GRAVITATIONAL-WAVE COSMOLOGY WITHOUT RIGID ASTROPHYSICAL PRIORS:

a critical-propositional reading of Amanda Mirna Farah's work in confrontation with the Theory of Objectivity

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ABSTRACT

This article presents a critical-propositional reading, in Chicago author-date style, of the work associated with Zenodo record **10.5281/zenodo.13363159**, authored by **Amanda Mirna Farah**, entitled *Code for "No Need to Know: Astrophysics-free gravitational-wave cosmology"*. The record corresponds to a software artifact published on Zenodo on August 22, 2024, related to the manuscript *No need to know: astrophysics-free gravitational-wave cosmology*, first made available on arXiv and later published in a scientific journal. The core of the work consists in proposing gravitational-wave cosmological inference that is less dependent on rigid parametric assumptions concerning the source mass distribution by resorting to nonparametric modeling. The present study examines compatibilities and tensions between that proposal and the Theory of Objectivity (TO), especially in light of its modal axioms, phenomenic elements, Inductive Effects, cosmogonic theorem, and cosmological Eras. It is argued that Farah's work enters into a fruitful dialogue with TO at the methodological level, especially through its emphasis on the intelligibility of signals and the reduction of inferential biases, yet it does not by itself attain the modal ontological grounding required by TO. It is concluded that the analyzed proposal constitutes an important operational bridge between phenomenon and cosmology and can be reinterpreted, within the horizon of TO, as an advanced case of informational reading of the universe through radiations and structured physical relations.

Keywords: Theory of Objectivity; gravitational-wave cosmology; Amanda Mirna Farah; nonparametric inference; standard sirens; cosmological information; critical-propositional analysis.

RESUMO

Este artigo apresenta uma leitura crítico-propositiva, em estilo Chicago autor-data, do trabalho associado ao registro Zenodo **10.5281/zenodo.13363159**, de autoria de **Amanda Mirna Farah**, intitulado *Code for "No Need to Know: Astrophysics-free gravitational-wave cosmology"*. O registro corresponde a um artefato de software publicado no Zenodo em 22 de agosto de 2024, relacionado ao manuscrito *No need to know: astrophysics-free gravitational-wave cosmology*, disponibilizado no arXiv e posteriormente publicado em periódico científico. O núcleo do trabalho consiste em propor uma inferência cosmológica por ondas gravitacionais menos dependente de pressupostos paramétricos rígidos sobre a distribuição de massas das fontes, recorrendo a uma modelagem não paramétrica. O presente estudo examina as compatibilidades e tensões entre essa proposta e a Teoria da Objetividade (TO), especialmente à luz de seus axiomas modais, de seus elementos fenomênicos, de seus Efeitos Indutores, do teorema cosmogênico e de suas Eras cosmológicas. Sustenta-se que o trabalho de Farah dialoga fecundamente com a TO no plano metodológico, sobretudo por sua ênfase na inteligibilidade dos sinais e na redução de vieses inferenciais, mas não alcança, por si só, a fundamentação ontológica modal exigida pela TO. Conclui-se que a proposta analisada constitui uma importante ponte operacional entre fenômeno e cosmologia, podendo ser reinterpretada, no horizonte da TO, como um caso avançado de leitura informacional do universo por meio de radiações e relações físicas estruturadas.

INTRODUCTION

Contemporary cosmology is living through a singular moment. After decades in which electromagnetic observation occupied the center of the construction of the cosmological picture, multi-messenger astronomy decisively expanded the empirical horizon. In this context, gravitational waves came to represent not only a new type of astrophysical datum but also a new regime of cosmological intelligibility. The possibility of extracting information about the expansion of the universe from the coalescence of compact objects opened a promising inferential pathway, frequently described in the literature as cosmology through *standard sirens*.

It is precisely within this environment that the work of Amanda Mirna Farah and collaborators is situated. The manuscript connected to the Zenodo record examined here argues that cosmological inference through gravitational waves can be carried out in a way that is less dependent on rigid assumptions concerning the mass distribution of the sources. Instead of assuming a closed parametric form, the work adopts a flexible, nonparametric framework, arguing that this reduces bias and broadens the robustness of cosmological reconstruction. The arXiv paper records that gravitational-wave events encode direct information about luminosity distance and, when combined with redshift measurements, allow one to probe the expansion of the universe. It further states that a simulated catalog of 1,000 events, consistent with expectations for the next LVK observational run, would already allow competitive percentage-level estimates for H_0 and $H(z = 0.9)$.

The present reading does not, however, limit itself to an internal description of the work. Its goal is to place it in confrontation with the **Theory of Objectivity**, by Vidamor Cabannas and Denivaldo Silva, understood here as an ontological-

cosmological system grounded in necessary modal axioms. TO does not content itself with an operational description of the universe; it seeks an intelligible genesis of reality from first principles, articulating observation, relationality, informational transcendence, and testability. For this reason, the question organizing this article is twofold: to what extent can the proposal of Farah et al. be read as compatible with the modal discipline of TO, and to what extent does it remain below the ontological grounding demanded by that theory?

The hypothesis defended in this study is the following: the analyzed work is not an ontology of the cosmos, nor does it claim to be one; its strength lies rather at the epistemological and methodological level. Even so, precisely because it operates on signals that transport cosmic information and because it seeks to reduce inferential distortions, it offers a fertile field for reinterpretation in light of TO. In other words, the point is not to claim that the article confirms the Theory of Objectivity, but rather to show that it constitutes a valuable component in the construction of **operational bridges** between phenomenon, information, and cosmology.

DELIMITATION OF THE ANALYZED OBJECT

It is indispensable to establish with precision the object under examination. DOI **10.5281/zenodo.13363159** identifies, on Zenodo, an item of type **Software**, published on **August 22, 2024**, under the title *Code for "No Need to Know: Astrophysics-free gravitational-wave cosmology"*. The record credits **Farah, Amanda Mirna** as creator, associates the item with the University of Chicago, states that it is the code of the manuscript at the stage of arXiv submission, and records a post-*peer review* update. The related repository is made available on GitHub, in Python, and Zenodo itself links this software to preprint **10.48550/arXiv.2404.02210**.

This delimitation is important for two reasons. First, because the Zenodo item is not, strictly speaking, the full text of the article, but rather a scientific artifact associated with the work. Second, because propositional analysis must respect this documentary status: what is examined here is the **scientific ensemble** formed by the Zenodo record, its explicit context, and the theoretical-methodological manuscript to which it is linked.

The arXiv version, in turn, presents the article *No need to know: astrophysics-free gravitational-wave cosmology*, authored by Amanda M. Farah, Thomas A. Callister, Jose María Ezquiaga, Michael Zevin, and Daniel E. Holz. The abstract states the problem explicitly: although the *spectral sirens* technique allows cosmological inference without certain electromagnetic association to host galaxies, its application had depended on simple parametric representations of the source mass distribution. The work proposes to overcome this limit by means of a flexible nonparametric model and argues that, even with such flexibility, both the mass model and the cosmological parameters can be correctly reconstructed.

This double nature of the analyzed object, software and manuscript, reinforces an epistemologically relevant aspect: contemporary science does not present itself only as text, but as an integrated architecture of theory, inference, simulation, and computational reproducibility. From the point of view of TO, this characteristic is suggestive, because it shifts attention from the isolated "result" to the **relational field** of the production of knowledge.

THE SCIENTIFIC CORE OF AMANDA MIRNA FARAH'S WORK

The problem addressed by the work can be formulated as follows: how can robust cosmological information be extracted from gravitational-wave events when knowledge of the source mass distribution is uncertain? The traditional answer relied on parametric models for that distribution. The inconvenience, recognized by the authors, is that an inadequate functional form introduces bias into cosmological inference.

The proposal consists in adopting an *astrophysics-free* scheme, that is, one not dependent on closed astrophysical knowledge of the population. The abstract of the article explicitly states that gravitational waves from the merger of compact objects contain direct information about luminosity distance and that, when combined with a redshift measurement, they allow one to build a Hubble diagram. It further states that, even without electromagnetic measurements, self-consistent redshift measurements may be obtained from features of the source mass distribution, and that the new method uses a nonparametric model of that distribution in order to avoid biases arising from incorrect representations.

There are here at least three central contributions. The first is methodological: the reduction of dependence on rigid astrophysical hypotheses. The second is statistical: the use of a more flexible model to capture the population distribution. The third is cosmological: the promise of reconstructing relevant expansion parameters with competitive precision. In this respect, the article reports a forecast of **5.8% for** H_0 when the remaining parameters are held fixed, and **6.4% for** $H(z = 0.9)$ when fitting

multiple cosmological parameters, using a simulated catalog of 1,000 events compatible with the next LVK observing run.

From the point of view of critical-propositional reading, the interest of this proposal does not lie only in its technical gain. Its value lies in showing that the cosmos may be interrogated through signals whose intelligibility does not depend exclusively on a closed population theory. The universe, in this case, does not appear as something that must first be fitted into an astrophysical mold before being measured; rather, it is read from its own observable traces, under statistical discipline sufficiently flexible not to violate the phenomenon.

METHODOLOGICAL FOUNDATIONS OF GRAVITATIONAL-WAVE COSMOLOGY

So-called gravitational-wave cosmology arises from the idea that certain astrophysical events function as self-calibrating cosmic messengers. Luminosity distance is inferred directly from the gravitational signal; the challenge concerns redshift. In approaches with an identified electromagnetic counterpart, redshift is obtained by association with the host galaxy. In approaches called *spectral sirens*, features of the source mass distribution itself allow one to infer redshift indirectly.

The great methodological virtue of the work under analysis lies in rejecting the false alternative between, on the one hand, dependence on electromagnetic hosts and, on the other, submission to excessively rigid astrophysical models. The article insists that cosmological inference may remain informative even when one does not impose in advance a simple parametric structure upon the mass distribution.

This option has important philosophical consequences. It implies recognizing that robust scientific knowledge does not necessarily arise from model rigidity, but from adequacy between the form of inference and the complexity of the phenomenon. In broader terms, this is a valuable epistemological lesson: to know more assumptions does not always mean to know the object better; sometimes excessive prior determination diminishes the fidelity of access to reality.

Such a principle dialogues very clearly with a demand dear to TO: that access to being must not be confused with the arbitrary imposition of an external form upon the real. Even though TO operates at a more radical level, its modal discipline also rejects *ad hoc* solutions that merely patch over experience. In this sense, the work of

Farah et al. may be seen as methodologically close to the demand for a science that respects the proper structure of the phenomenon.

THE EPISTEMOLOGICAL RELEVANCE OF AN *ASTROPHYSICS-FREE* APPROACH

The term *astrophysics-free* deserves philosophical attention. Evidently, the article does not eliminate physics or astrophysics from the problem; what it rejects is the necessity of knowing in advance, and in rigid form, the population of source masses in order to obtain useful cosmological inference. The expression must therefore be understood as a critique of excessive dependence on contingent population assumptions.

This move is epistemologically healthy for at least four reasons. First, because it explicitly recognizes theoretical uncertainty about the population. Second, because it treats that uncertainty as part of the scientific problem rather than as noise to be hidden. Third, because it seeks a technique that minimizes the risk of bias. Fourth, because it expands the reach of gravitational-wave data as a primary source of cosmological information.

In terms of philosophy of science, this procedure is closer to a critical posture than to naïve trust in inherited models. It aligns with the Kuhnian perception that scientific paradigms are not neutral containers, but frameworks that must be examined in terms of their conditions of validity. At the same time, the proposal also recalls Heisenberg's caution: the observable is always mediated by a conceptual apparatus, and the problem is not having mediations, but having inadequate mediations.

In the light of TO, this shift is especially suggestive. The Theory of Objectivity does not admit that reality be reduced to the result of an arbitrary formalism; on the contrary, it demands that conceptual determinations remain proportionate to the logical necessity of the real. Although Farah's article does not operate with this language,

its refusal of rigid parametric bias echoes, at the methodological level, the TO demand for rational discipline.

THE THEORY OF OBJECTIVITY: AXIOMATIC FRAMEWORK AND MODAL DISCIPLINE

The reading proposed in this article takes as its starting point the understanding that TO constitutes an ontological and cosmological theory of foundational ambition. According to the foundational and recent bibliography indicated for this analysis, its proposal is organized around necessary modal axioms intended to offer a third explanatory path for the origin and structure of the universe, alternative both to an uncritically understood Big Bang and to creationism.

Among its decisive axes are the following: the primitiveness of Nothingness as mathematical essence; the singularization of each element by a field or aura; the logical necessity of infinity as non-element; the requirement of boundaries between distinct elements; the constitutive relationality of full existence; the composition of elements by prior elements; and the necessary transcendence without which there would be no existential universe. In recent formulations, TO further deepens modal discipline, the law of logical minimum, operational bridges with experience, and the necessity of testability.

This means that any dialogue with TO must distinguish, rigorously, two levels. The first is the level of **empirical contact**, at which physical and observational theories may offer data, methods, and results compatible with the reality described by TO. The second is the level of **ontological foundation**, at which mere instrumental adequacy is not enough. A theory may be useful, elegant, and empirically promising without thereby satisfying the modal demand of TO.

It is precisely within this difference that the article of Farah et al. must be

situated. It is strong at the first level and silent at the second. This situation does not disqualify it; it merely delimits its status. The task of propositional analysis, then, is to avoid two errors: demanding from the work something it never intended to offer, and taking its methodological success as if it were, by itself, an ontological grounding of the cosmos.

COMPATIBILITIES BETWEEN THE ANALYZED WORK AND TO

The first compatibility appears in the centrality of **relation**. The work of Farah et al. deals with events that only become cosmologically significant because they may be read at the intersection of source, propagation, detection, and inference. The gravitational signal has no cosmological value in isolation; it acquires such value through its inscription within a relational system. This structure is broadly compatible with TO's insistence that full being cannot be thought as absolute solitude, but as a minimal relational structure.

The second compatibility lies in the idea of **informational singularity**. Each gravitational-wave event carries an observable profile that contributes to its identifiability. In To-ist language, this may be read as an approximation to the principle according to which every element possesses a distinctive field. TO formulates this point in much stronger ontological terms, but the analyzed work offers an operational correlate: the event is distinguishable by its signature.

The third compatibility concerns the notion of **boundary**. The article's inference requires separating source mass and observed mass, population form and inferential approximation, event and noise, cosmology and astrophysics. In To-ist terms, this corresponds to the recognition that distinct elements require lines of distinction. The scientific procedure is possible only because the field of the problem is structured by conceptual and measurement boundaries.

The fourth compatibility consists in the valorization of **information produced in physical relations**. The article depends entirely on the idea that propagated

signals transport cosmologically relevant content. This dialogues in especially fertile fashion with the To-ist interpretation of the transcendent element as knowledge or information generated in atomic relations and equivalent to atomic radiations. Although gravitational waves are not "atomic radiations" in the strict electromagnetic sense, they may be read, in a broader use of the category, as forms of informational transcendence of the relational physical state.

The fifth compatibility lies in the openness to **testability**. The work is grounded in a simulated catalog, explicit technique, and quantitative forecasts. TO, in its recent works, has insisted on the necessity of operational bridges and empirical contact. In this sense, the analyzed article offers a concrete image of the type of instrumental mediation that a serious ontology must know how to welcome without dissolving itself into it.

POINTS OF TENSION BETWEEN THE ANALYZED WORK AND TO

Despite these convergences, the tensions are significant. The first and deepest consists in the fact that the work of Farah et al. does not intend to derive the cosmos from modal necessity. It remains within the domain of **statistical inference** and **observational reconstruction**. The universe appears as a field of parameters to be measured, not as a reality whose possibility must be deduced from first axioms.

This difference is decisive. For TO, cosmology is not exhausted by reconstructing H_0, $H(z)$, mass distributions, or source populations. It demands an answer to why the universe is such that it can produce differentiation, observability, memory, and informational transcendence. The analyzed article does not answer this, nor does it need to answer it to fulfill its scientific purpose. But precisely for this reason, it does not constitute an ontological rival to TO.

The second tension lies in the way intelligibility of the real is treated. In the article, intelligibility is operationally assumed: the signals carry enough information for inference provided the model is adequate. In TO, by contrast, the intelligibility of the real requires grounding: it is not enough to note that the universe is legible; one must explain why legibility is constitutive of the universe.

The third tension appears in the underlying cosmological horizon. The work moves within contemporary physical cosmology, examining expansion and its parameters. TO, especially in its modal critique of origin cosmologies, may consider insufficient a description of the universe centered only on expansion parameters. The To-ist question is more radical: whence comes the order that makes possible both the sources of

gravitational waves and the parameters inferred from them?

The fourth tension is methodological. Although nonparametric modeling reduces bias, it still depends on statistical apparatus and simulation. TO may welcome this as mediation, but not as foundation. In other words, methodological flexibility does not replace modal discipline.

PHENOMENIC ELEMENTS, INDUCTIVE EFFECTS, AND ATOMIC RADIATIONS

The category of **phenomenic elements** is one of the most fertile for articulating the article with TO. Gravitational waves may be understood as phenomena of high epistemic power: they do not reveal the foundation of the real in itself, but they make certain structures of the cosmos accessible in measurable form. They are thus carriers of phenomenic intelligibility.

This reading deepens when one considers **Inductive Effects**. The article shows that the way in which the population of masses is represented induces different results in cosmological inference. If the representation is inadequate, the result becomes biased. There is here, then, a notable case of methodological inductive effect: the form of the inferential apparatus alters the content of what is obtained as knowledge.

From the To-ist point of view, this allows for a useful distinction between **legitimate induction** and **deforming induction**. Legitimate induction is that in which the model follows the possibilities of the phenomenon without forcing it; deforming induction is that in which the prior hypothesis imposes upon the datum a form it cannot bear. The article of Farah et al. is valuable precisely because it recognizes this problem and seeks to minimize the second modality.

If one adopts, as requested in this analysis, the idea that the transcendent element is equivalent to knowledge or information produced in atomic relations and corresponding to atomic radiations, a powerful reinterpretation of the article is obtained. The gravitational signal then becomes, within this framework, an informational manifestation of the relational state of extreme matter. It transcends the local site of

emission and reaches the observer in organized form. What the scientist receives is not merely "data," but a radiation of intelligibility produced by the real. At this point, the articulation with TO is not merely possible; it is philosophically quite rich.

THE PROBLEM OF COSMOLOGICAL INFORMATION AND THE TRANSCENDENT ELEMENT

Contemporary science is, to a large extent, a science of physical information. The analyzed article shows this with clarity: the aim is not to touch the cosmos directly, but to read trustworthy traces of its structure. Luminosity distance, self-consistent redshift, reconstruction of the population distribution, and inference of expansion parameters are all, in this sense, results of a process of transforming signals into knowledge.

In TO, the transcendent element is not an extrinsic or mystical supplement; it may be understood as the informational dimension that exceeds the mere local materiality of each interaction and makes objective intelligibility possible. Under this key, gravitational waves fulfill an emblematic role. They show how a localized physical relation may produce a knowable effect across cosmological distances.

The value of the article may thus be reformulated as follows: it offers a scientifically disciplined case in which the universe provides, through relational radiations, sufficient material for the reconstruction of global properties. The problem is not merely to measure; it is to understand how information traverses the real without being entirely dissipated as intelligibility.

This formulation brings the analysis closer to the dialogue between TO and certain currents in contemporary physics concerned with information, structure, and the reading of the observable. It also reinforces an important point: TO need not reject statistical methodology; it needs only to submit it to an ontology in which information

has a deeper status than that of a mere instrumental product.

THE COSMOGONIC THEOREM OF TO AND THE SCOPE OF THE ANALYZED ARTICLE

One of the clearest limits of the article by Farah et al. lies in its cosmogonic scope. The work does not intend to explain the origin of the universe, nor the genesis of the principles governing its intelligibility. Its domain is posterior: it interrogates an already structured universe, with compact objects, emission of gravitational waves, detectors, and statistical apparatus.

This does not mean that the article is irrelevant to the cosmogonic theorem of TO. It means, rather, that its relevance is **indirect**. It does not formulate origin, but shows that the mature universe preserves observable traces of its global order. In To-ist terms, one may say that it offers material for the level of **empirical contact** of the theorem, not for its level of deduction.

This distinction is crucial. There are theories concerned with origin and theories concerned with the reading of what already exists. The analyzed article belongs to the second group. Its importance, however, is considerable, because a robust cosmogonic theory should not only deduce the universe; it should also show how this universe may be read in its later manifestations. In this sense, gravitational-wave cosmology may be interpreted as an indirect proving ground for an ontology claiming structural intelligibility.

The critical-propositional thesis emerging from here is clear: TO may welcome the work of Farah et al. as an epistemological technology for reading the late cosmos. But it should not confuse it with its own cosmogonic architecture.

COSMOLOGICAL ERAS OF TO AND THEIR INDIRECT ARTICULATION WITH OBSERVATIONAL COSMOLOGY

The cosmological Eras of TO, as developed in previous and recent works, describe the progression of the universe from the sphere of Nothingness, through logical tracks, plasma currents, centrifugal era, and the emergence of complex units of intelligence and memory. The work of Farah et al. does not enter at this genealogical level. It treats the universe in an already highly developed regime, in which massive stars evolve, collapse, form black holes or neutron stars, and emit gravitational waves in merger processes.

Even so, an articulation is possible. If the Eras of TO describe the gradual constitution of the conditions of differentiation, memory, relation, and intelligibility, then gravitational-wave cosmology may be read as a late moment in which the cosmos begins to provide, through its extreme events, high-precision informational radiations. The point is not to identify directly a phase of TO with the article, but to perceive that the late universe observed by LIGO/Virgo/KAGRA is a universe whose historical structure has already made this type of intelligibility possible.

Under this perspective, gravitational waves appear as distant heirs of a discipline of cosmic formation. They are signals of a universe that has reached a degree of organization capable of externalizing its own physical history in measurable form. For TO, this could be interpreted as an advanced manifestation of the passage from material relations to informational intelligibility.

DIALOGUE WITH THE SUPPORTING BIBLIOGRAPHY

Reading the article in light of the supporting bibliography indicated by the user makes it possible to broaden its philosophical significance.

With **Heisenberg**, the work shares the awareness that the observable is not raw datum, but reality structured by schemes of measurement and formalization. The challenge of the article consists precisely in adjusting the formalization scheme to the plasticity of the phenomenon.

With **Einstein**, there is affinity in the confidence that the structure of the universe is legible through disciplined mathematical constructions, although the work is situated in a post-Einsteinian regime of much more sophisticated statistical instrumentation.

With **Bohm**, one may stress the idea of implicated totality: each local gravitational-wave event refers to a broader cosmic structure. The signal is not exhausted at its point of emission; it carries implications regarding the whole.

With **Prigogine and Stengers**, the article approaches the notion of order produced in complex systems, especially because it deals with populations whose distributions should not be arbitrarily simplified. Complexity is not an obstacle to knowledge; it is its proper field.

With **Penrose** and **Hawking**, the dialogue occurs at the level of interest in the global structure of the universe and the role of extreme gravitational regimes as windows into cosmological intelligibility.

With **Kuhn**, the article is exemplary of an internal refinement of paradigm: it does not abandon current observational cosmology, but corrects one of its model-dependent inheritances.

With **LIGO/Virgo** observations, the work is directly aligned, since its simulated catalog is presented as compatible with expectations for the next LVK run.

This set of dialogues shows that the analyzed article is neither isolated nor eccentric. It belongs to a serious tradition of methodological deepening within physical cosmology. This increases its value as an interlocutor of TO.

TESTABILITY, OPERATIONAL BRIDGES, AND SCIENTIFIC DISCIPLINE

One of the most important insistences of the recent bibliography of TO is the need for **operational bridges** between modal axioms and empirical contact. An ontology that does not allow itself to be tensioned by phenomena and by real scientific practices risks becoming a construction immune to reality.

From this point of view, the work of Farah et al. is especially useful. Its commitment to computational reproducibility, to the use of simulated catalogs, to the quantification of uncertainties, and to explicit forecasts of precision offers a model of the type of empirical discipline that a philosophy of nature must know how to assimilate. The Zenodo record, by making available the code related to the manuscript and by reporting repository, license, and version, reinforces this reproducible dimension of the proposal.

TO gains, with this kind of interlocutor, the possibility of showing that its modal ambition is not a flight from the empirical. On the contrary, it may claim that empirical contact is more valuable when it does not rest on deforming assumptions. In this sense, the article's critique of parametric bias may be reinterpreted as a concrete example of what TO would call the subordination of inference to phenomenon.

The result is an interesting rapprochement: TO offers the ontological depth that purely inferential cosmology lacks; the article of Farah et al. offers the observational and statistical discipline that prevents ontology from remaining too abstract. There is no identity between the two, but there is the possibility of epistemological cooperation.

CONTRIBUTIONS, LIMITS, AND PROPOSITIONS

The analysis carried out allows one to state some of the main contributions of the examined article.

The first contribution is the demonstration that cosmological inference through gravitational waves may benefit from less rigid modeling of the source population. This is a real technical gain.

The second contribution is the explicit formulation of the problem of bias. The article epistemologically educates the field by reminding it that a poorly specified population hypothesis is not a mere detail, but a factor that compromises the inferred cosmology.

The third contribution is the strengthening of the notion that the universe may be read through gravitational signals as autonomous cosmological messengers.

On the side of limits, the principal one is the absence of any deeper ontological grounding. The work shows **how** to measure better, but not **why** the real is structured in such a way as to make such measurement possible.

A second limit lies in the fact that the method, though more flexible, still inhabits a broad cosmological framework that is not questioned in its ultimate foundations. TO, at this point, would require a more radical interrogation of the horizon of origin and of the status of the universe.

From these observations, four critical-propositional theses may be proposed:

1. The work of Farah et al. should be incorporated into the dialogue with TO as

an example of serious empirical mediation, not as a competing theory of origin.

2. The To-ist notion of the transcendent element as information produced in relations may philosophically enrich the reading of gravitational signals.

3. The critique of parametric bias may be reinterpreted, in To-ist terms, as the distinction between legitimate induction and deforming induction.

4. TO could, in the future, develop a systematic phenomenology of cosmic informational radiations, including gravitational waves, as a chapter of its phenomenic table.

FINAL CONSIDERATIONS

The work connected to DOI **10.5281/zenodo.13363159** occupies a relevant place in contemporary cosmology because it proposes a more cautious and flexible way of inferring cosmological parameters from gravitational waves. The merit of the proposal lies in recognizing that excessive confidence in rigid parametric forms may deform access to the real, and in responding to this problem with a nonparametric modeling capable of reconstructing population and cosmology simultaneously.

In the light of the Theory of Objectivity, this work reveals important methodological affinities. It values relationality, the intelligibility of signals, the need to respect the phenomenon, and the search for testable operational bridges. For this reason, it dialogues well with the foundational, recent, and supporting bibliography of TO.

However, the analysis also showed that this affinity has clear limits. The article does not offer an ontology of the universe, does not deduce cosmological order from modal axioms, and does not present itself as a theorem of origin. Its language is that of inference, not of foundation.

The final balance is therefore twofold. In the strict sense, the article does not satisfy the highest demands of the Theory of Objectivity. In the strategic sense, however, it offers exactly the kind of interlocution that a scientific ontology needs: a disciplined practice of reading the cosmos, sensitive to the risks of bias and open to reproducibility.

For this reason, the best synthesis may be this: Amanda Mirna Farah's work does not provide the cosmogony of TO, but it does provide an excellent example of how the already structured cosmos may be read from its own relational radiations.

In To-ist terms, it is a science of phenomenon that, without yet attaining the modal necessity of being, helps to prepare the ground for it.

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TO-STYLE APPENDIX

A. Synthetic formulation of the modal reading

1. **Nothingness and intelligibility:** the analyzed article does not deal with Nothingness as primitive mathematical essence, but presupposes an already intelligible universe.

2. **Aura and singularity:** each gravitational-wave event manifests a distinctive signature that may be read as a phenomenic correlate of the singularity of each element.

3. **Infinity and inferential openness:** nonparametric modeling suggests that the real exceeds rigidly closed population forms.

4. **Boundary and difference:** correct inference requires clear boundaries between population, cosmology, noise, and model.

5. **Relational observation:** the event becomes cosmologically significant only when inscribed in an observational and inferential network.

6. **Constitutive anteriority:** each observed source is the product of prior physical histories.

7. **Informational transcendence:** the gravitational signal, reinterpreted as informational radiation, externalizes the relational state of extreme matter.

B. Propositional framework

The To-ist reading of the article allows one to affirm that gravitational-wave cosmology may be reinterpreted as a **phenomenology of relational radiations**. Under this key, the cosmos is not merely a set of objects, but a field of production and transmission of intelligibility.

C. Proposal for future research

It is suggested, within the scope of TO, that a theoretical program be developed under the provisional title:

"Phenomenic Table of Cosmological Radiations in the Theory of Objectivity"

This program could include:

- electromagnetic radiations;
- gravitational waves;
- quantum informational fluxes;
- material memory and structural signatures;
- correlation between observability and informational transcendence.

D. Appendix conclusion

Within the horizon of the Theory of Objectivity, Amanda Mirna Farah's work may be read as an exemplary case in which the universe, through extreme events and persistent signals, offers not only data, but organized traces of its own legibility. The contribution of the article is not cosmogonic; it is mediating. And precisely for that reason, it may occupy a relevant place in the dialogue between modal ontology and contemporary observational science.