

# **Qubit Pharmaceuticals**

## **Category:**

Best Startup

## **Company Name:**

Qubit Pharmaceuticals

## **Turnover and/or Funding:**

The company has raised \$33 M to date, including \$16M in seed equity funding, and the rest in non-dilutive funding. Series A fundraising is ongoing and expected to close this summer.

An initial pilot was completed with a mid-size Japanese pharmaceutical company in 2023, and initial licensing discussions are ongoing on our most advanced programme, KAT6A, as well as partnership discussions on our foundation model for quantum chemistry, the world's most advanced quantum AI model which will allow unprecedented accuracy in molecular dynamics (1,2).

## **Sub-Category:**

Biotechnology

## **Corporate history (creation, key milestones, main funding,...)Information on Condition / Disease and need for solution / product (prevalence, existing treatments / solutions):**

In the 1980s, computer-aided drug design (CADD) showed great promise, exemplified by the discovery of Saquinavir, the first HIV protease inhibitor. However, early CADD was limited by simplified physics and compute power, and today more than 90% of biological targets remain undrugged(3).

Recognizing this, Qubit's founders, Professors Jay Ponder (University of Washington in Saint Louis) and Pengyu Ren (University of Texas at Austin), pioneered incorporating quantum physics accuracy into physics-based models(4), enabling chemically accurate binding affinity predictions for complex targets. Their work, combined with algorithmic improvements by Professor Jean-Philip Piquemal and Dr. Louis Lagardère from the University of Sorbonne(5), and the advent of high-performance GPUs, made this precise technology viable for drug discovery.

In 2021, Qubit Pharmaceuticals was founded after the founders received the Atos Fourier Prize (Advanced Computing and AI) and members of the ecosystem, like Quantonation, the world's largest fund for quantum technologies, recognized the technology's potential to revolutionize drug discovery. Robert Marino, an experienced deeptech CEO, assembled a 60-person allstar team in Paris and Boston that covers over 20 nationalities, with 45% women and more than 75% PhDs.

Since 2023, Qubit has built its own drug discovery portfolio in oncology, inflammation, and antivirals, targeting currently undrugged complex targets (i.e., 90% of biological targets) like RNA, metalloproteins, and protein-protein interactions. RNA, for example, is significant in rare, neurodegenerative, and oncological diseases and also impacts conditions such as Alzheimer's, Parkinson's, and ALS. Our programs, focusing on LIN28 and MALAT-1, could offer treatments for colorectal, prostate, and pancreatic cancers, which account for about 4 million diagnoses annually.

Our KAT6A inhibitor is in lead optimization for hormone-resistant breast cancer (30% of 2.3 million annual diagnoses) and aims for best-in-class selectivity. This program shows similar tumor growth reduction to Pfizer's compound, achieved by synthesizing only 90 molecules in 18 months-a tenfold reduction over traditional methods.

In drug discovery, we partner with world-leading institutions such as the Institut Curie on TREX-1(6), the University of Sherbrooke for GPCRs(7), and the Frederick National Laboratory for RAS (rat sarcomas).

Beyond drug discovery, we continue research into high-performance and quantum computing to increase efficacy, precision, and cost efficiency. We own France's largest privately owned supercomputer dedicated to life sciences, built with NVIDIA, that boasts almost 200 GPU computing capability.

We partner with leading quantum hardware providers like Pasqal(8) and with Amazon Web Services and IonQ(9) to develop and test quantum algorithms for pharmaceutical use cases. Recently, we partnered with Argonne National Lab and Intel to leverage exascale supercomputing for a foundation model in quantum chemistry, offering quantum-level accuracy in dynamic molecular simulations at unprecedented speed(10).

Recognized as a Prix Galien USA 2024 finalist and by French Tech Health 20, French Tech 2030, and the 2024 World Economic Forum Technology Pioneers cohort(11), Qubit is poised to revolutionize drug discovery for complex, currently undruggable targets, improving patient lives.

## **History of the development of the solution/product (Intellectual**

## **Property, preclinical and clinical datas, development collaborations):**

Qubit Pharmaceuticals' drug discovery platform addresses complex, unaddrugged targets, enabling small molecule discovery in high unmet need areas like RNA, metalloenzymes, GPCRs, and protein-protein interactions. Our in-house approaches could lead to new treatments in oncology, inflammation, infectious diseases, and CNS.

Our core technologies are licensed from academic labs, including Sorbonne Université, CNRS, CNAM, the University of Washington in St. Louis, and the University of Texas at Austin. We've proven the accuracy of our polarizable force field by winning the SAMPL blind challenge in 2021(12,13) and 2023(14). Since our inception, we have submitted over 30 academic papers and 14 patent families, three specifically for our KAT6A inhibitor program.

We have seven ongoing drug discovery programs, two in partnership: one with the University of Sherbrooke(15) (June 2023) combining GPCR expertise with Quantum Computing R&D, and another with Institut Curie(16) (January 2024) aiming to modulate immune response in cancer by targeting the TREX1 enzyme. We are also collaborating with the Frederick National Lab to find an inhibitor for the SHOC2-MRAS-PP1C function in mutated-RAS cancers.

Our most advanced program is a KAT6A inhibitor for ER+ breast cancer. KAT6A is over-expressed in 10-15% of breast cancers and linked to SERD resistance. Combining KAT6A inhibition with SERD or CDK4/6 inhibitors could become a new standard of care and shows promise in other solid tumors. We've generated 12 novel chemical series and delivered two lead compounds with nanomolar potency (3-100 nM in enzymatic assays), improved tumor growth inhibition compared to competitors, and high selectivity over KAT6b and KAT7, which we believe will improve the safety profile. These compounds show a favorable early ADMET (Absorption, Distribution, Metabolism, Excretion, and Toxicity) profile and good Freedom to Operate (FTO), with 3 patents filed. We're also developing five fast-follower hit-to-lead series to further improve performance. Our KAT6A inhibitor program aims to be a best-in-class treatment with a better safety profile.

In collaboration with Institut Curie, we are developing a TREX1 inhibitor, as TREX1 was identified as a target in breast cancer cell lines. Addressing TREX1 could stimulate the cGAS-STING pathway, a novel approach to immune activation in cancer immunotherapy. In the US alone, 800,000 patients annually exhibit immune evasion through TREX1 upregulation. This treatment could be used in combination with anti PD-1/PD-L1 therapy and no drug is currently in the clinic. We've confirmed eight nanomolar hits.

We are also identifying a small molecule IL4R-IL4 inhibitor as a therapeutic alternative

to existing biologics. Our pipeline provides conformational and structural insights into the IL4-IL4R interface, characterizing three new binding sites. One pocket is novel and exhibits potential allosteric impact. Our IL4R program aims to offer a small molecule alternative to dupilumab, addressing a larger unmet medical need, as dupilumab, despite its efficacy, only addresses 3% of patients in its leading indication, atopic dermatitis. With 800,000 patients currently on dupilumab, this could benefit millions globally.

Last year, we demonstrated our ability to predict small molecule binding affinity to RNA(17) through a pilot with a Japanese mid-sized pharma company. We also have two RNA-targeting programs, including one with virtual hits and another with low  $\mu\text{M}$  hits confirmed by NMR. RNA targets have significant therapeutic potential, potentially benefiting over 4 million patients, and our technologies are well-suited to unlock new treatment pathways.

### **Why this drug or device is innovative, the broad implications for future research, and/or how it will improve the human condition:**

Qubit Pharmaceuticals, pioneers a transformative approach to drug discovery, leveraging quantum-accurate AI and high-performance computing to address over 90% of currently undrugged biological targets. This innovative strategy profoundly impacts future research and promises to dramatically improve the human condition.

Our core innovation, rooted in the accuracy of quantum physics, fundamentally expands the therapeutic landscape. This capability allows us to accurately predict binding affinities for complex, previously undruggable targets-including RNA, metalloproteins, and protein-protein interactions. This opens entirely new avenues for drug discovery research, enabling exploration of biological mechanisms once considered beyond reach.

A pivotal contribution to future research is our development of a foundation model for quantum chemistry, hailed as the \"world's most advanced quantum AI model\"(18). This model is designed to deliver unprecedented accuracy and speed in molecular dynamics, empowering researchers to simulate molecular behavior with fidelity and at scales previously unimaginable. This will undoubtedly drive novel theoretical insights and practical applications in understanding complex molecular interactions.

Furthermore, we are actively shaping the future of computation by partnering with leading quantum hardware providers. These collaborations focus on developing and rigorously testing quantum algorithms specifically tailored for complex pharmaceutical use cases. Our contributions are instrumental in laying the foundational research that will define the next generation of computational drug design methodologies, extending even beyond drug discovery.

Our strategic focus on the vast majority of currently undrugged targets directly addresses diseases with profound unmet medical needs. Our robust in-house drug discovery portfolio spans critical therapeutic areas including oncology, inflammation, and antivirals.

For instance, our KAT6A inhibitor program, targeting hormone-resistant breast cancer (affecting 10-15% of 2.3 million annual breast cancer diagnoses), achieved tumor growth reduction comparable to a competitor's compound by synthesizing a mere 90 molecules over 18 months-representing an astonishing tenfold reduction compared to conventional methods. This efficiency translates to faster development and potentially quicker access to a new standard of care when combined with existing therapies.

Our RNA-targeting programs (LIN28, MALAT-1) hold promise for treating colorectal, prostate, and pancreatic cancers, which account for approximately 4 million annual diagnoses. The approach also unlocks the therapeutic promise of these far-reaching biological targets.

The TREX1 inhibitor, developed with Institut Curie, offers a novel approach to cancer immunotherapy by stimulating the cGAS-STING pathway, potentially benefiting 800,000 US patients annually who exhibit immune evasion, with no current drug in the clinic for this target.

Crucially, we are developing a small molecule IL4R-IL4 inhibitor as an alternative to existing biologics like dupilumab (atopic dermatitis, severe asthma...). While dupilumab, despite its efficacy, currently addresses only 3% of patients in its leading indication, our small molecule alternative could benefit millions globally by offering a more accessible, orally bioavailable, and potentially cost-effective treatment option. This focus on small molecules has profound implications for global health equity, making life-changing therapies more widely available and convenient.

We are not only accelerating the discovery of novel therapies but also laying the groundwork for future scientific advancements, ultimately poised to deliver more effective, safer, and accessible treatments to millions worldwide.

### **Please provide appropriate references (PubMed, Abstract, Website):**

Publications on our polarizable force field:\\n- SAMPL7 Host-Guest Challenge Overview: assessing the reliability of polarizable and non-polarizable methods for binding free energy calculations - <https://doi.org/10.1007/s10822-020-00363-5>\\n- AMOEBA binding free energies for the SAMPL7 TrimerTrip host-guest challenge (PDF attached)\\n- QM/AMOEBA description of properties and dynamics of embedded molecules -

<https://doi.org/10.1002/wcms.1674> Publications on our molecular dynamics package: Tinker-HP: a massively parallel molecular dynamics package for multiscale simulations of large complex systems with advanced point dipole polarizable force fields: DOI <https://doi.org/10.1039/C7SC04531J> Publications on our results: Computationally driven discovery of SARS-CoV-2 Mpro inhibitors: from design to experimental validation - DOI <https://doi.org/10.1039/D1SC05892D> Water-Glycan Interactions Drive the SARS-CoV-2 Spike Dynamics: Insights into Glycan-Gate Control and Camouflage Mechanisms - <https://doi.org/10.1101/2024.06.04.597396> Targeting RNA with small molecules poster attached Press releases: <https://www.usherbrooke.ca/actualites/nouvelles/sante/details/50499> <https://presse.curie.fr/calcul-haute-performance-simulation-et-ia-qubit-pharmaceuticals-linstitut-curie-et-luniversite-de-bordeaux-sassocient-pour-accelerer-le-developpement-de-voies-therapeutiques-inedit/> <https://www.globenewswire.com/news-release/2024/06/06/2894413/0/en/Qubit-Pharmaceuticals-selected-as-one-of-the-100-Technology-Pioneers-2024-by-the-World-Economic-Forum.html> Company Website: <https://www.qubit-pharmaceuticals.com/>

## References File Document upload:

[SAMPL71 1.pdf](#)

[SAMPL7overview.pdf](#)

[RNABaselMarch24\\_Qubit.pdf](#)