

Theoretical Physics Digest - A Wiki for Back of the Envelope Calculations

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ABSTRACT

We describe a new pedagogical tool for the scientific community. This is a wiki dedicated to the curation of back of the envelope calculations, toy models and scaling arguments. The wiki currently contains more than 150 entries on a wide range of topics in astrophysics, each of them can be absorbed by an average graduate student in less than half an hour. We believe that this resource can help in the preservation and dissemination of scientific ideas, and invite members of the scientific community to contribute. The wiki can be found at https://theoretical-physics-digest.fandom.com/wiki/Theoretical_physics_digest_Wiki

1 INTRODUCTION

By far, the most important channel by which scientific knowledge is communicated is via papers. The main problem with papers is that they tend to be laconic and are aimed at presenting scientific results rather than teaching physics. Quite often, what stumps paper readers is an unfamiliar equation. In this case, said equation should be accompanied by an appropriate reference to another source that contains its explanation. However, there are cases when no reference is provided. In other cases, the reference does not point to a derivation, but rather to another work that uses the same equation, forcing the reader to traverse multiple levels of nested citations to reach the source. Yet another possibility is that the source is behind a prohibitively high paywall, unavailable online or written in a foreign language.

In many cases when a reader encounters an unfamiliar equation, they are not necessarily interested in a lengthy rigorous derivation, and would most likely be satisfied with a heuristic argument for the validity of the equation. For that purpose, back of the envelope calculations, toy models and scaling arguments are very useful. Furthermore, such tools are extremely valuable as intuition builders.

Many of these “back of the envelope” calculations might be familiar to experts in a certain field, but not to researchers in a different field. Some of these heuristic “tricks of the trade” are not even documented in textbooks or other official resources. Nevertheless, researchers in one field might be interested in progress made in a different field, and such knowledge “gaps” make it harder for them to assimilate new findings.

In this paper we describe a tool that can alleviate this problem. It is a wiki dedicated to curating the pedagogical tools described above. It currently contains over 150 entries in a large variety of topics in astrophysics, ranging from exoplanets through stars to planets and cosmology. Each entry introduces a new concept that the average graduate student or researcher would be able to absorb within less than half an hour.

The wiki is searchable, free to use and can be edited and commented on by anyone. We named it the “Theoretical Physics Digest” (TPD for short) and it can be found at the following address https://theoretical-physics-digest.fandom.com/wiki/Theoretical_physics_digest_Wiki

As an example, let us consider the Bahcall Wolf cusp. This is a model for the behaviour of dense star clusters, which predicts that the density of stars should scale with distance as $n \propto r^{-7/4}$. The original paper by Bahcall & Wolf (1976) contains over a hundred equations. In contrast, the corresponding TPD entry contains less than ten equations. Many researchers who encounter this topic would prefer (at least as an entry point to the subject) the second option.

One issue that has turned up is vetting. Our policy is that the entries will be moderated, but not refereed. Things that are blatantly wrong, or do not provide a quantitative result will be removed. Contested results are allowed, so long as the existence of a controversy is disclosed. In this sense, we consider the TPD to be more like the arXiv than a refereed journal. In our opinion, the speed and ease of editing outweighs the risk of data corruption.

At the time of writing, almost all of the entries have been written by the authors of this paper. We hope that these entries will be helpful to other members of the scientific community, and we invite them to contribute to this wiki in order to make scientific ideas more accessible. Furthermore, the more researchers participate in writing, editing and commenting on TPD entries, the more refined will the explanations become and the less prone to errors.

REFERENCES

Bahcall J. N., Wolf R. A., 1976, *The Astrophysical Journal*, 209, 214

This paper has been typeset from a T_EX/L^AT_EX file prepared by the author.