Abstract Submitted for the DAMOP14 Meeting of The American Physical Society

Digital quantum simulation of Dirac equation with a trapped ion YANGCHAO SHEN, XIANG ZHANG, JUNHUA ZHANG, JORGE CASANOVA, LUCAS LAMATA, ENRIQUE SOLANO, MAN-HONG YUNG, JINGNING ZHANG, KIHWAN KIM, No Company Provided, CENTER FOR QUANTUM IN-FORMATION, TSINGHUA UNIVERSITY, PR CHINA TEAM, DEPARTMENT OF PHYSICAL CHEMISTRY, UNIVERSITY OF THE BASQUE COUNTRY UPV/EHU, BILBAO, SPAIN COLLABORATION — Recently there has been growing interest in simulating relativistic effects in controllable physical system [1,2]. We digitally simulate the Dirac equation in 3+1 dimensions with a single trapped ion. We map four internal levels of ¹⁷¹Yb⁺ ion to the Dirac bispinor. The time evolution of the Dirac equation is implemented by trotter expansion. In the 3+1 dimension, we can observe a helicoidal motion of a free Dirac particle which reduces to Zitterbewegung in 1+1 dimension. This work was supported in part by the National Basic Research Program of China Grant 2011CBA00300, 2011CBA00301, the National Natural Science Foundation of China Grant 61033001, 61061130540. KK acknowledge the support from the recruitment program of global youth experts.

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Date submitted: 30 Jan 2014 Electronic form version 1.4