Quantum-Si's Single-Molecule Tech Enables Precise, Multiplexed Measurement of Nanobody Binding in a Single Assay

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Researchers at ESPCI Paris and Quantum-Si demonstrate scalable platform for parallel binding kinetics and sequencing in new preprint

BRANFORD, Conn.--(BUSINESS WIRE)--Jun. 10, 2025-- Quantum-Si Incorporated (Nasdaq: QSI) ("Quantum-Si," "QSI" or the "Company"), a proteomics technology company redefining protein analysis through single-molecule detection, announces a new preprint from researchers at Quantum-Si and ESPCI Paris that introduces a powerful method for measuring single-molecule binding kinetics at scale. The approach directly links nanobody function to identity without the need for genotype-phenotype coupling. Developed using the benchtop Quantum-Si Platinum® Next-Gen Protein Sequencing™ instrument, the technique allows scientists to study protein interactions at single-molecule resolution across tens of variants in parallel.

The process works by tagging protein variants, such as nanobodies, with sequence specific peptide barcodes. These barcoded proteins are then immobilized in millions of nanoapertures on a semiconductor chip. Researchers measure ligand-binding kinetics across all molecules in parallel using single-molecule fluorescence, then sequence the peptide barcodes to identify each protein variant after functional testing.

This dual detection strategy uses direct fluorescence to measure fast-binding events and a dye-cycling method to capture slow dissociation rates typical of high-affinity interactions. The team validated their results across 20 nanobody variants with more than a 1,000-fold range in affinity, showing strong correlation with surface plasmon resonance (SPR), a gold standard in binding analysis. The extended dynamic range allows for the single-molecule characterization of high-affinity antibodies, an area that has seen limited exploration and that could open up new possibilities in multiple applications.

"We wanted to build a platform that could tell us both what a protein does and what it is, all in one experiment," said Andrew Griffiths, Ph.D., lead author and researcher at ESPCI Paris. "By combining real-time single-molecule interaction data with protein barcode sequencing, we eliminate the need to physically link the protein and the gene that encodes it or one-by-one testing. It is a scalable, accessible method that opens the door to functional protein screening at unprecedented throughput."

"This pre-print is a great example of the power of Quantum-Si's core technology to extend beyond protein sequencing and help researchers perform single-molecule characterization of high-affinity antibodies in a way not previously possible with other technologies," said Jeff Hawkins, President and Chief Executive Officer of Quantum-Si. "The ability to combine kinetic detection precision with scalable sequencing on a commercially available instrument brings functional proteomics into a new era. It is faster, produces richer data, and is more accessible to researchers across fields."

This method offers several advantages over traditional approaches, including:

- Achieving high-throughput measurement of tens of thousands of single molecules per run
- Linking genotype and phenotype through post-measurement protein barcode sequencing
- Extending kinetic range through dye-cycling
- Delivering strong reproducibility with high data yield per protein variant
- Supporting compatibility with machine learning tools for protein design

The method also revealed previously hidden biological behaviors. In one case, the data uncovered possible conformational isomerism in a nanobody variant called LaG10. This level of resolution would likely be missed using conventional bulk assays.

"For years, single-molecule techniques were confined to specialized labs with custom-built equipment," said Marco Ribezzi-Crivellari, Ph.D., co-author and Principal Scientist at Quantum-Si. "This work changes that. We are making single-molecule analysis practical and routine. That means more scientists can explore how proteins behave at the molecular level, which could accelerate drug discovery, protein engineering, and our overall understanding of disease biology."

While this proof-of-concept study focused on 20 variants, with upcoming chemistry and hardware updates, the system has the potential to scale to over 1,000-member barcode sets. Future technological developments to expand the size of reaction chamber may allow similar increases in the size of variant panels. This makes it ideally suited for applications in synthetic biology, drug discovery, and AI-driven protein engineering.

Quantum-Si is seeking partners to advance Quantum-Si's platform, across innovative applications including nanobody research, ultrasensitive protein detection, and beyond. If interested, apply via our Technology Access Program.

The preprint entitled "Parallelization of single-molecule binding kinetic measurements via protein barcode sequencing," is now available at: Quantum-Si Resources.

About Quantum-Si Incorporated

Quantum-Si is transforming proteomics with a benchtop platform that brings single-molecule protein analysis to every lab, everywhere. The Company's platform enables real-time kinetic-based detection and allows researchers to move beyond traditional, multistep workflows and directly access dynamic, functional protein insights with unparalleled resolution. By making protein analysis simpler, faster, and more informative, Quantum-Si is accelerating proteomic discoveries to improve the way we live. Learn more at quantum-si.com or follow us on LinkedIn or X.

Forward Looking Statements

This press release includes “forward-looking statements” within the meaning of the “safe harbor” provisions of the United States Private Securities Litigation Reform Act of 1995. The actual results of the Company may differ from its expectations, estimates, and projections and, consequently, you should not rely on these forward-looking statements as predictions of future events. Words such as “expect,” “estimate,” “project,” “budget,” “forecast,” “anticipate,” “intend,” “plan,” “may,” “will,” “could,” “should,” “believes,” “predicts,” “potential,” “continue,” and similar expressions (or the negative versions of such words or expressions) are intended to identify such forward-looking statements. These forward-looking statements include, without limitation, the Company’s expectations with respect to future performance and development and commercialization of products and services, its anticipated cash runway, anticipated data and product launches, investor confidence in Quantum-Si and our strategic roadmap, and any financial guidance for 2025. These forward-looking statements involve significant risks and uncertainties that could cause the actual results to differ materially from those discussed in the forward-looking statements. Most of these factors are outside the Company’s control and are difficult to predict. Factors that may cause such differences include, but are not limited to: the inability to maintain the listing of the Company’s Class A common stock on The Nasdaq Stock Market; the ability of the Company to grow and manage growth profitably and retain its key employees; the Company’s ongoing leadership transitions; changes in applicable laws or regulations; the ability of the Company to raise financing in the future; the success, cost and timing of the Company’s product development and commercialization activities, including the use and benefit of artificial intelligence in these and other activities; the commercialization and adoption of the Company’s existing products and the success of any product the Company may offer in the future; the potential attributes and benefits of the Company’s commercialized Platinum® protein sequencing instruments and kits and the Company’s other products once commercialized; the Company’s ability to obtain and maintain regulatory approval for its products, and any related restrictions and limitations of any approved product; the Company’s ability to identify, in-license or acquire additional technology; the Company’s ability to maintain its existing lease, license, manufacture and supply agreements; the Company’s ability to compete with other companies currently marketing or engaged in the development or commercialization of products and services that serve customers engaged in proteomic analysis, many of which have greater financial and marketing resources than the Company; the size and growth potential of the markets for the Company’s products and services, and its ability to serve those markets once commercialized, either alone or in partnership with others; the Company’s estimates regarding future expenses, future revenue, capital requirements and needs for additional financing; the Company’s financial performance; and other risks and uncertainties described under “Risk Factors” in the Company’s most recent Annual Report on Form 10-K and Quarterly Reports on Form 10-Q and in the Company’s other filings with the SEC. The Company cautions that the foregoing list of factors is not exclusive. The Company cautions readers not to place undue reliance upon any forward-looking statements, which speak only as of the date made. The Company does not undertake or accept any obligation or undertaking to release publicly any updates or revisions to any forward-looking statements to reflect any change in its expectations or any change in events, conditions, or circumstances on which any such statement is based.

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