Abstract Submitted
for the SES20 Meeting of
The American Physical Society

Many-Body Thermodynamics on Quantum Computers via Partition Function Zeros[1] AKHIL FRANCIS, North Carolina State University, DAIWEI ZHU, CINTHIA HUERTA ALDERETE, Joint Quantum Institute, University of Maryland, SONIKA JOHRI, IonQ Inc., XIAO XIAO, North Carolina State University, JAMES K. FREERICKS, Georgetown University, CHRISTOPHER MONROE, NORBERT M. LINKE, Joint Quantum Institute, University of Maryland, ALEXANDER F. KEMPER, North Carolina State University — Partition functions are ubiquitous in physics: they are important in determining the thermodynamic properties of many-body systems, and in understanding their phase transitions. As shown by Lee and Yang, analytically continuing the partition function to the complex plane allows us to obtains its zeros and thus the entire function. Moreover, the scaling and nature of these zeros can elucidate phase transitions. Here we show how to find partition function zeros on noisy intermediate-scale trapped ion quantum computers in a scalable manner, using the XXZ model as a prototype. We illustrate the transition from XY-like behavior to Ising-like behavior as a function of the anisotropy. While quantum computers cannot yet scale to the thermodynamic limit, our work provides a pathway to do so as hardware improves, allowing the determination of critical phenomena for systems that cannot be solved otherwise.

[1]This work was supported by the Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering grant No. DE-SC0019469, the McDevitt bequest at Georgetown, the CONACYT doctoral grant No. 455378 and National Science Foundation grant no. PHY-1430094.

Akhil Francis
North Carolina State University

Date submitted: 12 Oct 2020 Electronic form version 1.4