



Delft, July 9th, 2017

To whom this may concern,

I am writing in support of the Stage 2 QuantERA proposal *AZX: A Flexible Intermediate Representation for Quantum Software*. I believe this project will produce tangible gains for quantum technology, both in the theoretical aspects of quantum computation and in the practical aspects of implementing quantum computing with hardware. The central goal of *AZX* is to develop a sophisticated stack of tools for compiling quantum software into low-level instructions for quantum hardware, adding error correction and performing optimizations along the way. This concept of a "compiler stack" has already become indispensable to the operation of classical computers and is crucial to producing scalable quantum computers. Furthermore, with quantum technologies still in their infancy, even small reductions in memory and computational overhead will produce substantial simplifications for physical implementations and experiments.

This proposal has several major strengths. First, it draws on a large body of theory (e.g., the recent textbook *Picturing Quantum Processes*, of Coecke and Kissinger). Second, the consortium has assembled a multidisciplinary team of experts in theoretical computer science, quantum programming languages, quantum error correction, and quantum hardware. For example: Valiron developed and maintains the *Quipper* quantum programming language, Horsman developed the technique of lattice surgery, a leading method for implementing fault-tolerant computation in the surface code, and Benjamin is the "Architectures" work-package leader for the NQIT Quantum Hub, a UK-based project engaged in the implementation of a large-scale quantum computation with trapped ions. Third, the project seems committed to engaging with the broader quantum hardware community, as evidenced by their proposed advisory board, which consists primarily of prominent members of quantum hardware groups throughout Europe. As the principal investigator (PI) of an experimental group implementing quantum computation via superconducting quantum circuits at the QuTech Institute in Delft, I am happy to serve on the advisory board of *AZX*. I look forward to collaborating with Kissinger, the PI for the project's Dutch site, who has visited my group and maintains active communication with several of my group members. I am also delighted to see the specifications of our transmon-based superconducting hardware serving as one of the first two test-case targets for the project's compiler tools.

In summary, I believe this project is timely and important, its consortium is well equipped to handle the challenges it presents, and I look forward to seeing the concrete benefits in the effort to implement effective quantum technologies.

Yours truly,

A handwritten signature in blue ink that reads 'Leonardo DiCarlo'.

Dr. Leonardo DiCarlo
Associate Professor
Delft University of Technology

l.dicarlo@tudelft.nl

+31 (0)68 324 7883