The 9th international Workshop in Air Shower Detection at High Altitudes
17-18 September 2018 Moscow

Variations of thermal neutron flux in the Moon-Earth-Sun geophysical relations

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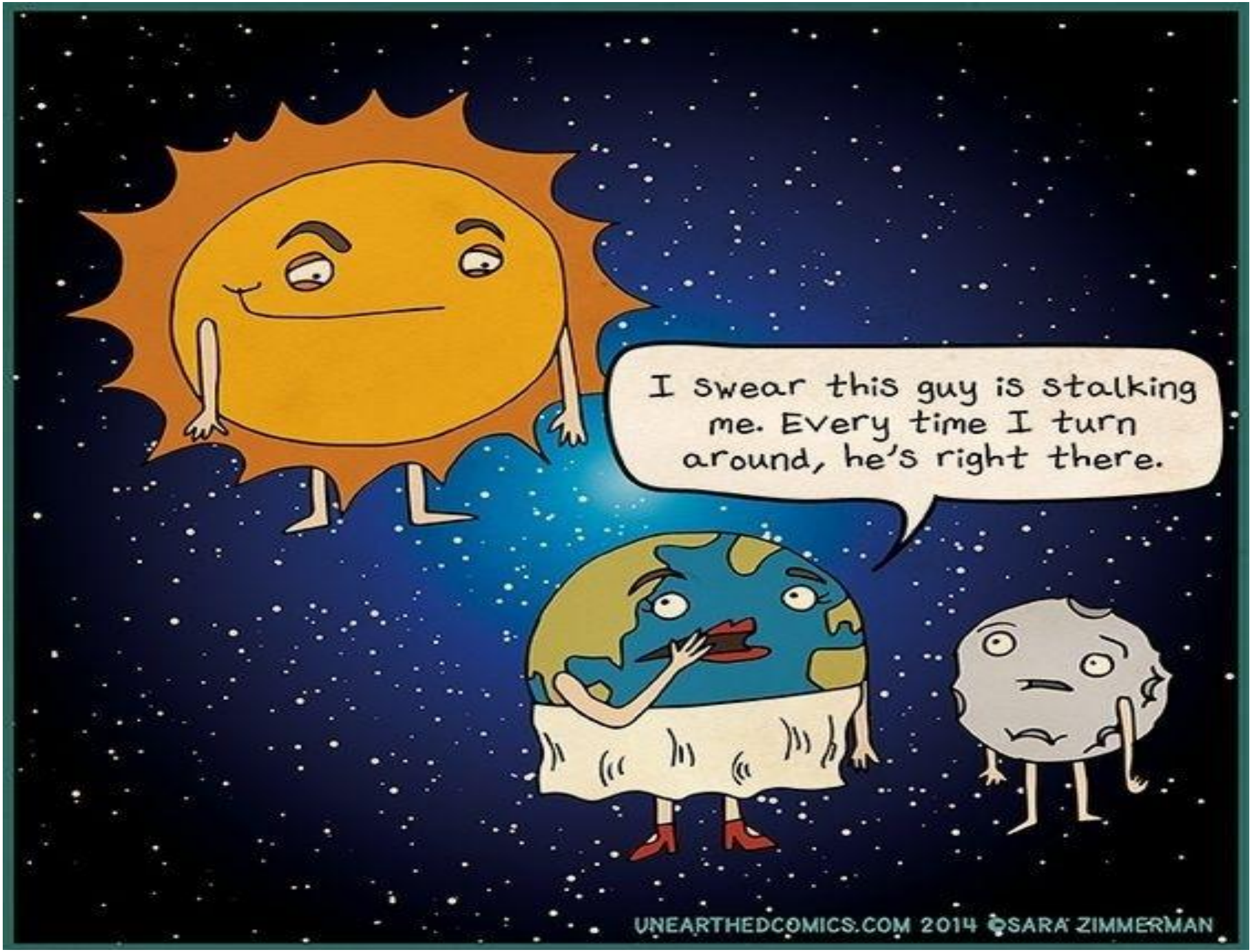
Original results of Fast Fourier Transformation of thermal neutron flux will be presented.

Those will be considered on the occasions of:

Moon Tidal Effect(or Radon-due neutron tidal wave) **,**

EarthQuakes, Free Earth Oscillations, Magnetic Storms.


I swear this guy is stalking me. Every time I turn around, he's right there.
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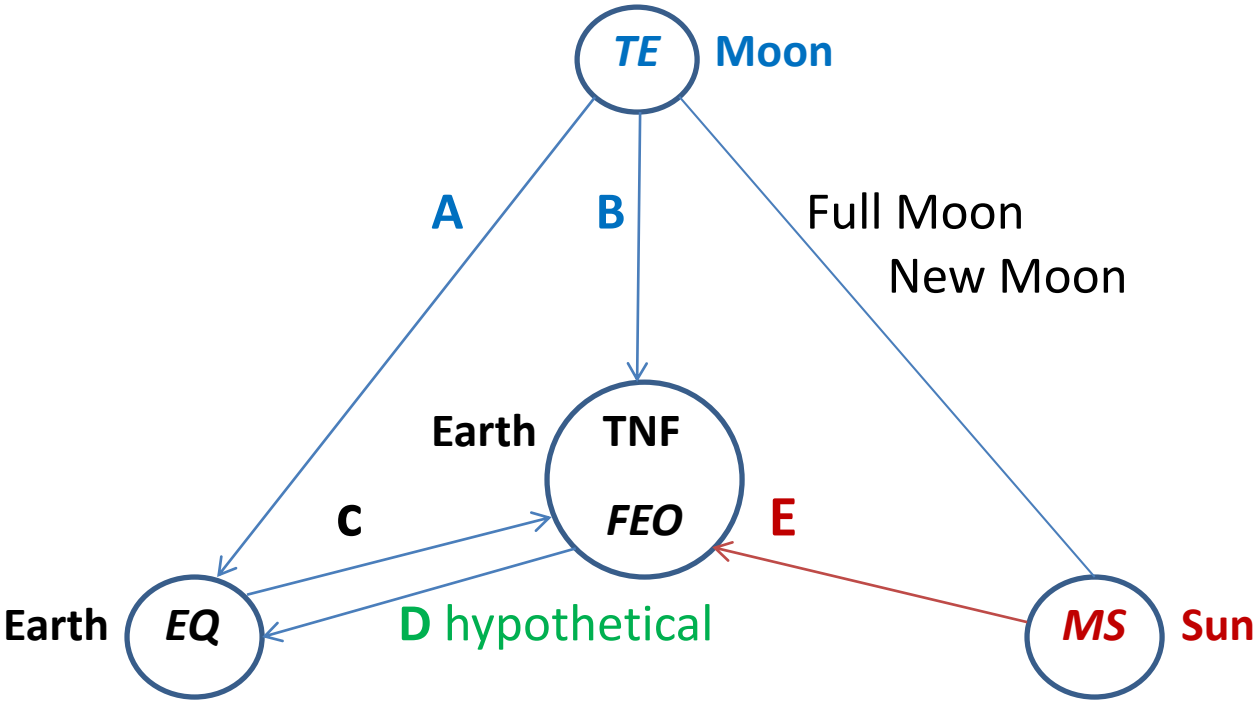
Content of the report

- Introduction
- Results
- Summary

Introduction

Moon Earth and Sun as the actors in the Nature play

A, B, C, D, E := ties between actors and phenomena



TNF-thermal neutron flux

Phenomena :

TE - gravitational Tidal Effect ***FEO*** -Free Earth Oscillations ***EQ***-earthquake

MS - magnetic storms

A, B, C, D, E := *ties* between actors and phenomena

those are for study

in neutron

variational

programme

What for ?

- Initial guiding light = *quite a long time ago geophysicist have noticed the time correlation between EQs and Moon months := tie A!*

  And can we, - *more correctly-neutron variational programme, -- to add something to geophysical knowledge ?*

- Final aim = *to predict EarthQuakes*

  Not less ! And may be even more !?

  Hmm …

Instrument :

thermal neutron detector *en*-detector

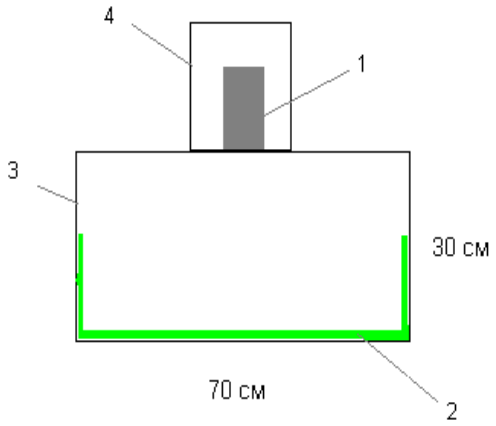
Data process approach:

Fast Fourier Transformation

FFT is the most effective way to get info about existence in a process of some periodicity.

Instrument

Schematic layout of the *en*-detector of **thermal neutrons**



- 1 - PMT
- 2 – working compound
- 3 - box for compound
- 4 – cap for PMT

essense compound : $^{6}LiF+ZnS(Ag)$

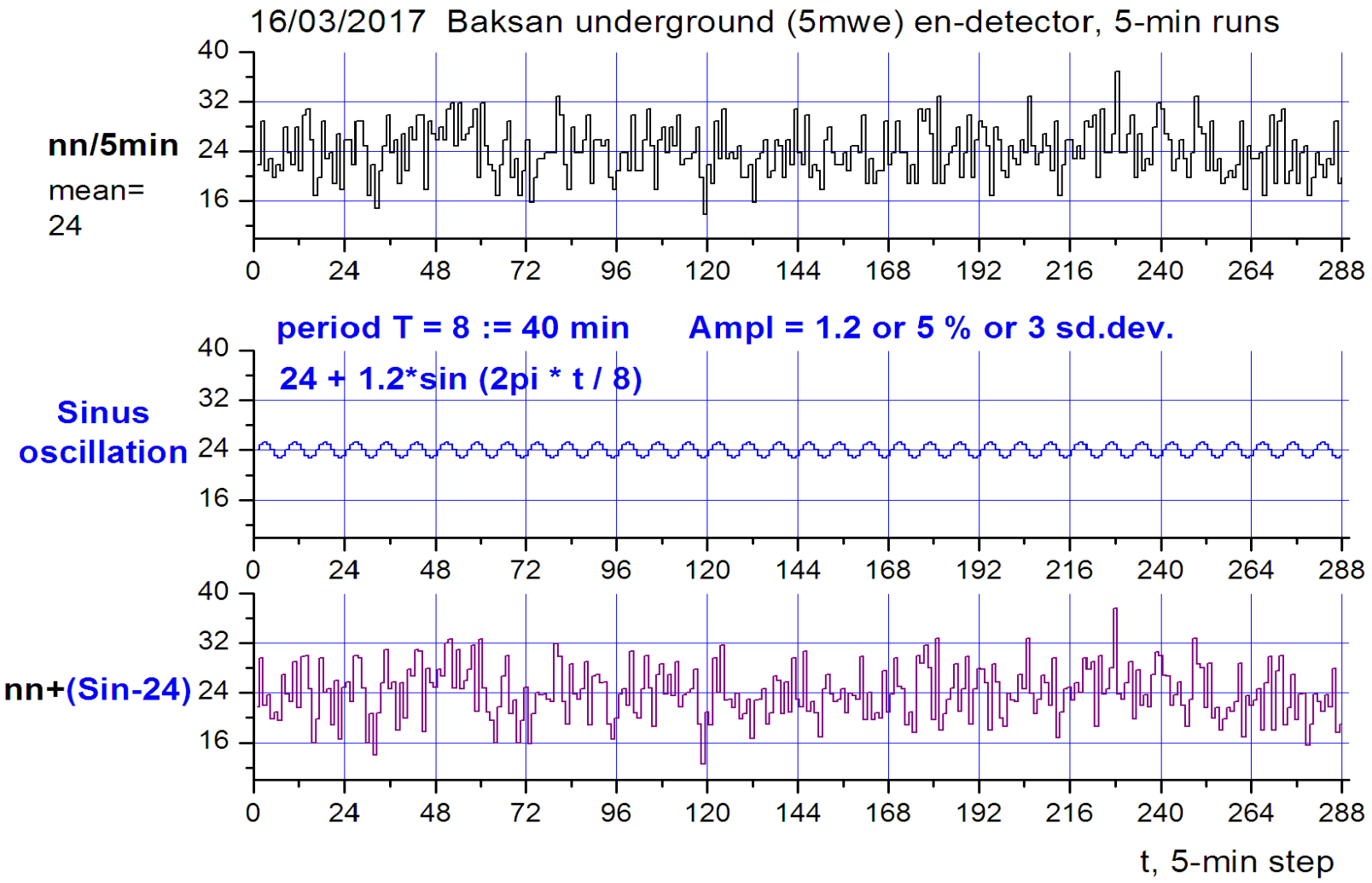
- Nuclear reaction in use:
- $^{6}Li + n \Rightarrow {}^{3}H + \alpha + 4.8$ Mev.
- Efficiency = 20 %
- Resulting particles produce scintillations in ZnS(Ag) which are registered by PMT .. at different geo sites -> global net of en-detectors

5-min(1-min after 2014) PMT's counting rate points, 288 points(1440)/day

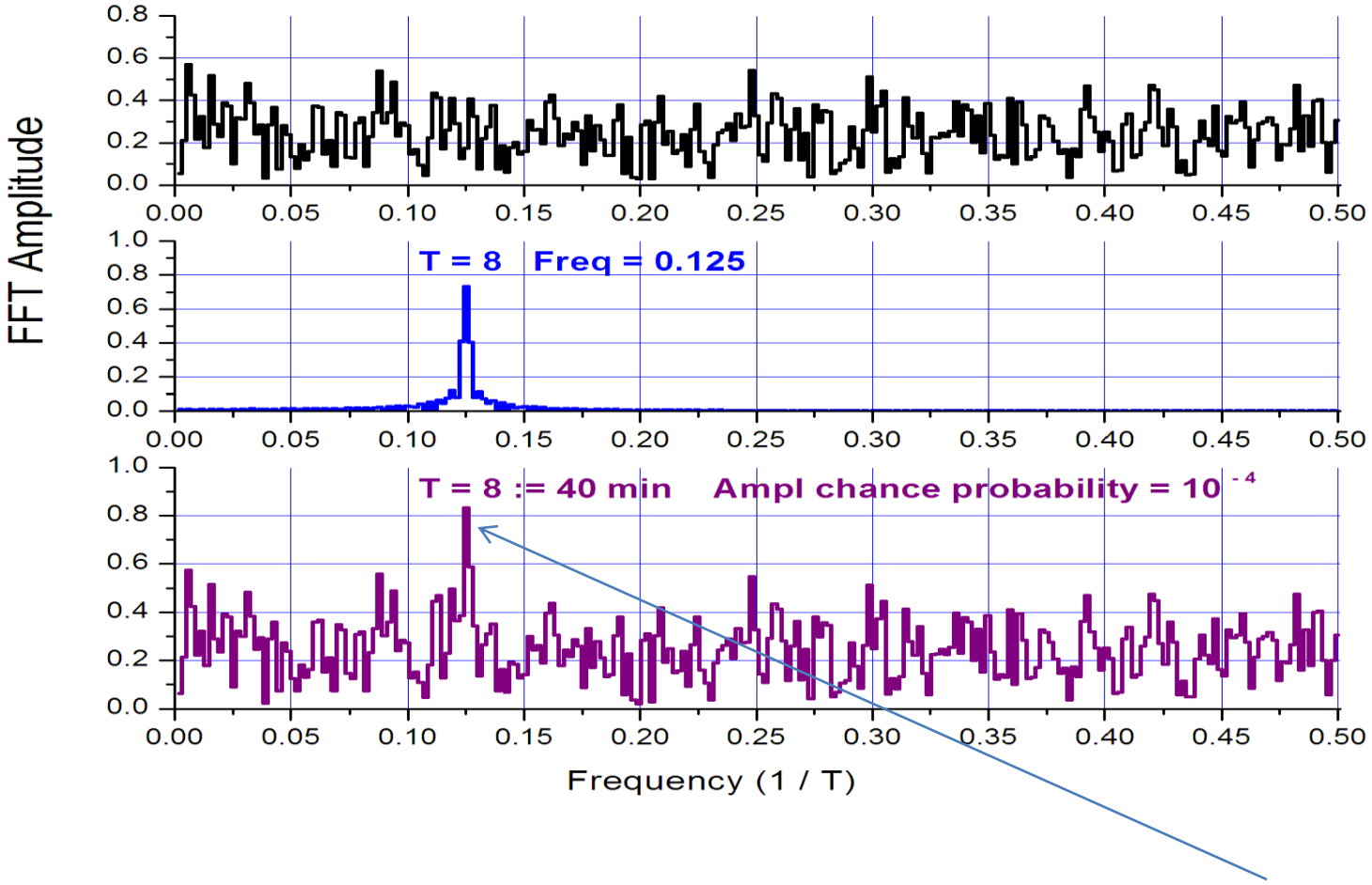
day after day, during months..

Data process approach: FFT

Picture shows possible hidden periodicity in experimental data :



Let us take a look at Fourier Transformation results for three time sequences from previous slide :



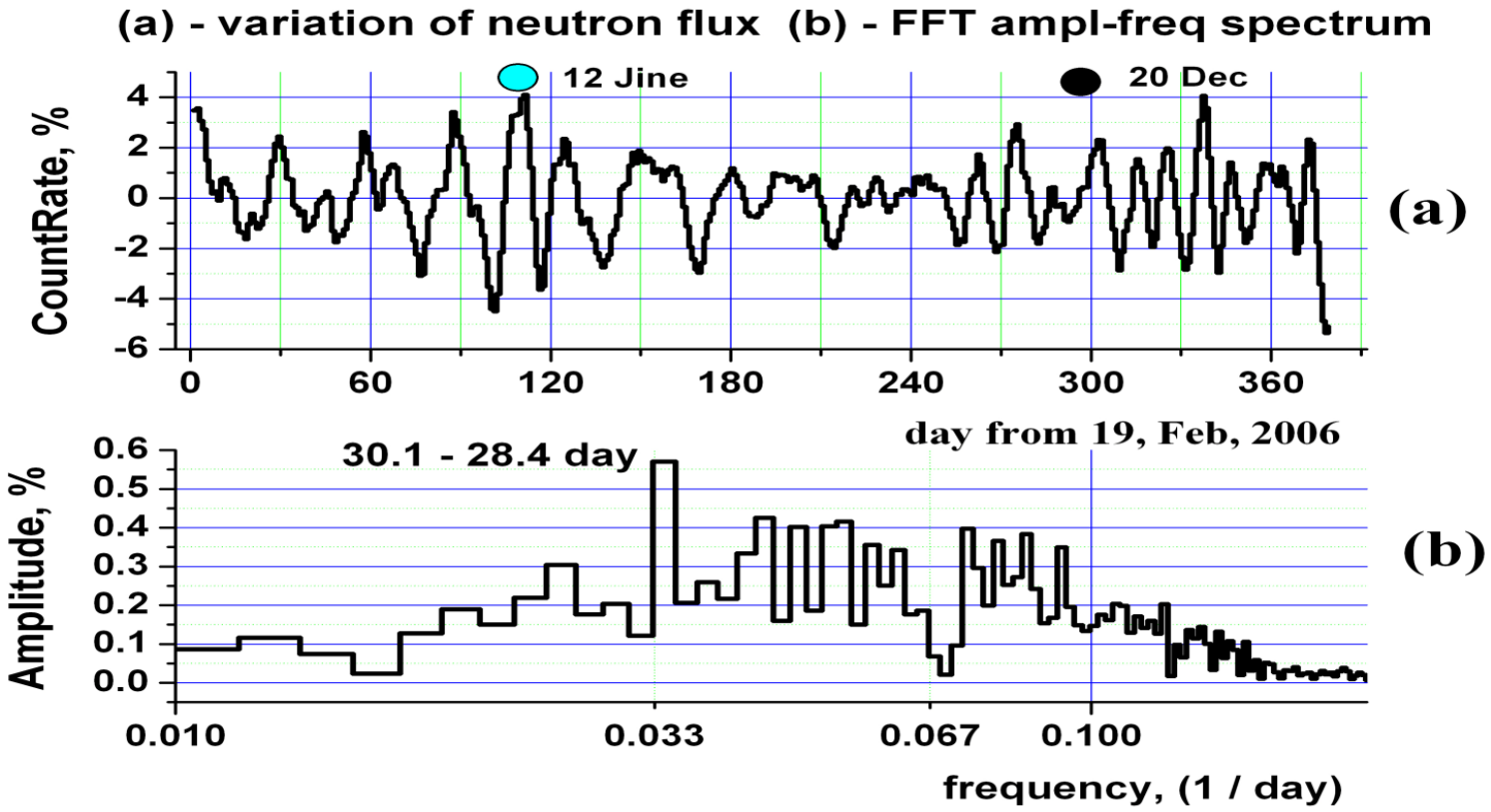
OK !, the hidden 40-min oscillation is successfully extracted

Results

..due to lack of the time number of shown pictures will be limited

Tie **B.** Old(2006year) Baksan FFT result: *Moon-Earth* Radon-due neutron tidal wave

Full Moon New Moon

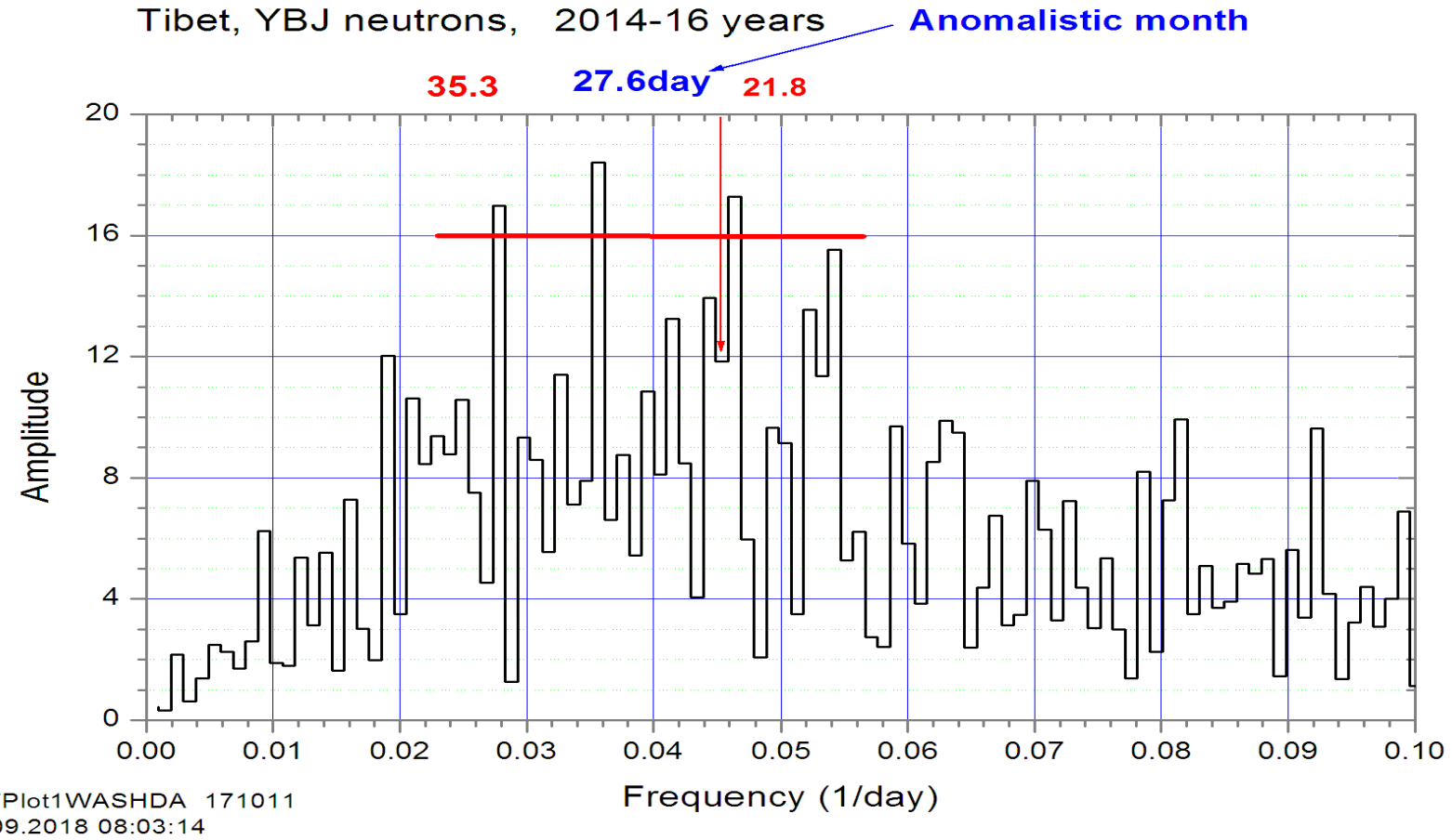


Synodic month = 29.53 day, period between two Full Moons (or New Moons)

Anomalistic month = 27.55 day, period between two perigees

Tie **B.** New(2014-16years, ~ 9 years after Baksan) Tibet FFT neutron result:

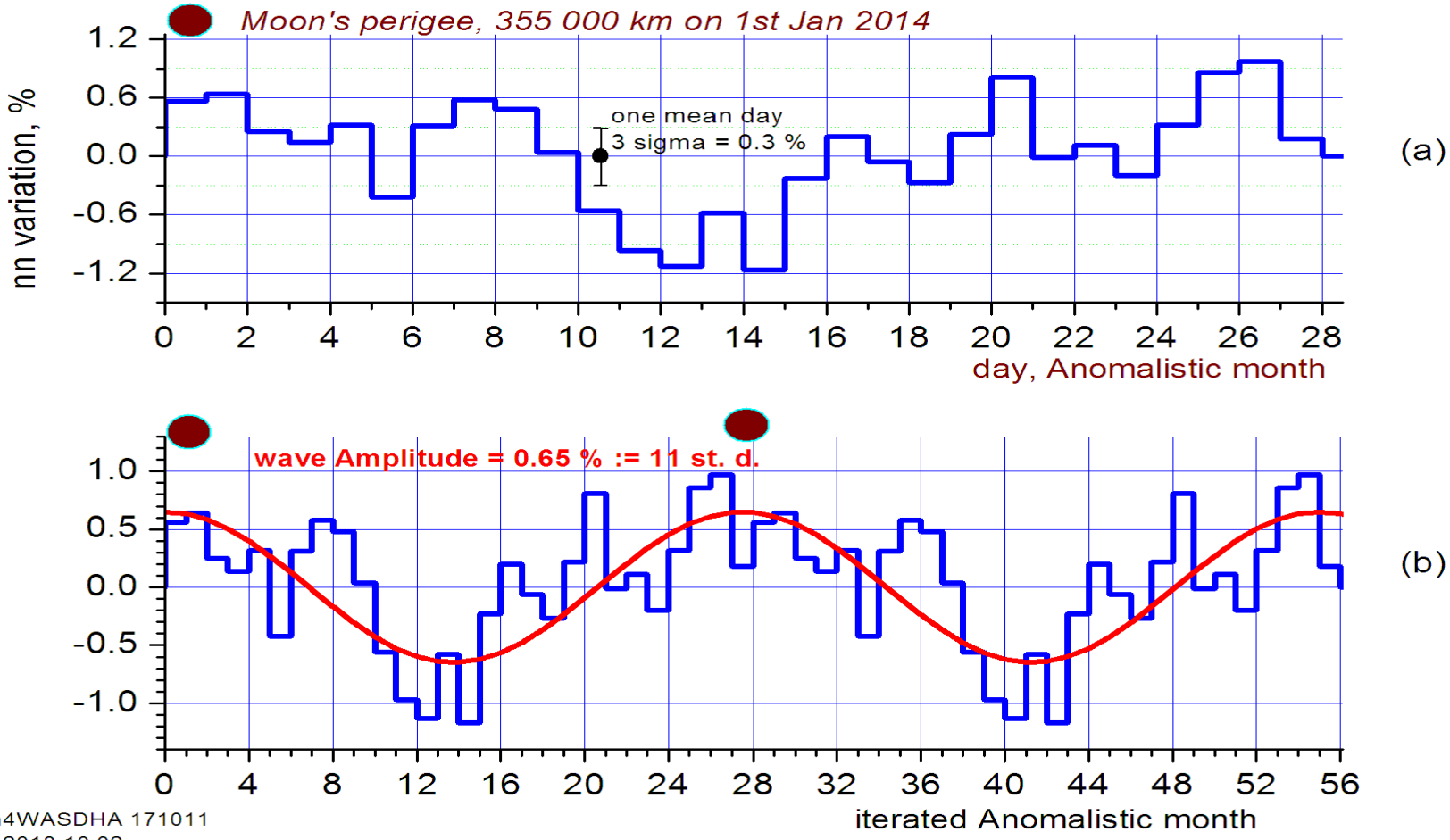
Moon-Earth Radon-due neutron tidal wave



Remember , please, 35.3 and 21.8 min periodicities

Tibet Moon-Earth Radon-due neutron tidal wave

Tie **B.** The nearer Moon - the more gravitational tidal force - the more excalating Radon - the more neutrons.



First basic preliminary conclusion -

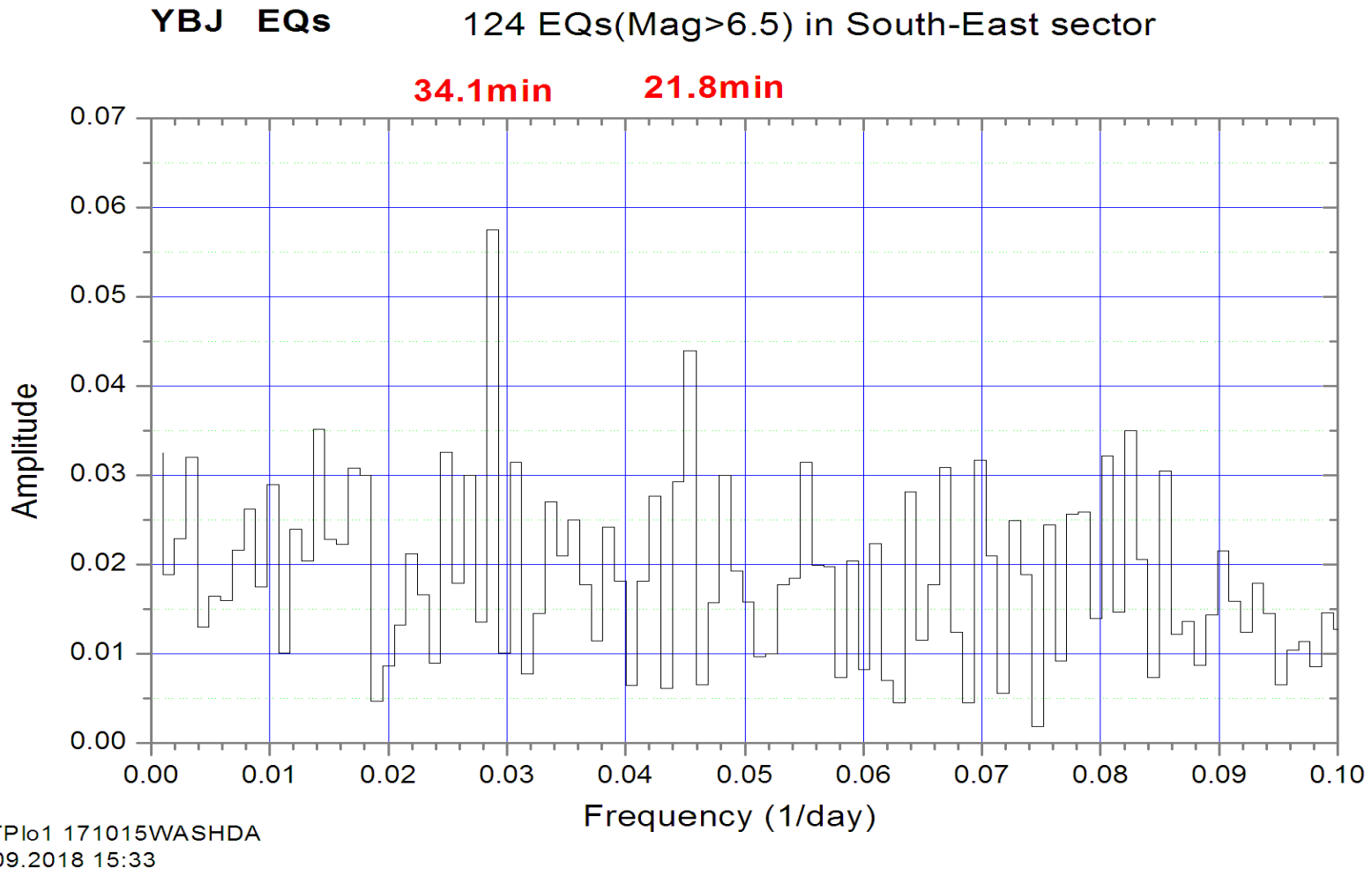
en-detector

feels and demonstrates

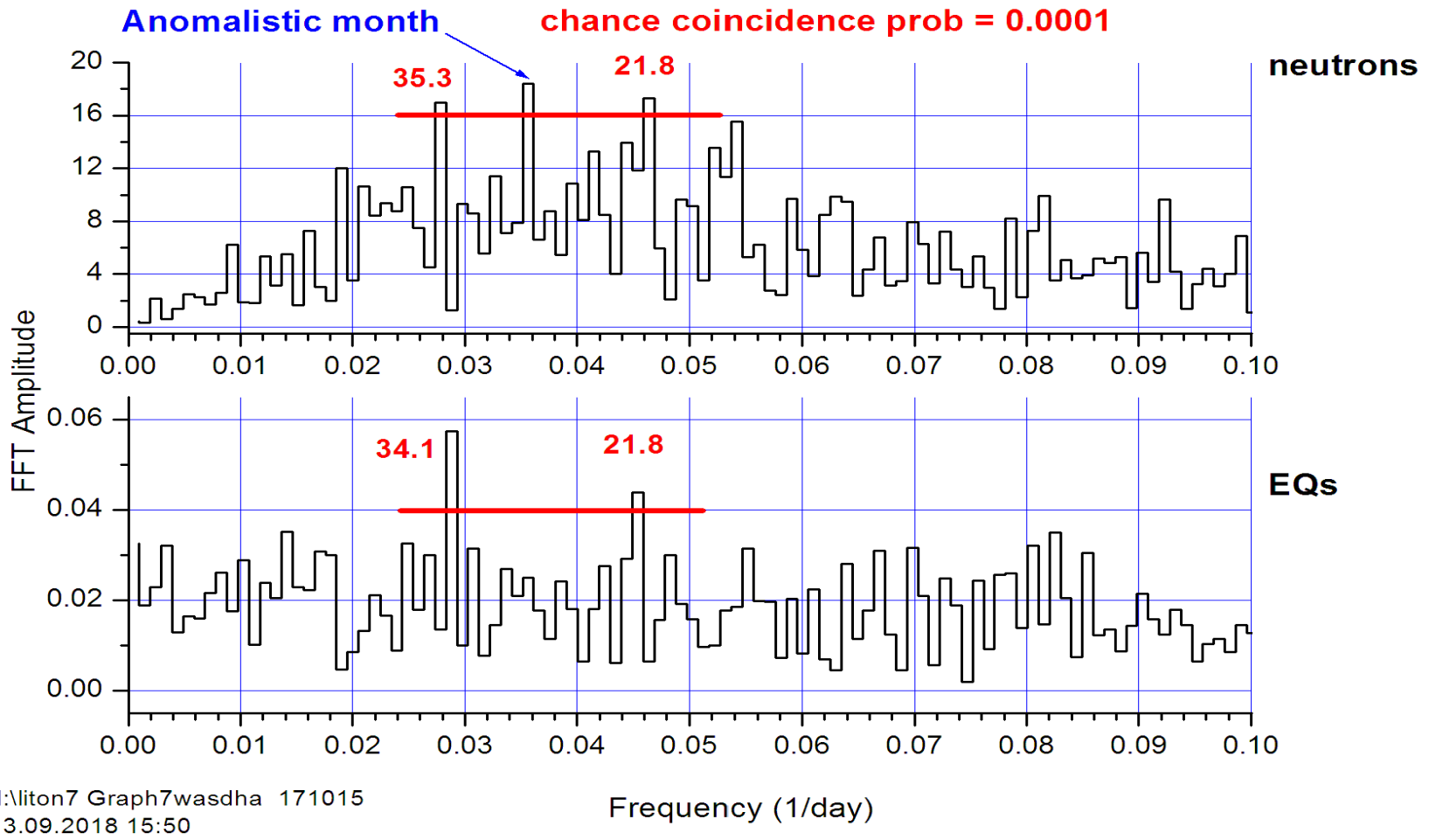
Moon tidal effects

Tie **C.** FFT for Tibet EarthQuakes :

? do you remember 35.3 and 21.8 min periodicities in neutrons? on slide #13



Tie **C**. Thermal Neutrons < -- > EarthQuakes coincidence



Second basic preliminary conclusion -

en-detector

feels

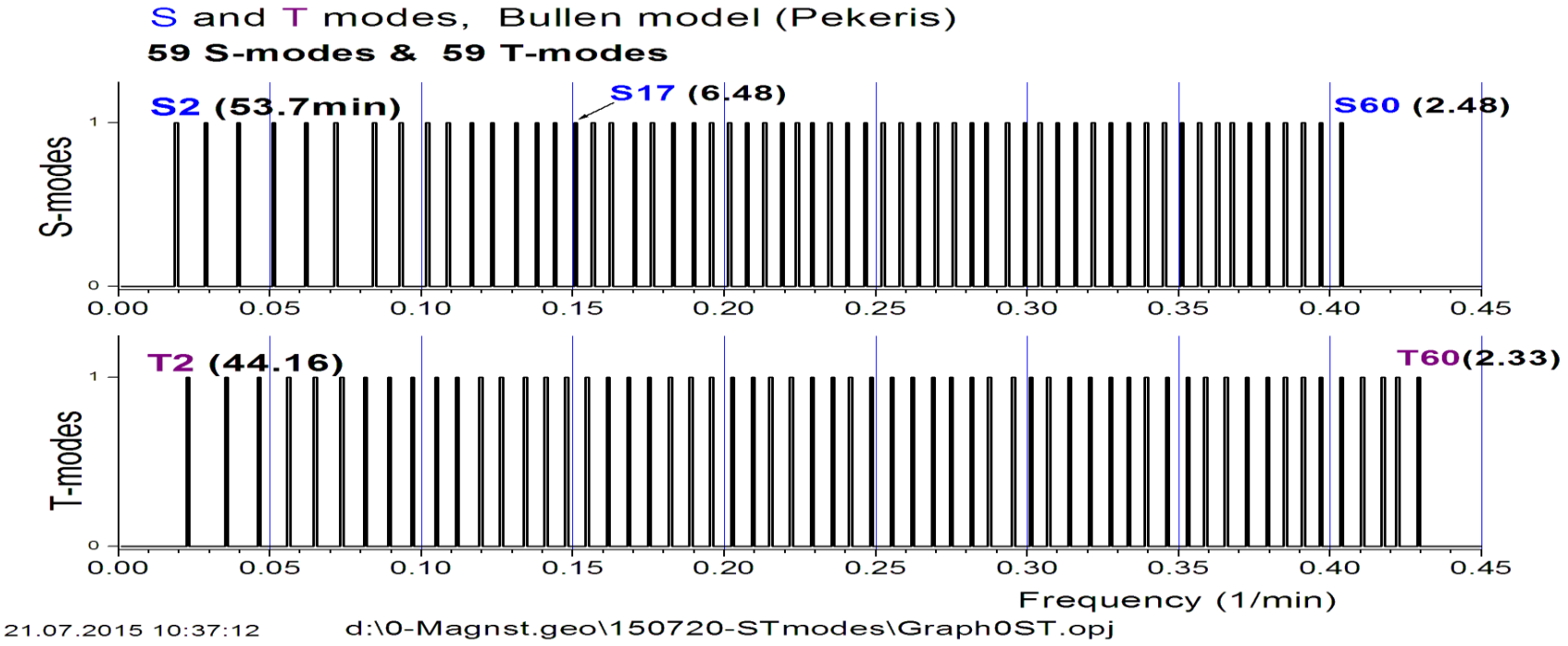
EarthQuakes

Next two slides concern to -

- theoretical spectra of Free Earth Oscillations

- original method of diagnosis of FEO

There is one interesting classic phenomenon in geophysics – Free Earth Oscillations.
Everyone knows: after the bell's tongue hits body of the bell, the bell begins to ring.
The same happens with Earth after Earthquake ->
→ result is FEOs, *tie **C**,* well known to geophysics phenomenon
spheroidal "S" and torsion "T" oscillations, with overtones.

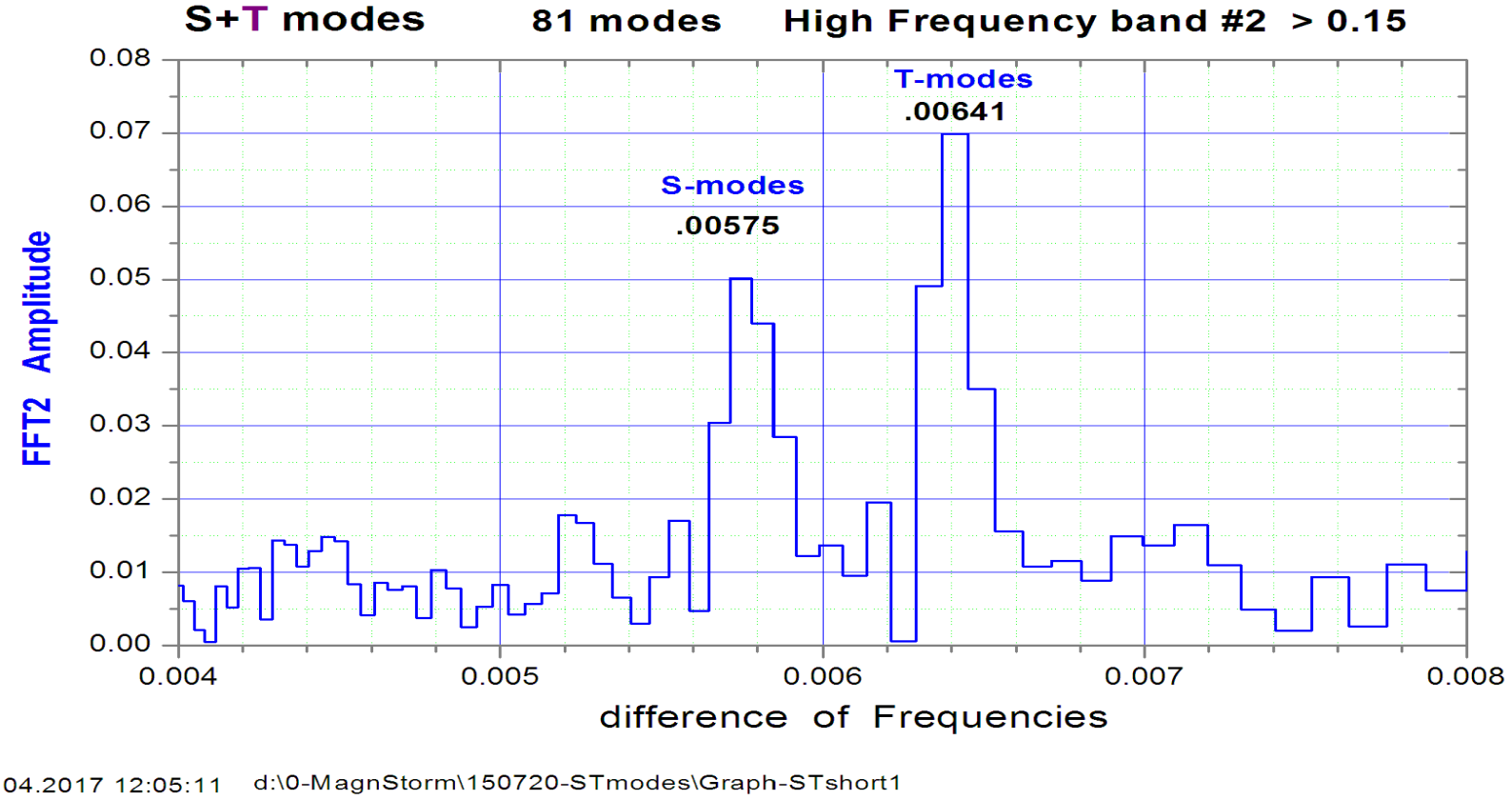


Note: ***quasi distant frequency distribution !, obvious periodicity in difference of adjacent Frequencies.***

Hence, let us apply FFT to S and T sets of FEO modes :

Second order FFT2 = FFT(S+T), ← *original diagnostic of FEO*

X-axis : doF == difference of Frequencies :



So, we understand now that if we see in FFT2-result some significant peaks at appropriate position of doF-axis – it means *the inherence of FEO oscillations* in the primary FFT spectrum.

Now –

to experimentally observed

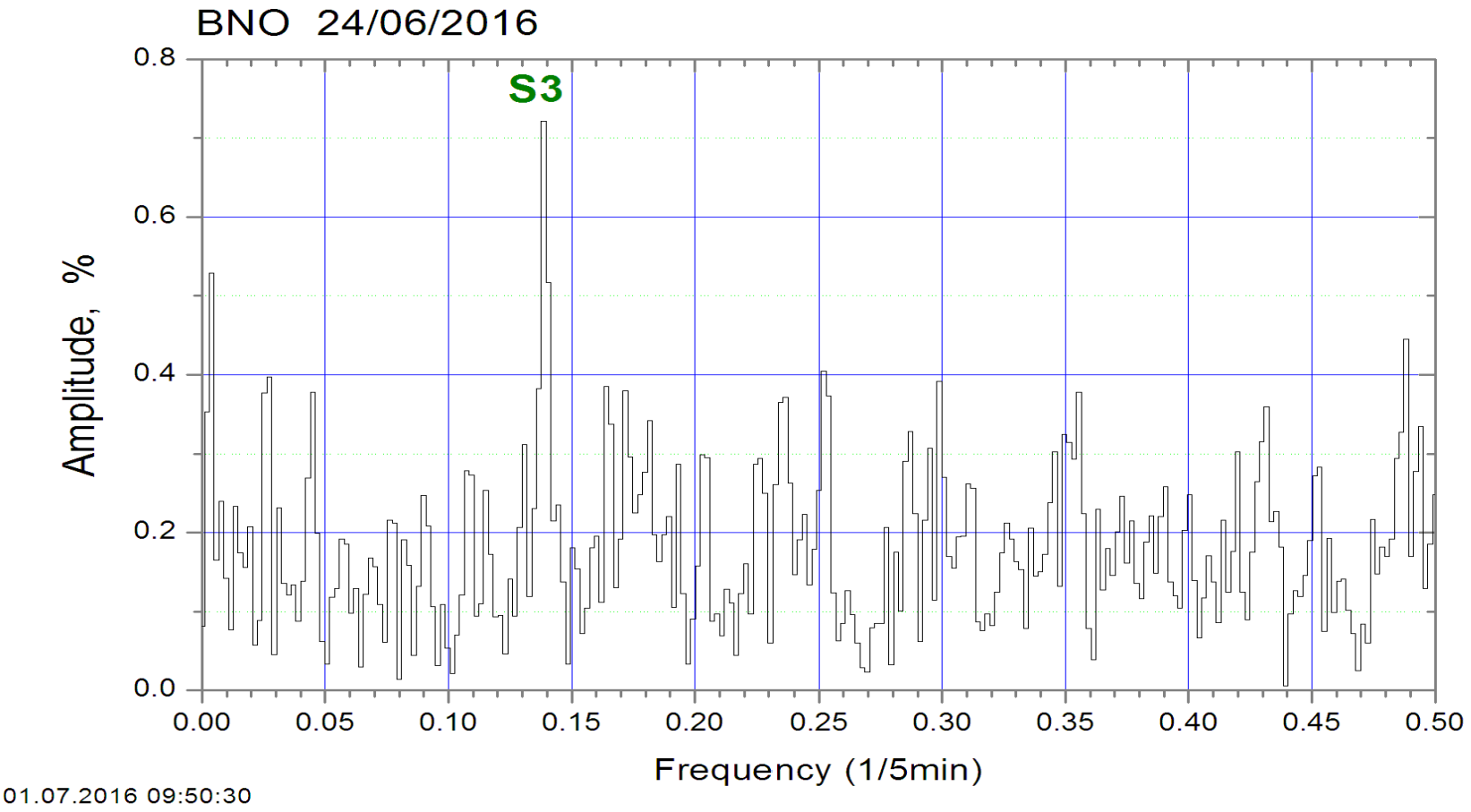
Free Earth Oscillations

in thermal neutron flux

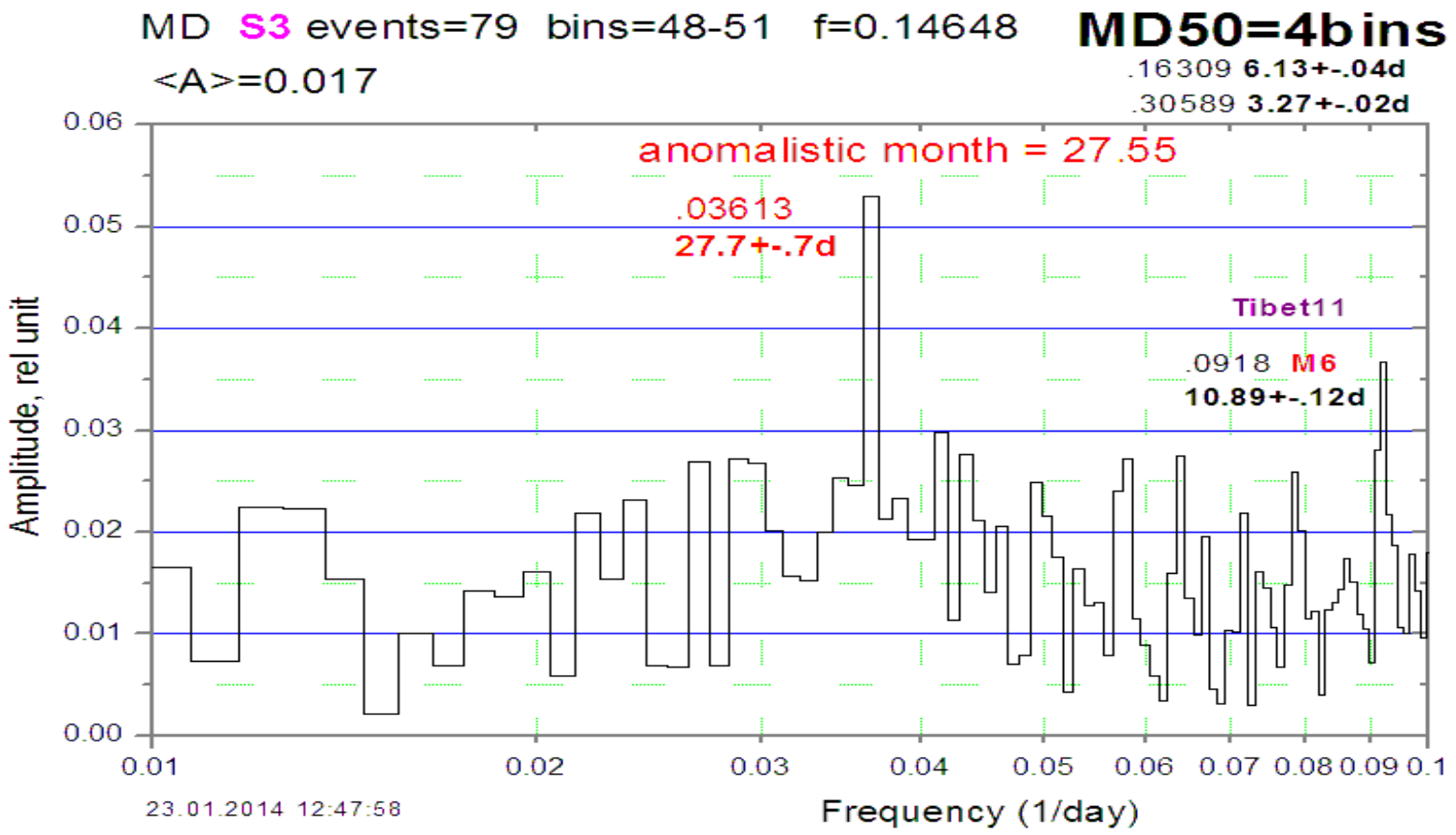
An example of Baksan registration of **S3** FEO mode on **24 June 2016**

But ! No powerful EQs with magnitude > 6.5 !?

Chance probability to get such peak = E(-6)



Sequence of days stirred up with **S3** mode was processed with FFT procedure .
Anomalistic periodicity (distance Earth-Moon) of excitation of **S3** FEO : tie B ??:



And immediately arises one formal for a moment question:
and/or ***tie E ?? := synodic period of Sun rotation is 27.3 days !!***

Third basic preliminary conclusion -

en-detector

feels

and

understands

Geophysics –

Moon tidal effects, Earthquakes

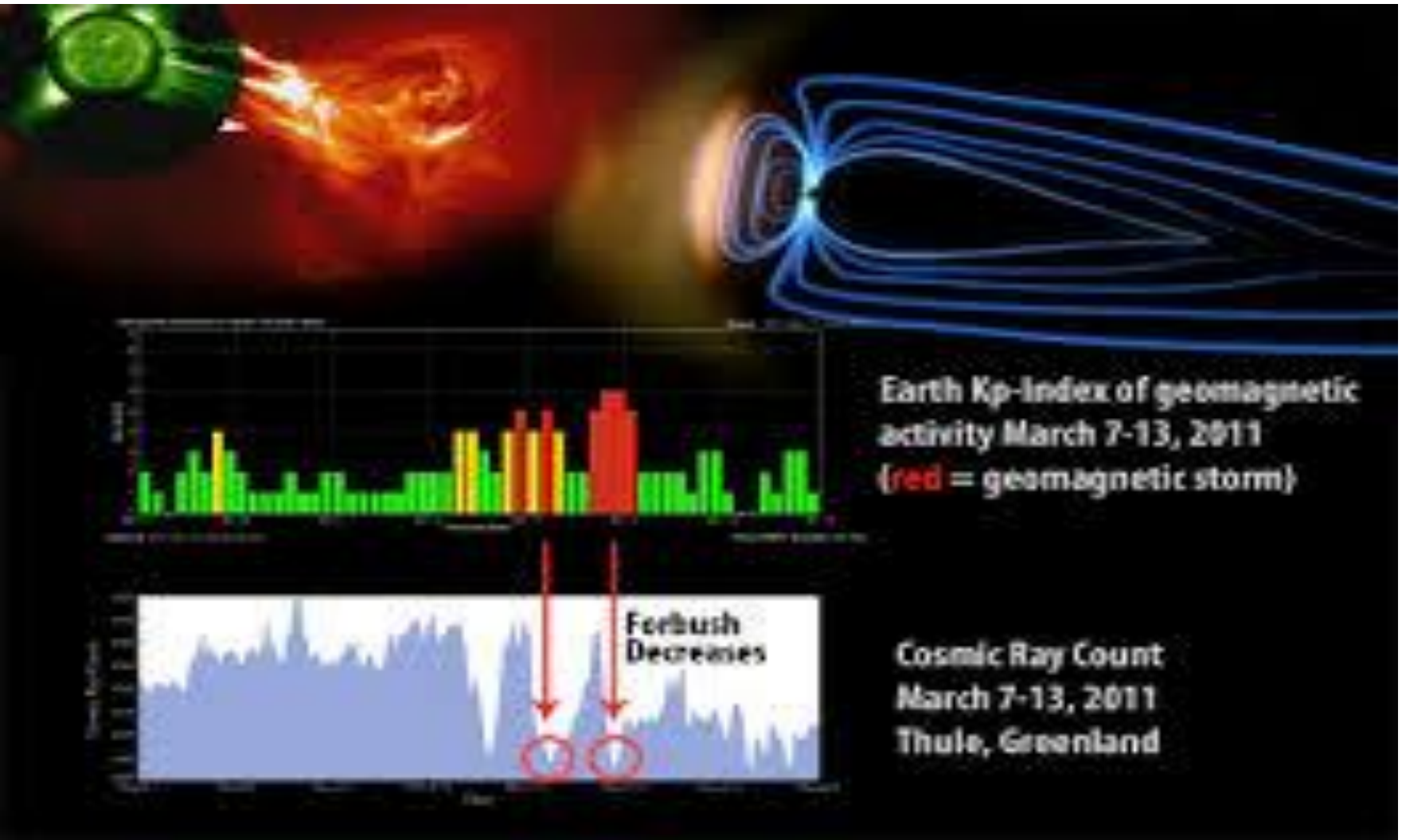
Free Earth Oscillations

Let us come back to the formal for a moment question (slide #24):

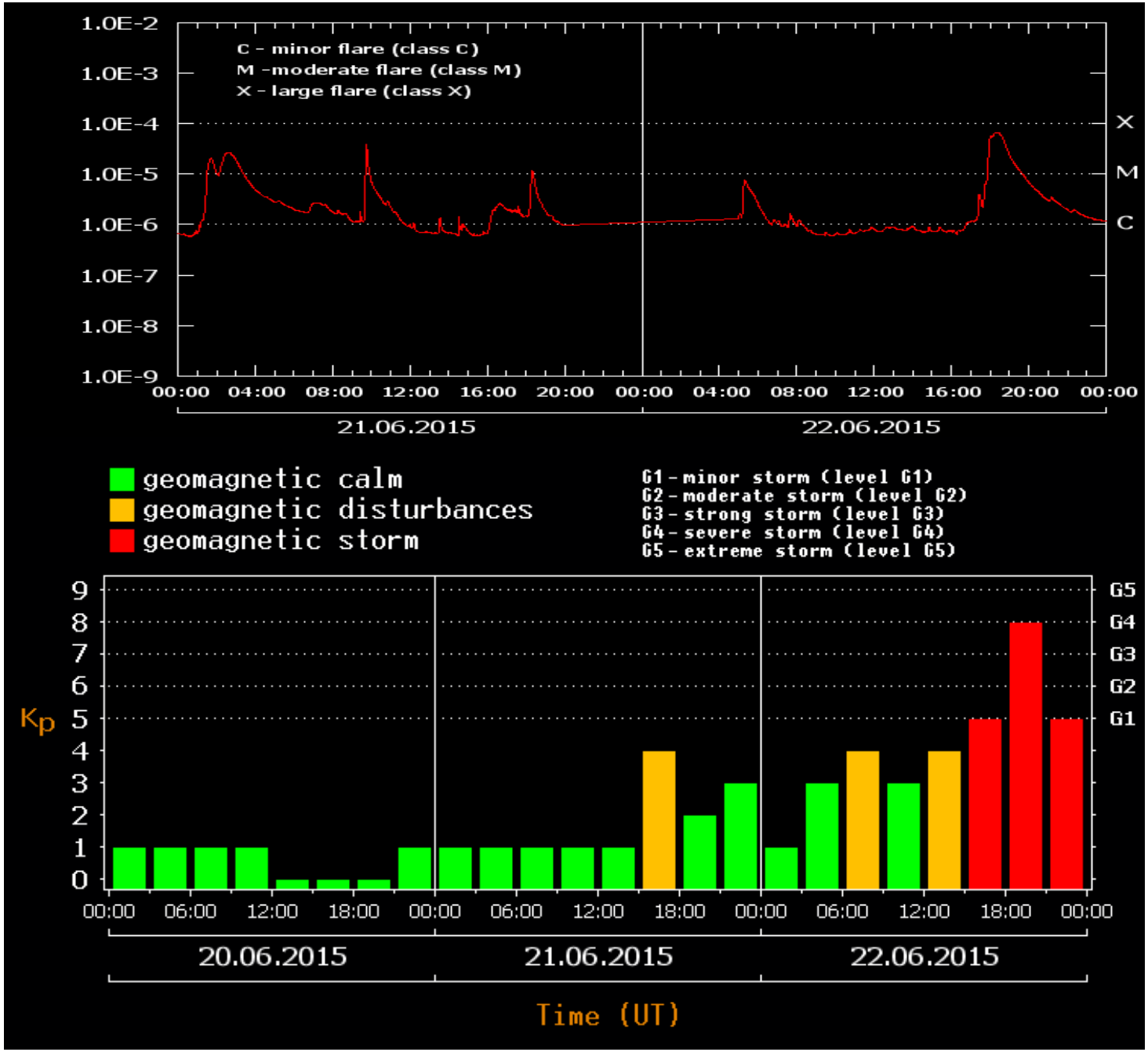
? **tie B** and/or **tie E** ? **:= synodic period of Sun rotation is 27.3 days !**

There are Sun's phenomena : Solar flares and Coronal Mass Ejection

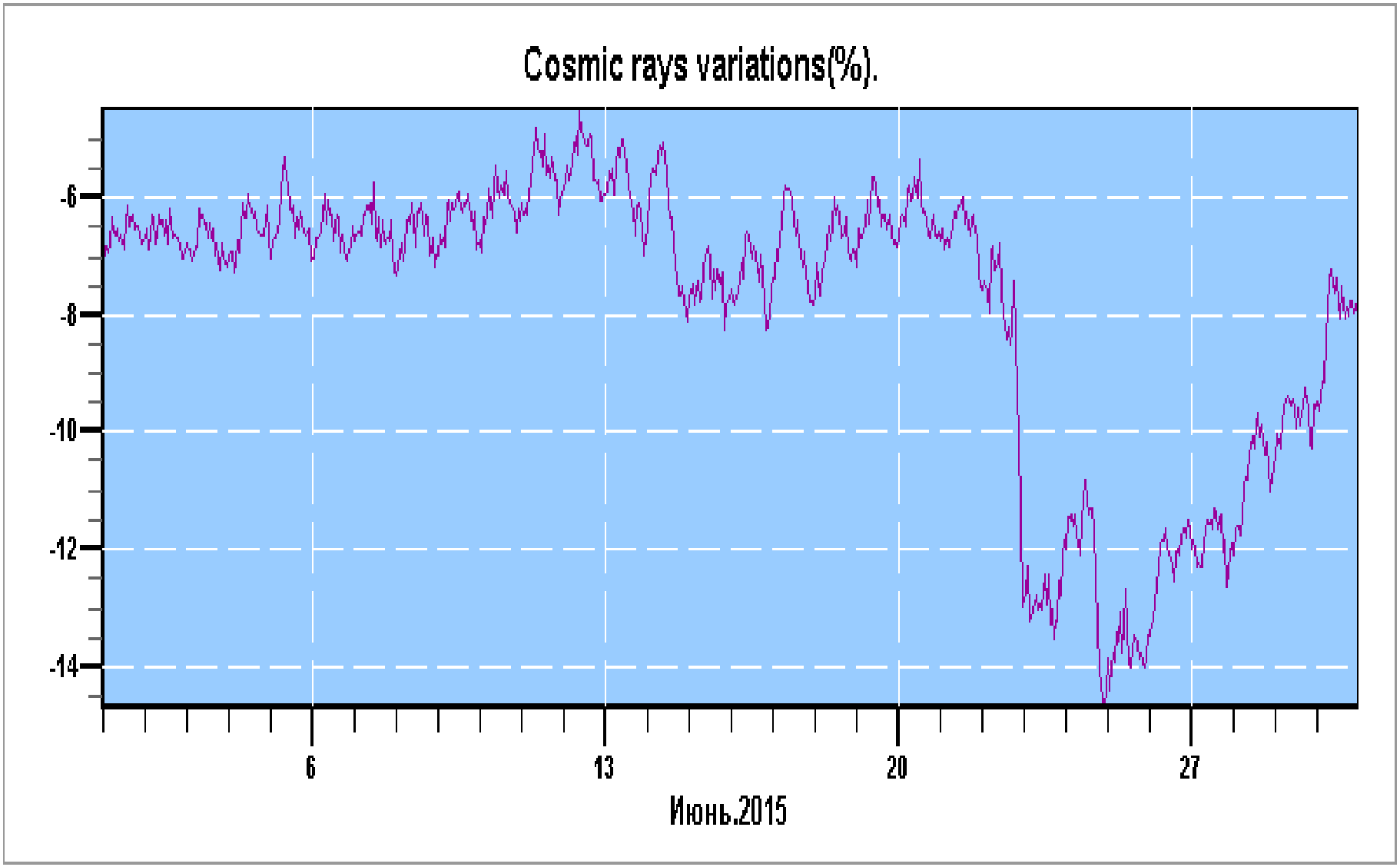
When the CME reaches geo-magnetosphere, the shock wave of the travelling magnetized plasmic cloud makes - a) a hit on the magnetosphere resulting in geomagnetic storm, b) a magnetic "mirror" reflecting Cosmic Rays = Forbush effect



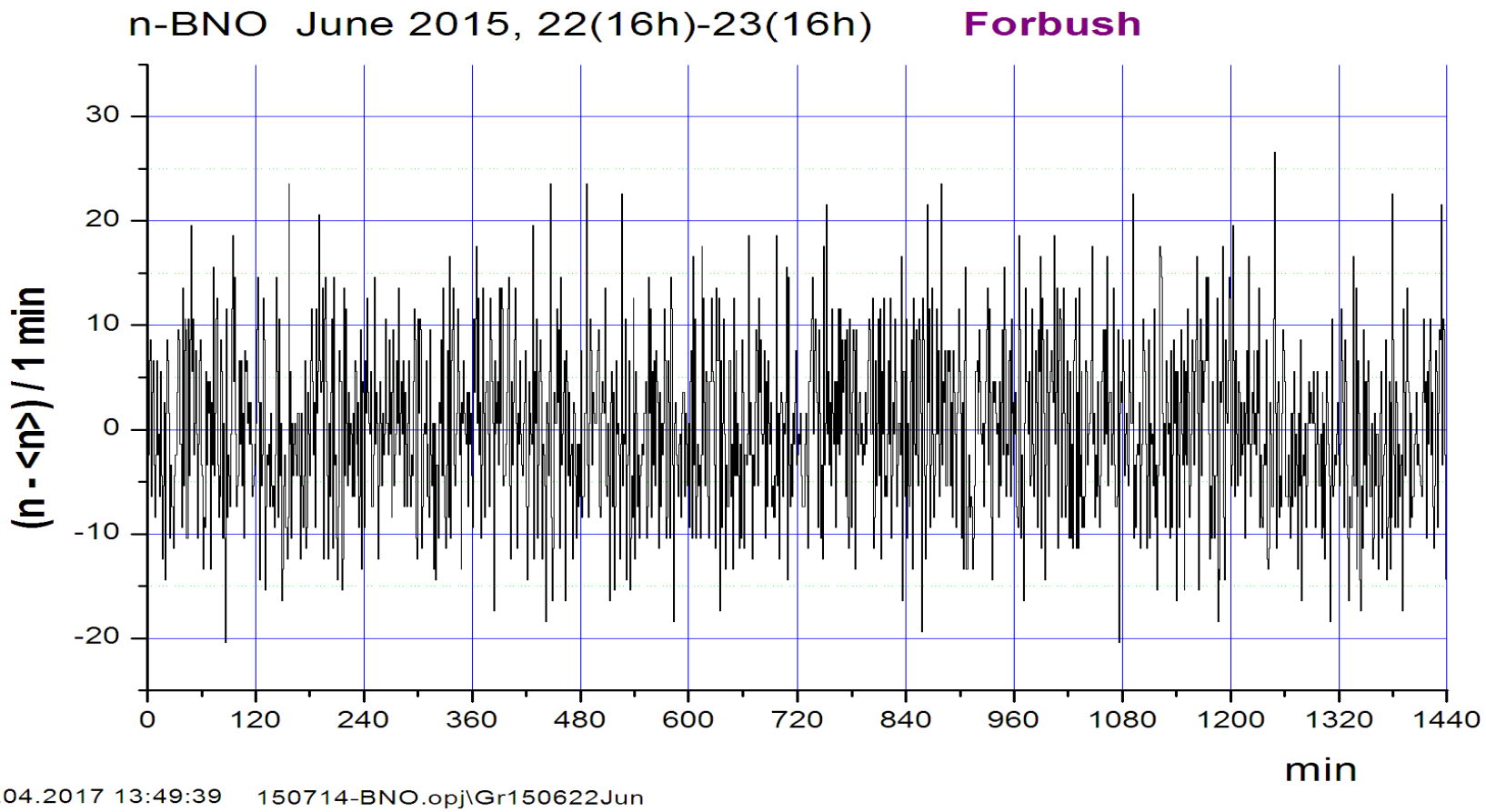
X-ray emission of the Sun **Geomagnetic storm** **June 22, 2015**



Forbush effect in Cosmic Rays, 22 June 2015

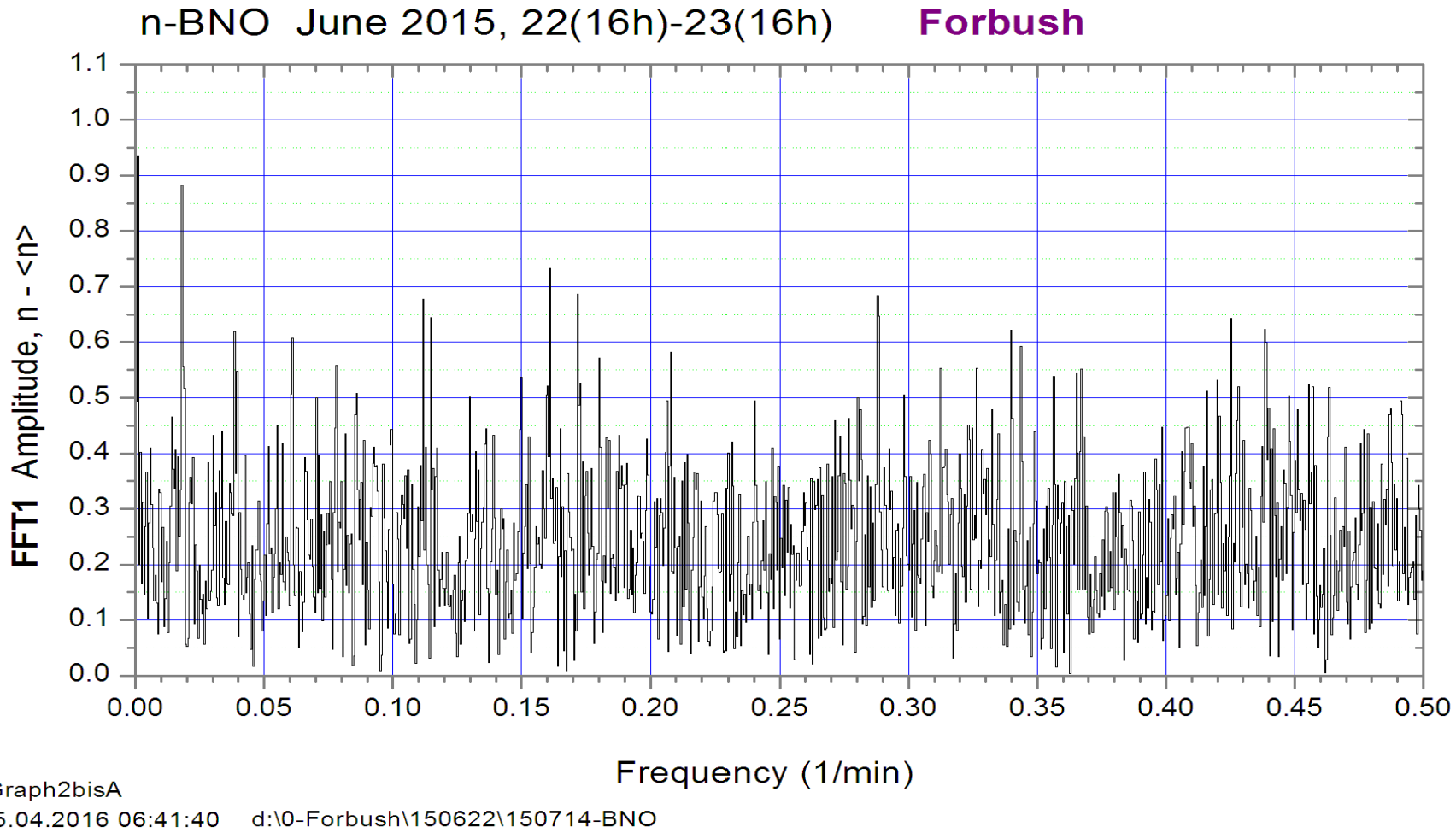


Baksan Neutrino Observatory, Centered 1min counting rate of thermal neutron detectors , <n> = 210/1min Forbush-day 22 June 2015



FFT of this day sequence is on the next slide →

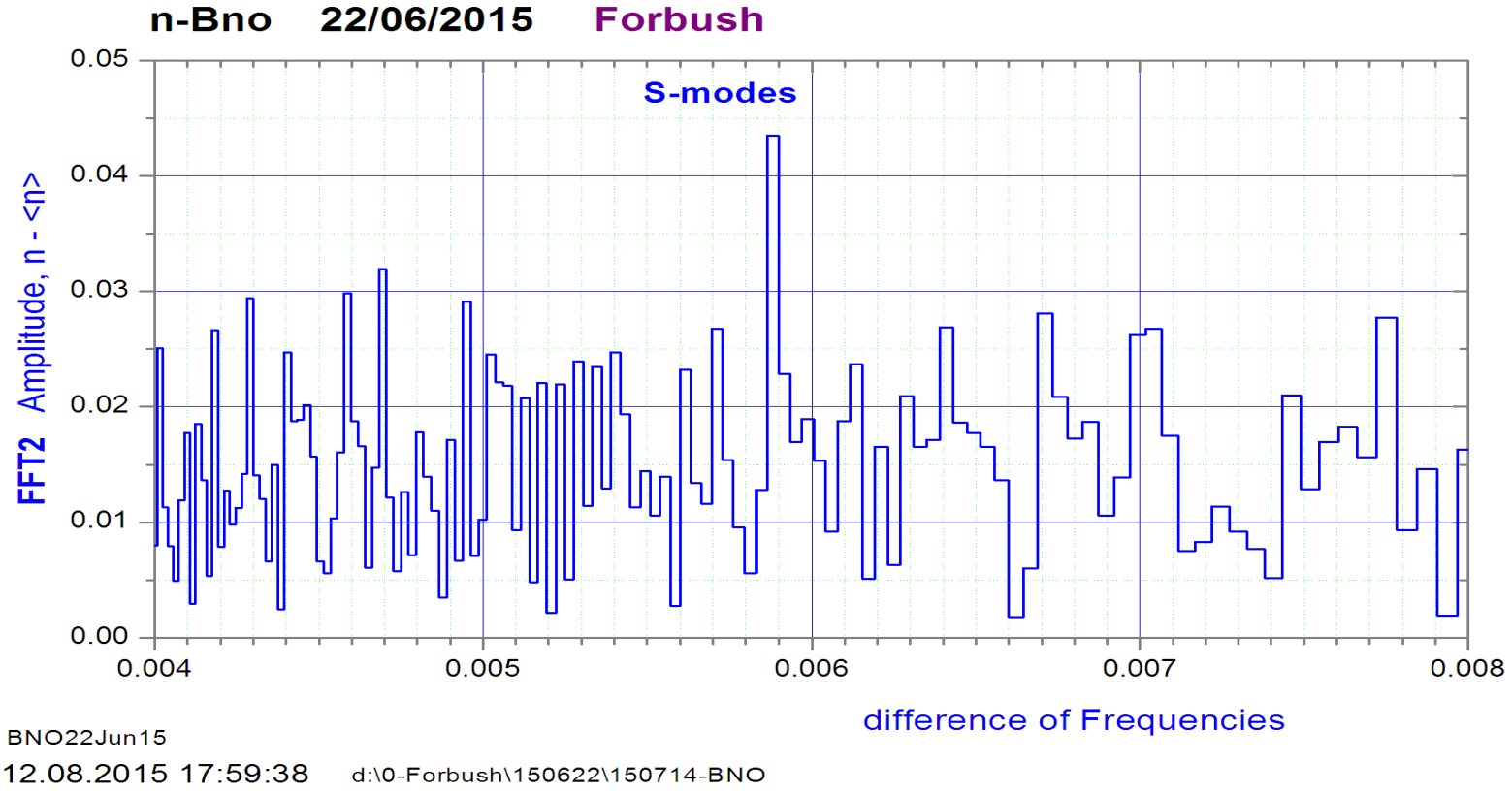
FFT1 of the counting rate of thermal neutron detector:
1024 (!!) frequency bins, it is *a terrible and irritating job* to analyze step by step this pale of 1024 amplitudes :



but FFT2 (slide #21) will rescue us ->

FFT2 := FFT of FFT1

amplitude-frequency spectrum of differences of Frequencies

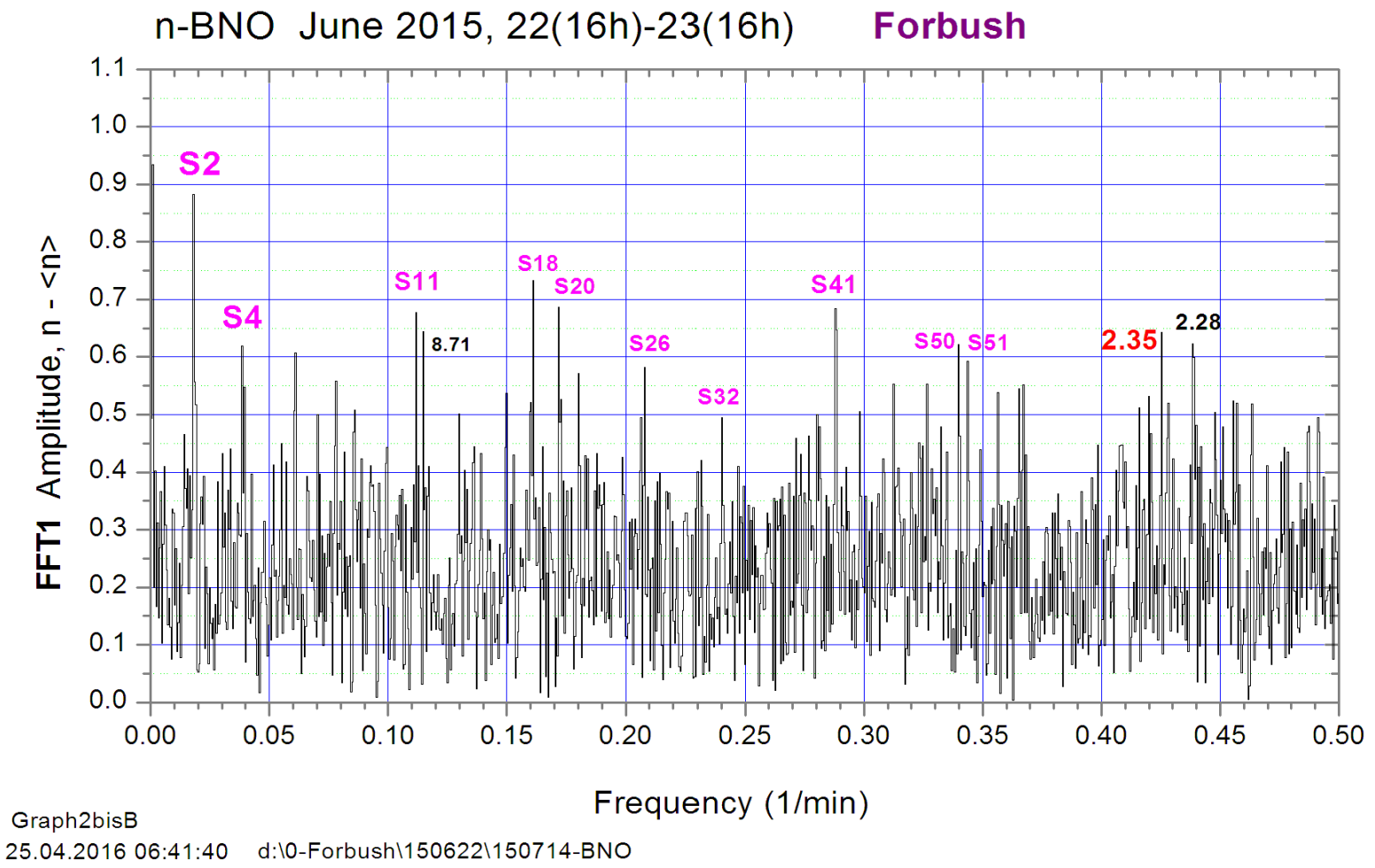


S-modes are detected ! Where they are ?

Now I may be confident and patient in 1024 step by step procedure ->

Tie **E.** FFT1 spectrum with marked peaks having largest amplitudes

! curious result ! S-modes of FEO are observed in the neutron flux



So, we may do

Fourth basic preliminary conclusion –

FEO event can arise not only after EQs(standard mechanism, tie **C**), but may also independently arise during strong

Magnetic Storm

due to some hypothetical magneto-hydrodynamic process between powerful solar plasma wind and magnetosphere

Note:

The choice , for individual event, between possibilities of FEO exciting -

- EQ = tie **C**
- possible Anomalistic tide = tie **B**
- possible Magnetic Storm = tie **E**
- - ????

is a matter of further statistical analysis in the frame of neutron variational programme [*a propositо: event 24/06/2016(slide #23 =* tie **E***)*]

Up to now there is unresolved geophysical problem - unpredictability of earthquakes

Below a hypothetical idea of δ-trigger mechanism for EQs - tie **D**

- is stated in a simple general terms

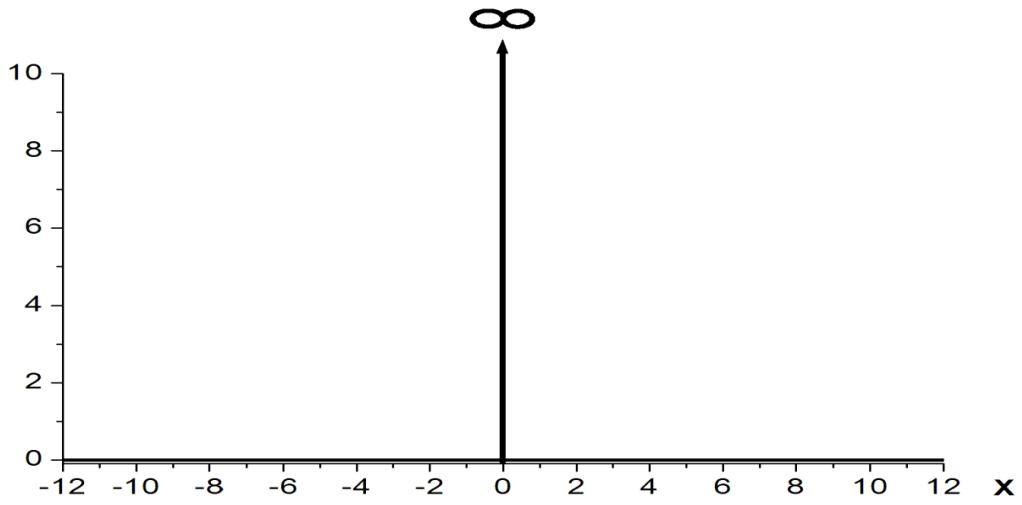
in maths:

δ-function or Dirac function

$$\delta(x) = \begin{cases} \infty, & x = 0 \\ 0, & x \neq 0 \end{cases}$$

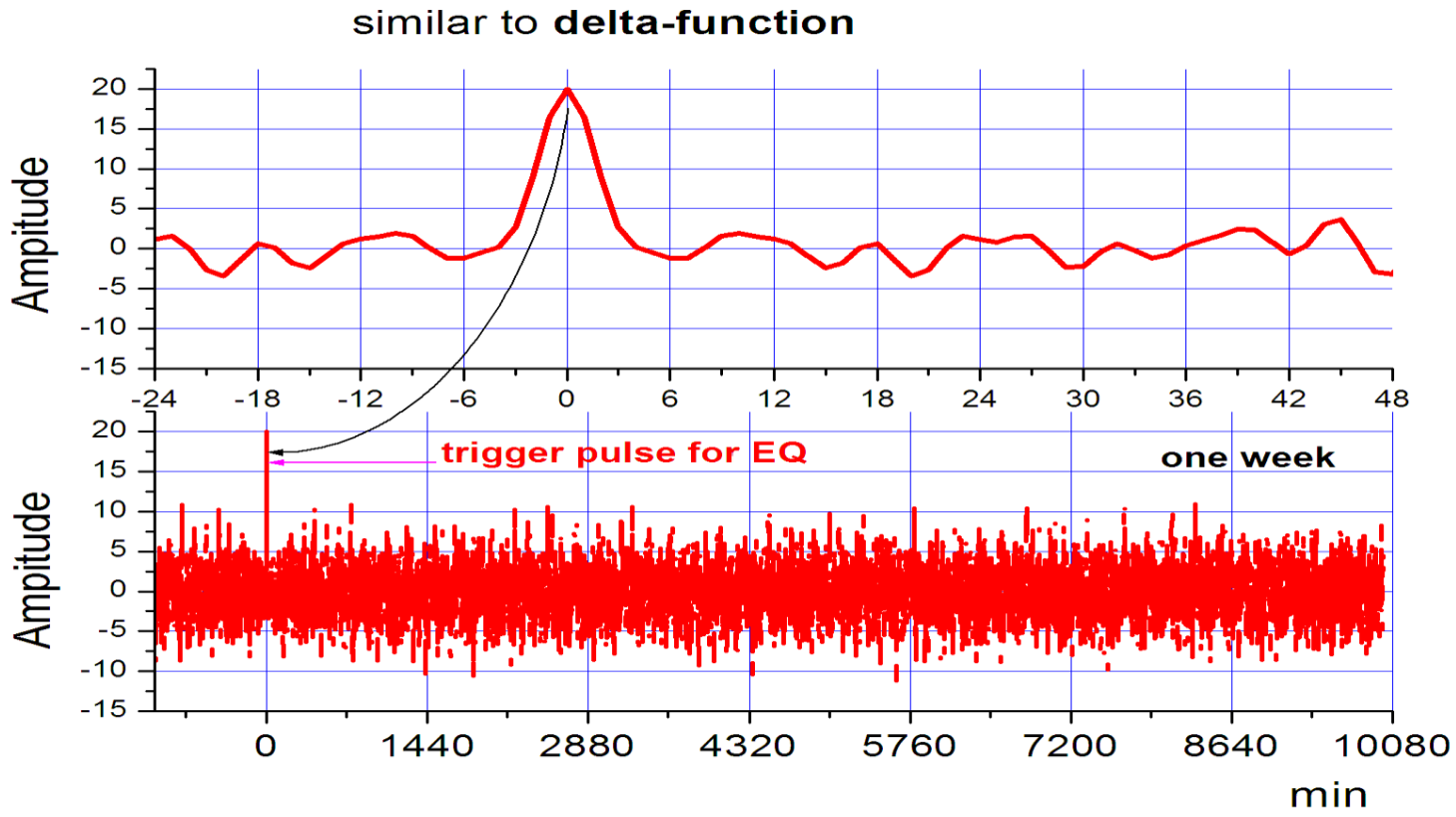
in ~physics:

$$\delta(X, t) \sim \Sigma_n \cos(X + t * 2\pi i * n / T_n), \qquad n \in [-\infty, \infty]$$



Geophysicists know some hundreds (!)modes of FEO in the range of periods 2 – 60 min; Spheroidal, Torsion, Overtone modes. Some part of them are incessant and with unclear origin, and these FEO have been recorded by geophysicists.

What will happen if we summarize only 20 Cos functions with random periods [2-60 min] but all, simply by chance, having at some moment fazes = 0 ?



Each of FEO mode transfers not a large portion of kinetic energy , but all together, being summarized at some moment and at some local volume of a substance, can act as trigger for releasing of internal potential energy accumulated in the stressed blocks of the crust.

This is an essence of δ-trigger hypothesis for EQs.

It is easy to say but too difficult to realize in practice :

for prediction "when and were" you must before know many parameters of many modes : existence, direction, frequency, velocity, attenuation and so forth.. to construct the fatal interference.

Summary

- Free Earth Oscillations of different origin were detected during long-time measurement of thermal neutron flux variations

- Moon-anomalistic and/or Sun-synodic periodicity of excitation of FEO were observed
- Excitation of FEO in thermal neutron flux during Magnetic Storms were observed
- Correlation in periodicities of Tibet EQs and TNF was observed
- South-East anisotropy of sensitivity of Tibet TNF to EQs was revealed
- Original method of FEO diagnostic is proposed

- the hypothetical "δ-trigger mechanism" for EQs was put forward

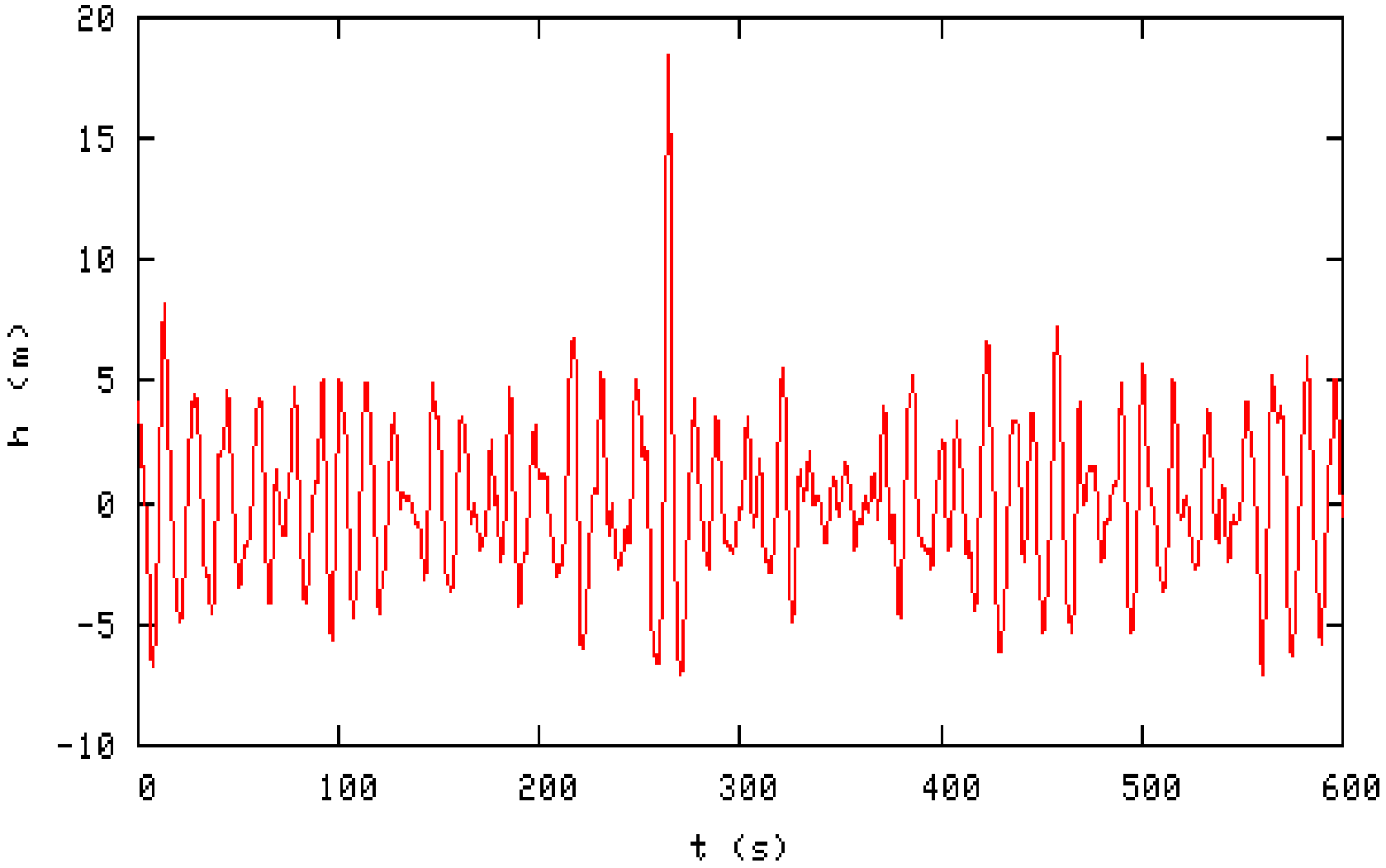
And now I might have put a point,

but there is one more mysterious phenomenon in

the Nature - Rogue waves

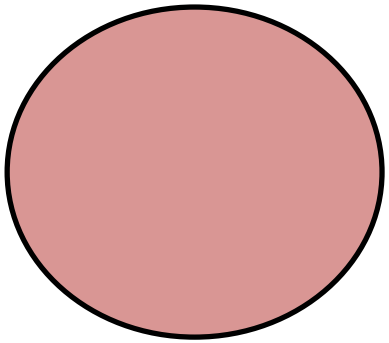
Wikipedia: Rogue waves or “freak” waves or “killer” waves – large, unexpected and suddenly appearing surface waves that can be extremely dangerous, even to large ships as ocean liners.

Wikipedia : Height(m) – time(sec) of Rouge wave



And now, finally -

the point



“ Thank you very much for attention… ”