The Hubble Tension. The Evidence of New Physics?

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After the detection of the accelerated expansion of the Universe and the introduction of an enigmatic „dark energy" component of the matter-energy content of the Universe, the physical explanation of the nature of dark energy has become a major challenge for astronomers and physicists. The recent empirical determinations of H_0 complicated even more our understanding of the Universe since they differ by about 4σ from the value obtained from Planck data and the ΛCDM model, which suggests that new physics might be required in the models.

I will present the recent progress on Hubble constant determination based on standard candles. In particular, I will concentrate on the calibration of an eclipsing binary method (often called Polish cosmic yardstick) which will yield 1% distances a thousand times further out than Gaia parallaxes. The great advantage of our approach is the full control of all the potential errors affecting the distance determinations, including the critical systematic errors that are elusive in most of other methods. Such accurate distances to the set of nearby galaxies will allow to very carefully check on the systematic errors in the applications of standard candles in H_0 determinations. Together with the new data from space telescopes supplemented with photometry and spectroscopy collected in the Polish Astrophysical Observatory in Chile, we expect to determine the H_0 with an unprecedented precision of 1%, which should shed light on the Hubble tension and physical nature of dark energy.