Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Quantum algorithm for topological and geometric analysis of data
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VANO GARNERONE, IQC University of Waterloo — Topological methods for ana-
lyzing data sets provide a powerful technique for extracting useful information from
data. Data that represents geometric features of the world typically gives a distorted
picture of those features, if only because the devices and systems that sense the world
and that generate the data by their very nature induce distortions. By definition,
topological features are those that persist under continuous distortions of the data.
Topological methods can therefore identify features of the real system from which
the data was collected, but that have been distorted by the data collection process.
Persistent homology is a sophisticated tool for identifying such topological features
–connected components, holes, or voids – and for determining how such features
persist as the data is viewed at different scales. This talk presents quantum machine
learning algorithms for calculating Betti numbers in persistent homology, and for
finding eigenvectors and eigenvalues of the combinatorial Laplacian (the quantities
that famously allow one to "hear the shape of a drum"). The algorithms provide an
exponential speedup over classical algorithms for topological and geometrical data
analysis.

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Date submitted: 11 Nov 2014

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