Radio astronomy, Planck, and the evolution of the universe

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Abstract
Since Karl Jansky’s discovery of radio waves from outer space in 1933, radio astronomy has played a major role in our growing and evolving understanding of the universe we live in. There are three main reasons for this.

First, radio was the first new window in the electromagnetic spectrum since Galileo Galilei and his optical telescopes over three hundred years previously, and it also remained the only other window until the advent of space telescopes. Radio waves revealed a universe mostly unexplored in the optical wavelengths.

Second, until the advent of modern giant optical telescopes, radio waves provided the best view to a more distant, and therefore younger, universe.

Third, with the expansion of the universe, radiation is progressively shifted to longer and longer wavelengths. The most extreme example of this is the celebrated Cosmic Microwave Background (CMB) radiation, which has been redshifted from its original optical wavelengths to the microwave regime. The CMB provides us a photograph of our whole universe when it was just a 400 000 years old baby.

Radio astronomy gave us the first clear proof that the universe is evolving, through observations which showed that the younger universe was indeed different from the present one. With the discovery of the CMB radiation by Arno Penzias and Robert Wilson in 1965, radio astronomy established the Big Bang theory of a hot, dense initial stage of the universe. The universe had a beginning, if not necessary an end.

In March 2013, the first cosmological results of the Planck satellite, built by the European Space Agency and with major Finnish participation, were made public. The analysis of these results is only beginning, but theorists are hoping to get answers – or at least gain a bit more understanding – of such basic questions as why the universe bothered to come into existence in the first place, how it did it, and whether it is just a tiny bubble in an incomprehensible multiverse.