CoRoT : Ageing of the instrument
I – Increase of the dark current and associated correction

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Effects of the radiations

- Drop of the overall transmission of the dioptric chain (objective (6 lenses), window, prisms)
- Effect on the detector (hot pixels, decrease of quantum efficiency

  Photometric loss of about 10% in 6 years
- Charge transfer inefficiency
- Increase of the dark current

Sky backgrouds components

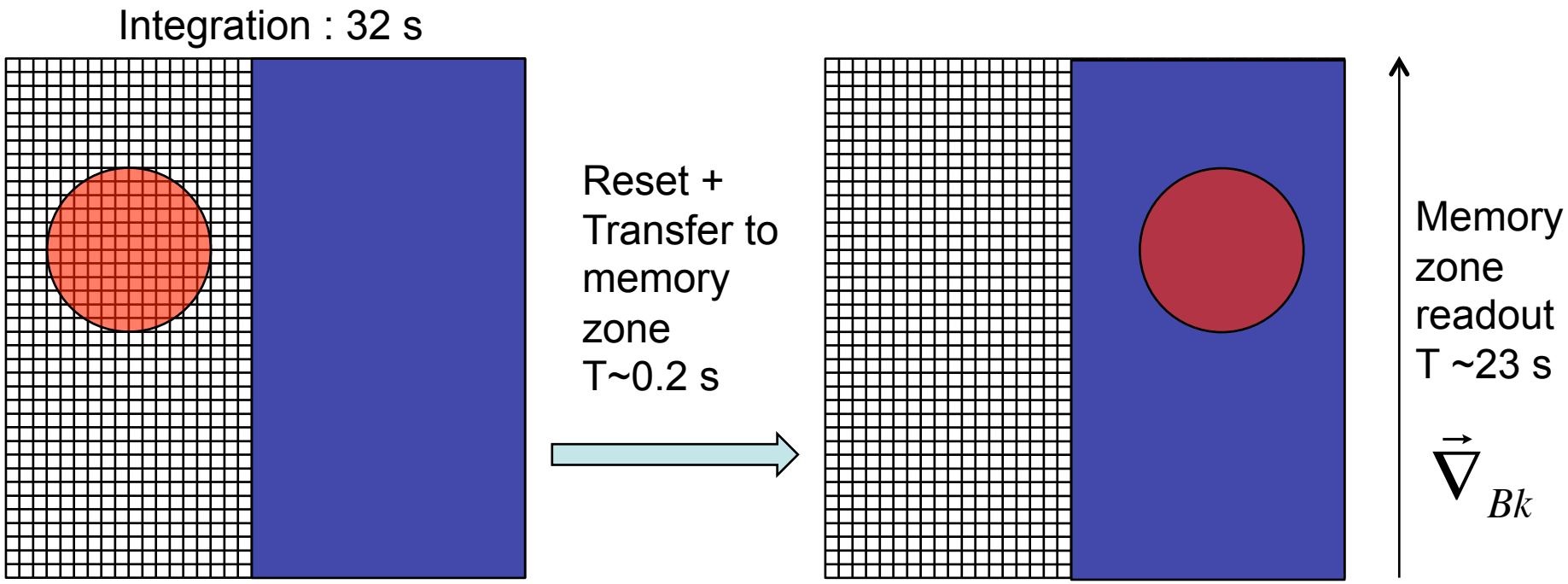
- The effective sky background
- The satellite environment : uniform effect, well corrected by the median value
- The dark current
  - A uniform value (integration phase) corrected by the median value
  - Depends on the position of the window (Y-axis) during the readout phase
    - Small effect at the beginning of the mission
    - The gradient increases with time
  - Depends on the CCD temperature

- Need to correct the lightcurves from the dark current

Dark current

- Negligible at CoRoT's launch
- Increase with time (and radiation exposition)

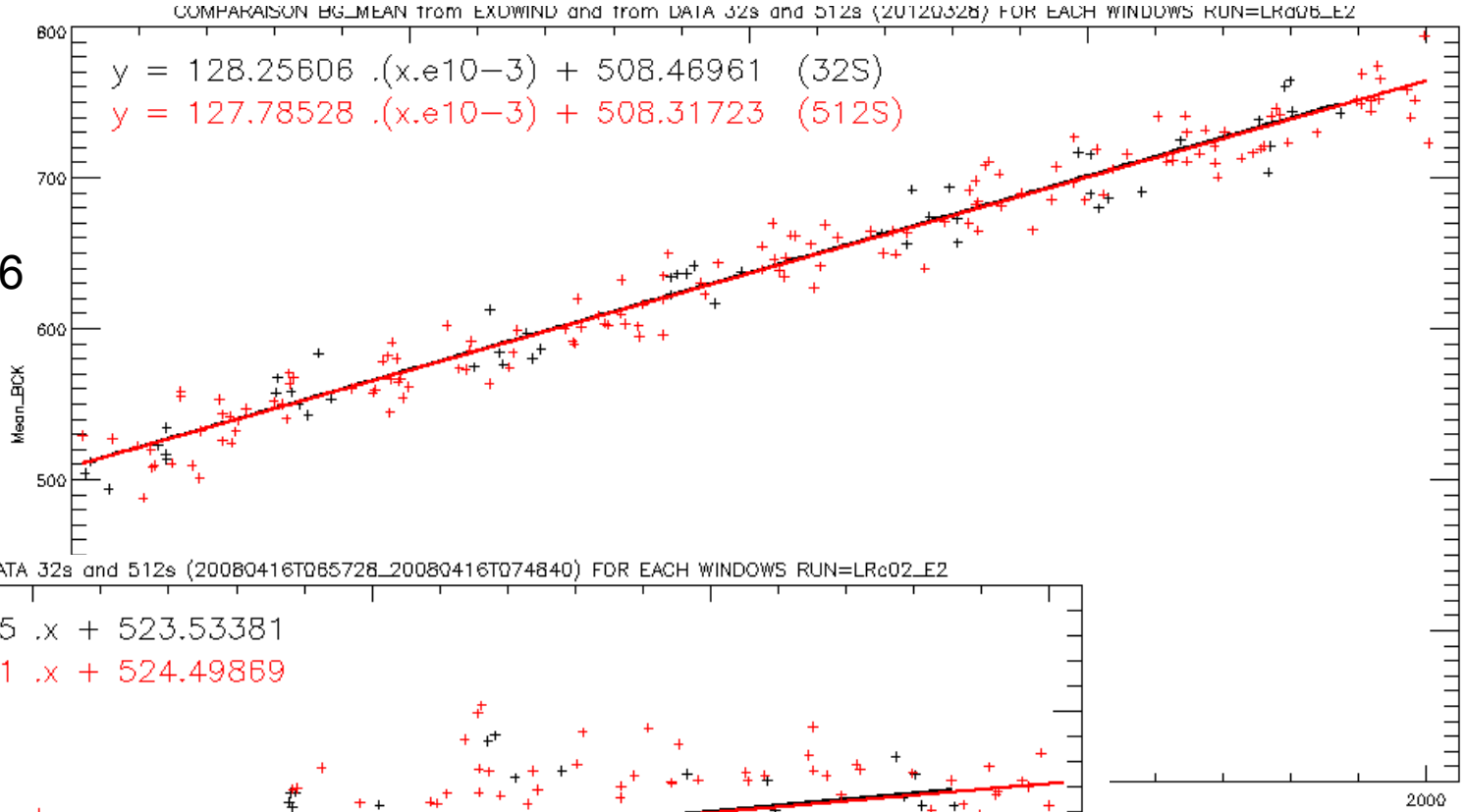
A slope appears on the background due to the readout time

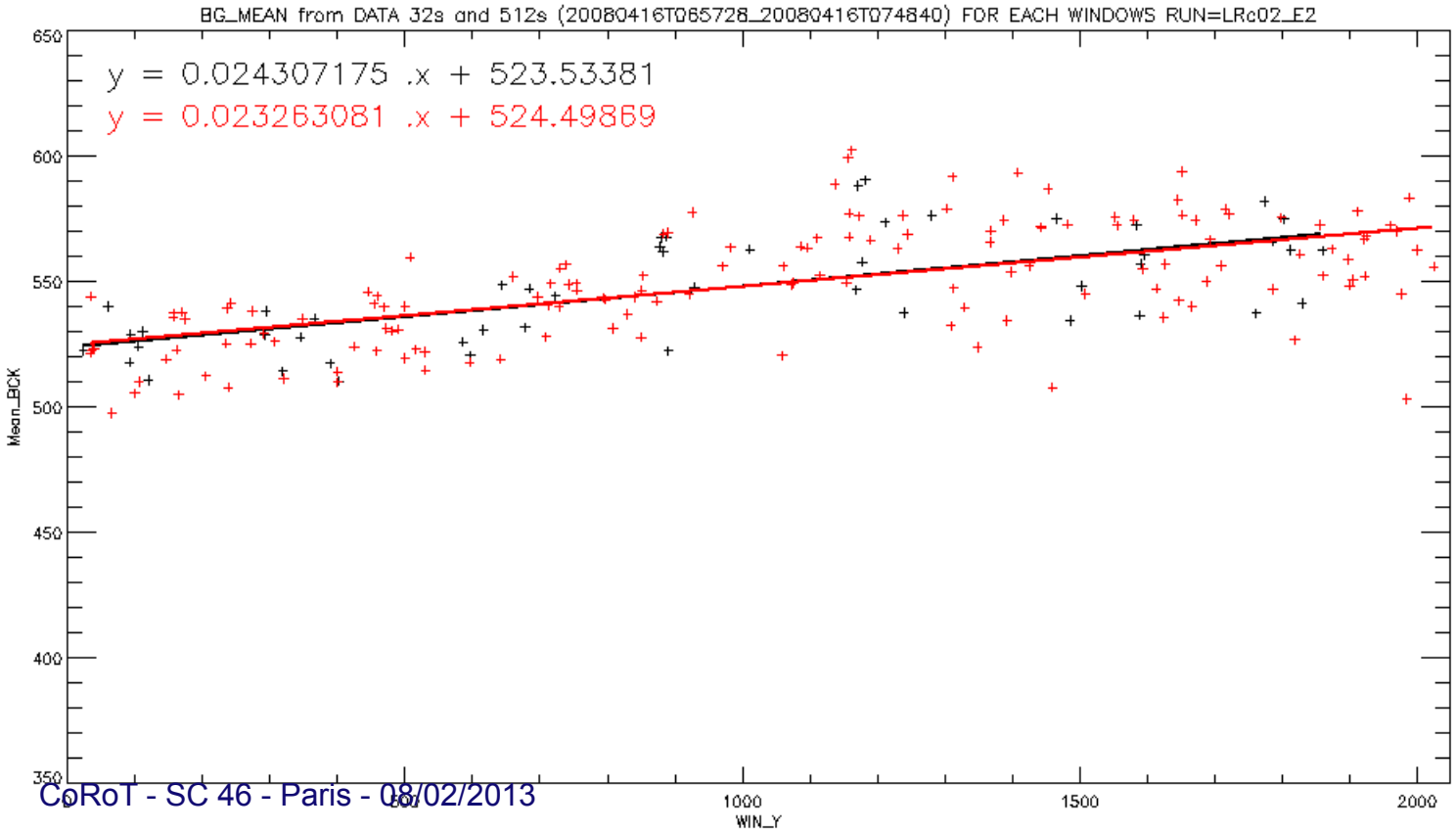


Reminders : evaluation of the background

- 196 sky background windows on the CCD : 147 windows @ 512s, 49 windows @ 32s
- The CCD is split in 14*14 square zones, 1 window per zone; ~ 3/4 sampled @512s and 1/4 sampled @ 32s (starting at SRc01)
- Several methods proposed for the background correction:
  - Subtraction of the nearest background window value
  - Subtraction of the combination of the 3 nearest background windows value
  - Subtraction of a sky background model
- The first two methods are very sensitive to hot pixels => subtraction of the median value of all the background windows
  - Small sensitivity to hot pixels
  - Same correction for the whole CCD
    - OK at the beginning (no dark current, uniform background)
    - Not OK with ageing (cf. dark current and readout process)

LRa06


COMPARAISON BG_MEAN from EXOWIND and from DATA 32s and 512s (20120328) FOR EACH WINDOWS RUN=LRa06_E2
y = 128.25606 .(x.e10−3) + 508.46961 (32S)
y = 127.78528 .(x.e10−3) + 508.31723 (512S)
Mean_BCK
800
700
600
500
2000


BG_MEAN from DATA 32s and 512s (20080416T065728_20080416T074840) FOR EACH WINDOWS RUN=LRc02_E2
y = 0.024307175 .x + 523.53381
y = 0.023263081 .x + 524.49869
Mean_BCK
650
600
550
500
450
400
350
1000
1500
2000
WIN_Y

LRc02

The components of the background and associated corrections

- BG (t) = C_obs + Sky_BG + scatt_light (t)

  C_obs = D_{MRR}(tpe) * [32+τ(y)]

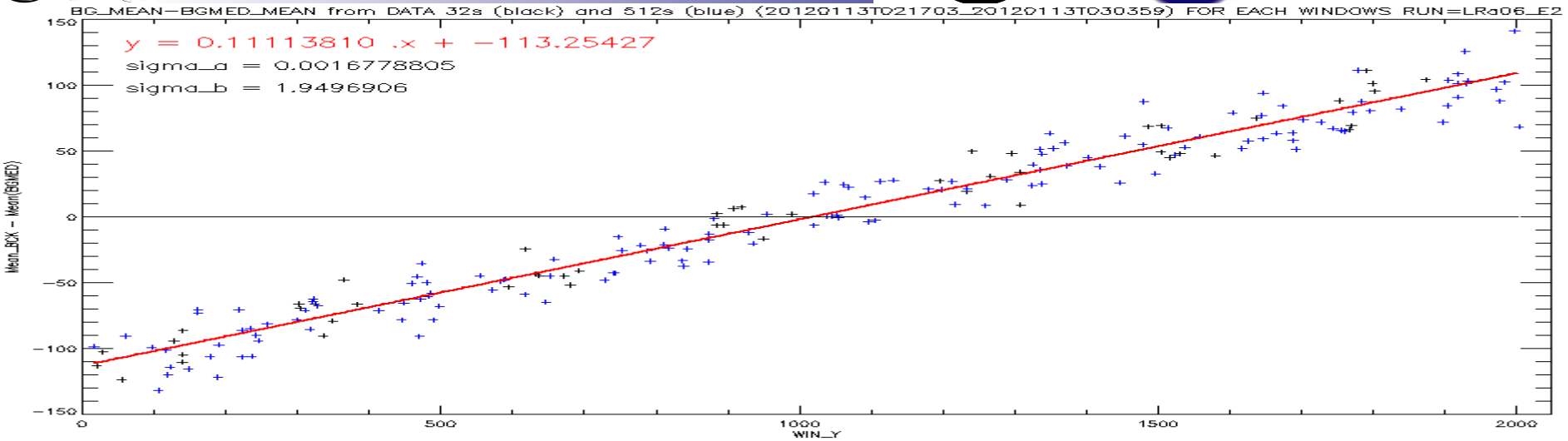
  Sky_BG = cte over the run (depends on the pointing direction)

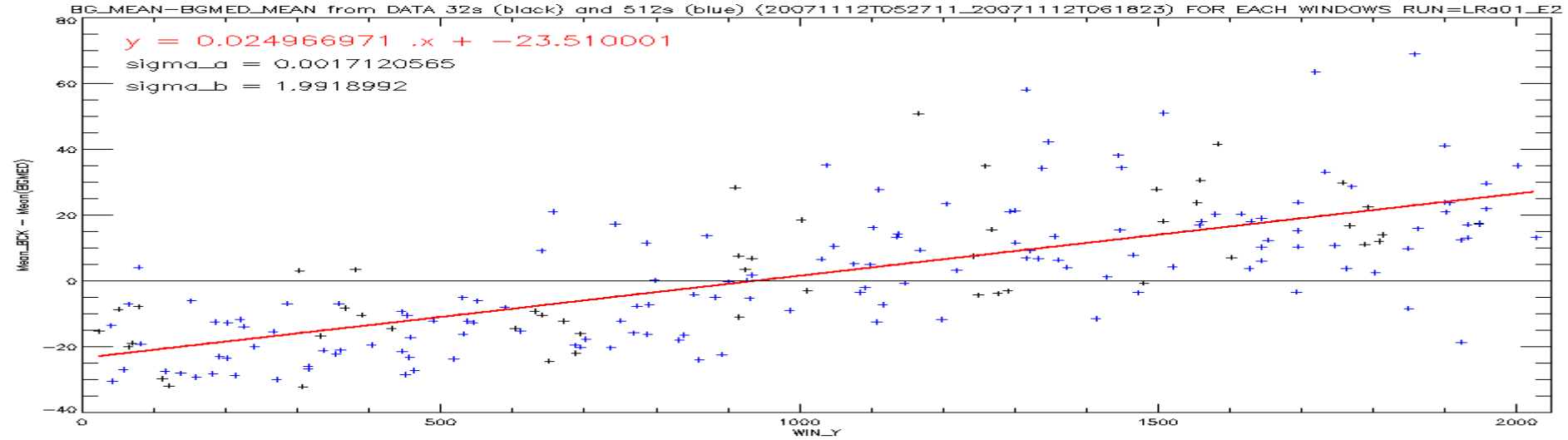
  scatt_light is a function of the date of the observation (varies along the satellite orbit, and slightly during a run)
- BG_{med} = D_{MRR}(tpe)*[32+y_{med}]+Sky_BG +scatt_light
- At a given date and a given temperature :

  $\langle BG \rangle - \langle BG_{med} \rangle = \alpha\,(y - ymed) = \alpha\, y + B$

  fitted at the beginning of the run on a quiet period (in the shadow of the earth, no SAA crossing)

Fit for BG-BG$_{med}$





One example from LRa01/E2

ΔBG : 0,02497 * y – 23,51

Corot_ID	Mag	Y CCD	Correction by pixel	Template size	Total Correction	Mean flux	Correctd flux	%
102 575 808	11.9	16	-23,11	103	-2 380	865 000	862 620	-0,3%
102 572 492	15.1	16	-23,11	43	-994	37000	36 006	-2,7%
102 798 926	13,9	2031	27,20	74	2 013	125 700	127 713	1,6%
102 799 211	15.8	2031	27,20	32	870	22 400	23 270	3,9%

The maximal correction is +/-6% of the median BG (~435 e-/pix/32s)
The amplitude of the scattered light is ~25 e-/pix/32s

One example from LRa06

$\Delta BG = 0{,}1111\ y - 113{,}25$

Corot_ID	Mag	Y CCD	Correct by pixel	Tem plate size	Total Correction	Mean flux	Correct d flux	%
102 601 900	13.4	24	-110,59	59	-6525	195 000	189 000	3.4 %
102 583 477	15.3	24	-110,59	33	-3650	35 700	32 000	10.2 %
102 813 622	14	2029	112,24	69	7745	118 800	126 500	6.5 %
102 809 183	15.8	2029	112,24	28	3143	26 100	29 200	12 %

The maximal correction is +/-19% of the median BG (~590 e-/pix/32s)
The amplitude of the scattered light is ~10 e-/pix/32s
The correction due to the y position is 10 times the scattered light
The jump due to temperature is around 70 e-/pix/32s for 1,5°C

Next steps

- Correction of Dark due to T variations
- Correction of QE due to T variations
- Cf. Sylviane's presentation