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Organisation: **University of Cambridge**
Funding Sought: **£86,786.00**

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Homotopy Type Theory and the Formalization of Mathematics

This proposal advances recent discoveries in the foundations of mathematics with far-reaching applications for the certainty and precision of mathematics, as well as for the everyday work of mathematicians and other scientists. Homotopy Type Theory is an emerging field combining logic, mathematics, and computer science and employing a fundamentally new approach based on primitive higher-dimensional structures and including new principles of reasoning not directly available in conventional foundations. Its applications include providing powerful and flexible computational tools that facilitate the large-scale formalization of mathematics.

Standard mathematical proofs are still just arguments in words; famous examples of erroneous published proofs abound. Recent advances in high-speed computing have permitted the development of powerful interactive theorem provers to aid in the verification of mathematical proofs. The current project employs a new interpretation of type theory recently discovered by the PI and Fields medalist Vladimir Voevodsky, which brings such systems much closer to everyday mathematical practice.

The PI also proposes to teach a graduate level course based on a current textbook in progress. He will also organize and lead a working group devoted to an ongoing formalization project developing a new interactive proof assistant for Homotopy Type Theory based on the popular Lean Proof assistant that is being developed by an international team based at Carnegie Mellon University.

These activities are intended to strengthen the interaction and cooperation between the Cambridge and CMU research groups involved in related work. Future exchanges and collaborations among faculty, postdoctoral, and doctoral researchers are expected to result.