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T2L2 Event Timer

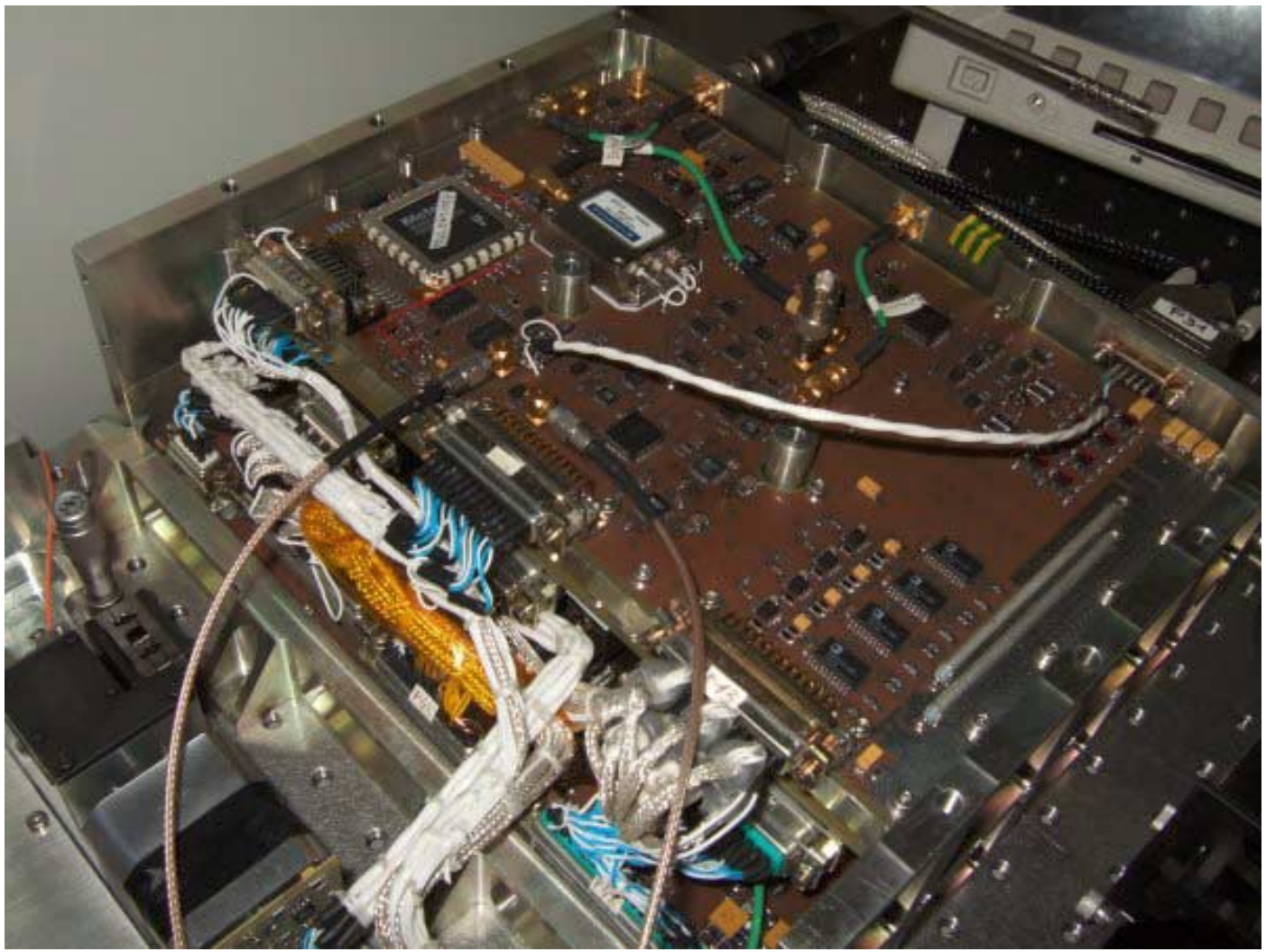
OCA Event timer

- OCA and CNES designed a Space event timer in the framework of the T2L2 project on Jason 2

- T2L2 requires both the start time and the return time
- Stations for T2L2 will need an event timer

- OCA and CNES are designing a ground model for laser ranging stations from the design of the space instrument
  - » Usual laser ranging activities
  - » Time transfert T2L2

T2L2 Event timer Space instrument Engineering Model



Space instrument Caracteristics

- Input frequency: 10 MHz sinus 0 dBm
- Internal frequency oscillator: 100 MHz
- Vernier period: 20 ns

- Resolution: 0.1 ps
- Dead time: 200 µs

- Size (one card with Counter, frequency Synthesis and vernier): 220 x 150 mm
- Power consumption: 15 W

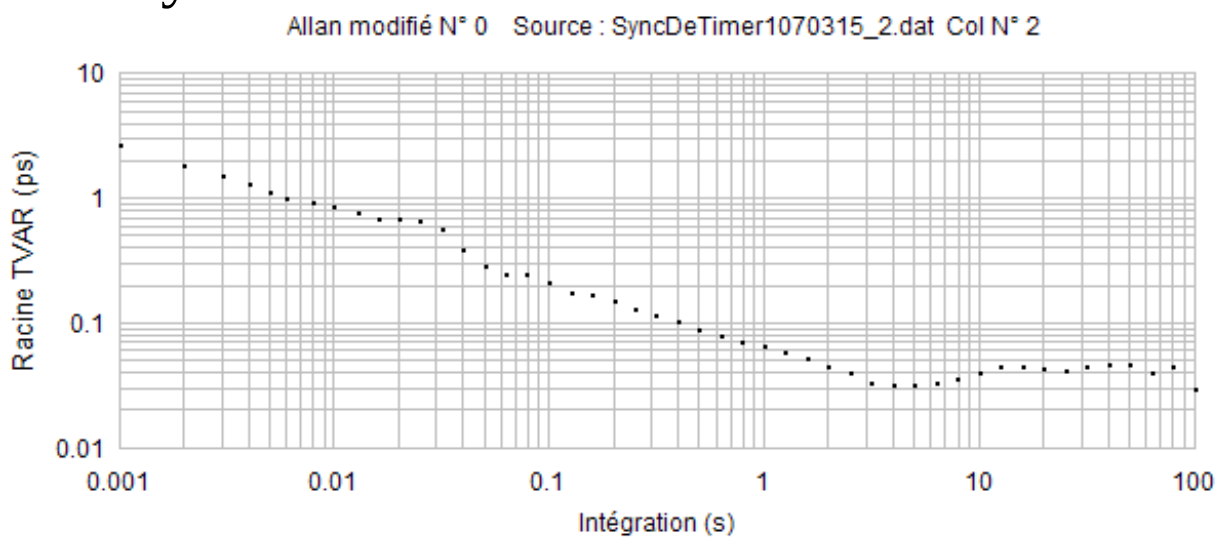
T2L2 Flight model
Frequency Synthesis

- Thermal analysis

File	T° oven	T° Instrum.	T° VCXO	U VCXO	x (ps)	σ (ps)	N
SynchDeTimer1070315_2	10	23.5	30	-0.0047	-1.87	2.3	296301
SynchDeTimer1070315_4	30	41.5	48.2	-0.0044	-11	2.3	299521

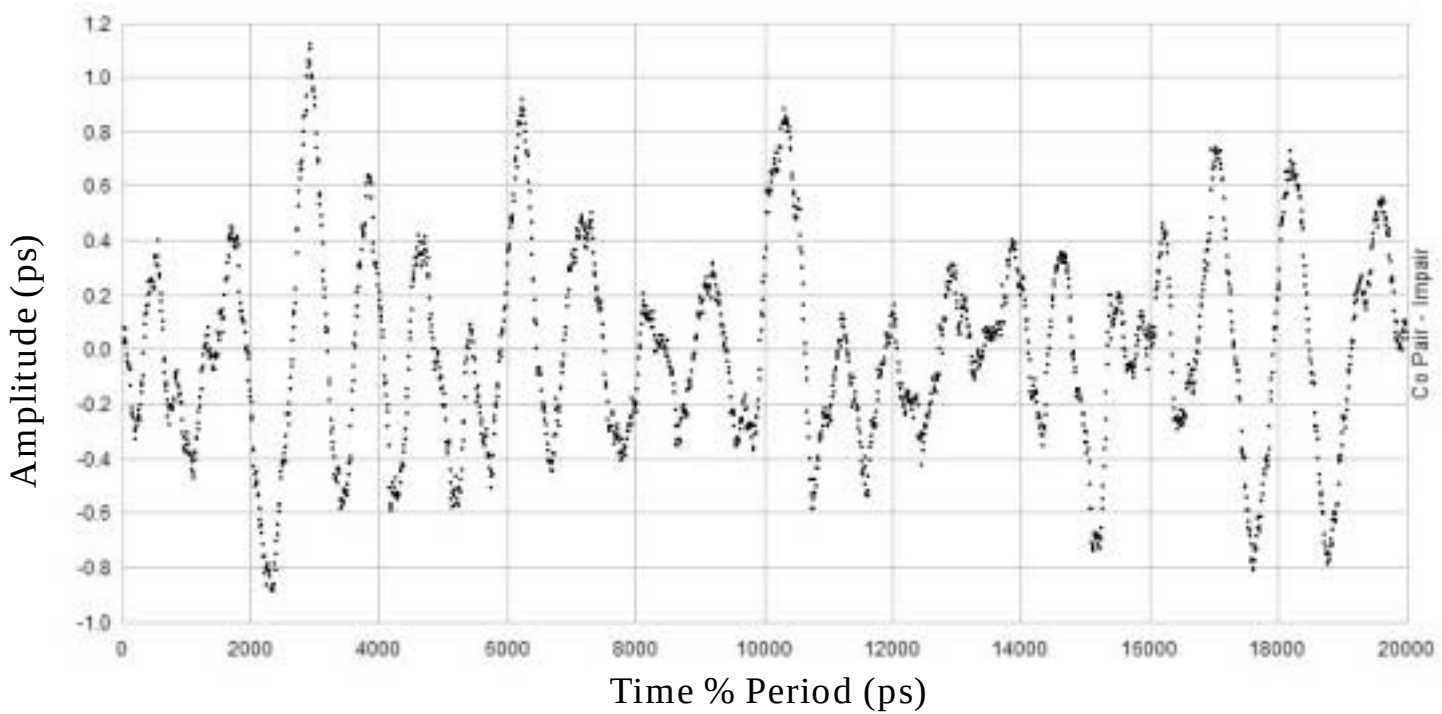
0.5 ps / °C

- Time stability TVAR



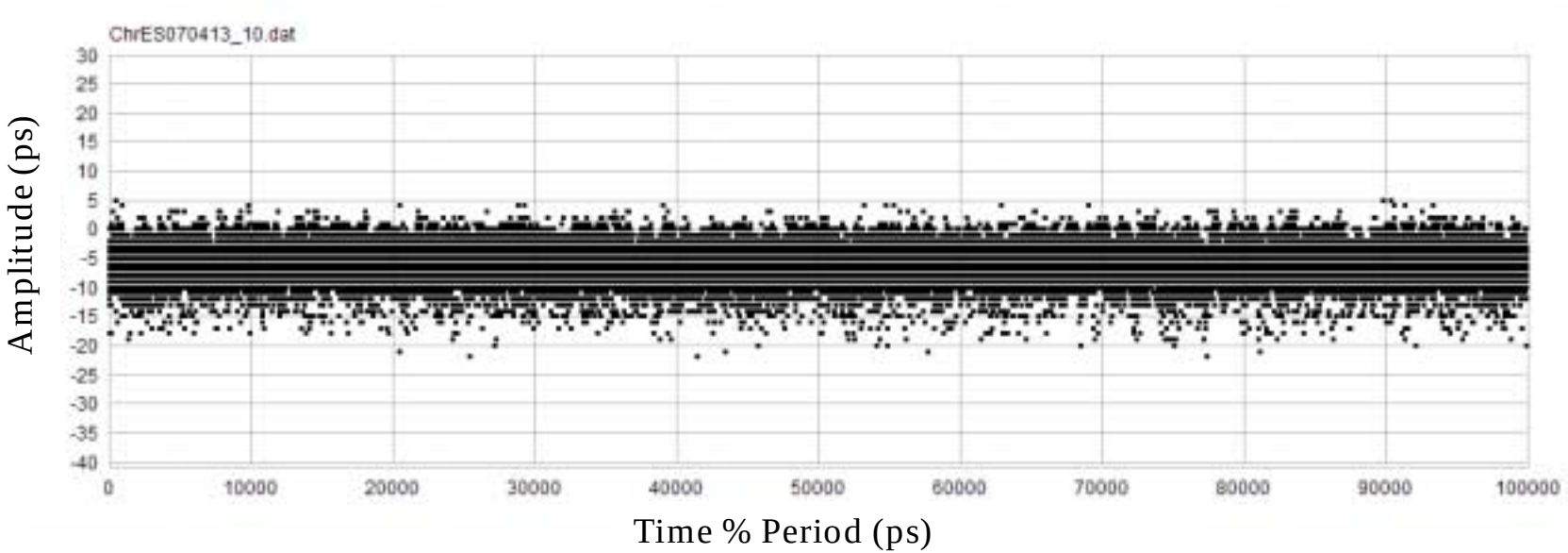
T2L2 Flight model
Event timer

- Short term linearity over the vernier period



T2L2 Flight model
Event timer

- Linearity over the input frequency period



Space instrument
General performances

- Precision < 2 ps rms (precision in calibration 0.9 ps)
- Time stability (TVAR) = 30 fs over 1000 s
- Thermal drift (vernier + frequency synthesis) < 0.5 ps / °C
- Magnetic field sensitivity: no effect
- Life time in space (Jason 2 orbit) : 2 years

Ground instrument Design

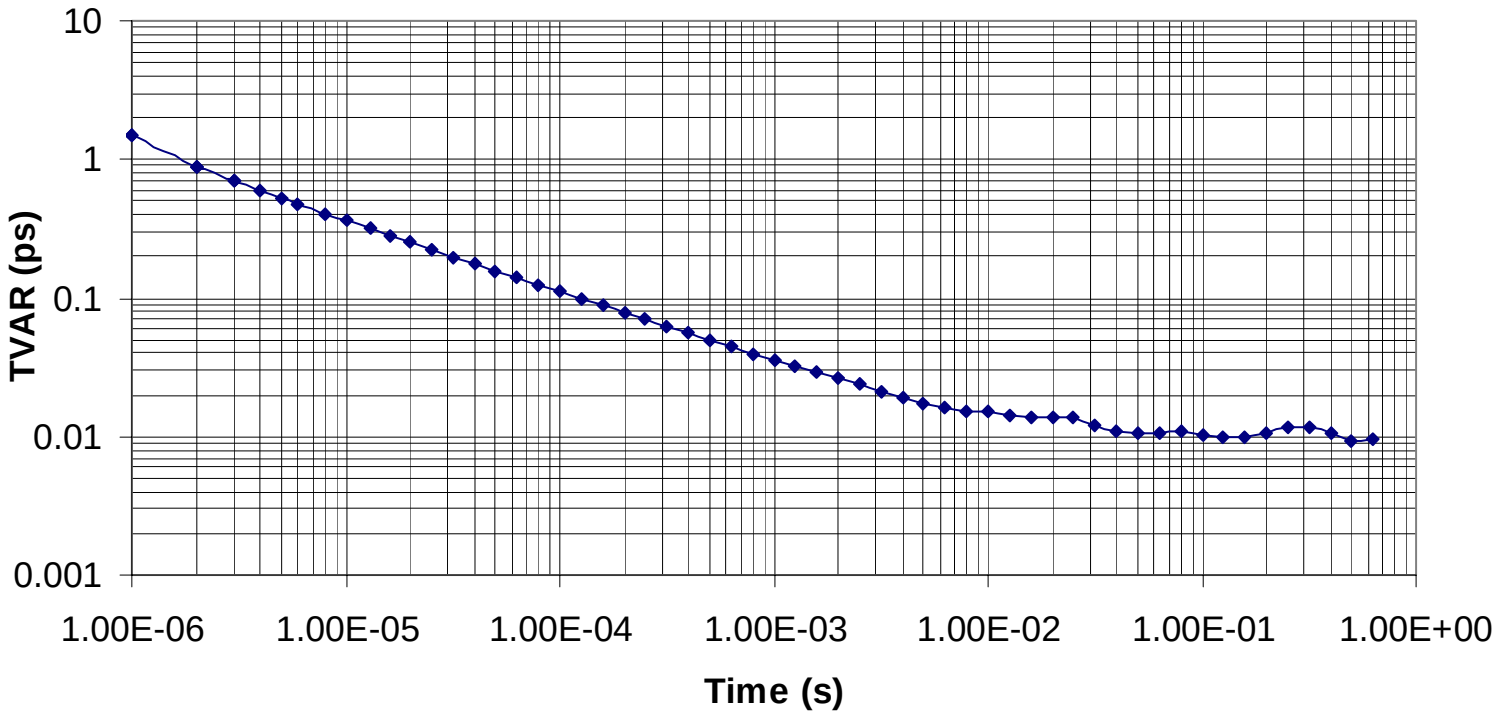
- 19 inches rack 4U based on a PC
- One card for the frequency synthesis and counter
- One card for the vernier; up to 4 verniers
- Trig Input
  - Analog with programmable comparator
  - NIM
  - ECL
- Ethernet Communication
  - Web server
  - Sockets

Ground instrument Design

- Frequency input: 10 MHz sinus > 0 dBm
- Internal frequency oscillator: 400 MHz
- Precision < 2 ps rms
- Linearity < 1 ps rms
- Dead time < 400 ns
- Maximum repetion rate: 2.5 MHz
- Internal memory: 8 10^6 events @ 2.5 MHz

Ground Event Timer
Preliminary performances

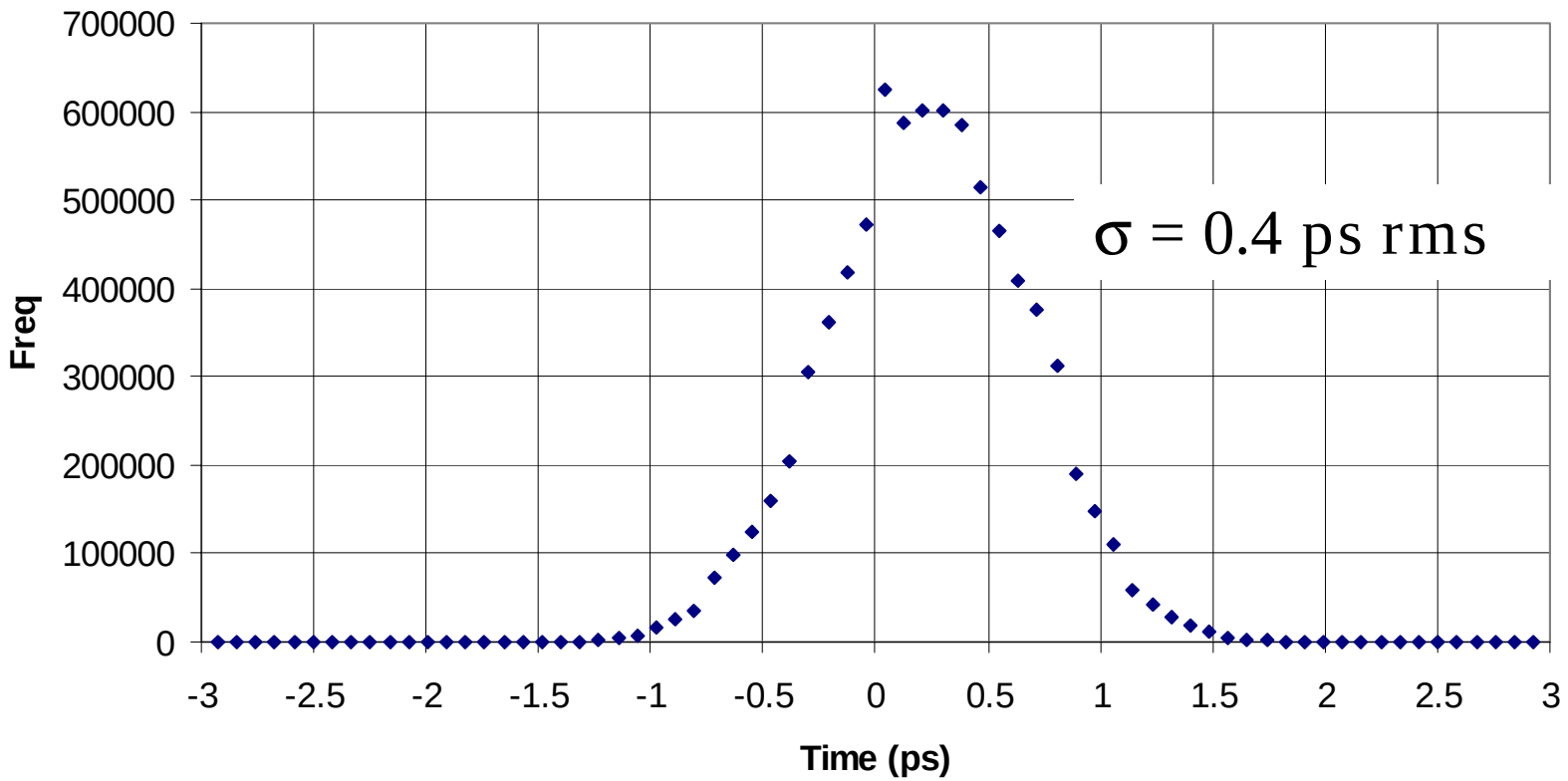
- Time Stability @ 1 MHz ; Synchronous events ; 8 10^6 events



- Floor : 10 fs @ 0.1 s (1.5 µm rms)

Ground Event Timer
Preliminary performances

- Precision ; synchronous events: 1.2 ps rms
- Precision ; synchronous events ; diff between 2 verniers:



Ground instrument Development plan

- Delivery of the first model for the FTLRS station: May 2008
- Delivery of the first reccurent model: January 2009
- Delivery of the following models: + 4 months

Conclusions

- T2L2 event timer will be the first ps event timer in space in june 2008
- A ground version of this timer will be available in may 2008
- The short dead time (400 ns) will permit laser calibration @ 60 m
- A fastest version could be envisioned in the near future with a dead time up to 20 ns and a repetition rate @ 50 MHz
- We will try to improve the actual time stability limit (10 fs – 3 µm) in order to permit sub micrometer measurement and then interferometry with nm resolution