QUBIC experiment

The “QUBIC” acronym stands for “the Q&U Bolometric Interferometer for Cosmology. It is a future experiment dedicated to the measurement of the B-MODES POLARISATION of the COSMIC MICROWAVE BACKGROUND (CMB) anisotropies. It will be situated at the Dome C antarctic site, and it will be the first BOLOMETRIC INTERFEROMETER.

**Inflation** is a model of the Universe at age $10^{-34}$s after the Big Bang (BB) that can explain some difficulties of the BB model:
- It naturally solves the horizon problem: why the Universe is so homogeneous, though the causal connected region earlier in the Universe history was very small?
- It explains why the space is flat (to get a flat space without inflation the fine tuning of initial conditions is needed).
- It also generates the primordial perturbations and produces SM particles.

At the period of inflation Universe expands exponentially => huge acceleration of a huge mass gives gravitation wave (GW) => GW modulates the polarization of CMB producing B-modes (as on the picture on the left). B-modes are often called “smoking gun” of inflation as it is the only direct observational signature of the inflationary phase of the early Universe.

Why bolometric interferometer? Other possible instruments are:
- Imagers with bolometers, which have very good sensitivity.
- And interferometers, which has clean systematics due to well known angular resolution.

Bolometric interferometer would have both those pros due to sensitivity of bolometers and systematics control by **self-calibration**

**SCANNING STRATEGY** is a way to move the instrument and its parts that allows to collect most clean data and reconstruct the power spectrum with highest accuracy possible. It has to be balanced between:
- Sample variance (bigger total coverage => spectra are better defined at low ell)
- Noise variance (bigger total coverage => more noise in each pixel)

**The QUBIC instrument concept**
- Millimetric equivalent of the Fizeau interferometer
- Modulation of the incoming polarization using a half-wave plate (HWP)
- Each couple of horns = a diffractive pupil
- The interference patterns are imaged on the bolometric array.

The mapmaking for a bolometric interferometer is not the same as it for the imagers: the synthesized beam (SB) of QUBIC has a multi-peaked feature, which makes the inversion of equation $y = Hx + n$ (where $y$ is a noisy timeline, $H$ – acquisition model, $x$ – IQU sky and $n$ is a time-correlated gaussian noise) very challenging and CPU costly.

An example of MC simulation of QUBIC ability to reconstruct CMB temperature and polarization. SB is approximated as a sum of gaussian peaks. Input sky is monochromatic. 

References:
[The QUBIC collaboration, 2010], arXiv: 1010.0645
[Hamilton et al., 2008], A&A 491, 923-927