Real processing of the data produced by the PLANCK - Low Frequency Instrument, such as: on board acquisition, processing and transmission and ground processing, introduces systematic effects which have to be quantified and when possible removed. Signal quantization (i.e. discretization) has been the first one of such effects studied in a quantitative way in order to assess its impact on the LFI scientific performances. The main effect of quantization is equivalent to add a baseline to the power spectrum. Such baseline is equivalent to a $\Delta C_l/C_l < 0.01$ or 10% of the noise plus CMB r.m.s. but may be very well modeled, estimated and removed from power spectrum.

**Planck/LFI: Scientific Impact of Signal Quantization and OnBoard Processing**

M. Maris 1, D. Maino 1, C. Burigana 2, A. Menella 3, M. Bersanelli 4, F. Pasian 1

1 INAF – Osservatorio Astronomico di Trieste; 2 IASF/CNR – Sez. Bologna; 3 IASF/CNR – Sez. Milano; 4 Univ. Milano

### Main Elements of the On-Board Processing Concept

- One Horn Radiometers Assembly
- One Horn Data Flow (from Horn Carries two Identical Horns)
- Acquisition - Differentiating - Coadding - Plane Switch - Coadding - Lossless Compression - Packeting - Transmission

### The Quantization Problem

The way in which the quantization problem has been studied is paradigmatic of the method of quantization errors induced by the digitization process.

- Signal quantization (i.e. $+\text{pure, uncorrelated}$)
- Small deviations from normality for the error distribution

Other operations are intrinsically $+\text{completely reverted by the Ground Segment operations.}$ Some of these operations are $-\text{choice, assessment and calibration of valid analytical methods, optimized for Planck/LFI.}$ $-\text{Quantitative evaluation of the quantization effects in a realistic situation.}$

### Results

Results confirm the adequacy of the standard noise model [7] to describe the quantization effect in the present situation.

- Analysis is performed comparing simulated signals, generated by an accurate Mission Simulator [1], with real-world quantization + reconstruction, in taking account of the sky signal composition, with the real standard and SST, the scanning strategy and different options for the quantization process.

### Bandwidth Constraints, Data Rate and Compression Efficiency [5, 6]

- $\text{Expected scientific uncompressed data rate from LFI:}~\approx 20 \text{ Kb/sec}$
- $\text{Transmission of a single measurement (on LFI):}$
  - $\text{short signal:}~\approx 15 \text{ Kb/sec}$
  - $\text{long signal:}~\approx 15 \text{ Kb/sec}$

### Statistical Evaluation of $Q_0$

### Power Spectrum

- Maps
- The quantization effects range.
- The quantization error $\epsilon$ is defined as the difference between the map reconstructed from the quantized data and the map reconstructed from the original, unquantized data.

### Conclusions and Work in Progress

- Even in the present case, the quantization process may be at first order approximated as a source of white noise.
- The quantization noise is at a first approximation normal, residuals may lead to some quasisymmetric uncertainties which should be accounted for before to search for non-gaussianities in the LFI data.

- $\text{At least for } l < 30, \text{ the power excess induced in the power spectrum by quantization is constant.}$
- $\text{For } l \geq 30, \text{ the power excess induced in the power spectrum by quantization is constant.}$

- $\text{Quantization may be one of the major source of systematic errors and shall be removed.}$

### References


The LFI is funded by the national space agencies of the Institutes of the Consortium. In particular the Italian participation is funded by ASI.