US 20240223216A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2024/0223216 A1**

Campbell et al. (43) **Pub. Date: Jul. 4, 2024**

(54) **QUANTUM COMPUTING DECODER AND ASSOCIATED METHODS**

(71) Applicant: **RIVERLANE LTD**, Cambridge (GB)

(72) Inventors: **Earl Terence Campbell**, Cambridge (GB); **Luka Skoric**, Cambridge (GB)

(73) Assignee: **RIVERLANE LTD**, Cambridge (GB)

(21) Appl. No.: **18/410,972**

(22) Filed: **Jan. 11, 2024**

Related U.S. Application Data

(63) Continuation of application No. 17/932,837, filed on Sep. 16, 2022, now Pat. No. 11,901,915.

Publication Classification

(51) **Int. Cl.**

H03M 13/15	(2006.01)
G06N 10/70	(2006.01)
H03M 13/00	(2006.01)

(52) **U.S. Cl.**

CPC ***H03M 13/159*** (2013.01); ***G06N 10/70*** (2022.01); ***H03M 13/611*** (2013.01)

(57) **ABSTRACT**

A method and apparatus for decoding syndromes of a quantum error correction code is disclosed. The method includes the steps of receiving syndrome data for a plurality of quantum error correction rounds performed on a plurality of qubits; identifying a plurality of first blocks within the syndrome data, wherein each first block has a respective first central block surrounded by one or more respective first buffer blocks; decoding each first block to obtain a first committed correction for each respective first central block; identifying a plurality of second blocks within the syndrome data, wherein each second block comprises at least part of at least one first buffer block; and decoding each second block to obtain a second committed correction for each second block. An apparatus including a plurality of block decoders and a process manager is disclosed.