Posudek práce

předložené na Matematicko-fyzikální fakultě
Univerzity Karlovy v Praze

❑ posudek vedoucího ☒ posudek oponenta
☒ bakalářské práce ❑ diplomové práce

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Název práce: Standard and alternative cosmological models
Studijní program a obor: obecná fyzika
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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:
I believe the thesis should state at the very beginning whether it is a compilation and overview of previous results or whether it contains original work and, in that case, what is new here. It seems the former is the case.
P. 3: The Newtonian limit additionally requires its spacetime region of applicability not to be too large. The quotation from MTW should read "Geometry tells matter how to move, and matter tells geometry how to curve." (see MTW, p. 130).
P. 5: The sentence "is not slow, but accelerated" should read "is not slowing down, but accelerated".
P. 7: "The orthogonality of the covariant metric tensor…" should read "The diagonal form of the covariant metric tensor…" Furthermore, for the metric (1.1) to make sense, one needs to at least mention the coordinate system one is using.
P. 8: There is a problem with the definition of the Christoffel symbols of the 2nd kind—in (1.4), mu should be up and first, followed by alpha and beta down. The following expressions (1.6)-(1.8) do not adhere to the Einstein summation convention, which should be stated clearly.
Section 1.1.4: It would be perhaps appropriate to include and explain the cosmological constant here since it is used later on. Likewise, some comment on it would be in order on p. 16 at the bottom.
P. 12: The formulation of conservation laws is a bit unfortunate since they seem to be an ansatz although they are a consequence of the Bianchi identities as correctly stated in the last paragraph above section 1.1.6.
Section 1.1.6: The density of energy and pressure perceived by an observer can generally depend on all coordinates. There is a general problem with integration constants in most expressions specifying the scale factor as a function of time. For instance, (1.56) is incompatible with the formula right above it. The standard choice of constants is only ever first mentioned below (1.92). The choice is different again in (1.99) and at the bottom of p. 25 and of p. 26, and in Fig. 3.3. Along the same lines, a comment would be helpful in Fig. 1.1.
Section 1.2: The curvature of the spacetime was non-zero in the previous section too (see, e.g., (1.32)). The author means non-zero spatial curvature.
Fig. 1.4: The parameters have wrong indices.
P. 27: Dependence of the densities on the scale factor only applies to single-component models even when the fluids are non-interacting.
P. 29, bottom: It is stated that entropy is automatically conserved but this is a global property. Locally, we must assume adiabaticity.
P. 31: Below (3.3) it is stated that "the type of the resulting function does not depend on the sign of the curvature". This cannot hold generally since, for instance, for C0 and A vanishing, kappa cannot be positive.
P. 34, below the definition of the stress-energy tensor: Do we require the homogeneity and isotropy of the gravitational field or also of the source field? The former does not imply the latter.
P. 35: One should comment on what is meant by the density and pressure associated with the scalar field.
Fig. 3.7: This is the scalar field, not the scale factor. Also, what is meant by "the equation of state for the scalar field"?
The choice of literature is a little peculiar with many references to a book only available in Russian (Alekseev), which is difficult to check. The quotation from Mukhanov on p. 4 is inaccurate. The formatting of the Bibliography section also requires some brush-up—e.g., MTW, Visser , Zwicky.
There are some typos in the formulae (e.g., (1.27)) and quite a few spelling ones. The language is sometimes rather awkward with funny wording and inventive grammar (e.g., p. 3, "In 1915…").

Případné otázky při obhajobě a náměty do diskuze:
Could the author state which results are new? Is it the numerical solution in section 3.2.2 represented by the two plots 3.7 and 3.8?
Which components is the scalar field supposed to replace in the cosmological fluid—the dark sector plus it should ensure the inflation?
Is the scalar field assumed to interact in any way with standard observable matter apart from its gravitational field? Would it, for instance, have an impact on the motion of galaxies, etc.?

Práci
☒ doporučuji ❑ nedoporučuji
uznat jako bakalářskou.

Navrhuji hodnocení stupněm:
❑ výborně ☒ velmi dobře ❑ dobře ❑ neprospěl/a

Místo, datum a podpis oponenta: Praha, 6.8.2018