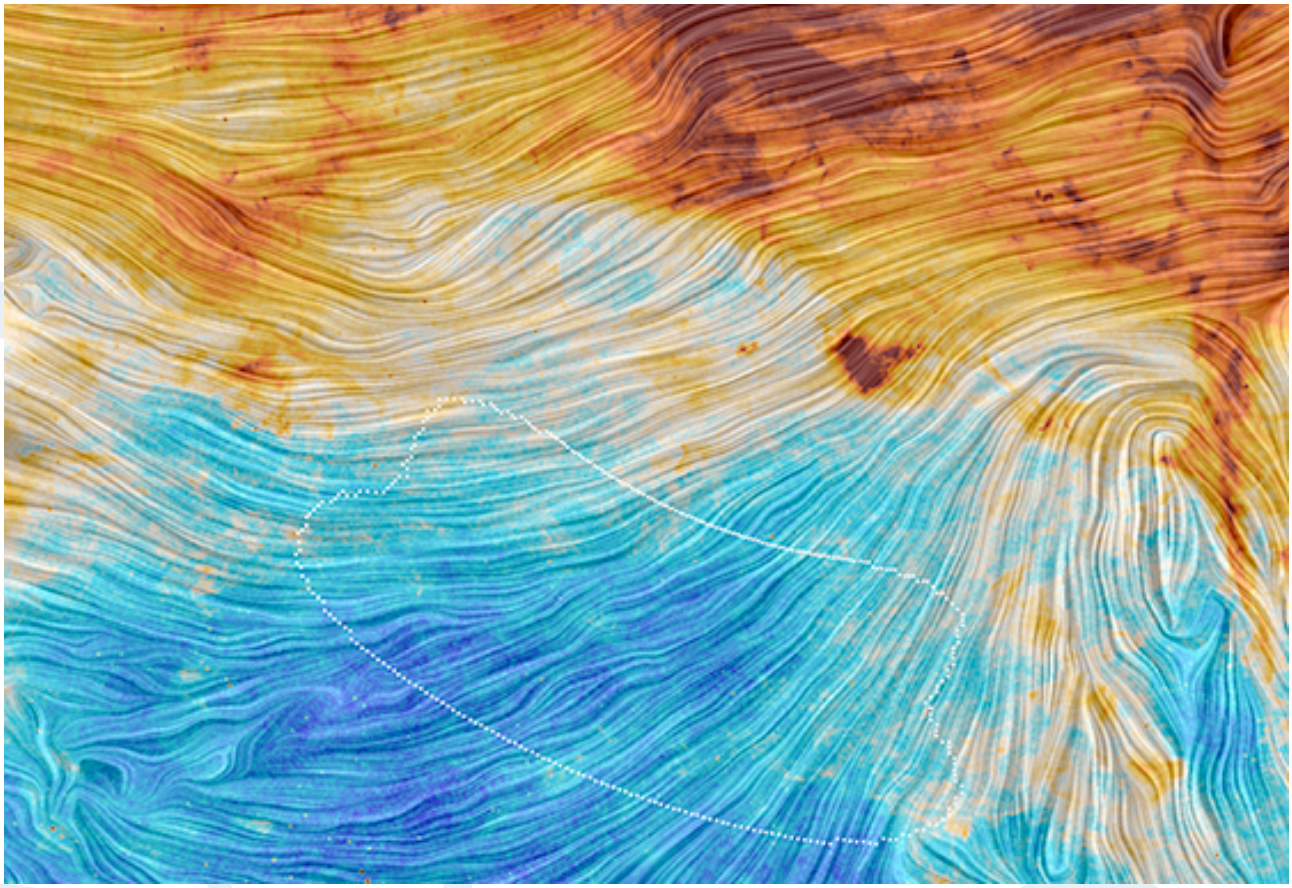
Still doubts on gravitational waves



The Planck - BICEP2 collaboration confirms the presence of contaminants

February 2, 2015

In March last year the BICEP2 team (the Antarctic observatory) claimed to have observed, for the first time, the effects of gravitational waves in cosmic background radiation. In September Planck demonstrated that the signal observed might be the result of "contaminants" due to the polarised radiation produced by our Galaxy. The Planck and BICEP2 teams therefore joined forces to better investigate the problem, and will publish a paper in Physical Review Letters (announced by an ESA press release). The paper confirms the Planck observation: even following a more accurate analysis (and the adoption of new instruments) there is still evidence of contaminants that are difficult to control and preclude the possibility of making any definite statement on cosmological gravitational waves.

Third (and most probably not the last) chapter in the ongoing story about the "first direct image of gravitational waves through the primordial sky". In March last year the BICEP2 team announced that it had observed the portion of cosmic background radiation (the "fossil radiation" from the Big Bang) generated by gravitational waves. In other words, this would have been the first observation of the cosmological effects of this important yet elusive phenomenon predicted by Einstein's theory of General Relativity. If confirmed, the discovery would have been a milestone in the history of astrophysics, cosmology and physics of fundamental forces. For that very reason, the news made several people prick up their ears: "Are we sure that the signal observed is genuine and not the effect of contaminants due to the polarised emission of our Galaxy?" The team, however, excluded that possibility: even in the March paper the researchers stated that current knowledge indicates that contaminating radiation is small compared to the observed signal. Planck's response arrived in September, and basically said: "Watch out, our data have shown that polarised galactic radiation is not negligible in these measurements". In this setting, Planck's voice is authoritative as the instrument (also) observes the same portion of sky as BICEP2, with the advantage that it uses a far wider range of frequencies.

And now to the present. After September BICEP2 and Planck joined forces to work on the problem, and their collaboration has resulted in a study just published in Physical Review Letters, which further confirms the Planck view: despite a more in-depth analysis and the acquisition of a new instrument (Keck) by BICEP2, we confirm that the galactic contaminants are sufficiently intense to preclude, given the current state of equipment and quality of data, any definite statement concerning the presence or absence of cosmological gravitational waves.

"Basically, what we conclude", explains Carlo Baccigalupi, SISSA cosmologist and one of the authors of the paper, "is that no investigation of this kind can escape a systematic study of contaminating sources. And it can only be systematic if several instruments are used at the same time". Planck can act as an "alarm bell", but owing to its very nature and the instrumental noise contained in its observations, it requires additional, "sharper" eyes to better distinguish the signal.

"Our work isn't over", concludes Baccigalupi. "Current experiments (including BICEP2) and future projects (a new satellite, a 'descendent' of Planck called CORE+ has just been proposed to the European Space Agency) have understood the message of Planck and BICEP2 very well, and are planning to equip themselves with technology capable of observing the Galaxy with very sharp eyes, to be able to distinguish it from the signal of the Big Bang, if indeed it did emit gravitational waves".

More in detail…

Planck is a European Space Agency satellite, designed to observe, with an unprecedented degree of accuracy, the Big Bang through cosmic microwave background radiation. Proposed in the early 90s, the satellite and its instruments were developed thanks to huge efforts that involved several national space agencies in Europe coordinated by ESA, whereas the NASA developed the cooling system.

On-ground analysis of the data has been conducted in only two centres in the world, Paris and Trieste. In Trieste, in particular, SISSA, INAF-Astronomical Observatory of Trieste, and the University of Trieste participate in the Data Processing Centre for the low-frequency instrument. In recent years, about fifteen scientists from the three institutions collaborated intensely with continuous exchanges with the rest of the Planck collaboration made up of the world's leading experts in data analysis, computer science, cosmology and astrophysics for a total of over 200 scientists and technicians.

USEFUL LINKS:

- **ESA press release: http://goo.gl/ft6cnY**

IMAGES:

- **Credits: ESA/Planck Collaboration. Acknowledgment: M.-A. Miville-Deschênes, CNRS – Institut d'Astrophysique Spatiale, Université Paris-XI, Orsay, France**

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