We present possible and actual observation strategies for Cosmic Microwave Background experiments. Such experiments largely aim at covering the whole sky or a significant part of it, with the challenges associated to this. In particular, orbital constraints (for space experiments) or geographical constraints (for ground-based or balloon-borne experiments) make it difficult to observe the sky in a smooth and uniform way. Additionally, depending on the instrument characteristics, noise and systematic effects control may demand some particular types of observation strategies. We shortly describe the WMAP and Planck scanning strategies as well as those used for some CMB balloon-borne experiments, and possible conclusions for future experiments.

**CMB balloon-borne experiments**

Scanning strategies for balloon-borne experiments make good use of the daily rotation of the Earth and the proper motion of the balloon over the Earth while the observations take place. In most cases, CMB balloon-borne experiments scan the sky through constant elevation circles at a constant rotation speed, as Archeops and TopHat did for example. This allows to observe a large area of the sky. The launch place and flight duration have a crucial influence on the sky coverage and the redundancy in the map pixels. Experiments using this constant elevation scanning strategy have to balance between coverage and redundancy. Maximum redundancy is obtained with high elevation angles and high-latitude launch sites. In contrast, the best coverage/flight time ratio is obtained at near-equatorial sites and with low elevation angles. The factors controlling the observation characteristics are the place and date of launch, the trajectory of the balloon, the flight duration, the elevation angle of scanning above the horizon, (the sampling frequency and the rotation speed of the gondola). Fast-sampling of a large part of the sky often leads to difficult map-making challenges due to the nature of the noise (1/f, systematic effects). Maximizing number of crossings and redundancy in pixels is important to process properly the noise during map-making. Elevation angle of scanning and/or launch site latitude are crucial for this. Reference: (3).

**Space-based CMB experiments**

Space-based CMB experiments (COBE (7), WMAP (1), Planck (5)) are normally of much longer duration than balloons, making it possible to observe the whole sky, several times. A natural scanning strategy is to sweep the sky in great circles – or near great circles. For a satellite in a low-Earth orbit, this strategy allows for example to always point towards the zenith, in order to avoid light contamination from the Earth. This kind of strategy also works for a spacecraft at L2, such as Planck (5,6). In the case the strategy can be as simple as a constant great circle in the Ecliptic meridian perpendicular to the Sun-Earth axis, which slowly shifts with the revolution of the Earth. A whole-sky survey is therefore completed in six months. In the case the bore-sight angle is ~90 deg, the six-month survey leaves a hole in the coverage, which can be mitigated using slightly more complicated strategies. Some CMB experiments cross scan in the most intricate way possible, in order to maximize redundancy at all time/angular scales, therefore have a rotating + precessing spacecraft. References of the figures: (4, 5).

**Conclusion**

Cosmic Microwave Background time-ordered datasets tend to be remarkably complex and difficult to process properly, taking into account noise statistical properties, signal properties, systematic effects, beam shape issues, etc. In order to help with the data-processing challenges, an optimal scanning strategy is an asset. For balloon-borne data, the issue is even more critical since the CMB signal is tinier and foreground signals no less annoying. An "optimal" scanning strategy may be defined as one which maximizes redundancy at all time/angular scales, in order to have redundant information in pixels at different times and with various scanning directions. An obvious example are the "stripes" in large sky maps: these are usually efficiently reduced when using a fast-processing scan-crossing strategy.

Observation strategy is an essential part of the design of a CMB experiment, which should be defined together with the other aspects of the experiment (instrumentation, data processing…). It is rather than a posteriori. Future Cosmic Microwave Background experiments would benefit from comparing data-processing issues found in past ground-based, balloon-borne and space-based experiments whose scanning strategies differ, and drawing conclusions for the design of their own observation strategy.

**References and acknowledgements**