POLARBEAR Rules Out Cosmic Birefringence

No rotation of polarization vector in cosmological distances

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The polarization vector of cosmic background radiation could rotate during the course of its journey towards us, and if it did, it could also cause trouble for the Standard Model for electromagnetic interactions. To understand if this rotation is taking place, we need an "eye" that can see great distances, like POLARBEAR, an instrument located in Chile at the top of the Andes. The POLARBEAR research team (which includes SISSA) carried out measurements and recently published results, which can be found on the first page of the latest edition of *Physical Review D.*

To understand certain things, we need to look at them from afar. To see far enough, a pair of glasses are not enough: we need tools like POLARBEAR, an astronomic observational instrument located in the desert of Atacama, in Chile, for observing cosmic background radiation of the Universe (residual fossil energy emitted by the Big Bang). One of the things we cannot see under normal conditions and in the size we are used to is an effect that deals with light as it crosses cosmic distances. Not a property provided for by the Standard Model (accepted by the majority of the scientific community as the most plausible model for explaining the Universe), if "cosmic birefringence" is actually observed, it could have an important effect on our understanding of Physics, such as the existence of primordial magnetic fields, or even a new particle coupling to photons.

What is cosmic birefringence? "It has to do with the rotation of the polarization vector of light, rotation that could happen when electromagnetic radiation travels very long distances, and in different manners along different directions," explains Carlo Baccigalupi, Astrophysicist of the International School for Advanced Studies in Trieste (SISSA) and member of the group managing the POLARBEAR project and head of the SISSA group, "like from us to the cosmic horizon of the Big Bang, a distance that separates us from space but also in time from the catastrophic event that created our Universe."

"The light we are more familiar with in our daily life is non-polarized. When we talk about polarization of an electromagnetic wave we are talking about the plane where the electric cevtor oscillates during propagation of the wave in space and time," continues Baccigalupi. To better understand, we can imagine holding a tight rope at two ends and shaking it to cause a wave along the rope that goes from one end to the other. Polarized light resembles a train of waves which all travel and oscillate on the same plane, while non-polarized light is more of a chaotic movement of waves with disordered oscillations on various planes.

"Some theorize that the polarization vector of light can rotate at very long distances, differently along different directions," says Baccigalupi. "POLARBEEAR gives us the chance to see if it really happens." The POLARBEAR project, led in this analysis by Cheng Fang, a young member of the collaboration from San Diego, in California, has recently published its findings in a paper in *Physical Review D* which has been dedicating to that the first page of the current Issue. The paper is authored by the POLARBEAR collaboration, including the SISSA team made by Baccigalupi, Giuseppe Pugliese and Giulio Fabbian..

The results? "We found no rotation. It may seem disappointing, but that's how it works in Science—even a negative result is positive. For now we can say that the Standard Model is safe. We have also obtained extremely-detailed measurements, and that, too, is an important result."

The polar bear that observes fossil radiation

POLARBEAR (Cosmic Microwave Background Polarization And Cosmology) is a project funded by the National Science Foundation (USA), led by the University of California Berkeley and involving a large number of research institutes around the world. The instrument is mounted on the Huan Tran Telescope (HTT), at an altitude of over five thousand meters (in some of the best atmospheric conditions on the planet). Its purpose is to observe the cosmic microwave background, fossil remnants of the Big Bang, which is important for reconstructing the history of the Universe.

LINK UTILI:

- **Articolo originale su Phy. Rev. D: http://journals.aps.org/prd/abstract/10.1103/PhysRevD.92.123509**

IMMAGINI:

- **POLARBEAR – Crediti: NASA (http://lambda.gsfc.nasa.gov/product/polarbear/)**

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