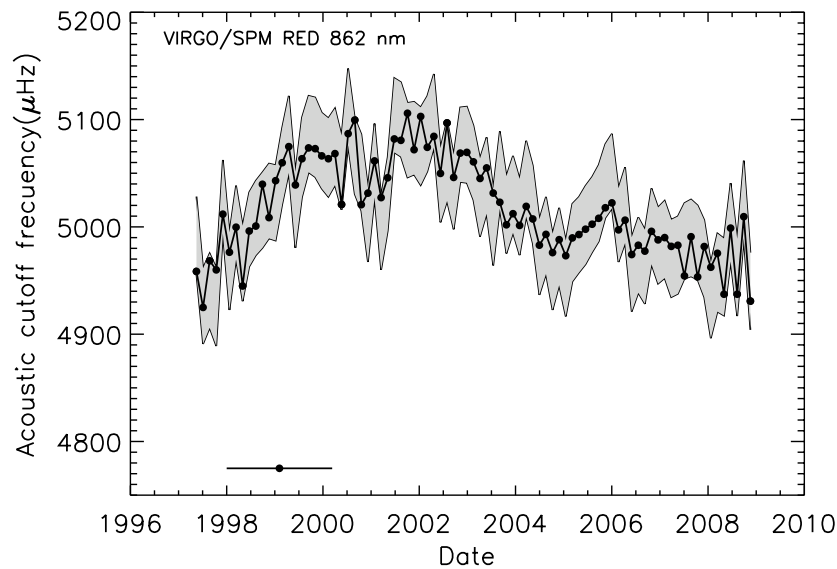


2. Things to do ...(for which I had no time ..)

(A) I-V phase differences and amplitud ratios thought 2 solar cycles

Jiménez et al 1999

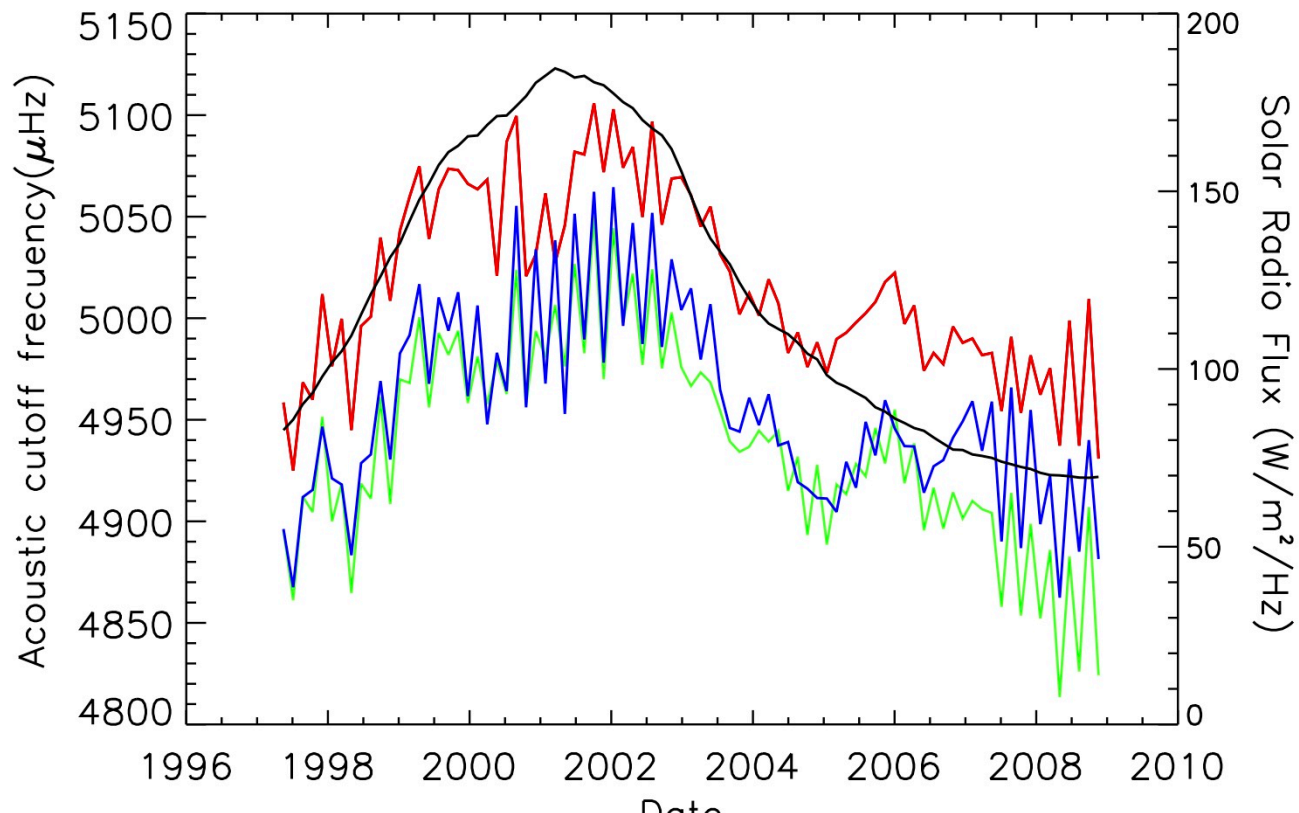




(B) Acoustic cut-off frequency.

Jiménez et al 2011

(C) V_{max}



Conclusions:

1. We have now the frequencies of acoustic oscillations of the Sun between 2300 μHz to 7700 μHz during two Solar Cycles
2. p-modes:
 - a. Frequency shifts: Correlated with Solar Cycle.
 - b. Amplitudes: Anticorrelated with Solar Cycle
 - c. Widths: No clear, may be anticorrelated?
 - c. Splitting: 0.46 μHz , seems some correlation.
3. High n p-modes:
 - a. Frequency Shifts: Seems correlated at minimum and crazy at maximum.
 - b. Amplitudes: Anticorrelated.
 - c. Widths: Anticorrelated (mainly the Red channel)
4. Pseudomodes: (Red Channel)
 - a. Frequency Shifts: No clear conclusions (less dispersion at minimum at again crazy at maximum).
 - b. Amplitudes: No correlated.
 - c. Widths: Anticorrelated.

That's all. Thanks for your attention