# Introduction to Our Research in Formal Math and Our Interest in Formal Physics

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# Outline

# Why Are We Here? - Part I

- We develop proof automation for HOL Light and are interested in its use in larger projects
- We are interested in presenting formal proofs
- We are also generally interested in examples of formalizations that need computer algebra (near future work)

# Why Are We Here? - Part II

- We are interested in formal physics: unlike math this is not just a deductive science - how will formalization work?
- 50 years from now, exact sciences will very likely be to a large extent understandable to computers - how can we get there?
- What are the bottlenecks for formalizing physics?
- What are the things physicists can gain?
- semantic search, verified computer algebra and reasoning, automation of reasoning, better formal treatment of various physical models and theories that can be inconsisten
- better integration with math: having it all in one formal framework allows different experts to collaborate
- better education (linking of formal theories to wikipedia, etc.) ...

# Why Are We Here? - Part III

- What are the immediate applications of formal physics?
- Can we convince at least some physicists/engineers that they need formal proofs?
- Optics? Quantum computers/cryptography?
- Security of nuclear reactors? Large Hadron Colliders?
- Space exploration? (some formal verification done in NASA - E. Denney), etc.

# What is Our Research

- Proof automation in large theories (HOL Light, Mizar, Isabelle, HOL, ...)
- AI and automated reasoning research over large formal theories
- Formalization, managing large formal repositories (wikis), tools for presentation and authoring of formal math
- Tools/systems for translating between various ITP and ATP systems and formalisms (HOLs, Isabelle, Mizar, Vampire, SMTs, etc.)

# What Could Be the More Immediate Results?

- Some of our systems working and being useful on the physics formalizations
- Perhaps a short CICM (MKM/Calculemus/DML) paper on the topic/prospects of physics automation/presentation/formalization?