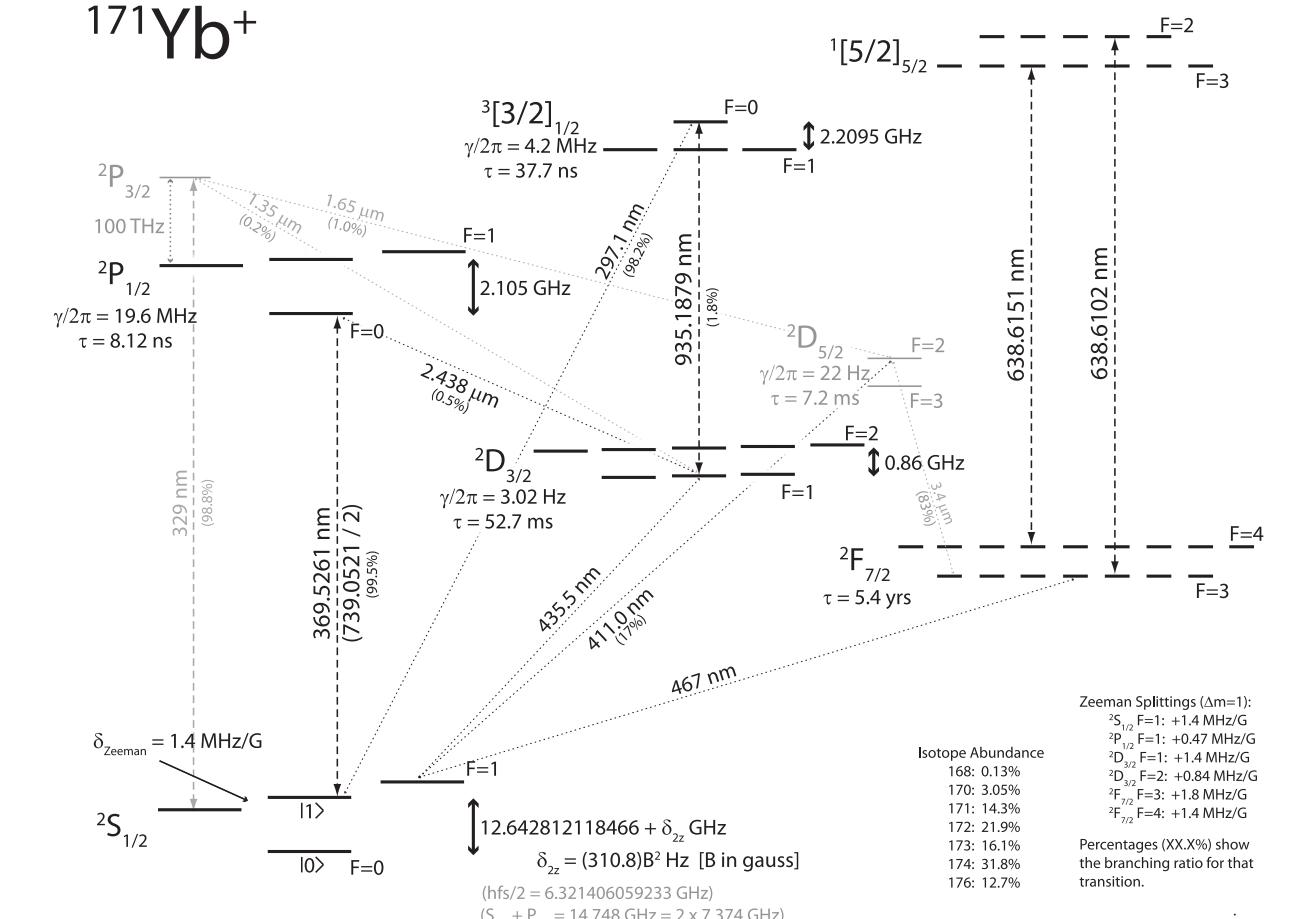


# A next-generation trapped ion quantum computing system - a.k.a. “brassboard”

Yichao Yu <sup>1</sup>, Liudmila Zhukas <sup>1</sup>, Lei Feng <sup>1,2</sup>, Marko Cetina <sup>1,2</sup>, Crystal Noel <sup>1,2</sup>, Debopriyo Biswas <sup>1,2</sup>, Andrew Risinger <sup>2</sup>, Alexander Kozhanov <sup>1</sup>, Christopher R Monroe <sup>1,2,3</sup>

<sup>1</sup>Duke Quantum Center, Duke University <sup>2</sup>Joint Quantum Institute, University of Maryland <sup>3</sup>IonQ, Inc.

# Trapped Ion Quantum Computing

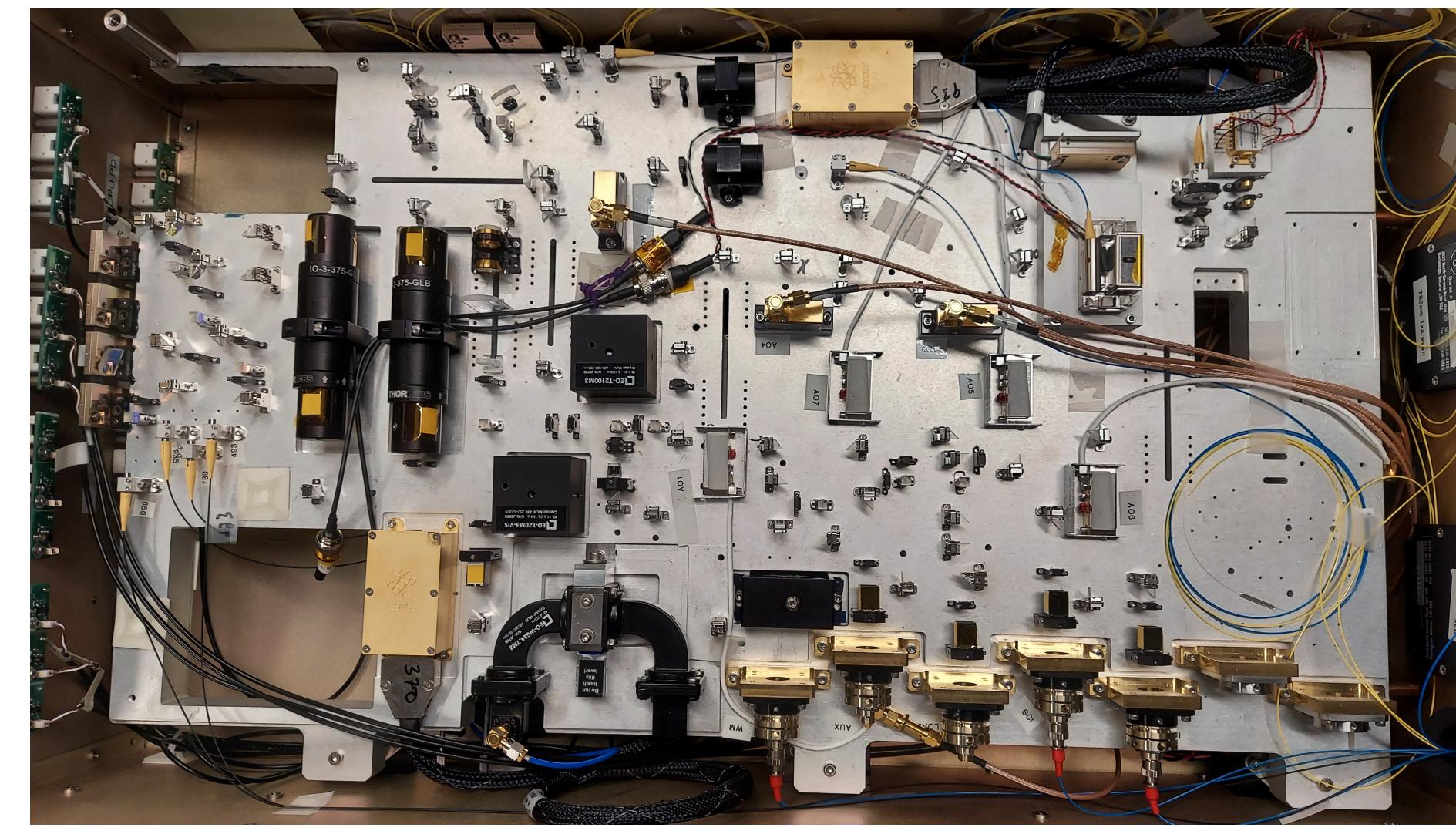


# Vacuum System

# Phoenix Surface Trap

# Raman System

# Miniaturized 369/399/780/935nm Beam Path



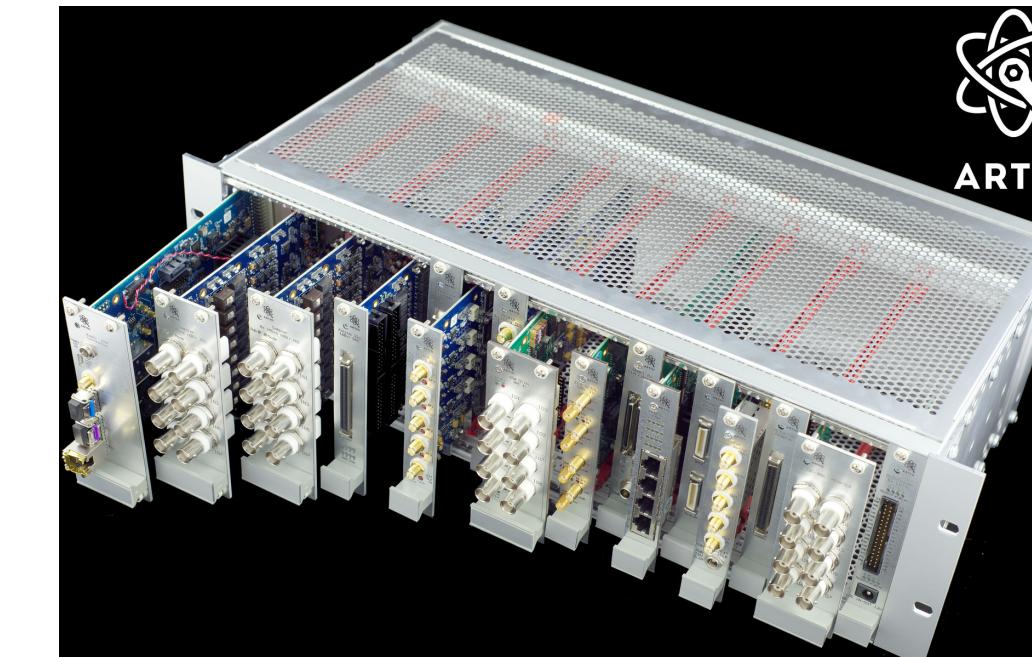
# Imaging System



# Control System

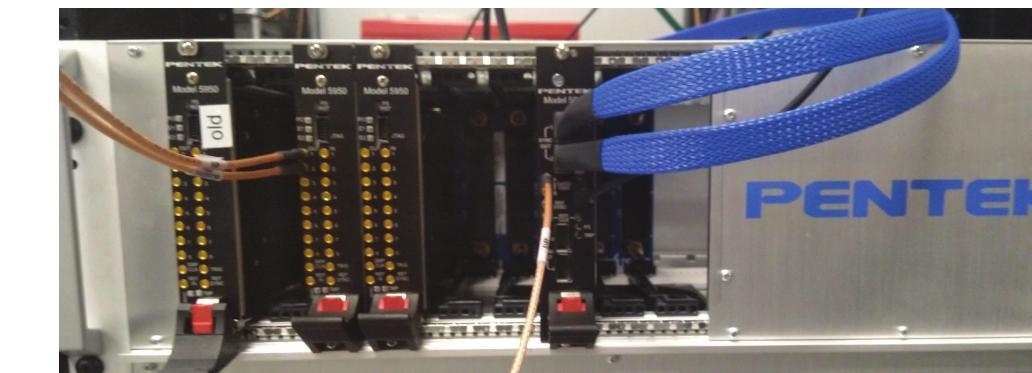
ARTIQ

- Artiq software
  - Sinara hardware



# RFSoC/Pentek

- integrated pulse-level control
  - phase synchronization



# Duke Artiq Extensions

- modular control software
  - system code organization

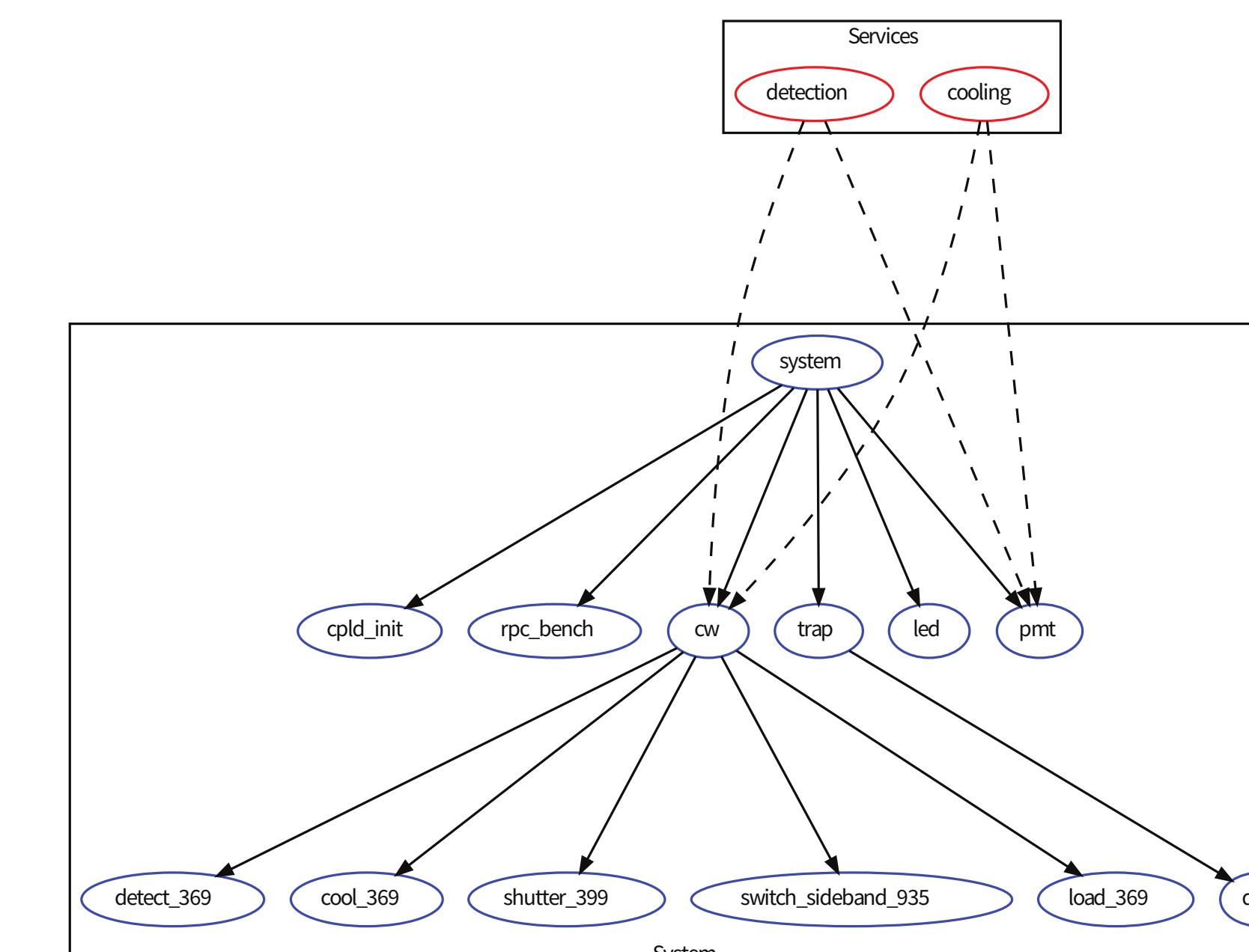
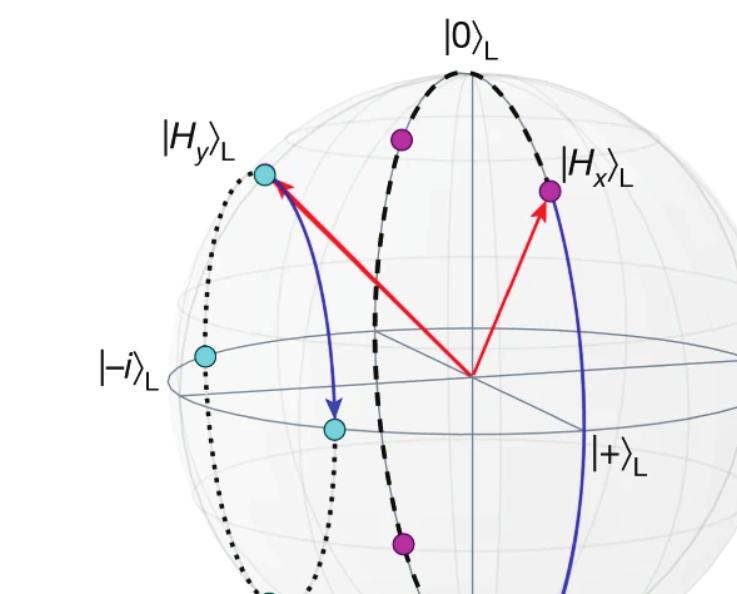


Figure by Leon Riesebo

# Applications



- Universal Quantum Computer
  - 20+ qubits and high fidelity
  - Quantum simulations of many body physics
  - Quantum chemistry
  - Quantum gravity
  - Nuclear theory
  - Quantum Error Correction

