PLANETARY RADIO SCIENCE MEASUREMENT SCHEME BASED ON THE DOWNLINK SIGNALS OF CHINA'S FIRST MARS PROBE. D. Q. Kong, C. L. Li, H. B. Zhang, G. L. Zhang and X. Ren (Key Laboratory of Lunar and Deep Space Exploration, National Astronomical Observatories, Chinese Academy of Sciences, 20A Datun Road, Chaoyang District, Beijing, China 100012, kdq@bao.ac.cn) .

The deep space telecommunication link performance will be seriously affected by the solar wind and solar corona, during the superior solar conjunction. The influence of solar wind and corona on communication reflects its irregular internal structure. Observations of solar wind and corona are of great significance in the study of solar evolution, solar outer atmosphere, solar-terrestrial space and geophysics. In addition, occultation observation is also one of the important tools for studying the composition and structure of the planet's atmosphere.

The first Mars probe of China will be launched in 2020, and in order to meet the requirements of the massive scientific data, the downlink data transmission will be performed using an antenna array, including at least Miyun 50m and 40m, Wuqing 70m and Kunming 40m four antennas. Planetary radio science measurements of the entire time of the Mars probe will be performed throughout the data reception and VLBI orbital determination, including carrier phase, signal to noise ratio and power spectrum. The high-precision digital terminals have been designed and are being developed to meet the needs of the Mars other deep space probes downlink signals measurement.

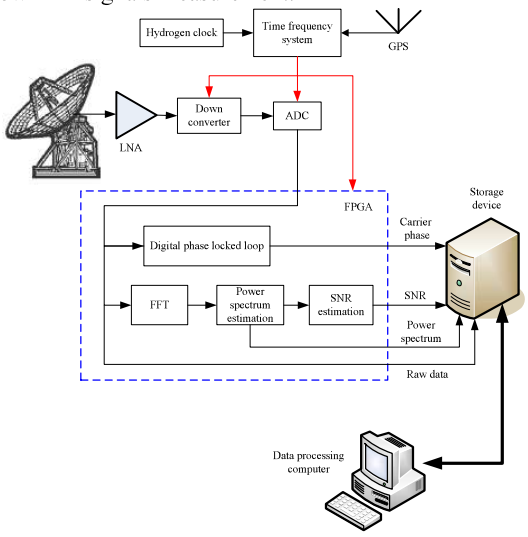

Fig. 1 The single station observation system diagram

Measurement items will include signal power, Doppler frequency shift, and spectrum spreading. Telemetry beacons and downlink data transmission signals will be observed simultaneously. Fig. 1 is a schematic diagram of a single station observation system based on the downlink signals of china's first mars probe. For convenience, only one signal processing device is shown in the figure. The frequency and time module uses the hydrogen clock and timing system in the station to provide frequency standards for down converter and ADC (Analog-to-digital conversion). After the signal is amplified and down-converted, it is sampled by ADC and then processed by FPGA (Field programmable gate array). FPGA mainly includes the modules such as FFT, power spectrum estimation, signal-to-noise ratio estimation, and digital phase-locked loop. The raw data and the carrier phase, signal-to-noise ratio, and power spectrum data are recorded in the high-speed storage device. The data processing computer realizes the post-processing of observation data, including solar wind or planetary atmosphere characteristic inversion and data management.

The digital terminals will be equipped for the Miyun 50m and 40m, Wuqing 70m and Kunming 40m radio telescope, and observations will be carried out throughout the course of the Mars probe.

References:

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