Examining quasi-thermal noise on STEREO and CASSINI

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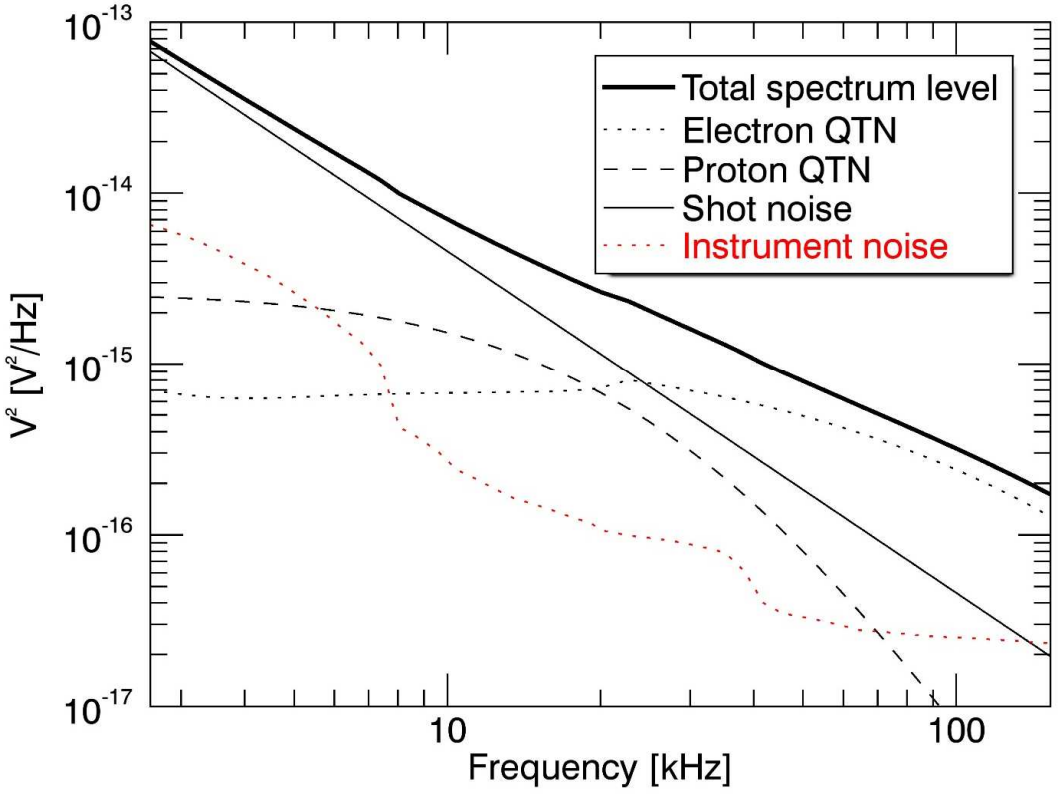
Quasi-thermal noise on STEREO; shot noise model

Quasi-thermal noise on STEREO

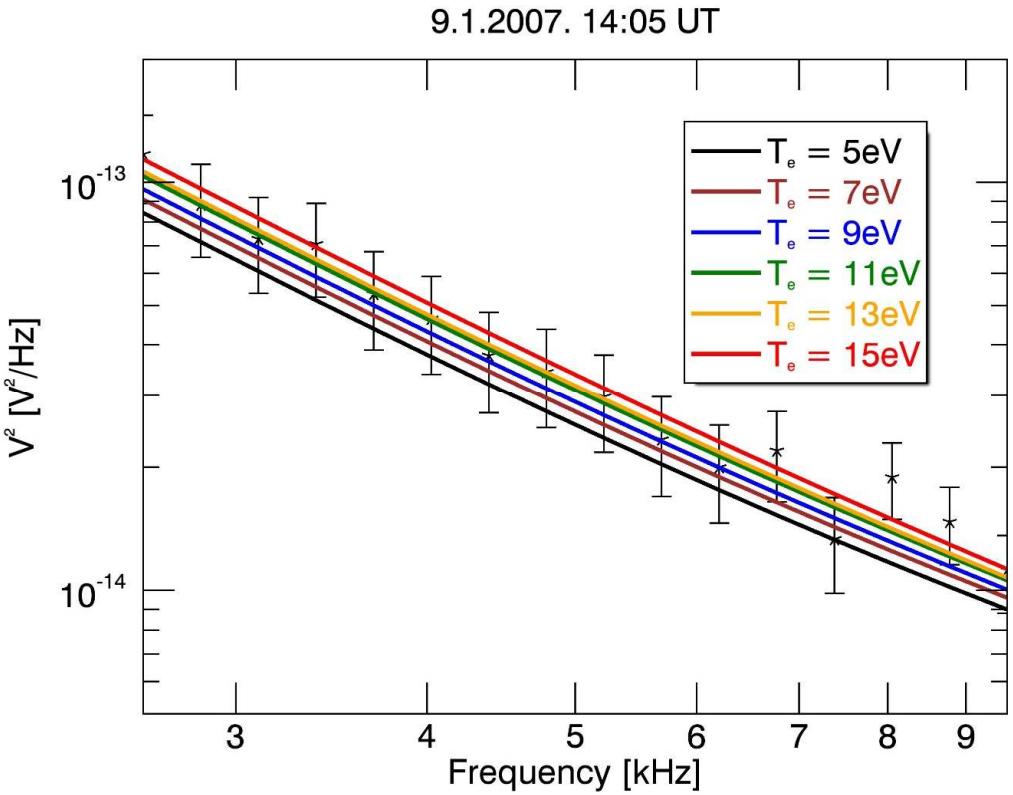
- Multiple difficulties because of short and thick antennas
  - Characteristic “plasma peak” at plasma frequency is not visible in free solar wind
  - Shot noise dominates - electron impact rate to the antenna strongly affects the spectrum

$$V_{sn}^2 = 2e^2 N_{impact} |Z^2|$$



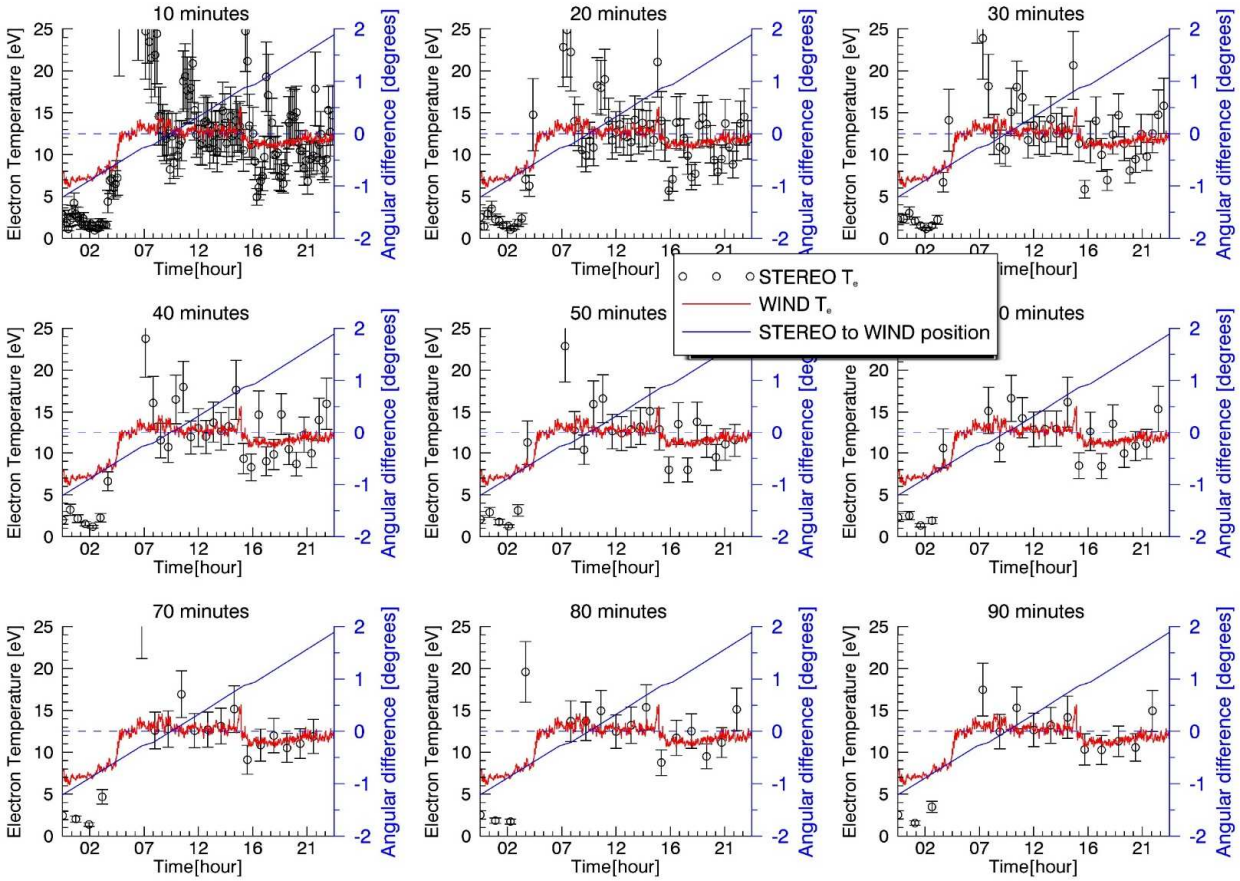
Fitting and averaging of results

- On the nearly flat spectrum only one parameter can be fitted - T_e
  - n_e values are approximated from PLASTIC data as 108% of measured proton density
- Since the model is very sensitive to the spectrum level very high uncertainties appear in the fitting process
  - Results need to be averaged over a certain period of time



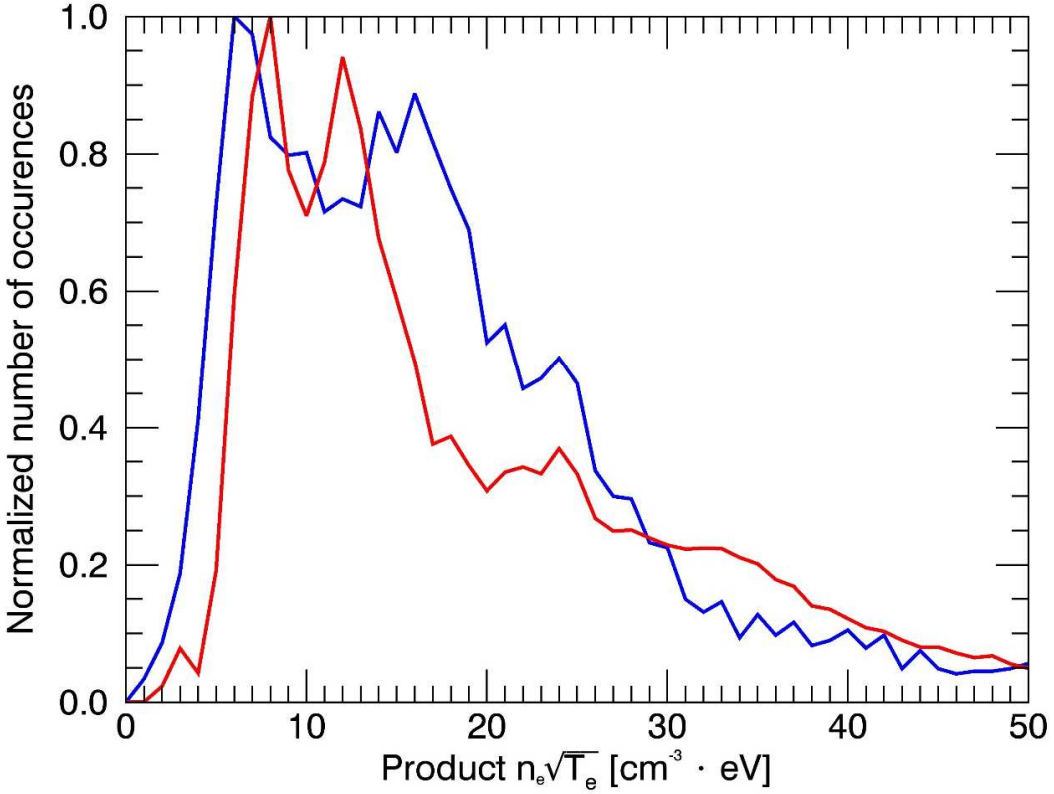
Comparison with WIND

- The day when STEREO B was in line with WIND (9.1.2007) is used
  - To validate results for T_e
  - To chose adequate time interval for averaging of the results



S/WAVES database - ten-month histograms

- At this time, we are able to provide approximate values of $n_e\sqrt{T_e}$
- Problem is in systematic errors in PLASTIC data
- In the future, as soon as the PLASTIC data is updated, we will perform a complete study of the entire STEREO database



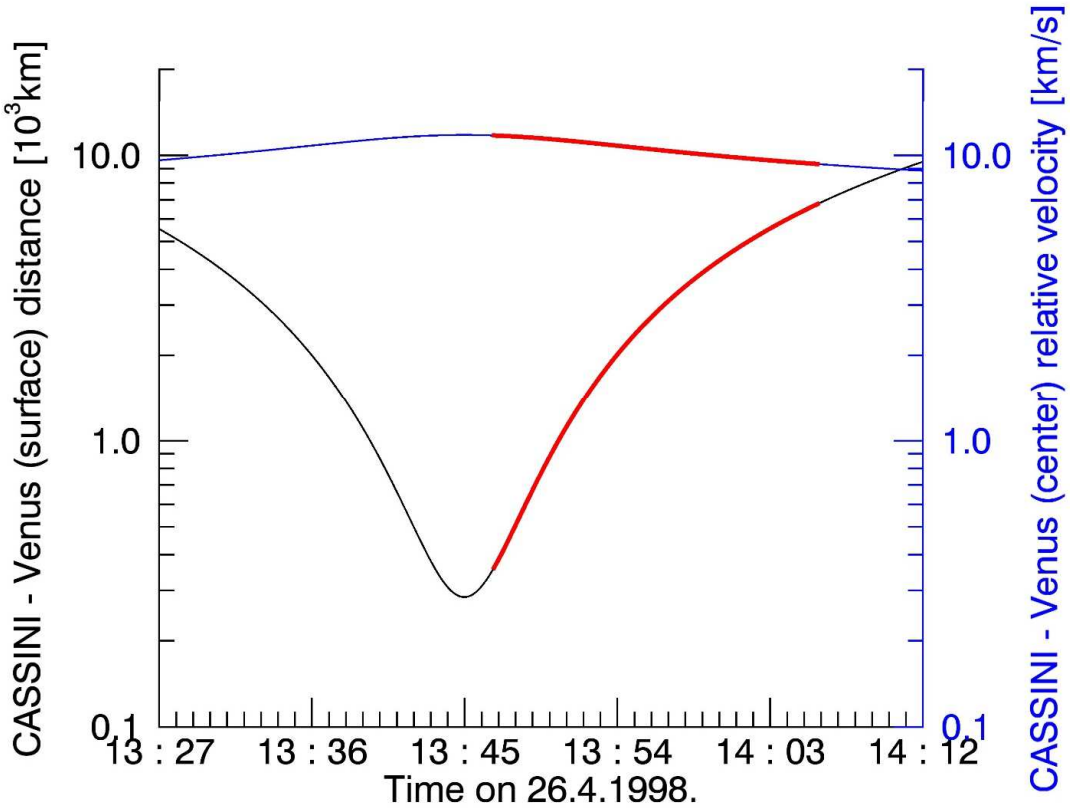
T_e survey - results

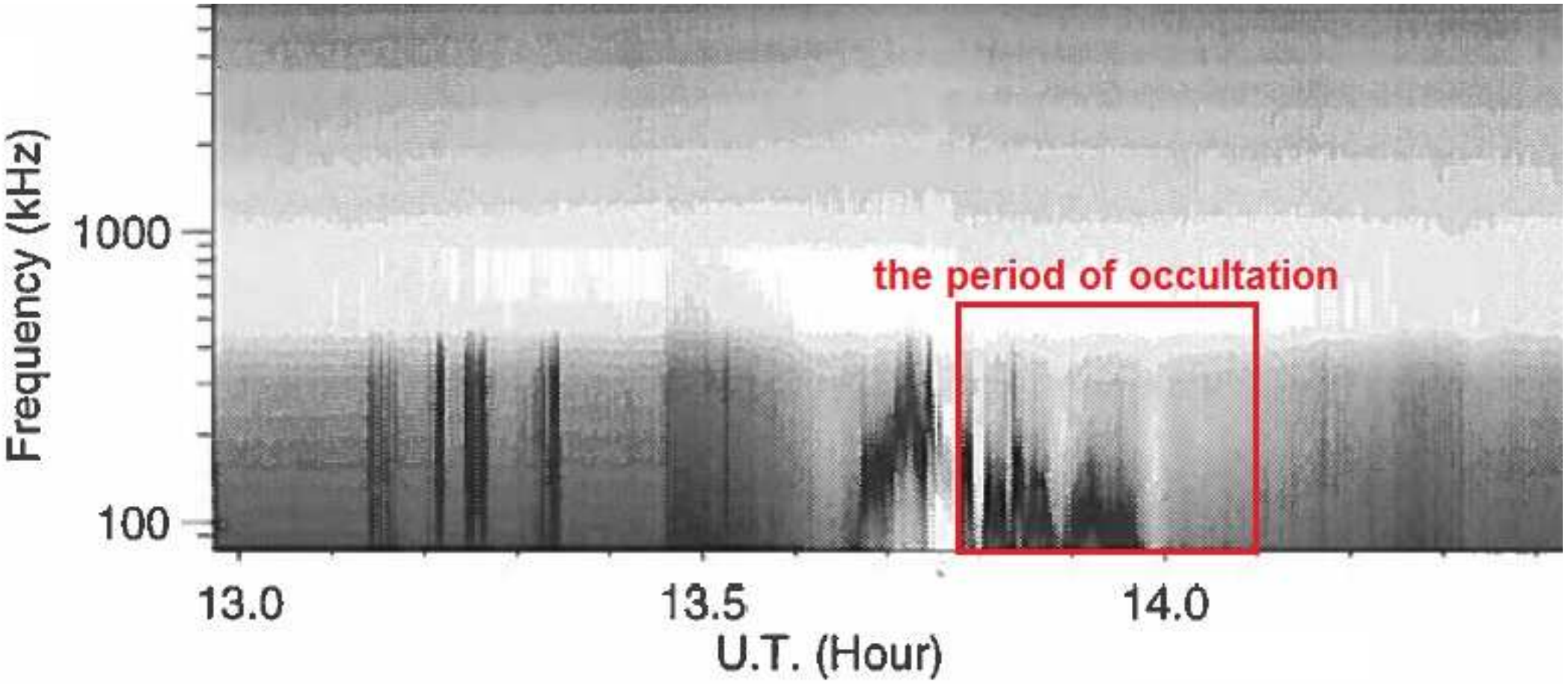
- Possible to realize: “Version 0” data
  - $n_e\sqrt{T_e}$ value will be provided
  - Approximately 85% of the STEREO flight time covered (whenever there is no dust, Langmuir waves…)
  - 1 hour time intervals
  - Uncertainties will be determined after the analysis of PLASTIC data
    - PLASTIC is considered errorless in the present study
    - Expected to be greater then 40%
    - For possible smaller time intervals - error increases significantly
  - Will be made public until the end of 2016.

Quasi-thermal noise on CASSINI during flyby of Venus (work in progress)

CASSINI flyby of Venus

- Near the equatorial plane
- Down to 284km from the planet surface
- CASSINI spends almost 20 minutes in the shadow of Venus




Frequency (kHz)
1000
100
the period of occultation
13.0
13.5
14.0
U.T. (Hour)

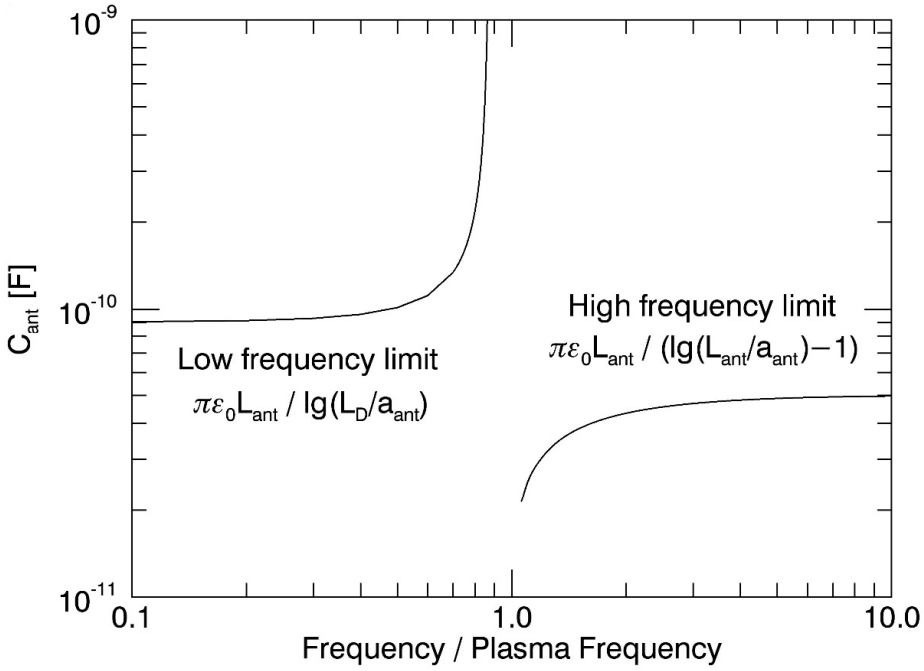
Antenna capacitance - long dipole

- Thermal plasma in the ionosphere
- For $L >> L_D$ antenna capacitance plays a mayor role due to gain

$$\Gamma = C_{ant}/(C_{ant} + C_b)$$

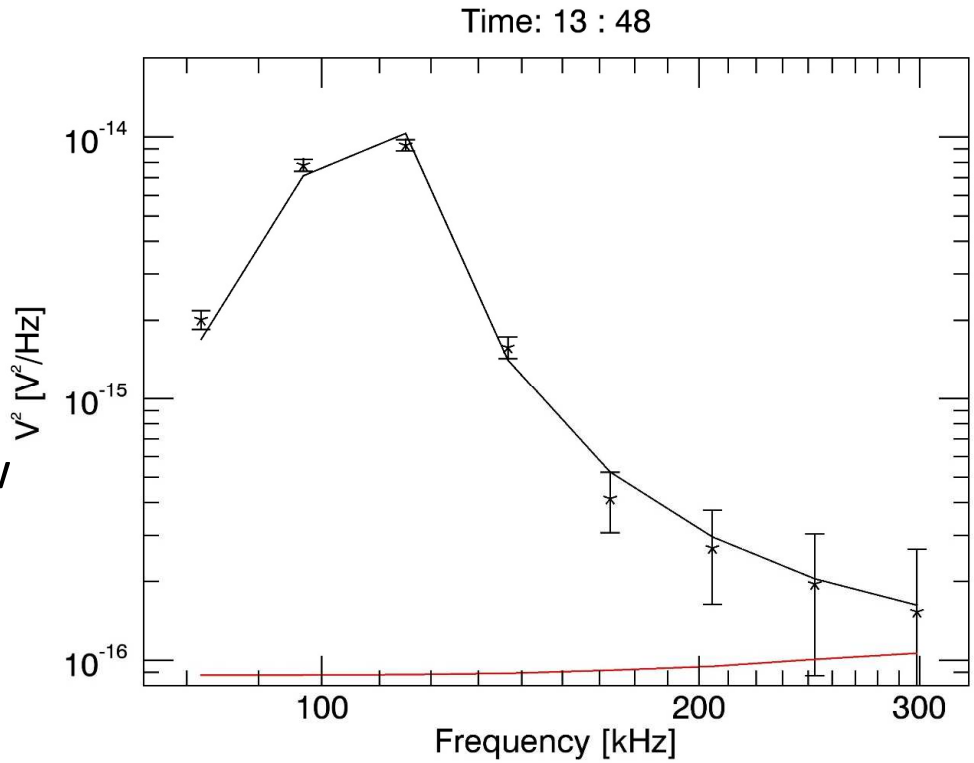
- as

$$V^2_{obs} = \Gamma^2 V^2$$



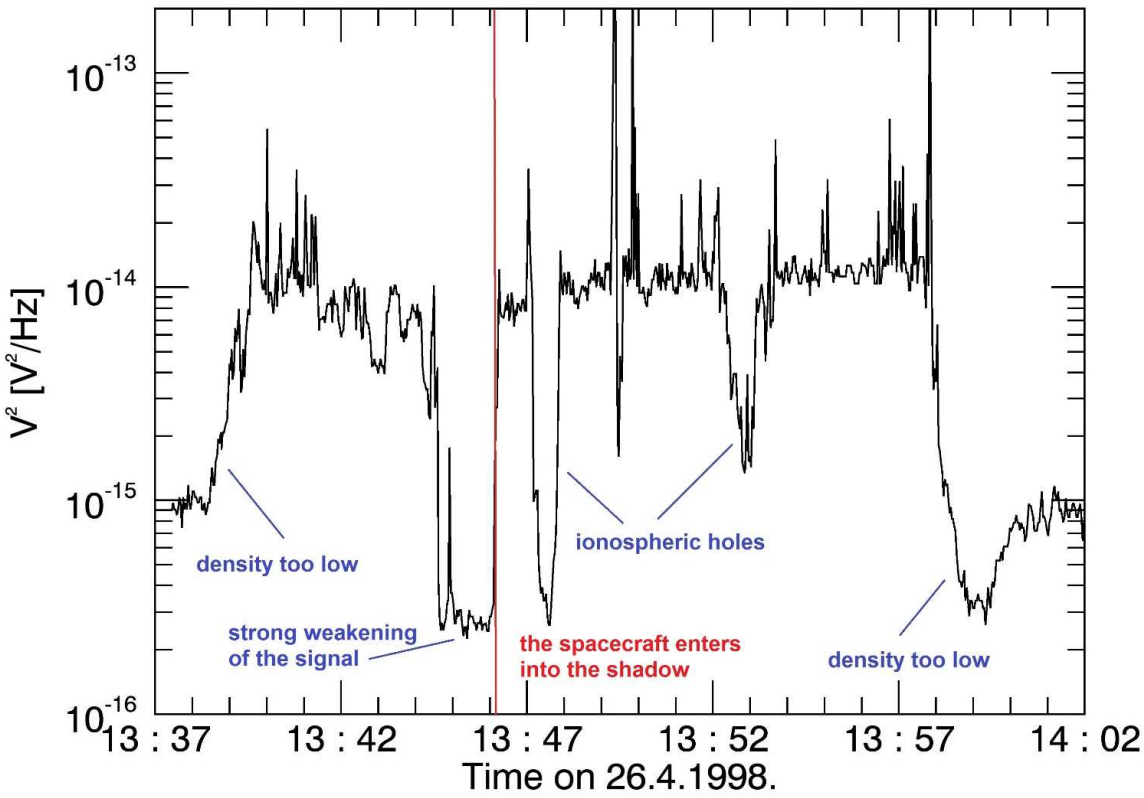
Example of the QTN fit

- Plasma parameters
  - $n_e = 173cm^{-3}$
  - $T_e = 1.1eV$
  - Red line is receiver noise
- Problems
  - Only 8 data points available
  - Results obtained for n_e are below ones from particle analyzers
  - Some unusual behavior of the signal (next slide)



Remaining issues

- QTN peak intensity is on the figure
  - Can't use QTN spectroscopy in ionospheric holes
  - Strong weakening of the signal just before the spacecraft enters the shadow is still not explained



THANK YOU FOR YOUR ATTENTION!!!