ISSI International Team #490

SH_0T: the Stellar path to the H_0 Tension in the Gaia, TESS, LSST and JWST era

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There is an intriguing discord between measurements of the expansion rate of the Universe (the Hubble constant, or H_0) based on early- and late-Universe probes. The former include inferences based on the anisotropy of the Cosmic Microwave Background, while the latter are typically based on stellar candles in nearby galaxies. Currently, this tension ranges from 4σ to 5.8σ (Verde+19, Verde+23) and might imply new physics beyond the ΛCDM model.

Our team worked on improving the characterization of the H_0 tension and associated systematics using different stellar distance indicators (classical Cepheids, RR Lyraes, Miras, Long Period Variables, Tip of the Red Giant Branch) accurately calibrated using astrometric measurements from the European Space Agency mission *Gaia*. The main outcomes of our collaboration were:

(1) the recognition of *Gaia*'s unparalleled role in providing unprecedented parallax measurements for fundamental standard candles;
(2) the need to properly characterize the magnitude- and color-dependent parallax offset currently limiting the accuracy of *Gaia* parallaxes, advocated in a letter (**here**) to the Executive of the *Gaia* Data Processing and Analysis Consortium in which we requested that a specialized processing of Cepheids and RR Lyraes (accounting for color and magnitude variation for each epoch) be assigned a significant priority in future data processing; this triggered activity by DPAC;
(3) the start of new projects for measuring H_0 using Population II methods (RR Lyrae stars, TRGB and Surface Brightness Fluctuations) totally independent from SNeIa calibrated by classical Cepheids.

We published more than 20 papers (**list here**) presenting results for different distance indicators at the basis of the local measurement of H_0, largely profiting from discussions and exchanges during three meetings at ISSI in Bern and a number of telecons between team members (**highlights on team activity here**). We are now working on the monograph: «The stellar perspective on the H_0 tension in view of *Gaia*» upon invitation from the Italian Physics Society magazine, where we review advancements on stellar distance indicators in Gaia DR3. We further plan a peer-reviewed paper on improvements on the H_0 tension based on *Gaia* DR4 results.