Constraining theories of gravity by velocity distribution of elliptical galaxies

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The velocity distribution of elliptical galaxies can be used in the framework of f(R) gravity to constrain these theories avoiding the issues related to dark matter to fit the observations. In particular, we used the power-law version f (R) ∝ R^n (Borka Jovanović et al., 2016; Borka Jovanović et al., 2019), Yukawa-like gravity model (Capozziello et al., 2020), Sanders (Capozziello et al., 2014), Hybrid (Borka Jovanović et al., 2021) and non-local (Borka et al., 2023) gravity model in the weak field limit.

We compared theoretical predictions for circular velocity in above mentioned gravity models with the corresponding values from a large sample of observed elliptical galaxies. In our investigations, from this sample of data, we use surface brightnesses, effective radius and velocity dispersion. In this way, we are able to constrain the different gravity parameters. We showed that the gravity parameters are scale-length depending on the gravitational system properties. Also, we showed that analysed modified gravity models are able to reproduce the stellar dynamics in elliptical galaxies. These gravity models fit the observations very well, without the need for a dark matter.

References

Borka, D., Borka Jovanović, V., Capozziello, S., Jovanović, P., 2023, Advances in Space Research 71, 1235

Borka Jovanović, V., Borka, D., Jovanović, P., Capozziello, S., 2021, Eur. Phys. D 75, 149

Borka Jovanović, V., Capozziello, S., Jovanović, P., Borka, D., 2016, Physics of the Dark Universe 14, 73

Borka Jovanović, V., Jovanović, P., Borka, D., Capozziello, S., 2019, Atoms 7(1) 4
Capozziello, S., Borka, D., Jovanović, P., Borka Jovanović, V., 2014, Phys. Rev. D., 90, 044052
Capozziello, S., Borka Jovanović, V., Borka, D., Jovanović, P., 2020, Physics of the Dark Universe 29, 100573