

# From Ground radiometry to space applications

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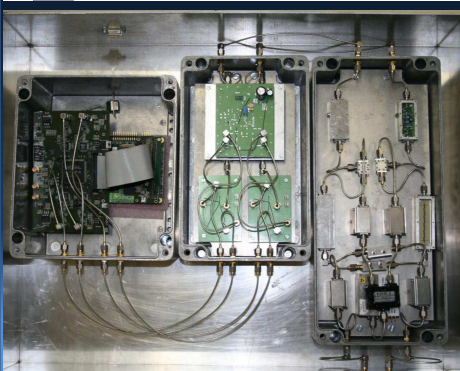
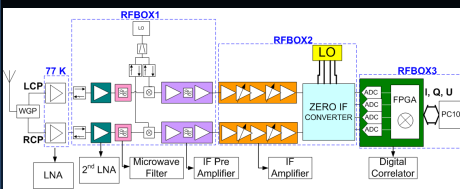
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## Cosmic Microwave Background Foregrounds

Foreground: study the radiation from the Milky Way at 5GHz and at 10GHz on both Hemispheres (Portugal and Brazil) for space data processing.

### THE 5GHz EXPERIMENT



- $T_{sys} < 20$  K;  $B = 200$  MHz; 104 dB gain
- High-performance IF strip
- Latest RF tech + microstrip design + MMIC
- Zero-IF Converter + I,Q modulation
- Digital Correlator : 4-channel, FPGA implemented processing 16Gbps!
- An SKA (Potential!) Digital Demodulator
- Dynamic Range: Total=20dB, Instantaneous=80dB
- Suitable for state of the art RA applications.
- MoU with ESA Planck Science Team.



For this project was implemented a C-band (5GHz) Low Noise Amplifier (LNA) using new low noise Pseudomorphic High Electron Mobility Transistors (pHEMTS) from Avago. The amplifier was developed to be a cost effective solution in a receiver chain for Galactic Emission Mapping (GEM-P) project in Portugal.

Bergano, M.; Rocha, A.; Cupido, L.; Barbosa, D., "A 5 GHz LNA for a radio-astronomy experiment," *EUROCON - International Conference on Computer as a Tool (EUROCON), 2011 IEEE*, vol., no., pp.1-4, 27-29 April 2011  
doi: 10.1109/EUROCON.2011.5929355  
URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5929355&isnumber=5929030>

### GEM-Portugal Antenna

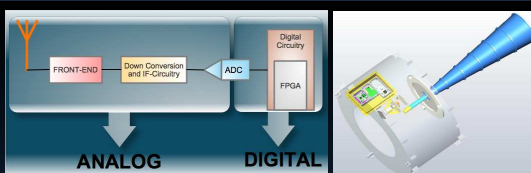


The receiver system is equipped with a novel receiver with a full digital back-end using a low-cost Field Programmable Gate Array without compromising its performance relation. This new digital backend comprises a base-band complex cross-correlator outputting the four Stokes parameters of the incoming polarized radiation.

[Bergano\\_IB](#); F. F. Fernandes; L. Cupido; [Barbosa\\_D](#); R. Fonseca; I. S. V. Ferreira; B. Grossan; G. F. S. Smoot; "Digital Complex Correlator for a C-band Polarimetry survey", *Experimental Astronomy*, Vol. 30, No. 1, pp. 23 - 37, February, 2011.

### THE 10 GHz EXPERIMENT

- Development of a full digital polarimeter;
- Measurement of the Stokes-Parameters (circular polarization)
- Measure the change ( $\Delta T$ ) in the antenna equivalent noise temperature ( $T_A$ ) which is extremely low (10K). Targets:
- Sensitivity ( $\Delta T$ ) is 0.2 mK
- Equivalent Temperature of the Receiver is 17 K
- Center Frequency = 10GHz with 1GHz Bandwidth
- Technology comparison:
- Low Noise Front-end  $\rightarrow$  LNA
- Cost-effective performing solution



- Measuring Cosmic Noise Signal Signatures
  - Research topic very important in radio-astronomy
- Equipment complex and expensive
  - Several Architectures reviewed and compared
- Our Proposal: a cheap but potentially performing solution
  - Total Power approach with very large bandwidth
    - Low Noise front -end development
    - Temperature stabilized IF circuitry
  - Implementation of an innovative digital detector based on high data rate sampling and FPGA processing
- Approach relevant to other niches: Telecommunications and Earth-Sensing
- Versatile solution: integration times, resolution, calibration, easy reproduction of the hardware, etc

### GEM-Brasil Antenna



 universidade de aveiro

 instituto de telecomunicações

