

## Richard Küng: A Man for all Seasons (Math, Physics and Computer Science)

What if you were 32 and getting job offers from Google, Amazon, and IBM? What would you choose? Why, the Johannes Kepler University Linz, of course.



Richard Küng

For all intents and purposes, this is true in Dr. Richard Küng's case. Dr. Küng has been working at the JKU since April 2020 as a..... what exactly?

**Dr. Richard Küng:** Well, it's a combination of many things – a bit of computer science here, a bit of physics there, and lot of math.

*And what are you working on that has large US corporations interested in getting you on board?*

**Dr. Richard Küng:** Quantum algorithms.

*Those are?*

**Dr. Richard Küng:** Everyone seems to be talking about quantum computers, but quanta are rather indeterminate. In fact, quanta are not an object like a microchip found in a conventional computer. They are only described by probabilities. They are only fixed when we measure them. When I observe quanta, I do not know whether the result will be X or Y.

*When a computer calculates using quanta, you won't know whether  $2+2=4$  is really the outcome?*

**Dr. Richard Küng:** A quantum computer will almost rarely calculate  $2+2=4$ . It will offer a bandwidth. My work focuses on reducing - or completely eliminating - this random scattering of results. Although this is a bit complicated, my algorithms already work quite well.

*And companies that dabble in quantum computers find this interesting?*

**Dr. Richard Küng:** Absolutely. At the moment there are quantum computers that perform calculations using 53 qbits. That's fine, but a real computer would need hundreds of these information carriers. These aren't computers in our sense of the word, but first attempts at walking. However, in a short period of time, these "quantum computers" can solve specially designed tasks that would take our best supercomputers thousands of years to solve.

But at some point, you have to "translate" the quantum results back into our "normal" terms and hardware. I am working on this "quantum to classical" interface.

*Sounds great. That means in a few years we'll be able to play Fortnite without judder on our home quantum computers?*

**Dr. Richard Küng:** Well, no. Quantum computers are not the next generation of computers. They are advanced and progressive, able to perform immense simulations - even simulations for extremely small systems. They will revolutionize cryptography and enable uncrackable codes. Their quantum properties, however, will never make them a normal computer that uses normal software.

*Why are you conducting researching into these key technologies at the JKU? Does the JKU pay better than Google?*

**Dr. Richard Küng:** Not really (*laughs*). But seriously: I love conducting base-knowledge research. I'm happy when I can solve and prove problems and mathematical problems. Above all, a quantum computer's computing power will completely change science and research and that's the reason there is currently a race to see who can dominate this particular technology. The USA and China are ahead, Europe is clearly behind. In this regard, I find it incredibly important to incorporate our democratic values into the development. And, not all new discoveries only serve state or corporate interests.

*This makes you an idealist then?*

**Dr. Richard Küng:** Yes. It is incredibly important to me that new technologies improve the world, not just give one group an advantage.

*You are a tenure-track professor, meaning you hold a professorship position for life. Isn't Austria a bit too small for you? The "brain drain" is a real thing.*

**Dr. Richard Küng:** That's nonsense. Austria is very strong, particularly in quantum research, and can definitely keep up with players in America and Asia. Austrian Erwin

Schrödinger was one of the founders of quantum mechanics and even today, we are still at the forefront of quantum research, at least for the time being.

*In addition to conducting research at the JKU, you will also be teaching classes. Why should students take your class?*

**Dr. Richard Küng:** I am a passionate educator and I like to pass on everything I know. I've taught university-level classes on three continents. Hopefully I have soaked up everything that can help me be a good educator as well as eliminate those things that don't work well in the classroom. In any case, my classes will be refreshingly different.

*Where do you go from here?*

**Dr. Richard Küng:** The JKU has been a stroke of luck for me - my colleagues at IIC are doing very cool things in the field of quantum computing. I would also want to set up a small task group at the JKU to develop algorithms for quantum computers. On a personal level, I would like to put down some roots. I'm from Hagenberg and after 13 years of traveling around, I am back here once again. I'm not used to being in one place for more than a few months. This is a change but one I am really looking forward to it and I feel like I have finally found a professional home here at the JKU.

## About Richard Küng

Born in 1988, Richard Küng studied physics at ETH Zurich, completing his dissertation titled "*Convex Reconstruction from Structured Measurements*" at the University of Cologne (2016) summa cum laude. He spent a semester conducting research for his dissertation at the University of Sydney. Research stays at universities in Berlin and California followed and he has been a tenure-track professor at the Institute for Integrated Circuits (IIC) at the Department of Computer Science at the JKU since April 2020.

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**Startseite**

**BACK TO OVERVIEW**

JOHANNES KEPLER UNIVERSITY LINZ  
Altenberger Straße 69  
4040 Linz, Austria

T: +43 732 2468 0  
F: +43 732 2468 4929  
Contact

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