Contribution ID: **616** Type: **Invited talk in a parallel session**

On the statistical assumption on the distance moduli of Supernovae Ia and its impact on the determination of cosmological parameters

Type Ia Supernovae (SNe Ia) are considered the most reliable standard candles and they have played an invaluable role in cosmology since the discovery of the Universe's accelerated expansion. During the last decades, the SNe Ia samples have been improved in number, redshift coverage, calibration methodology, and systematics treatment. These efforts led to the most recent "Pantheon" (2018) and "Pantheon +" (2022) releases, which enable to constrain cosmological parameters more precisely than previous samples. In this era of precision cosmology, the community strives to find new ways to reduce uncertainties on cosmological parameters. To this end, we start our investigation even from the likelihood assumption of Gaussianity, implicitly used in this domain. Indeed, the usual practice involves constraining parameters through a Gaussian distance moduli likelihood. This method relies on the implicit assumption that the difference between the distance moduli measured and the ones expected from the cosmological model is Gaussianly distributed. In this work, we test this hypothesis for both the Pantheon and Pantheon + releases. We find that in both cases, this requirement is not fulfilled, and the actual underlying distributions are a logistic and a Student's t distribution for the Pantheon and Pantheon + data, respectively. When we apply these new likelihoods fitting a flat ΛCDM model, we significantly reduce the uncertainties on the matter density Ω_M and the Hubble constant H_0 of ~ 40%. As a result, the Hubble tension is increased at $> 5\,\sigma$ level. This boosts the SNe Ia power in constraining cosmological parameters, thus representing a huge step forward to shed light on the current debated tensions in cosmology.
This analysis has also been extended to the GRBs and BAO, and results show a decrease in terms of cosmological parameters when these probes are added.

Primary author: DAINOTTI, Maria (National Astronomical Observatory of Japan)

Presenter: DAINOTTI, Maria (National Astronomical Observatory of Japan)

Session Classification: Current status of the H_0 and growth tensions: theoretical models and model-independent constraints

Track Classification: Cosmic Microwave Background, Cosmological Tensions (CM): Current Status of the H_0 and growth tensions: theoretical models and model-independent constraints