CHINA LUNAR PROBE CHANG'E-1 MICROWAVE SOUNDER --- DESIGN AND SOME RESULTS

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Abstract

China first lunar probe satellite "Chang'E-1(CE-1)" was successfully launched on Oct.24th, 2007 and reached the lunar polar working orbit with 200km altitude from lunar surface on Nov.7th . CE-1 satellite had been working normally during more than one year life time and has collected huge scientific data and images. Chang'E-1 microwave sounder (CELMS) is a four-frequency microwave radiometer. The frequencies are distributed in 3GHz, 7.8 GHz, 19.3 GHz and 37 GHz, in which the 3GHz and 37GHz frequencies are emphases for the selection. For deeper penetration to lunar regolith, lower frequency is preferred. We select 3GHz as the low frequency due to the space limitation of antenna, 37GHz as the high one to obtain essential emission from lunar surface. The other two frequencies of 7.8GHz and 19.35GHz are selected to acquire an internal layer construction [1, 2, 3].

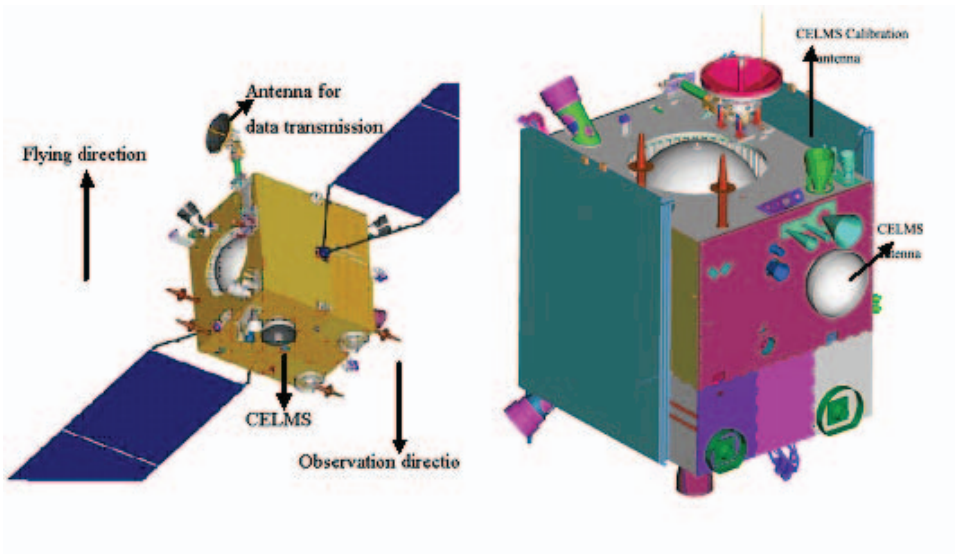

FIG.1 TECHNICAL CONFIGURATION OF CELMS

TABLE.1 TECHNICAL SPECIFICATION OF CELMS

Frequency （GHz）	Bandwidth （MHz）	Integral Time（ms）	Sensibility （K）	linearity	Space Resolution (km）
3.0	100	200	0.5	0.99	50
7.8	200	200	0.5	0.99	35
19.35	500	200	0.5	0.99	35
37	500	200	0.5	0.99	35

To improve the calibration accuracy, we paid great attention to in-orbit calibration. Usually 2.7k was used as the low temperature reference for microwave cosmic background. Actually for different calibration antenna pointing, the space microwave cosmic background temperature varies and it should be considered as an effect in microwave emission data processing [4, 5].

Using the CELMS data, we got the moon global microwave brightness temperature (TB_L), with which the world-first “Microwave Moon (MicM) ”was established [6](fig.2).

The microwave moon is important not only for lunar resources exploration and applications, but also for lunar science and cosmic science research, which significantly improves the level of human knowledge on origin of space and lives.

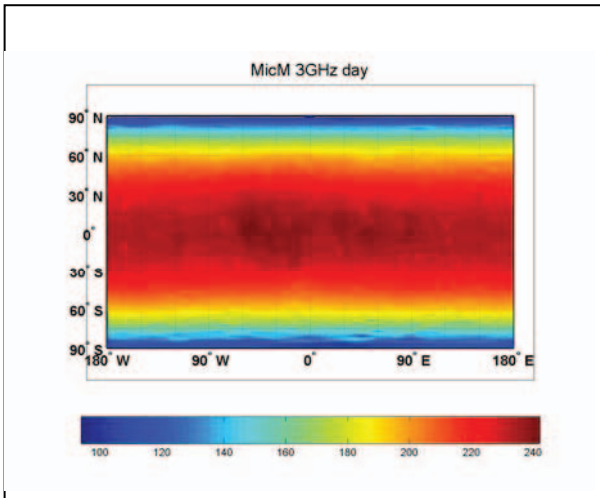

Fig 2A Equidistant cylindrical projection maps for 3GHz day

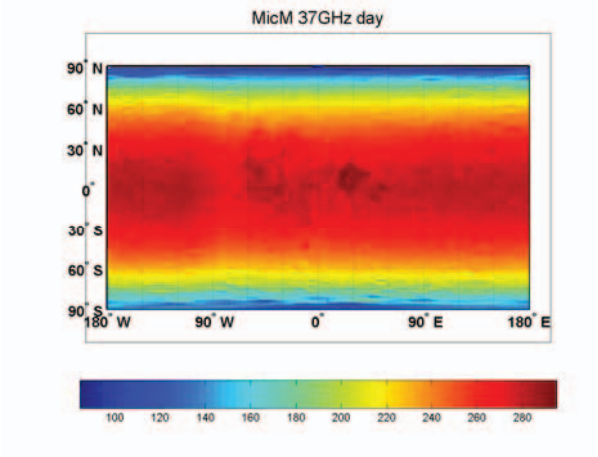

Fig 1B Equidistant cylindrical projection maps for 37GHz day

This paper discusses comprehensively the Radiometer system design and its' on- ground and in-orbit calibration. The discussion also concerns with the CELMS initiative results we have achieved and some new conclusions which are significantly different from earlier works performed by other lunar scientists. The new conclusions are of revolutionary values for future lunar and cosmic science researches, which will improve human knowledge to reach the real nature of the moon.

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