

Posudek práce

předložené na Matematicko-fyzikální fakultě
Univerzity Karlovy

jedna se o posudek *v zastoupení* skutečného vedoucího Attilu Meszarose

- posudek vedoucího posudek oponenta
 bakalářské práce diplomové práce

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Název práce: [The cosmological constant on the non-cosmological scales](#)

Studijní program a obor: [Physics / Astronomy and Astrophysics](#)

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Odborná úroveň práce:

- vynikající velmi dobrá průměrná podprůměrná nevyhovující

Věcné chyby:

- téměř žádné vzhledem k rozsahu přiměřený počet méně podstatné četné závažné

Výsledky:

- originální původní i převzaté netriviální kompilace citované z literatury opsané

Rozsah práce:

- veliký standardní dostatečný nedostatečný

Grafická, jazyková a formální úroveň:

- vynikající velmi dobrá průměrná podprůměrná nevyhovující

Tiskové chyby:

- téměř žádné vzhledem k rozsahu a tématu přiměřený počet četné

Celková úroveň práce:

- vynikající velmi dobrá průměrná podprůměrná nevyhovující

Slovní vyjádření, komentáře a připomínky vedoucího/oponenta:

The existence of the cosmological constant Λ in Einstein's theory implies that its Newtonian limit does not give the classical Poisson equation but contains additional terms with the cosmological constant. Therewith it becomes possible to test for the existence of the cosmological constant on small, classical scales.

This thesis elaborates on these tests. It is divided into 5 chapters which are augmented by one appendix. The topic is very well introduced in Chapter 1. Chapter 2 nicely and concisely explains how taking into account causality and how a covariant reformulation of the classical Poisson equation leads to a field equation which contains a term that can be interpreted to be Λ . The interpretation of Λ is also discussed. The Newtonian limit of Einstein's field equation with and without Λ are calculated in Chapter 3. In Chapter 4 solutions to Einstein's field equation in the classical limit are sought in Cartesian, spherical and polar coordinates. The results of numerically solving these for the potential are presented in Chapter 5. The numerical integrations are checked by studying special cases for which analytical solutions exist. The results within the Solar-system dimension are explored. This discussion is very interesting, but could have been more explorative by explaining how and which experiments could be done to verify the existence of Λ .

The thesis is terse but well written overall. The reader would have benefitted if the thesis has included some more depth of discussion to the particularly interesting points (e.g. how Λ emerges naturally from making the Poisson equation covariant and causal and what this might mean physically). Also, a discussion of why different coordinate systems are needed to be looked at at all, since the results ought to be independent of the coordinate system.

Případné otázky při obhajobě a náměty do diskuze:

In Chapter 2, the argument of developing the classical Poisson equation into a covariant form is interestingly performed, but identifying the ratio c_3/c_1 as Λ could have been explained more clearly, rather than just as a statement of fact. The statement (on p.49) "We have also shown that the existence of Λ in Einstein's field equations follows directly and relentlessly from the basic principles the general relativity is built upon." should have been better explained.

One would have hoped to see the expression 3.24 (Chapter 3.1, without Λ) reflected in a similar expression in Chapter 3.2 which recognisably differs by having the Λ terms.

In Chapter 5, with which method was the numerical integration achieved?

In Chapter 5, why is not a point-mass density distribution in the Solar system assumed (virtually all mass is in the Sun)? An explanation/motivation would have been useful to see.

The thesis could have explained better how unique, new this approach is: if so, why has this approach to explore the local measurability of Λ not been done before?

In the Conclusion and future prospectives: The statement "To create a theoretical model that could measure the cosmological constant Λ on such small scales." appears unclear: how would a theoretical model measure something? Again, a few more words of explanation would have been useful.

Práci

doporučuji

nedoporučuji

uznat jako diplomovou/bakalářskou.

Navrhuji hodnocení stupněm:

výborně velmi dobře dobře neprospěl/a

Místo, datum a podpis vedoucího/oponenta:

Bonn, 20.08.2021

Paul Trupa