WEAKENED CELL - INTERMITTENT STUCK BIT

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OUTLINE

- **IN-FLIGHT OBSERVATION**
  - ✦ PICARD
  - ✦ CARMEN2

- **FOLLOWING INVESTIGATIONS & RESULTS**

ESA-CNES Final Presentation Days   03/08/2017

IN FLIGHT OBSERVATION CASE 1: PICARD STAR TRACKER

PICARD CNES Scientific satellite for sun observation

LEO (725km/98°), launched 06/15/2010

- Star tracker from DTU
  - COTS SDRAM: HY57V651620BLTC-10S, HYUNDAI
  - TID tested up to 30kRad (protons)
  - SEL free (protons)
  - SEU protected (EDAC + Scrubbing)

- This EDAC is able to:
  - Detect and correct single bit errors
  - Detect multiple bit errors

- EDAC activity is reported in TM (priority mode)

Date	Latitude	Longitude	@ hex	@ dec
2014/01/26 19:58:27.141	-14.831039	325.295582	B7E410	12051472
2014/01/26 19:58:31.141	-14.831039	325.295582	B7E410	12051472

IN FLIGHT OBSERVATION CASE 1: PICARD STAR TRACKER

A few days after PICARD being set into an operational mode (725km, 98°), the EDAC exhibited a large number of errors.
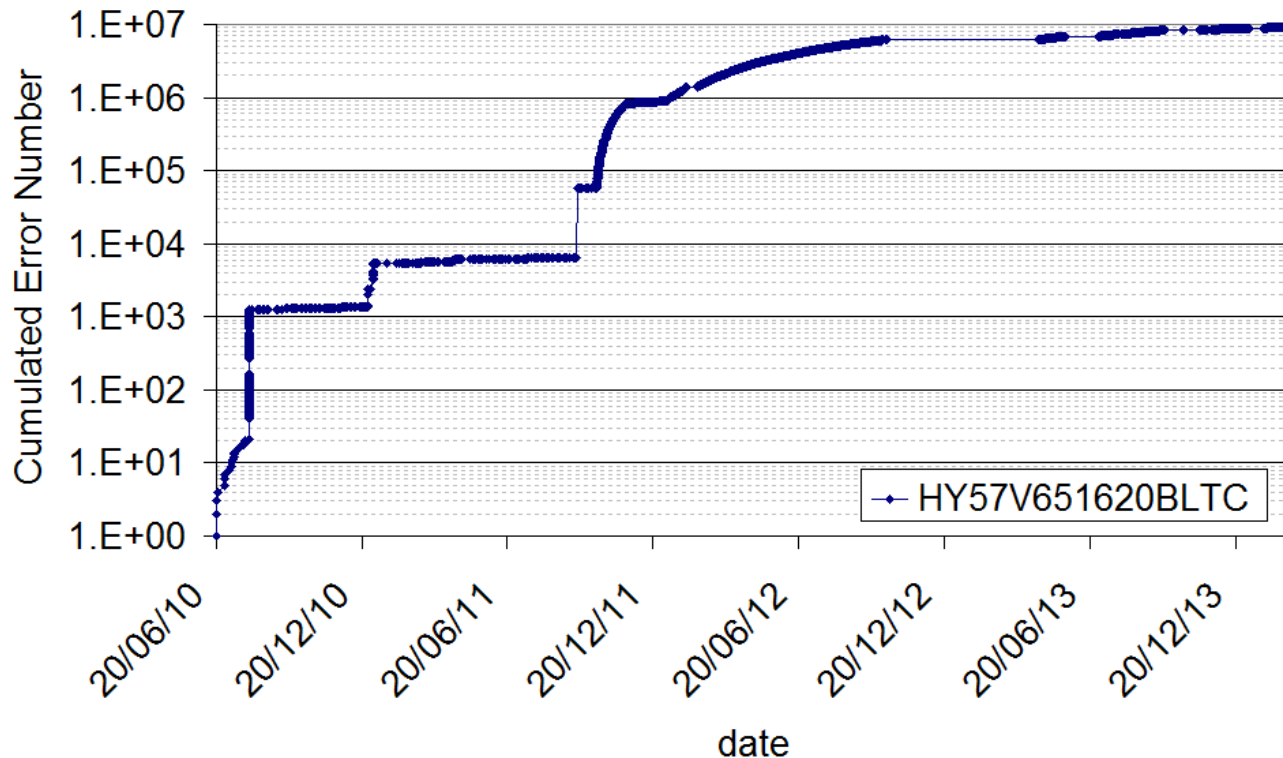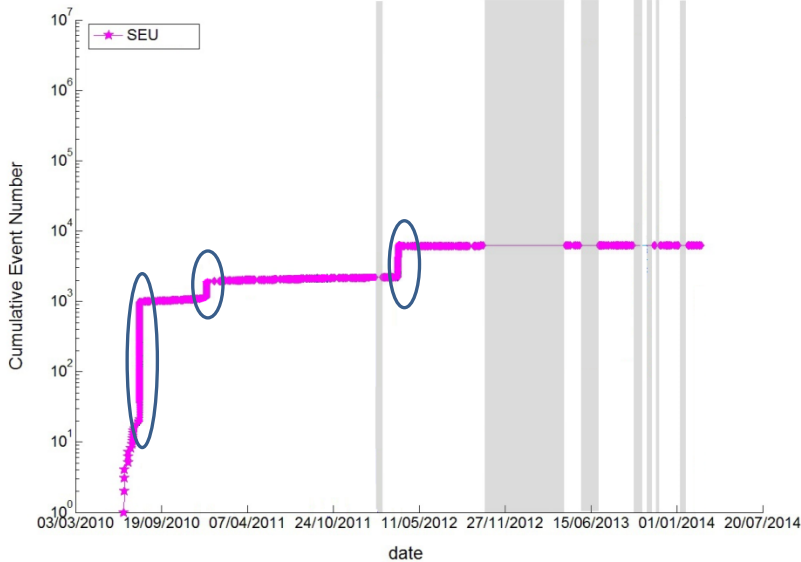

EDAC errors compiled between 06/20/2010 & 10/09/2012 (PICARD anomaly) and between 04/17/2013 & 03/02/2014 (technological experiment)
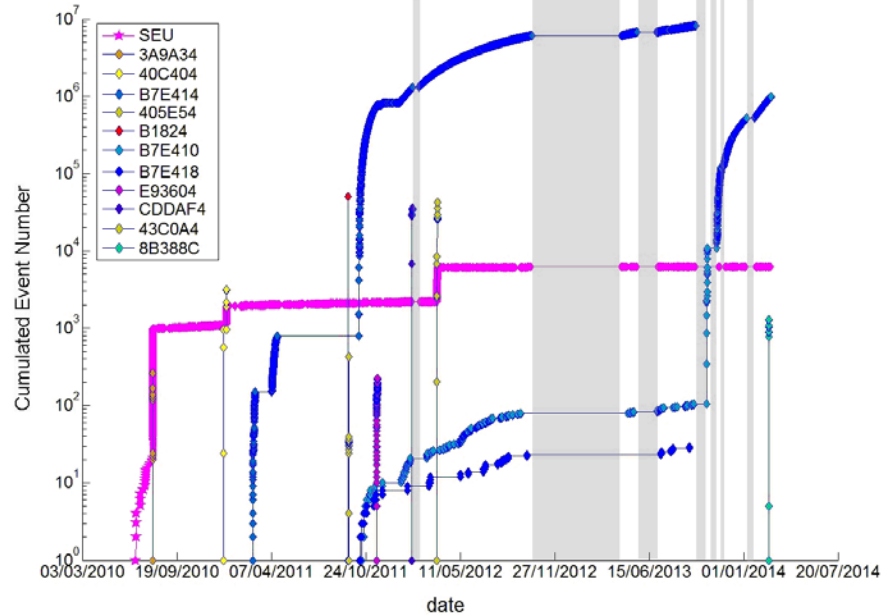
These errors can be split in 3 categories:

- SEU

- Burst (3)

- Weakened cells (11 addresses)
  - Same corrupted bit
  - Not definitively stuck

Not a problem of cumulated dose:

- First occurrence only 2 weeks after launch (TID~100Rad)
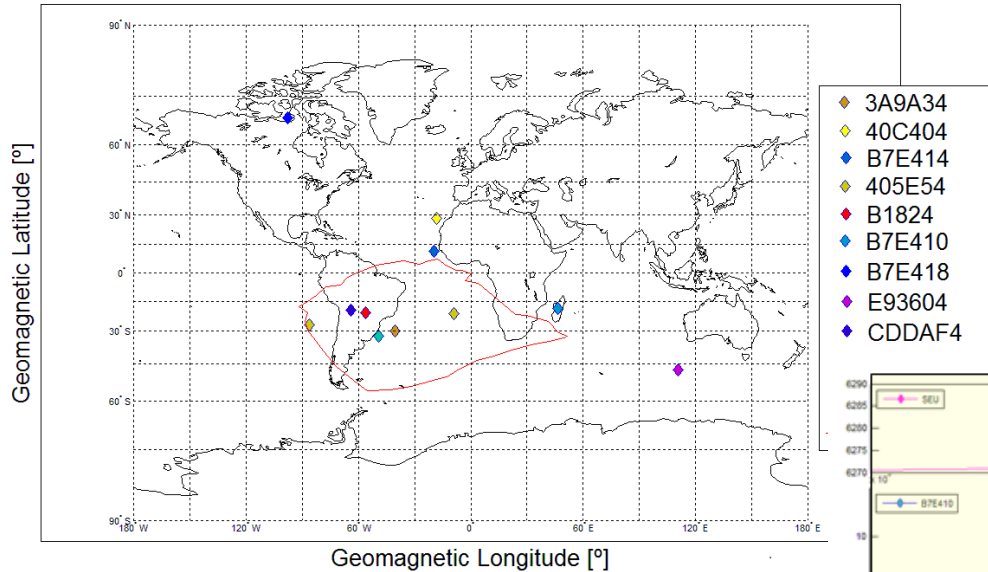- Worst case (@B7E414) after 1,8kRad(Si)

@B7414

@B7410
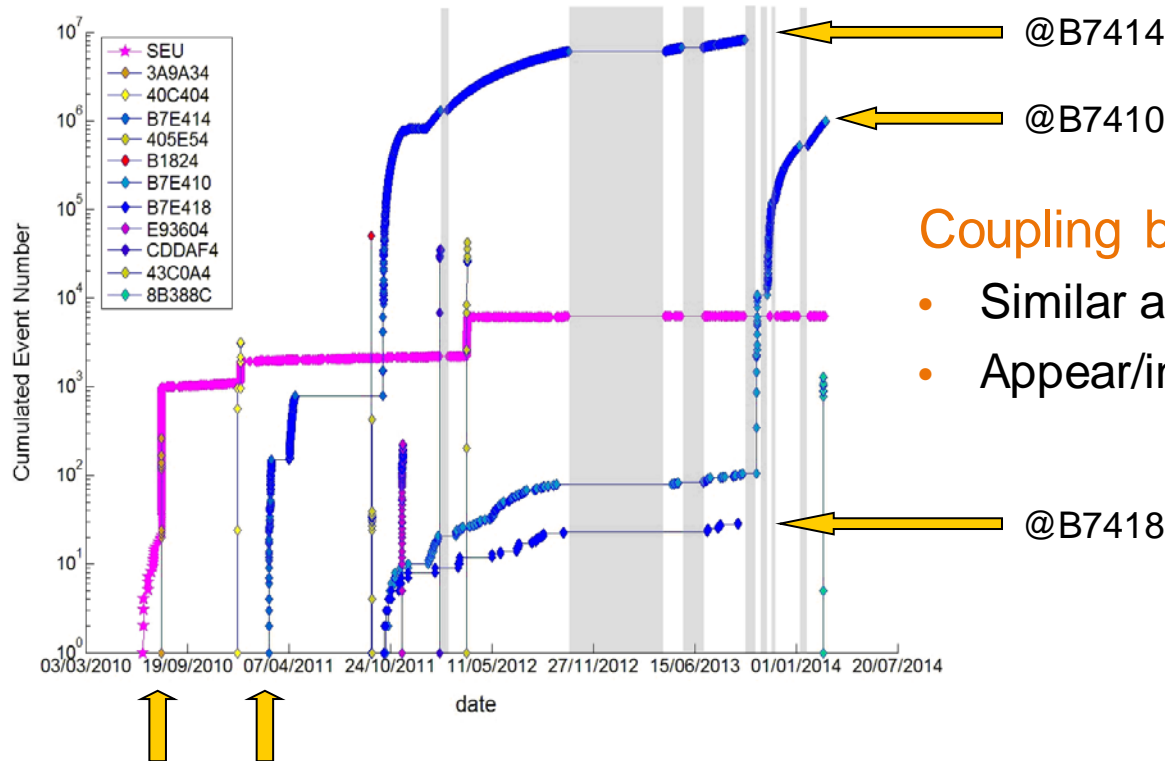
Coupling between cells:

- Similar addresses
- Appear/increase simultaneously

@B7418

Localization of first occurrence for each @

◆	3A9A34
◆	40C404
◆	B7E414
◆	405E54
◆	B1824
◆	B7E410
◆	B7E418
◆	E93604
◆	CDDAF4

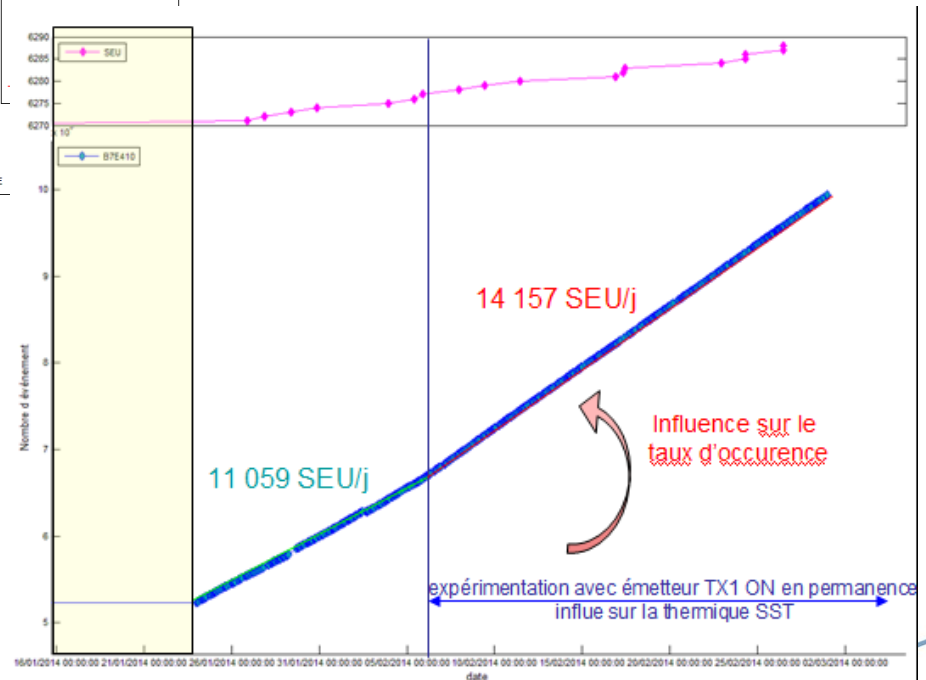➡ Most probably induced by protons

Thermal effect:

When temperature increases,
- ISB rate increases
- SEU rate stays stable

14 157 SEU/j
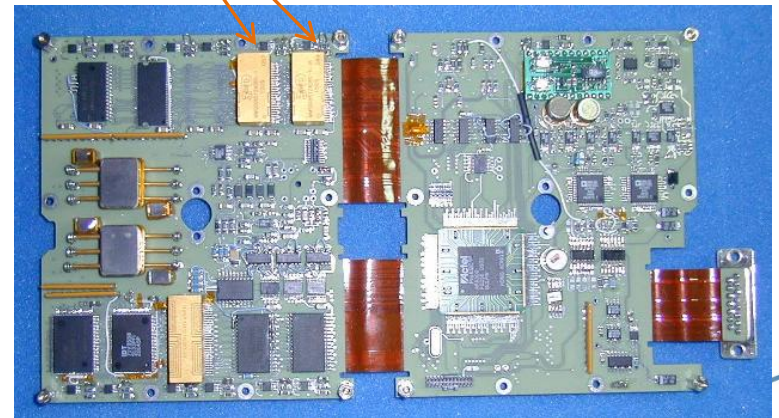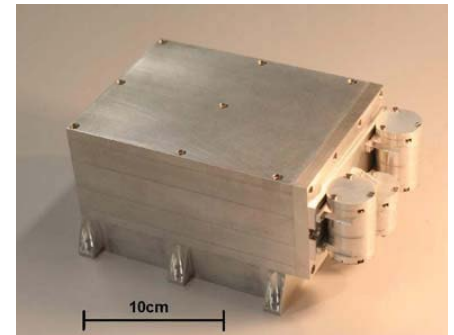
11 059 SEU/j

Influence sur le taux d'occurence

expérimentation avec émetteur TX1 ON en permanence influe sur la thermique SST

CARMEN2-MEX experiment on board of JASON2 satellite for the study of radiation effects on electronic components.
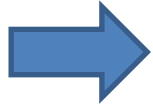
1336km/66°, launched 06/20/2008

- 2 3DPlus SDRAM modules (MMSD08512408S-Y)
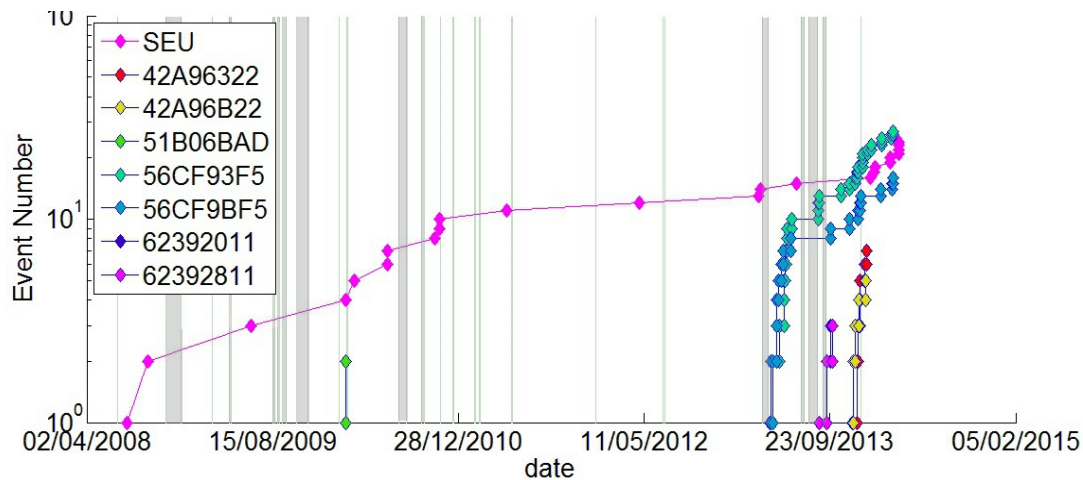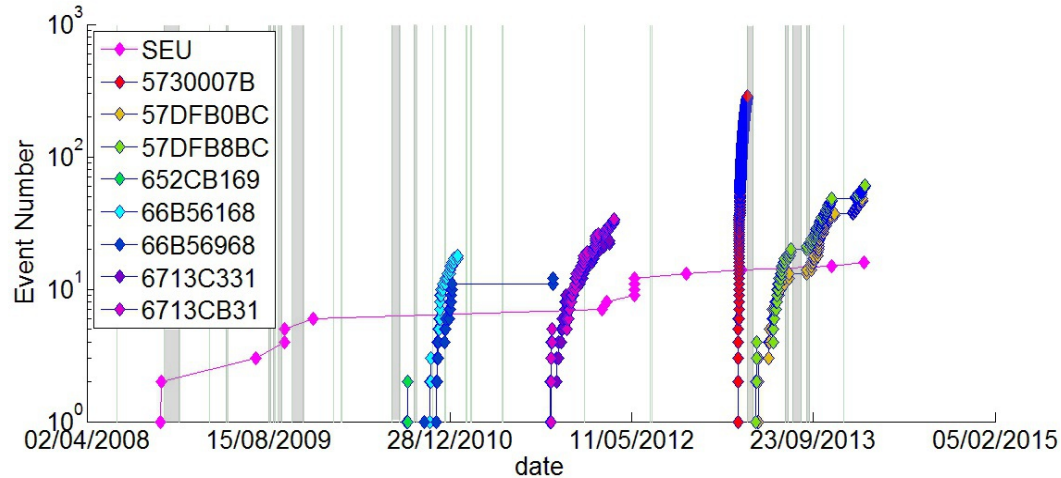- Each module made of 8 stacked Elpida EDS5104ABTA.

The 2 modules exhibited weakened cells with similar behavior

FOLLOWING INVESTIGATIONS

2011-2012 — Inflight data analysis

2013-2014 — Experimental evidence of Stuck bit on SRAMs

2014-2015 — ISB on SDRAMs

2016-2017 — What about DDR3/SDRAMs?

3 CNES R&D studies shared by TRAD & UM/RADIAC

1 Ministry funded PhD at RADIAC on this specific topic

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WHERE ARE WE NOW?

Very good results and work still in progress.

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