SPACE & COSMOS | NYT NOW

Study Confirms Criticism of Big Bang Finding

By DENNIS OVERBYE SEPT. 22, 2014

Stardust got in their eyes.

In the spring a group of astronomers who go by the name of Bicep announced that they had detected ripples in the sky, gravitational waves that were the opening notes of the Big Bang. The finding was heralded as potentially the greatest discovery of the admittedly young century, but some outside astronomers said the group had underestimated the extent to which interstellar dust could have contaminated the results – a possibility that the group conceded in its official report in June.

Now a long-awaited report by astronomers using data from the European Space Agency's Planck satellite has confirmed that criticism, concluding that there was enough dust in Bicep's view of the sky to produce the swirly patterns without recourse to primordial gravitational waves.

"We show that even in the faintest dust-emitting regions there are no 'clean' windows in the sky," the Planck collaboration, led by Jean-Loup Puget of the Astrophysical Institute in Paris, wrote in a paper submitted to the journal Astronomy & Astrophysics and posted online Monday.

As a result, cosmologists like the Bicep crew cannot ignore dust in their calculations. "However," said Jonathan Aumont, another of the Planck authors, also from the Paris institute, "our work does not imply that they did not measure at all a cosmological signal. Moreover, due to the very different observation techniques and signal processing in the Bicep2 and Planck experiments, we cannot say how much of the signal they measured is due to dust" and how much to gravitational waves.

So this is not the end of the story, both the Planck scientists and the Bicep group agree. But the original euphoria that the secrets of inflation and quantum gravity might be at hand has evaporated. Planck and Bicep are now collaborating

on a detailed comparison of their results.

John M. Kovac of the Harvard-Smithsonian Center for Astrophysics, lead author of the Bicep paper, said the new report confirmed in greater detail the trend suggested by the first Planck papers in the spring, which indicated there is more dust even in the cleanest parts of the galaxy than anyone had thought.

Raphael Flauger of the Institute for Advanced Study in Princeton, New Jersey, who first raised the issue of dust in the Bicep report, said it confirmed what he had thought. “It doesn’t leave a lot of wiggle room,” he wrote in an email, “and it seems clear that at least the majority of the signal is caused by dust.”

The gravitational waves may exist, although they would be weaker than the Bicep analysis indicated, causing theorists to reshuffle their ideas. As Richard Bond, an early universe expert at the University of Toronto and a Planck team member, put it: “Planck showed that dust could possibly be the entire Bicep2 signal, but Planck alone cannot decide. We have to do this in combination with Bicep2.”

The joint comparison and Planck’s own polarization maps are due at the end of the year.

If true, Bicep’s detection of gravitational waves would confirm a theory that the universe began with a violent outward antigravitational swoosh known as inflation, the mainspring of Big Bang theorizing for the last three decades.

The disagreement over the Bicep finding will not mean the end of inflation theory; it just means it will be harder for cosmologists to find out how it worked. The Bicep group and an alphabet soup of competitors are soldiering on with new telescopes and experiments aimed at peeling away the secrets of the sky.

Michael S. Turner, a cosmologist at the University of Chicago, said: “This is going to be a long march, but the goal of probing the earliest moments of the universe makes it well worth the effort. Dust is the bane of the existence of astrophysicists — and cosmologists. It is everywhere, and yet our understanding of it is very poor.”

Others are less optimistic. Paul J. Steinhardt of Princeton University, a critic of the Bicep paper — and of inflation theory — said in an email that the Bicep paper should be retracted, “and we should return to good scientific practice.”

The Bicep observations are the deepest look yet into a thin haze of microwaves, known as cosmic background radiation, left over from end of the

Big Bang, when the cosmos was about 380,000 years old.

According to theory, the onset of inflation, less than a trillionth of a second after time began, should have left ripples in space-time known as gravitational waves. They would manifest as corkscrew patterns in the direction of polarization of the cosmic microwaves.

The Bicep group — its name is an acronym for Background Imaging of Cosmic Extragalactic Polarization — is led by Dr. Kovac; Jamie Bock of Caltech; Clement Pryke of the University of Minnesota; and Chao-Lin Kuo of Stanford. They have deployed a series of radio telescopes at the South Pole in search of the swirl pattern.

Their most recent, Bicep2, detected a signal in the sweet spot for some of the most popular models of inflation, leading to a splashy news conference and a summer of controversy and gossip.

As the critics pointed out, things besides quantum ripples from the beginning of time could produce those swirls, including light from interstellar dust polarized by magnetic fields in space.

Planck, launched in 2008 to survey the cosmic microwave sky, can distinguish the characteristic signature of dust by comparing the sky brightness in several radio frequencies, as well as measuring its direction of polarization. Bicep2, in contrast, looked at only one frequency, 150 gigahertz.

The Bicep astronomers asked for Planck data on their patch of sky, but it was not available until now because of suspected instrument problems, Dr. Aumont said.

So they extrapolated from existing data to conclude that there was little dust interfering with their observations.

The new Planck report has knocked the pins out from under that. But there are still large uncertainties that leave room for primordial gravitational waves at some level. For example, the Planck team had to extrapolate some of its own measurements.

As the Planck report says, “This result emphasizes the need for a dedicated joint Planck-Bicep2 analysis.”

The group hopes this analysis will include data from the latest Bicep telescope, called the Keck Array, which has been gathering data for several months.

In an interview this summer, Dr. Kovac said, “It’s been a funny year to be in

the spotlight like this.”

He said the group stood behind its work, even if the ultimate interpretation of the measurements is up for grabs.

Acknowledging that dust would not be as sexy a discovery as ripples from inflation, Dr. Kovac said, “It’s really important as an experimentalist that you can divorce yourself from an investment in what the answer is.”

He went on: “One thing that would distress me bitterly is if a major mistake in the measurement or of the analysis would come to light. The most pressing question is, what are the dust contributions to the signal?”

Stay tuned.

Lyman Page, an astrophysicist at Princeton, said the episode illustrated the messy progress of science.

“Taking a step back,” he said by email, “it is amazing that a precise measurement of the cosmos can be made, discussed in fullness, and refuted by another measurement in such a short amount of time. It is testament to a healthy field.”