

# **EVOLUTION OF THE IN-ORBIT**

## **RESPONSE OF THE EIT INSTRUMENT**

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## GLOBAL RESPONSE OF THE INSTRUMENT

### Observations.

Monitoring of the total counts/s

4 channels

**171 Å** *shows a regular decrease of the response*  
but oscillations due to active regions crossing the FOV

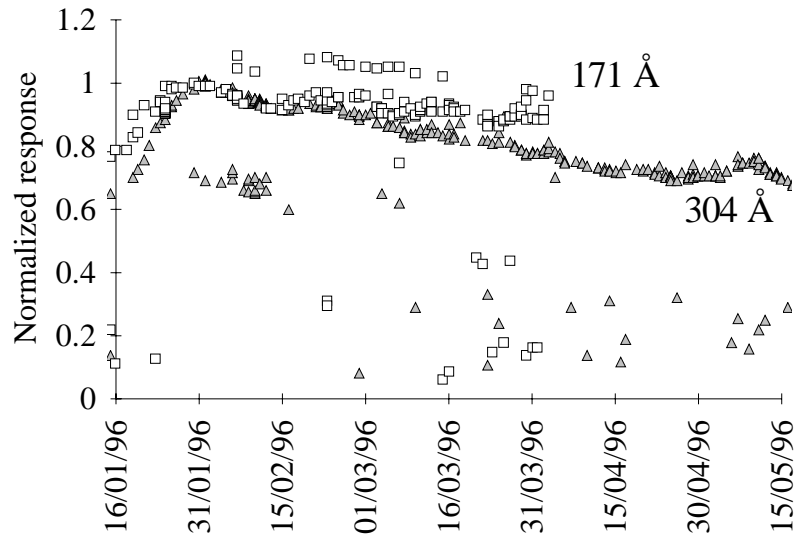
**195 Å** *does not provide useful informations on the response*  
Important variability due to solar activity

**284 Å** *does not provide useful informations on the response*  
Solar flux at 284 Å is faint, therefore exposure times are long and a lot of cosmic rays are recorded.  
Active regions produce very high contrast in the images and drive the overall response.

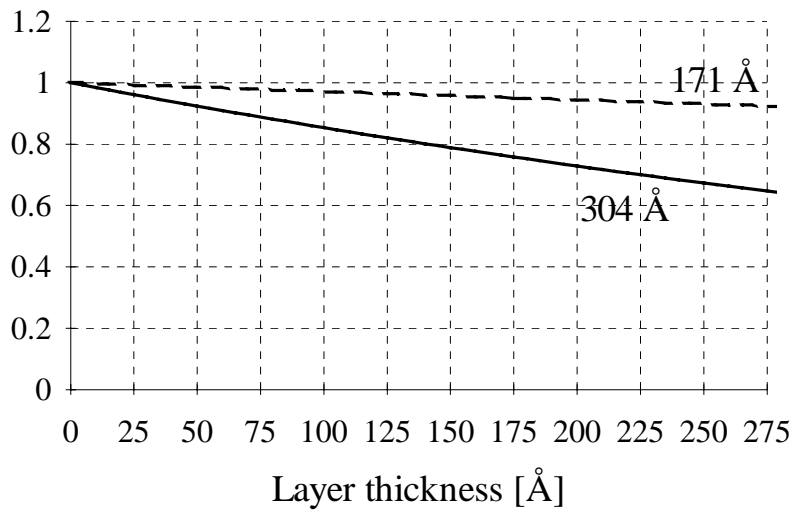
**304 Å** *shows the most important degradation rate*  
Homogeneous flux on the overall disk area during the quiet sun period  
Global response is less affected by the crossings of active regions

Depth penetration length of 304 Å photons is the shortest among the 4 EIT channels.  
This makes the 304 Å photons more sensible to absorption by potential contaminants.

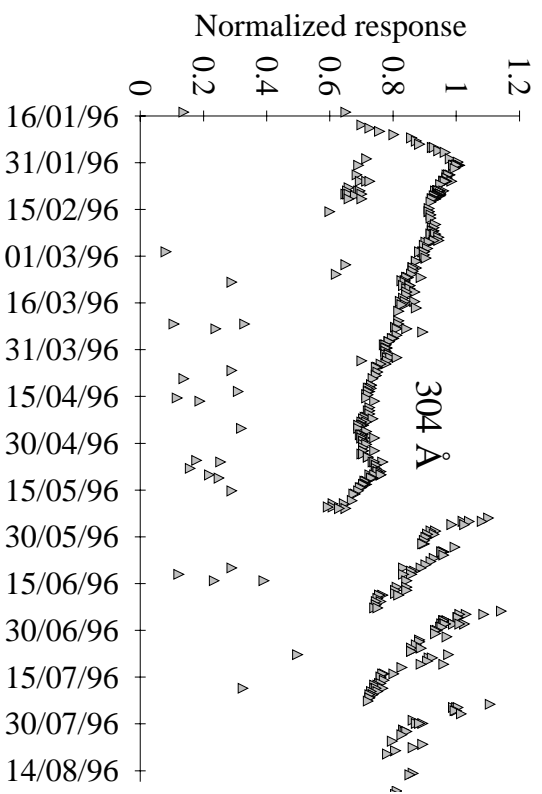
### 6 first months of operation - Total response at 304 and 171 Å



### Typical absorption effect of a contaminant layer (ice)



# 8 FIRST OPERATING MONTHS: TOTAL RESPONSE @ 304 Å



## First CCD bake out

Operating CCD temperature:  $-67^{\circ}\text{C}$  continuously with passive radiator

CCD heating during several hours @  $+15^{\circ}\text{C}$

Recovery of the response

=> CCD response decay is probably due to "outgasable" contaminant on the CCD

=> monthly CCD bake outs are planned

## Shutter problem

In July 96, the EIT shutter is accidentally left open during 7 hours, with the selecting mask at the  $304 \text{ \AA}$  position.

The following images showed an important loss of sensitivity where an active region was present.

- local decay of 90 % at  $304 \text{ \AA}$
- total response decay of 20 % at  $304 \text{ \AA}$
- local decay of 60 % at the 3 other wavelengths

=> long EUV exposures create local damage to the CCD response

## Calibration lamp images

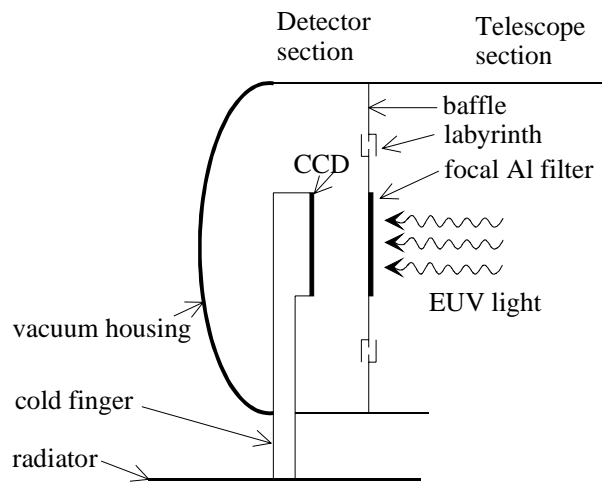
- a global loss of the visible response
- global response recovery after bake out
- local variation of the visible response
  - showing a direct correlation with EUV highly exposed areas
  - showing the negative imprint of the  $304 \text{ \AA}$  highlighted grid support of the aluminium filter
- low recovery of the local variations with bake outs.

=> global degradation of the CCD sensitivity in the visible

=> local degradation of the CCD sensitivity in the visible for highly exposed areas at  $304 \text{ \AA}$

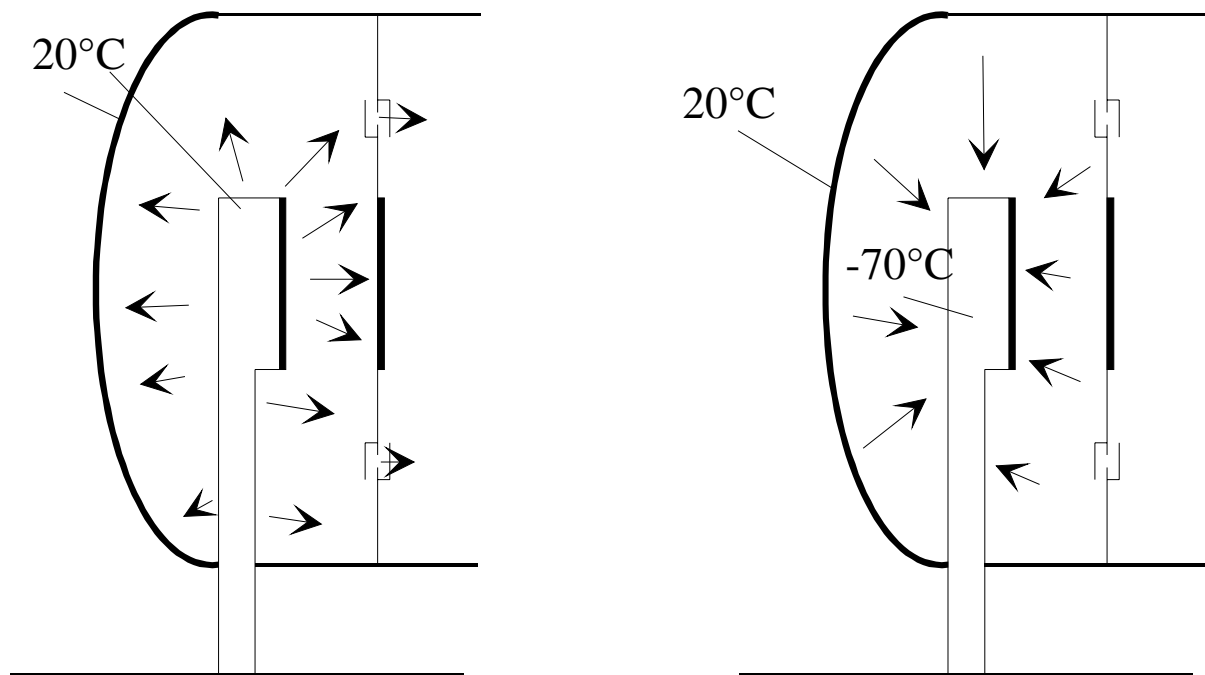
# Diagnostic of the CCD degradations

## 1. CCD section configuration



Enclosed volume with very small venting apertures  
Cold finger permanently at  $-70^{\circ}\text{C}$

A condensable contaminant seems present in the CCD section (global response decay)  
Nature of the contaminant still TBD.





## PHOTON TRANSFER METHOD TO EVALUATE RADIATION DAMAGE ON THE CCD.

### GOAL:

- verify if the CCE is locally modified by long EUV exposures

Photon transfer method (Jannesick, SPIE 570, 1985)

$$\text{CCE} = (K/J) / \eta_i$$

K (e-/DN) measured with visible photons => calibration lamp or pre-launch measurement

K is only dependent on the electronics.

K should remain unchanged since pre-launch tests (~ 16 ~ 17 e-/DN IAS Orsay)

K should be the same over all the CCD surface.

***Evaluation (verification) of K (e-/DN) → 2 similar images with calibration lamp***

J (ph/DN) can be evaluated with EUV photons.

We expect local variations of J.

Local increase of J implies a local CCE degradation.

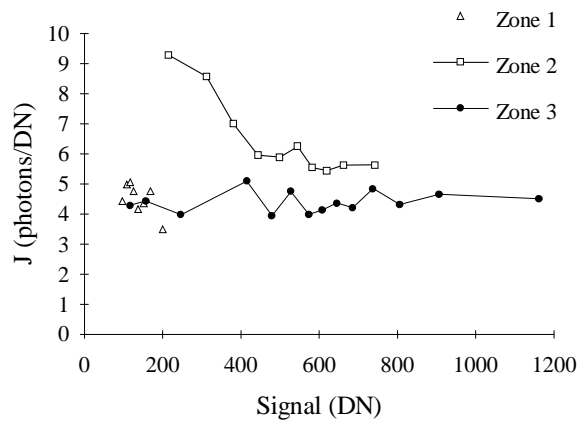
***Evaluation of J → 2 successive images with the same EUV input***

Pairs of high temporal cadence are required to reduce the effects of the solar rotation and solar activity

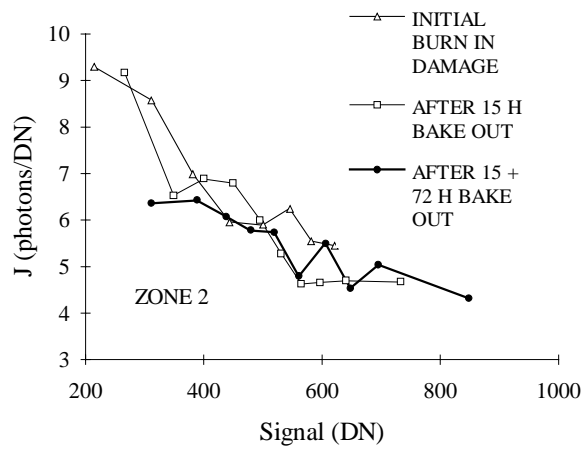


# PHOTON TRANSFERT ANALYSIS ON SOLAR IMAGES @ 171 Å

## JUST AFTER SHUTTER HANG OUT

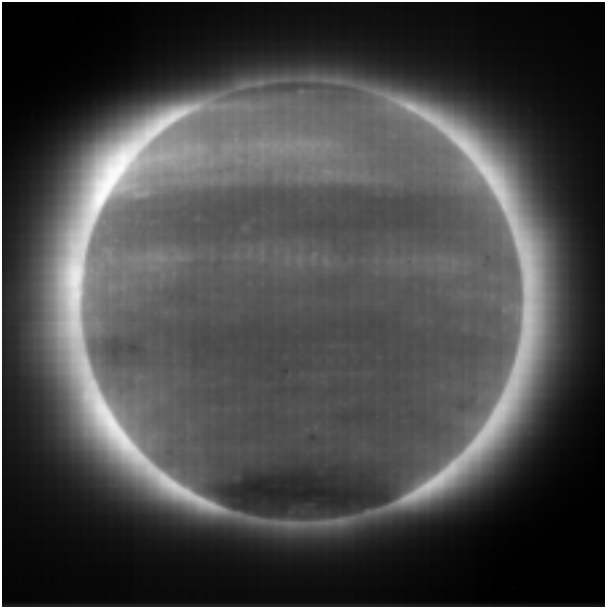


## BAKE OUT EFFECT

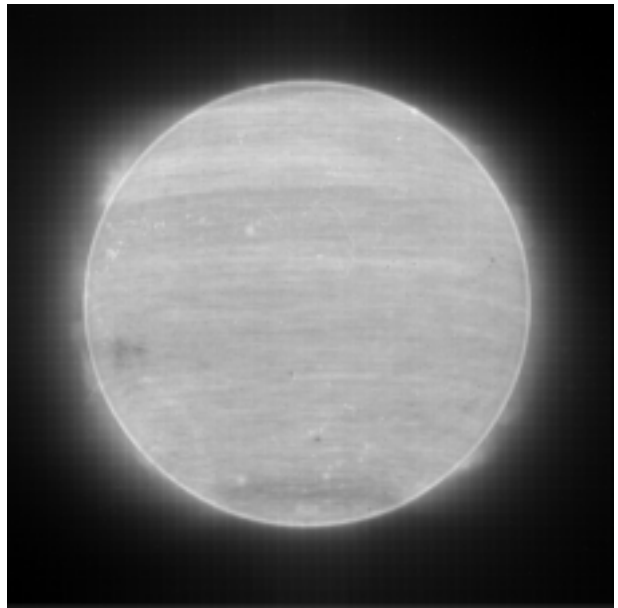


Slow recovery

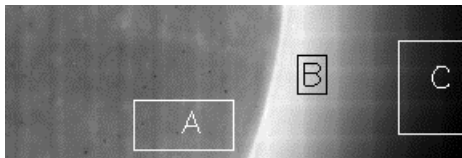
# TOTAL ACCUMULATED EUV DOSE EFFECT



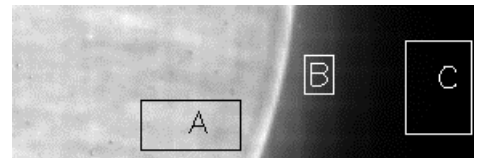
Total accumulated 195 Å signal (in Feb-Mar 97)



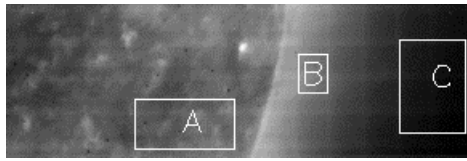
Total accumulated 304 Å signal (in Feb-Mar 97)



Total 195 Å signal

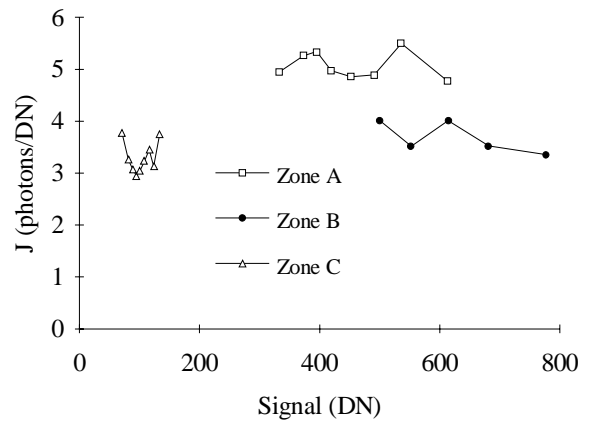


Total 304 Å signal



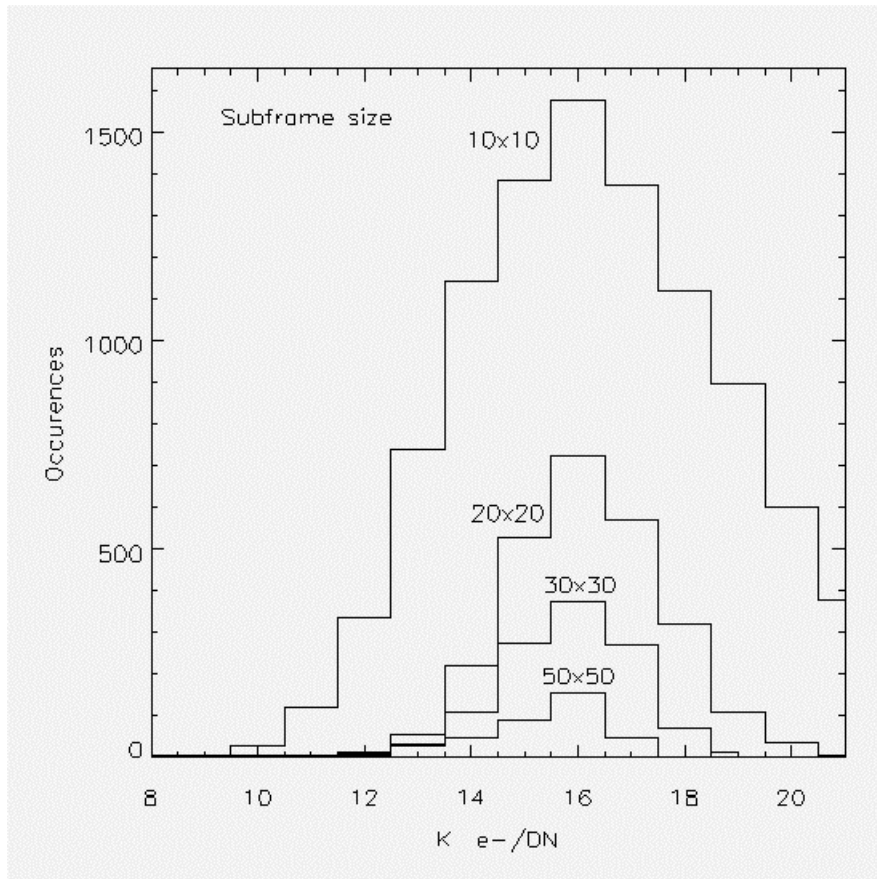
: 171 Å subfield image taken at high temporal cadence on 04-Mar-97

Result of the PT analysis in regions A, B & C.

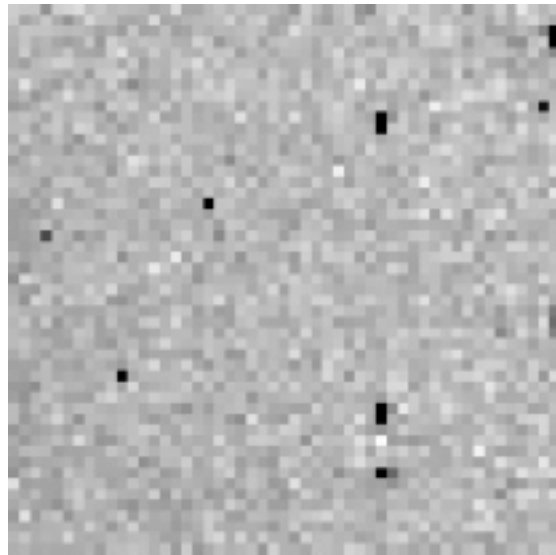


## PHOTON TRANSFERT ANALYSIS IN THE VISIBLE

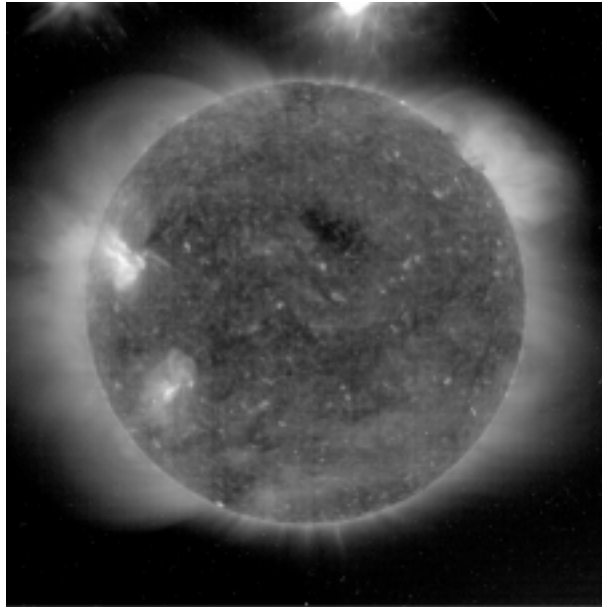
### *Calibration lamp PT analysis:*



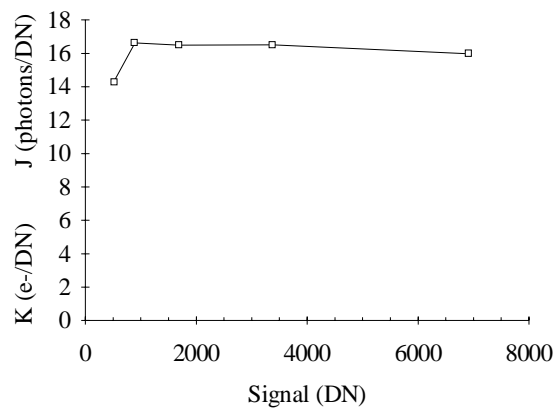
### *Spatial map of K computed in different subarrays*



### *Light leak in the 284 channel*



### *Photon transfert analysis in the light leak area*



EUV photons at 304 Å give a J close to 7 photons/DN, that would be a maximum value for 284 Å photons.

J = 16 e-/DN is very similar to on-ground measurements

**This confirms that the light leak is made of visible light.**

## PRELIMINARY CONCLUSIONS

### *2 competing degradation processes*

<u>CONTAMINATION</u>	<u>EUV DAMAGE</u>
Global effect on the whole CCD surface	Local effect
Fast bakeout recovery	Very slow and variable bakeout recovery
CCE efficiency is unaffected	CCE efficiency is decreased
No EUV dose effect	Dependant on the local accumulated
Is also detectable with response of the CCD in the visible range	EUV dose Also affects the CCD sensitivity in the visible

Comparison of the 2 in-flight response degradation processes of the EIT detector.

## **WORK IN PROGRESS**

- determination of a CCE degradation law as a function of the EUV total dose.
  - evaluation of the bake out recovery
- 

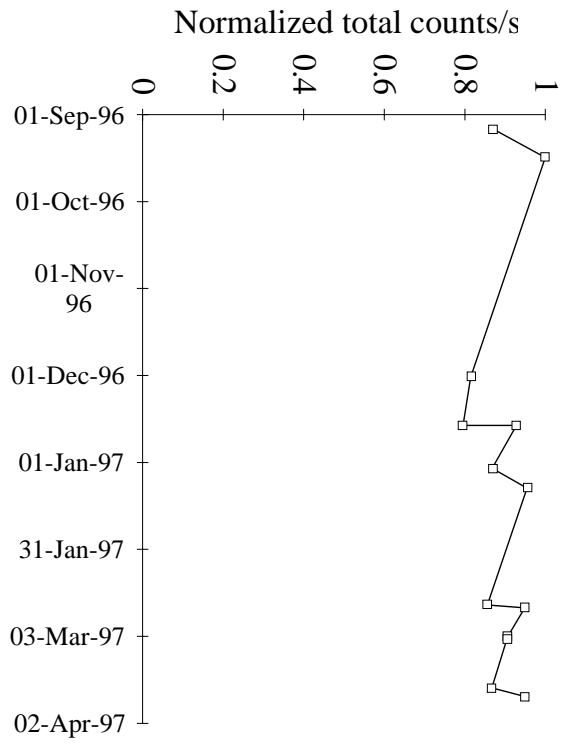
## **JUILLET 97:**

**BAKE OUT 17 → 28 juillet  
entrecoupé de refroidissements du CCD pour des mesures diverses.**

plusieurs types d'analyses à faire

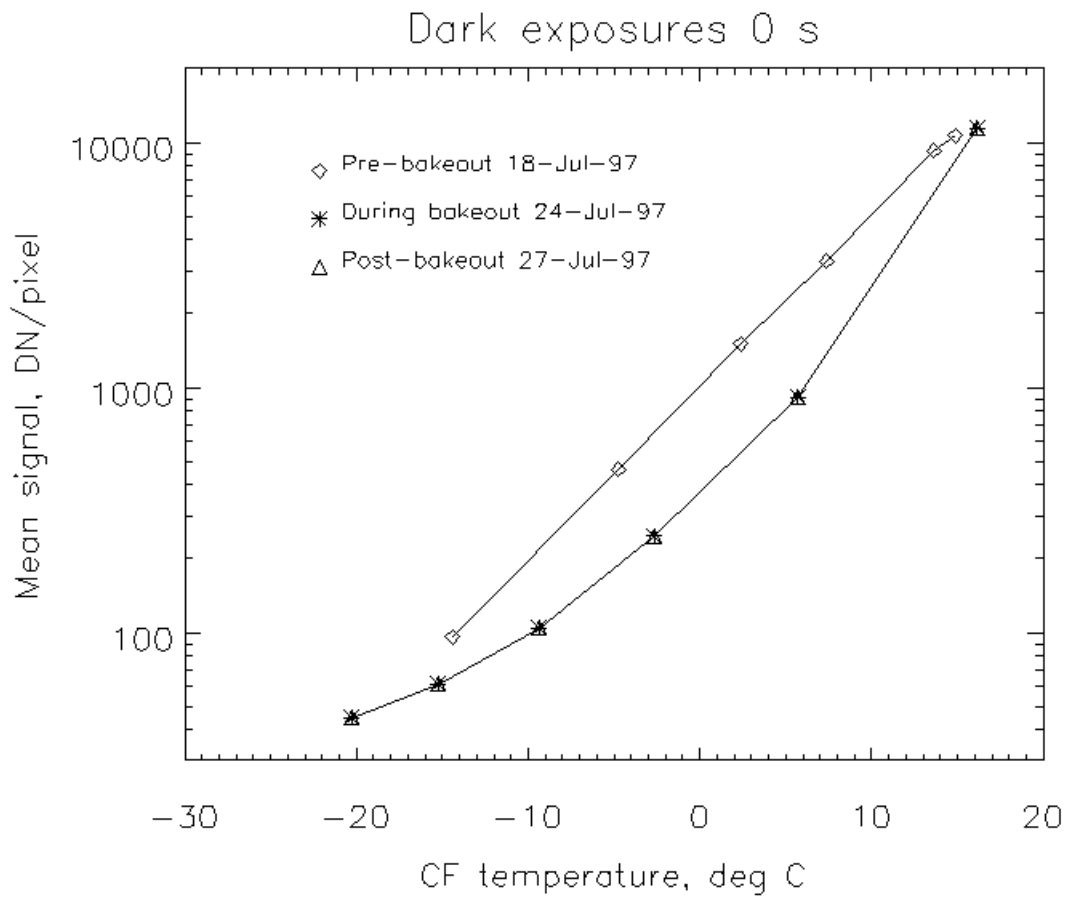
- Evaluation du taux de récupération du CCE local (changements du J, ph/DN)
- Evaluation de la récupération globale du signal EUV
- Evolution du courant d'obscurité
- Tests de linéarité

**BAKE OUT EFFECT ON OVERALL CAL LAMP RESPONSE**





## EIT DARK EXPOSURES - Bake out July 97



**=> Changes in the dark current occur at the beginning of the bake out**

## DARK EXPOSURES - 75 s exposure time

