Increasing Mathematics Engagement in an Astronomy Outreach Context

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Keywords
FRAS, Outreach, Mathematics, Engagement

Summary

The ability to better understand the Universe is very enticing, but for many of us mathematics can be a steadfast barrier to getting there. This article explores the role of mathematics in astronomy outreach and shares my experience of using mathematics to engage an audience, rather than shying away from it.

Introduction

I am currently in my third year of study for an astrophysics degree, but it was not long ago that I too felt that maths was going to stop me fulfilling my ambition of becoming a physicist. Until I had an epiphany. I realised that mathematics is not just vital to a career in physics but is in fact wonderfully interesting in its own right. The more complex maths becomes, the more interesting it is, and the easier it becomes to understand. The key is to transition from *having* to know maths to *wanting* to know maths. Then the rest more or less falls into place. It is for this reason that engaging the public with the maths of astronomy, which is more often than not completely left out of outreach, can be very important.

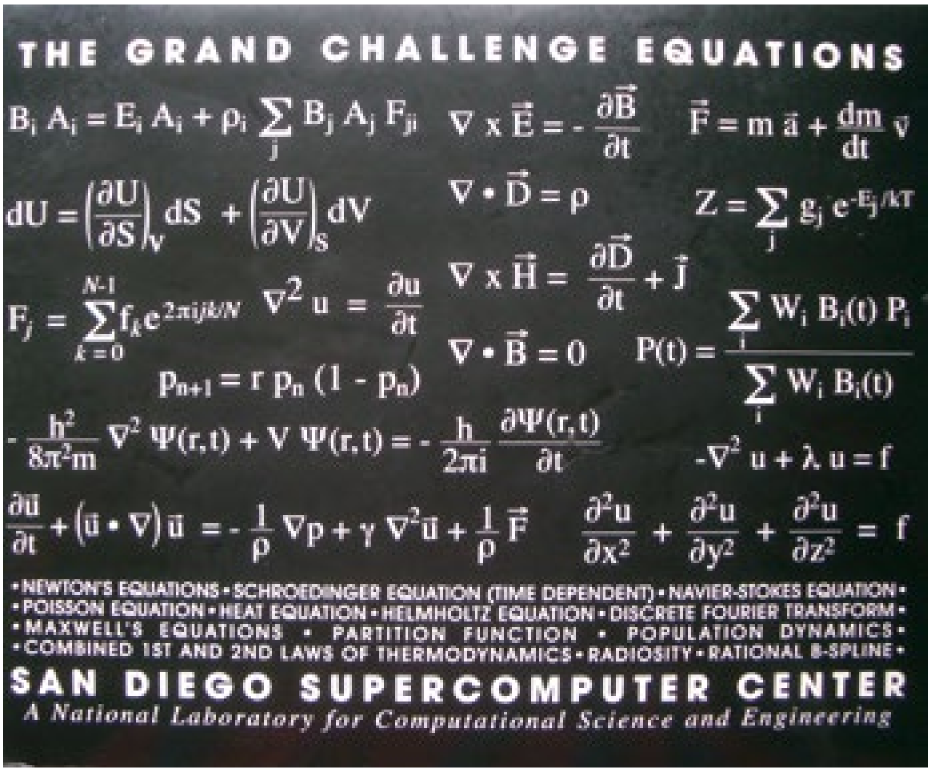

Figure 1. *The Grand Challenge Equations. Credit: Duncan Hull https://www.flickr.com/photos/dullhunk/*

Mathematics in engagement

I recently gave a talk as part of National Astronomy Week on stellar remnants, with particular attention given to black holes. In an astrophysics context this is a very mathematical subject yet in the vast majority of talks on the subject the maths is either extremely sparse, or nonexistent. This is a great shame. So, I went out with the intention of presenting the subject a little differently. To quote Feynman:

"…All kinds of interesting questions which the science knowledge only adds to the excitement, the mystery, and the awe of a flower. It only adds, I don't understand how it subtracts."

This quote can be just as true of maths. If it is communicated in the right way maths does not subtract from the wonder of physics, it only makes it more interesting. Communicating maths in an engaging way is a challenge, due in no small part to the common and instant "I don't understand it" public reaction, but never the less it is something that more science communicators should strive to achieve. It adds, for want of a better word, another dimension to our understanding of the Universe and to the astonishment of learning about it.

In my presentation on stellar remnants, I showed Einstein's equations for general relativity, with an explanation of what was represented in these single lines of letters and numbers. The key here is to plant the seed of curiosity. A full explanation would have lost the majority of the audience, but giving them just enough to get their minds latched onto what was being conveyed was sufficient. Being able to represent gravity in a one-line equation is a beautiful thing, and there is a wonder in it that many in the audience would not have been exposed to before that evening.

I had forewarned my audience that there would be some mathematical content to the talk. This was met with a laugh of trepidation. However by the end of the talk, the audience was transfixated, and I was bombarded with interesting questions about black holes, wormholes and the fate of matter that falls into black holes. Even from the youngest member of the audience, who I believe to have been about six years old.

After the talk, I was approached by a gentleman who shared my opinion on mathematics in outreach:

"It is so refreshing to see maths in an astronomy talk. I wholeheartedly agree with you, it is important to include equations. Even if not explained in full, you can at least talk about what the maths can show you. It is the worst feeling, attending a talk on astronomy, and there is no maths. You know they're dumbing it down!"

My efforts to engage the audience with mathematics had clearly hit home with a number of people and there was a feeling of shared belief in the room that maths does not detract from the subject material.

There will be certain circumstances where heavily mathematical content might not be appropriate, and we have a long way to go before a general audience will see an equation and not shy away from it. However, we should be doing all we can to inspire the next generation of scientists to go out and explore the world for themselves, and to do this they need to both know and want to know about maths. We need to show them that maths isn't just for answering questions for exams. Mathematics is the language of physics; it is something to be embraced, not feared.

Biography

Mark Woodland has been a student in astronomy/astrophysics for nearly ten years. Mark is a fellow of the Royal Astronomical Society, Student member of the Institute of Physics, British Interplanetary Society, UKSEDS, and sits on the committee of the Wells & Mendip Astronomers group. Mark's main interests are black holes and high energy astrophysics.