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Alternative cosmological theories

PREFACE

According to the modern cosmological paradigm, about 2/3 of the energy of the Universe is in dark form and about 5/6 of the matter is invisible. However, numerous recent independent attempts to detect dark-matter particles failed, and a number of other problems with the existence of dark energy and dark matter (such as the anomalous friction in the dark-matter halos of galaxies) become now more and more obvious. All these problems raise the question if the "dark" substance is merely a result of the use of erroneous assumptions or incorrect models based e.g. on excessive extrapolations. Consequently, it is timely to gather specialists from various branches of astronomy and astrophysics to discuss these questions.

Yet another subtle issue is that the Friedmann equation – the cornerstone of modern cosmology – was derived from the system of ten Einstein equations applied to a perfectly symmetric universe, which is homogeneous and isotropic for every fixed time instant. The question is whether this is justified and, in particular, at which scale the effect of Hubble expansion begins to be manifest.

For instance, recently it was found by the sky survey programs GALEX, SDSS and Spitzer S^4G imaging that the expansion speed of our Galaxy is about $0.6 - 1\,\mathrm{kpc/Gyr}$ (i.e. $600 - 1000$ m/s) even though the extragalactic gas and dust continuously fall on the galactic disk, see C. Martínez-Lombilla et al., MNRAS 483 (2019), 664–691. It is interesting that this number is of the same order as the Hubble constant $H_0 = 68\,\mathrm{km/(s\,Mpc)}$ recalculated to the Galactic radius $R = 16$ kpc, namely $H_0 \approx 1000\,\mathrm{m/(s\,}R)$. The expansion speed of the Solar system is of order H_0, too.

To shed more light onto these topics, we decided to organize the International Conference *Cosmology on Small Scales 2020: Excessive Extrapolations and Selected Controversies in Cosmology*. It was held at the Institute of Mathematics of the Czech Academy of Sciences at Žitná 25, Prague 1, from 23 to 26 September 2020 (see `css2020.math.cas.cz`). It was a continuation of our previous conferences *Cosmology on Small Scales 2016: Local Hubble Expansion and Selected Controversies in Cosmology*, and *Cosmology on Small Scales 2018: Dark Matter Problem and Selected Controversies in Cosmology* which took place four and two years ago (see `css2016.math.cas.cz, css2018.math.cas.cz`).

The main topics of the conference "Cosmology on Small Scales 2020" were:

- ▷ Mathematical aspects of the extrapolations used in cosmology
- ▷ Arguments for and against dark matter, and revisiting the foundations of physics
- ▷ Alternative models for dark matter and dark energy
- ▷ The systematic disagreement on the value of the Hubble constant computed by different methods
- ▷ Theoretical possibility and observational evidence for small-scale cosmological effects

- ▷ Complementary redshifts of non-cosmological nature
- ▷ Quantum effects on the early universe and their observational imprints at the present time

In these Proceedings we present several papers showing that the claimed amount of dark matter and dark energy can be a result of vast overestimation and may not conform with reality. At the end of the Proceedings, there are several papers on "history and philosophy of cosmology" and "alternative cosmological theories". Although they may be questionable and the Scientific Committee is not responsible for their content, we believe that it is reasonable to present them to the wide audience.

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These Proceedings can be downloaded from the website:

`http://users.math.cas.cz/~krizek/list.html`

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