Quantum Computing: Moving Out of the Lab?

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www.HyperionResearch.com
www.hpcuserforum.com

Bob Sorensen
Currently, the Promise of QC is Substantial

- QC systems have the potential to exceed the performance of conventional computers for problems of importance to humankind and businesses alike in areas such as:
  - Physical Simulation
    - Materials science
    - Chemistry
    - Pharmaceuticals
    - Oil and gas
  - Machine learning
  - Optimization
- And the list grows longer each day
Broad Range of Contenders

- Hardware-wise, several competing quantum modalities under development
  - Superconducting
  - Photonic
  - Trapped Ions
  - Spin/Quantum Dot
  - Cold/Neutral/Helium Atom
  - NV/Diamond/NMR
  - Adiabatic
  - Topological

- Each offers their own unique strengths and weaknesses
  - There may not be a clear winner
  - And the ultimate winner may not be here

Source: Michel Kurek
https://www.linkedin.com/in/michelkurek/

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Substantial Challenges Ahead

In almost every dimension

- **Materials research**
  - Coherency, defect management, power

- **Device and processor development**
  - Gate/logic designs
  - Coherency, entanglement, control, measurement, error rates and error correction schemes

- **Architecture: memory, interconnect, storage**
  - Heterogeneity ahead
  - No cloning theorem, no broadcast theorem
  - Integration and control
  - Error correcting / Error tolerant designs
  - Designs absent applications
Substantial Challenges Ahead (cont.)

In almost every dimension

• **Software**
  - QC assembly, instruction sets, programming language and tools
  - QC interfaces to classical systems
  - Validation and verification

• **Algorithms**
  - A wide-open field

• **Despite these challenges, the lure of potential performance is driving a growing perspective within both the supplier and (potential) user base that the technology may soon be coming of age**
  - The shift from research topic to market phenomena is a growing reality

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QC Supplier Roadmaps Emerging

Designed to build confidence, highlight long-term commitment.

HONEYWELL QUANTUM SOLUTIONS

Modular system architecture designed for rapid scaling to advantage and beyond.

Source: IBM, Honeywell, IonQ, Rigetti: 2021
Growing Interest as An Investable Technology Sector…

Global VC deals in quantum computing

<table>
<thead>
<tr>
<th>Company</th>
<th>Deal Date</th>
<th>Deal Size (millions)</th>
<th>Post-money Valuation (millions)</th>
<th>Select Investors</th>
<th>Company HQ</th>
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</thead>
<tbody>
<tr>
<td>PsiQuantum</td>
<td>7/27/2021</td>
<td>$450.0</td>
<td>$3,150.0</td>
<td>Baillie Gifford, BlackRock, M12, Temasek</td>
<td>Palo Alto</td>
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<tr>
<td>Xanadu</td>
<td>5/25/2021</td>
<td>$100.0</td>
<td>N/A</td>
<td>Bessemer Venture Partners, Georgian, Tiger Global</td>
<td>Toronto</td>
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<tr>
<td>Rigetti</td>
<td>8/4/2020</td>
<td>$79.0</td>
<td>N/A</td>
<td>Andreessen Horowitz, Battery Ventures, Bessemer Venture Partners, DCVC</td>
<td>Berkeley, Calif.</td>
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<td>IonQ</td>
<td>6/16/2020</td>
<td>$62.0</td>
<td>$192.0</td>
<td>Airbus Ventures, Amazon Web Services, Mubadala</td>
<td>College Park, Md.</td>
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<td>Quantum Machines</td>
<td>9/6/2021</td>
<td>$50.0</td>
<td>N/A</td>
<td>Battery Ventures, Red Dot Capital Partners, Samsung NEXT Ventures, Valor Equity Partners</td>
<td>Tel Aviv</td>
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Source: Pitchbook: Data as of Sept. 8, 2021
...and as a Mainstream Investment Opportunity

- **March 2021: IonQ, first publicly traded full-stack QC company**
  - Merger agreement with dMY Technology Group III, $650 million in gross proceeds
  - Pro forma implied market capitalization of the combined company is approximately $2 billion

- **July 2021: Quantum Computing Inc. listed on Nasdaq**
  - QCI becomes one of a handful of first pure-play quantum software company to list there

- **October 2021: Rigetti plans to go public via a Special Purpose Acquisition Company (SPAC) merger**
  - The combined company is expected to receive approximately $458 million in gross cash proceeds
  - Plans to merge with Supernova Partners Acquisition Company II, Ltd. would value Rigetti at around $1.5 billion
Perhaps More Important, Users are Also Taking an Interest...

- **September 22, 2021**: Widespread interest in quantum computing across industry sectors
  - Majority of U.S. professionals (89.8%) believe that IT departments should have budgets dedicated to quantum computing
  - 61.9% already have budgets for quantum computing, and an additional fifth (21.6%) plan to incorporate quantum computing into their IT planning
  - Source: Classiq, quantum algorithm design platform provider, 2021

- **October 10, 2021**
  - Hyperion Research study for D-Wave: What is the current state of quantum computing activity in your organization?
  - More research on the way

<table>
<thead>
<tr>
<th>Exploring options and monitoring technology development</th>
<th>47%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantum use case analysis and prioritization are being used</td>
<td>35%</td>
</tr>
<tr>
<td>Proof of concept research programs underway</td>
<td>33%</td>
</tr>
<tr>
<td>Fully funded research efforts are being used</td>
<td>27%</td>
</tr>
<tr>
<td>Limited in-house pilot programs underway</td>
<td>23%</td>
</tr>
<tr>
<td>Production use of quantum computing for one or more business processes</td>
<td>22%</td>
</tr>
<tr>
<td>No current activity but planning to start up activity within the next few years</td>
<td>21%</td>
</tr>
<tr>
<td>No activity and no plans to have any activity in the next few years</td>
<td>8%</td>
</tr>
<tr>
<td>Don’t know/Not sure</td>
<td>2%</td>
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</table>
So How Does This Play Out?

- Interest in quantum computing technology and its potential to help accelerate advanced computing workloads is growing, from both supply and demand perspectives

- For suppliers, it’s going to be less about the technology and more about the end-use and end-users
  - An early lead in a hardware or software capability could help ensure long-term success, but performance claims need to be realistic, and expectations need to be managed for both potential clients and investors

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So How Does This Play Out? (cont.)

• For users, it’s about accelerated or new performance that they can readily integrate into existing and planned IT workloads
  • Enabling innovation, driving research, and realizing competitive advantage are the performance indicators that increasingly will carry the day

• Is the current enthusiasm with QC investment a good news or bad news story?
  • A show of hands, please
QUESTIONS?

Questions or comments are welcome. Please contact us at: info@hyperionres.com