

“Superfluous”:
The Stories of Einstein’s Special Relativity
Response to Reviewers’ Comments

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I appreciate the responses from the two early reviewers and would like to react to them individually, as they are slightly different. I’ve responded as I might to a journal referee. I hope that’s appropriate for this venue.

A word about me, however, might help as they both wonder about my experience.

I’ve indeed never written a book-length document. My whole career has been purely research, teaching, and administration (I was chair of the Michigan State University Department of Physics and Astronomy for 100 years during the 1990s) and so my scientific writing has been individual papers and proposals. However, a prominent side of my academic scientific life is teaching which I do all over the physics curriculum. I fell in love with teaching non-science students — called “general education” in U.S. universities — 20 years ago. The two courses I created were unusual enough that no textbook would fit and so I started to prepare an on-line text specifically for the bigger of the two. I began emphasizing biography as a contextual marker for physics concepts early on when I saw positive responses from students. I think non-science students can attach themselves to those personalities and that the science “sticks” perhaps more easily by association. This project stems from the biographical parts of the (so far) 18 chapters of that on-line textbook. It’s real university physics, so much more technical than the proposed *Superfluous!* book.

My classroom style is intentionally “light” knowing that non-science physics students are typically nervous. I try to be humorous and of course never condescending. I will note that I’ve won every teaching award that my department, college, and Michigan State University offers and my reviews from students are usually very positive. Whether my non-threatening style can translate to print remains to be seen and the Michelson chapter draft was my

very first attempt to do that for a non-student audience.

I want to subtly stress two themes. A meta-theme is that major events in physics do not spring forth, fully formed. There's a history to every theoretical and experimental discovery and in science's odd way, it's selectively cumulative. Of course my primary theme is the physics of Special Relativity and the problems that it solved. In teaching Relativity (to physics majors as well as non-science students), I view it as a merging of Three Threads which were originally non-overlapping and then, through primarily Einstein, mutually convergent.

The Three Threads are: What is the nature of:

1. Motion of the earth.
2. Motion on the earth.
3. Electricity plus magnetism.

Each of the chapters (people) in the proposal contributed to one or more of these Three Threads — some productively (Newton) and some unproductively (Galileo's motion of the earth argument was totally wrong). I think this is an important message and if I'm successful, readers will know a lot of my particular subject, but also learn to appreciate how current science inherits from the past.

At the risk of being repetitive from the proposal, I have a distinct structure in mind for this book. Since some of the concerns of the reviewers speak to where and how much technical information is presented, let me reprise that structure here and then speak to how I might modify my original idea if that's desirable.

Each chapter will be built in three "sections": the primary narrative biography, a section on legacy inheritance of the person's original work in modern terms, and the technical appendices. I called them "A Little Bit About...", "The Modern Bits From...", and "The Technical Bits Of..." For the Michelson chapter this looked like this:

Chapter 13 The Most Important Zero Ever – Albert Michelson

13.1 A Little Bit About Michelson

the biographical narrative

13.2 The Modern Bits From Michelson

a topical set of outcomes from Michelson's work that are important today

13.2.1 The Speed of Light

- 13.2.2 Michelson’s Interferometer (including lab bench and astronomical uses)
- 13.2.3 The Immediate Aftermath of the Michelson-Morley Experiment

Appendix 13

The Technical Bits Of Michelson

Technical explanations of his experiments, some derivations of relations referred to in 13.1 and 13.2

I had in mind that the “Little Bit About” would be entirely non-technical, that the “Modern Bits From” might have some diagrams and equations, and the “Technical Bits Of” would be diagrams and equations.

In light of the comments, I could imagine that the “Modern Bits From” might be more in the style of the biographical narrative, leaving the mathematics and more complicated diagrams to the appendices.

What follows are my responses to a picking-and-choosing among the comments by the two reviewers.

1 Reviewer #1

1.1 Proposal

1.1.1 Strengths and Weaknesses

I appreciate the strengths and weaknesses comments that Reviewer #1 offered. Reviewer #1 correctly points out that biography is a useful vehicle to teach difficult subject matter and that’s something I learned as I began this general education journey. I’m committed to it in my teaching and obviously wanted to try that out in a bigger context. Reviewer #1 is also correct that the mathematics of Special Relativity is surprisingly simple.

Reviewer #1’s weakness concern is right-on. I know that it looks like I’ve deployed the “kitchen sink” as a dangerous weapon in the proposal! My plan would be to limit the biographical material to that which is relevant to the **Three Threads**. So for example, Newton is a huge subject, but while much of his scientific life was concerned with optics, I’d probably not mention it. I’ve more to say to this legitimate concern below.

So the biographies would not be exhaustive, far from it. They will, however cover their

entire lives and in as humanizing a way as possible.

1.2 Could this proposal be improved or have a better focus? If so, how?

“too many of the scientists in the list seem peripheral”

I can see how this is a concern, but as I noted above, if I do this right the relevance of each will be apparent. They’re all there because of their relationship to the “Three Threads .”

“I was a little scared by the estimate of 50-100 equations.”

Granted. I really didn’t know how to estimate this. In these classes I try to treat equations like a language. When I took high school Latin, I was taught to read Latin, but I never had to write Latin. That’s my approach to mathematics in these courses. Here, while I might want to note that the speed of a falling object, à la Galileo, behaves like $v \propto t$, I would not launch into a full discussion of the standard kinematics equations. Rather, it would be to contrast it to the contemporary opposing view that he disproved that maybe $v \propto x$. There’s a story there that goes back to the Medievals which would serve to recalibrate one’s misconception that all was dark in science until Copernicus.

I am highly motivated by Weinberg’s books as both reviewers point out. Reviewer #1 wonders if his first popular book, *The First Three Minutes* had technical appendices. Indeed it did, as did every one of his books. I very much want to continue that tradition. For example, just how the Medievals’ “Merton Rule” informed Galileo’s recognition that the distance of a falling object would go as the square of the time would be cumbersome in the biography, but easily explained in an appendix. I’ll bet that many of my professional colleagues are not familiar with the Merton mean speed theorem. The point is that Galileo was partly guided by past work.

“If it really is going to be a book for a popular audience, I would suggest not having technical appendices, but technical boxes at various points through the book.”

Obviously, I don’t agree with this suggestion. I very much prefer to keep those technical discussions separate from the narrative and let them stand alone as independent, little essays in the appendices. Again: identical to Weinberg’s approach.

1.2.1 Is there a need for this book?

“Yes, I don’t know of any book like it.”

I don't either, which is why I'm trying to write one!

2 Reviewer #2

2.1 Market

"Yes, I believe students might find this book appealing. Considering the scope of topics covered, the relevant courses would be courses in electromagnetism, surveys of physics or the history of science. If the book ends up as comprehensive as planned, libraries might buy it as a reference work."

That was gratifying.

"...imaging of black holes and the physics of black holes, and gravitational lensing are currently of interest. The proposal does not say if it covers these topics or not."

This will be about Special Relativity. Those topics are General Relativity.¹

2.2 Proposal

"From the sample chapter, I would say that historians of physics might take issue with the author's writing style, which might tend to gloss over nuances in the history of his topic. For example, the author tells the story of Michelson being accused of sexual harassment by his maid, and being "completely exonerated." The author appears to have gotten this story from Michelson's daughter's account (the book *The Master of Light*). By today's standards it seems very risky to take the daughter's account as being unbiased, or to think that the maid got a fair hearing in her accusation against a notable figure!"

Actually, that story in Dorothy Michelson Livingston's biography did get my attention (that's a very fine book), but I was inclined to accept it as it's also described in more detail—including the sting operation—in the May 1, 1987 edition of *Physics Today*, the centenary issue on the Michelson-Morley experiment. The *Physics Today* account includes entries from court transcripts and *Cleveland Leader* reporting from October of 1887 (which

¹If this approach works, I could imagine follow-on books that would indeed tell the stories of General Relativity and Cosmology as well as Quantum Mechanics and Particle Physics. Some of the same characters would be a part of those stories, but from different contributions than their work that pointed at Special Relativity.

are also referenced in Livingston's biography). They noted, "Documents from police court disclose that in November the case against Michelson 'was called up and dismissed.'" He charged her with blackmail and she with assault. Both were dropped.

"Another example of a potential issue with the proposed book is the selection of facts the author made in his abbreviated biography. Michelson was the first American Jew to receive a Nobel Prize, and his difficulty getting accepted (as a young man) into the US Naval Academy may have been due to antisemitism. These facts are not mentioned at all."

That's probably fair. He was not only the first American Laureate, but the first Jewish Physics Laureate and I should have noted those facts. But Michelson was notoriously agnostic. He was married in churches, buried in a church cemetery, and his children were baptized and so I didn't include his heritage of indeed, being the son of Jewish parents. I'm not sure that his entrance to the Naval Academy speaks of antisemitism as a "fact." The Jerusalem Post notes, "Ironically, the reference letter by Rep. Thomas Fitch of Nevada to US president Ulysses Grant, which was instrumental to Michelson's admission to the Naval Academy and the subsequent success of his career, stressed the point that Michelson's father was a prominent 'member of the Israelite persuasion... has largely contributed to the success of our cause and induced many of his co-religionists to do the same.'" Obviously, Grant stretched the rules in order to admit Michelson.

2.2.1 Strengths

"The sample chapter (at least the narrative part, as the technical appendices were not included) needs editing, but has a good balance of detail and "big picture." I found it an enjoyable read."

"The proposed book would have a somewhat unusual format, combining elements that would appeal to the "general public" perhaps (more likely, it would appeal to a subset of readers with science and engineering backgrounds) and to students."

Again, I'm pleased that this reviewer notes that this would be an unusual approach to writing about physics. Reviewer #2 later notes that its success would depend on the quality of the writing. That's what I'm eager to try to develop: a voice that would serve my needs and appeal to curious readers.

2.2.2 What are the weaknesses of this proposal? How could they be remedied?

Again,

“I would say that historians of physics might take issue with the author’s writing style...”

That’s fair. As I pointed out my “voice” tends to be informal. I know that works in-person, but will it work in writing? That’s my number one challenge, and frankly, the one that I’m most interested in developing.

As to what I included and didn’t. His reference to Mt Wilson Observatory is one of those choices about his professional work that in my mind was “more of” and not necessarily critical. I was going to refer to his astronomy (he developed the stellar interferometer at Mt Wilson), but not in detail—the Modern Bits From would refer to astronomical (including LIGO) uses of interferometry. His relationship with Mt Wilson was primarily continued measurements of the speed of light, which doesn’t need more than a mention given my focus and an account of his first measurements of c . This is an example, frankly, of trying not to allow the scope to broaden beyond Relativity.

The reviewer’s comments to the details of the Michelson chapter draft are fair. I decided to include a sample chapter to see whether I could actually do it! My understanding was that it was not necessary for the first stage of the approval process. I think it’s too long, not tight enough, and intentionally lacking citations for this exercise.

“The style of the sample chapter is somewhat glib. Unfortunately, some remarks that work well in lecture don’t always come off as well in writing.”

Again, fair enough. I suspect that being too informal could be hard to pull off without being irritating, but on the other hand, I’m reluctant to be too academic-sounding, as it’s not really authentically me or how I think. So I might need some editorial help here to figure this out.

“What do you think of the title? I worry that the potential reader will not relate to it.”

Maybe. “Superfluous” by itself doesn’t make sense without the subtext. I’d envisioned “the spine” to include the entirety of, *“Superfluous”: The Stories of Einstein’s Special Relativity*. Special Relativity is the hook, but “Why Superfluous”? might lead to curiosity. I hope it can be made to work somehow as Einstein’s phrase is actually represents an important addition to the tools that we now use to evaluate the scientific worth of a statement: “if you can’t measure it, you can’t state that it exists” is Einstein’s whole argument for eliminating the ether. But being pithy with “Superfluous” requires thought.

“The outline suggests a very wide scope for the book, but does not go into much specific detail (other than naming names) for each chapter.”

“The author could explain in more detail the key ideas of each chapter, and how they relate to the overall theme of the book. What IS the main idea of the book, anyway? Alternatively, the author could narrow the focus to Einstein, special relativity, and simple questions with intricate answers (as he says).”

I apparently didn’t highlight the Three Threads adequately. As a particle physicist, I’m wedded to the amazing notion that historically disparate subjects become unified into common themes as we learn more and more. This unification idea seems to be something that Nature does and that we’re learning. My Three Threads were not obviously related to one another until 1905 when Einstein decoded it. So if I do this right, the reader will know just how each person contributed to one or more of them.

I’d been thinking of how to make apparent what each person’s contributions were and I’d even imagined a graphic that would follow the historical flow... maybe even at the top of each chapter. Figure 1 is a sketch of what is germinating in my mind. Galileo did much for motion on the earth, so he gets a line. He messed up motion of the Earth, so he gets a red x. Faraday, only electricity and magnetism. Newton brought the two motions together, so a different sort of graphical symbol. Einstein would be the only one to get a “dot” on all three threads. This way I’m envisioning the reader following the Three Threads and who contributed to what until they’re merged in 1905. The reader should then understand what each person did to move the Relativity story forward.

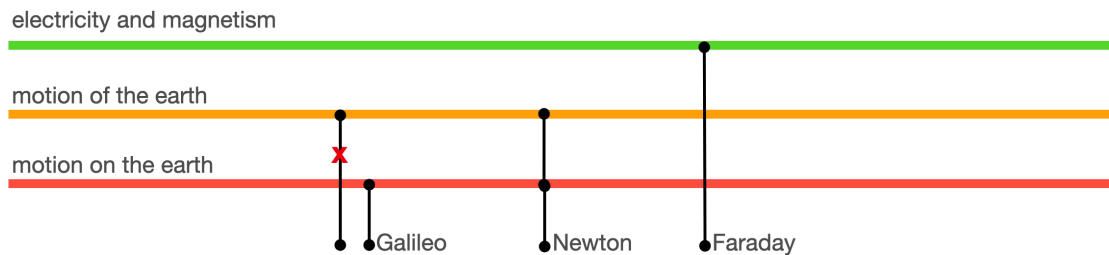


Figure 1:

“The proposal seems to cover much of the same ground as *Einstein for Dummies*,”

I’ve looked at Calle’s book and I don’t think what he and the Dummies franchise do is what I’m about here. *Einstein for Dummies* is really intellectually thin. It’s also about Einstein’s entire physics menu with Special Relativity taking only a portion of the book.

Reviewer #2 mentions that the Greeks as being a part of *Dummies*, but it is very sparse. My need for the Greeks is focused: to establish Aristotle's motion and his rules and to highlight Plato's Forms, which truly inform Galileo's departure from the Aristotelean notion that every object's motion is distinctly "personal" depending on it's earthy and lighter elements. What's interesting about Aristotle's approach is that what he describes is indeed what someone observes. But there are no underlying, predictive principles.² It couldn't have led to physics.

Galileo taught us that what's important in motion are the common —dare I say hidden — laws that we should seek to uncover even though no actual object will practically obey those ideal rules. (The dropping of the hammer and the feather on the Moon is the first such observation of one of those hidden rules.) Our job is to unravel them and then explain actual observations by noting the forces of resistance that make the observed motions behave the way they appear to. But what's primary are the hidden rules. Galileo was very Platonic in that sense and with that change of perspective and establishment of those new goals, physics was born. So my interest in the Greeks will be meant to be interesting and important.³

"The sample chapter has promise because there is quite a strong narrative arc and the level of detail is generally appropriate (with some caveats). But I believe the proposed book as a whole lacks focus, and covers far too much ground to be commercially viable."

Well, I hope that's not the case! I think that the focus is the Three Threads leading to 1905. But I understand that the scope can look daunting.

3 Conclusion

I think that overall, the major issues is scope and to that end I envision:

- A clear organizational pattern that re-emphasizes in each chapter that the narratives are following the evolution of the Three Threads. I anticipate that the reader will quickly learn to expect that organizational structure as they progress.
- Keeping the technical content to the appendices so that the body of the book is all of the same "voice" and level.

²I will note that I have a masters degree that was joint between a physics and philosophy department and so I've an unusual philosophy of science background that eventually became full-on physics alone.

³You'll notice that I included the Wachowskis in the Galileo outline. Galileo chose to swallow the Red Pill. The *Matrix* is very much a Platonic allegory to physics in my mind.