

Final project report

<i>Project ID</i>	2002/7.12
<i>Title</i>	B2K3 – Ultrasensitive measurements of the Cosmic Microwave Background with stratospheric balloons
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<i>Duration</i>	2 years
<i>Assigned funding</i>	77.000,00 Euro

Activities and results

We have fully analyzed the data from the 2003 flight of the BOOMERanG experiment, devoted to the measurement of the polarization of the CMB. The system was sensitive at 145, 245, 345 GHz, and produced maps of about 3% of the sky at high galactic latitudes (Horologium constellation). These maps show very clearly the presence of anisotropy in the CMB, with a power spectrum featuring three peaks, consistent with the adiabatic inflationary scenario. The maps and the CMB anisotropy power spectrum are described in full detail in Masi et al. (2006) and Jones et al. (2006). We have detected polarization in the CMB (E-modes) both as a correlation with the temperature field (Piacentini et al. 2006) and as E-mode polarization (Montroy et al. 2006). These measurements have produced stringent constraints on the most important cosmological parameters (MacTavish et al. 2006). We have also studied the non-gaussianity of the maps (DeTroia et al. 2007) and the presence of diffuse SZ signals (Veneziani et al. 2009) and of cirrus dust (Veneziani et al. 2010).

We have prepared a new flight of the BOOMERanG payload devoted to the measurement of polarization from interstellar dust at high Galactic latitudes, at a frequency of 350 GHz. This frequency has been selected as the best compromise between level of the foreground signal and distance from the CMB signal. The new payload is ready to be launched by the Italian Space Agency in a circumpolar Arctic flight from Svalbards, and is on-hold while the necessary authorization for overflight over the Russian territory is being released.

For the new experiment we have developed, in collaboration with Chalmers University, a large array of a hundred detectors, working as Cold Electron Bolometers. These allow extreme sensitivity and pure polarization analysis properties.

Products

A – papers in scientific magazines

1. S. Masi, et al., "Instrument, Method, Brightness and Polarization Maps from the 2003 flight of BOOMERanG", 2006, *Astronomy and Astrophysics*, **458**, 687-716, astro-ph/0507509
2. W. C. Jones, et al. "A Measurement of the Angular Power Spectrum of the CMB Temperature Anisotropy from the 2003 Flight of Boomerang", 2006, *ApJ*, **647**, 823-832 astro-ph/0507494
3. F. Piacentini, et al., "A measurement of the polarization-temperature angular cross power spectrum of the Cosmic Microwave Background from the 2003 flight of BOOMERANG", 2006, *ApJ*, **647**, 833-839, astro-ph/0507507
4. T.E. Montroy, et al., "A Measurement of the CMB $\langle EE \rangle$ Spectrum from the 2003 Flight of BOOMERANG", 2006, *ApJ*, **647**, 813-822, astro-ph/0507514
5. C. J. MacTavish, et al., "Cosmological Parameters from the 2003 flight of BOOMERANG", 2006, *ApJ*, **647**, 799-812, astro-ph/0507503
6. G. De Troia, et al. "Searching for non Gaussian signals in the BOOMERanG 2003 CMB maps", *ApJ*, 670, L73-L76, (2007)

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7. S. Masi, et al. "The millimeter sky as seen with BOOMERanG", New Astronomy Reviews, **51** (2007) 236-243
8. F. Piacentini, et al. "CMB polarization with Boomerang 2003", New Astronomy Reviews, **51** (2007) 244-249
9. G. De Troia, et al. "Searching for non Gaussian signals in the BOOMERanG 2003 CMB map: preliminary results", New Astronomy Reviews, **51** (2007) 250-255
10. M. Veneziani, et al., "Sub-Degree Sunyaev-Zel'dovich Signal from Multi-Frequency BOOMERanG observations", The Astrophysical Journal, 702, L61-L65 (2009), astro-ph/0904.4313
11. M. Veneziani, P. A. R. Ade, J. J. Bock, A. Boscaleri, B. P. Crill, P. de Bernardis, G. De Gasperis, A. de Oliveira-Costa, G. De Troia, G. Di Stefano, K. M. Ganga, W. C. Jones, T. S. Kisner, A. E. Lange, C. J. MacTavish, S. Masi, P. D. Mauskopf, T. E. Montroy, P. Natoli, C. B. Netterfield, E. Pascale, F. Piacentini, D. Pietrobon, G. Polenta, S. Ricciardi, G. Romeo, J. E. Ruhl "Properties of Galactic Cirrus Clouds observed by BOOMERANG", submitted to Ap.J., 2009, astro-ph/0907.5012, in press.

B – book chapters

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C - proceedings of international conferences

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D – proceedings of national meetings and conferences

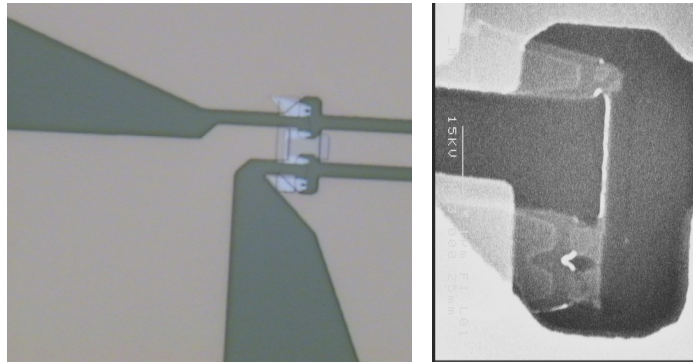
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E – thematic maps

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F – patents, prototypes and data bases

1. Focal plane with 100 cold electron bolometers for operation at 145 and 345 GHz (see picture below of details of the CEBs)



2. Balloon-borne payload BOOMERanG ready for the long duration arctic flight

G – exhibits, organization of conferences, editing and similar

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H - formation (PhD thesis, research fellowships, etc.)

1. Veneziani Marcella, Tesi di Dottorato di Ricerca, Ciclo XXI (2005-2008) "Misure della Radiazione Cosmica di fondo e dei foregrounds con gli esperimenti BOOMERanG e Planck" Relatori: prof. P. De Bernardis, prof. K. Ganga

Research units

Dipartimento di Fisica, Università La Sapienza, Roma (P. de Bernardis et al.)
Istituto Nazionale di Geofisica (G. Romeo et al.)

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Notes