

BaR-SPOrt: Balloon-borne Radiometers for Sky Polarization Observations

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Abstract. BaR-SPOrt, funded by ASI (Italian Space Agency), is a 32 (90) GHz balloon-borne correlation polarimeter for direct measurements of the Q and U Stokes parameters, with an angular resolution of 0.6° (0.2°). Aim of the experiment is the detection of the polarized emission of the diffuse Galactic Background and the Cosmic Microwave Background (CMB). The most likely launch site is Antarctica (2 to 4-week flight). Kiruna (Sweden, 1-week flight) and Svalbard (Norway, > 1-week flight) are possible launch site to observe the Northern sky.

1 The Science

Main scientific goal of BaR-SPOrt is measuring the linear polarization level of the sky emission on small sky patches [1]. Good observing targets, characterised by low emission from dust and synchrotron, exist in both the Southern and the Northern emisphere (the area already observed by BOOMERanG [2] and, e.g., the area centered at RA=11h, DEC=45°, respectively).

The expected polarization level ($P_{rms} = \sqrt{\langle Q^2 \rangle + \langle U^2 \rangle}$) of the CMB is maximum at small angular scales and is only weakly dependent on the cosmological model. If flown for 2 weeks or more, the instrument at 90 GHz, having a

beam of 0.2° , is expected to detect CMB polarization irrespective of the presence of a reionization period.

The instrument at 32 GHz, with a beam of 0.6° , will at least be able to improve current upper limits on both CMBP and synchrotron polarized emission.

2 The Instrument

The polarimeter design has been developed to minimize instrumental effects and to increase long-term stability [4], as to reduce $1/f$ noise effects. The instrument shares most of the SPOrt [3] know-how. The main instrumental characteristics are:

- Low cross-polarization (< -40 dB) on-axis optics providing HPBW $\simeq 0.6^\circ$ at 32 GHz and HPBW $\simeq 0.2^\circ$ at 90 GHz;
- Correlation Unit based on custom design waveguide Hybrid Phase Discriminator, with unpolarized component rejection > 30 dB [5];
- Custom design OMT with high isolation (> 60 dB) to limit contamination from the unpolarized component;
- Custom design internal calibrator for polarized signals [6];
- A Cryostat to cool (< 80 K) LNAs, circulators, polarizer and OMT by a closed-loop cryocooler, and a thermal shield, temperature regulated, located inside the cryostat to increase the thermal stability.

Table 1. BaR-SPOrt technical characteristics

Frequency	Bandwidth	Angular resolution	Instantaneous sensitivity
32 GHz	10%	0.6°	$0.5 \text{ mKs}^{1/2}$
90 GHz	20%	0.2°	$0.5 \text{ mKs}^{1/2}$

References

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