Meet the Dean: Thomas Koch

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They're experts in their fields and essential campus leaders. But how well do you know deans across the University?

This occasional Lo Que Pasa series introduces deans across campus and provides insight into their motivations, challenges and reasons for choosing to work at the UA.

This week, meet a dean who holds 37 patents, many of which are related to waveguides – microscopic structures that help power the internet.

Name: Thomas Koch [1]

College: Optical Sciences

When and why did you choose to join the UA?

I joined in January 2012, and I was drawn to the UA because of the high quality and exciting scope of the College of Optical Sciences – all the way from fundamental physics to engineering optical solutions that can have huge impact on society. Our faculty's work impacts your life by enabling unprecedented medical diagnostics, new imaging capabilities for discovery in biology, astronomy or nanoscale science, imaging or laser systems for defense and manufacturing, the optical communications behind the internet, virtual and augmented reality – the list goes on and on.

What do you enjoy most about serving as dean of the College of Optical Sciences?

I enjoy being with really creative, motivated faculty and students – and our great collaborative culture for pursuing challenging projects. My roots are in physics, so I'm always excited when our team unravels unexpected new phenomena when harnessing the quantum properties of light and matter. I have also had research and leadership roles in industry, and I like the culture here of making and demonstrating real things that have impact, often in partnership with industry.

What are some of the challenges and rewards of serving as dean?

We're a small college, so we're often more exposed than most colleges to fluctuations in research or educational finances. But our small size and close-knit team is also a plus, because we're nimble and can focus and respond quickly to opportunities – a real differentiator in working with many agencies and companies. We also have challenges because our faculty members often have entrepreneurial ambitions and we need to manage conflicts of interest. But these are good problems that come with the territory when you're doing things with real value.

What's one thing happening in your college right now that people should know about?

We just received an unprecedented **$20 million endowment** [2] from Jim Wyant, the founding dean of our college. This stunning and fantastic gift will enable us to expand our faculty size by at least 10 new endowed chairs to address the amazing opportunities for optics that lay ahead. And we're thrilled that the nearby new $150 million Grand Challenges research building will put us close to the epicenter of the convergent Fourth Industrial Revolution science and engineering investments in the UA's new strategic plan.

What does the future hold for the College of Optical Sciences?

Applications of optics continue to multiply every day. Pretty much everything in world around you is governed by, or impacted by, electromagnetic radiation – light – and we're always finding clever new ways to harness it. For example, right now we're mobilizing a growing team to address the remarkable opportunities in quantum information science. In December, the National Quantum Initiative Act was passed in Congress and signed by the president authorizing resources well in excess of $1 billion to advance the application of quantum technologies in areas such as computing, sensing and communications – and optics has a big role to play there.

What is your leadership philosophy?

I think my primary job is to identify, hire and support the work of great people who are smarter than I am. Where I can, I try to stay well-connected both inside and outside the UA to bring opportunities to the table. But most of my time goes into trying to make sure we're healthy, to provide for a productive and collegial environment where faculty innovations can flourish.

What is one thing most people don't know about you?

My first word was "light"!

What is a fun fact about you?

I love playing electric guitars. I didn't say I was good at it, just that I love trying!

The UA is a world leader in optical sciences. Why?

We've created a very research-intensive culture in this area we call optical sciences that has attracted extraordinary talent, both in faculty and students. This has ranged from Nobel Prize winners to industry veterans who really understand what it takes to create valuable solutions. Combined with the scope of our interests, this makes for an unprecedented fertile environment.

With your appointment as dean in 2012, you joined a list of highly respected optical scientists who have held the same position – Aden Meinel, Peter Franken, Robert Shannon and others. What's it like to be part of that legacy?

In a word, humbling. But when it's time to step down, I hope that people will believe that we have some great new talent and that I contributed to a healthy future for the college.

When you took over as dean, you mentioned the "huge opportunities for high-impact, high-value engineering solutions" in a variety of areas. Can you give some examples that show how the College of Optical Sciences is capitalizing on those opportunities through its research?

Today we're making fantastic inroads with the new players in the IT space who now realize that optics is an important part of their lives, including innovations for things like augmented reality. Our innovative architectures in image science and computational imaging are attracting strong interest and funding from federal agencies. Recently we've embarked on some high-risk new space telescope designs that could be transformative if successful. We're contributing to photonic integrated circuit manufacturing as a core partner in the $600 million **AIM Photonics initiative** [3]. The unique capabilities of our optics shop attract companies and agencies from around the globe with challenging large optics or free-form designs that we can make better than anyone else.

One metric for the value of our faculty's work is that a large fraction of our research funding comes from industry – it has been as much as 40 percent in some years. That's not philanthropy; we're helping them advance their product capabilities or business potential. And it's a win-win: Companies bring outstanding, challenging problems to our doorstep that stimulate our research and result in real stuff that benefits our lives.

Your research area is photonics. Can you explain what that is and where it appears in everyday life for those of us who aren't optical scientists?

We use that term for applications where the concept of light as a particle, a photon, is useful or necessary to understand what's going on. Most often that's in the realm of devices that convert back and forth between light and electricity, such as semiconductor imaging devices in your cellphone camera. I'd say one of the premier applications is optical fiber communications, including all the tiny lasers and information encoding devices that make the internet work.

How has optical science research evolved since you began your career?

Things that were the subject of comic books became possible because of advances in optics and photonics. Dick Tracy's wrist radio! And I remember being absolutely fascinated as a kid by an article in Time magazine illustrating lasers used to communicate over a fiber, thinking that it was just like radio wave communications but a million times faster. I was really disappointed years later when I learned that people were just pulsing lasers on and off to encode digital ones and zeros. So we all set out to change that, and now the lasers on the internet are indeed finally using the same methods as your cellphone radio waves but a million times faster! People's dreams are being realized by harnessing new insights in physics combined with cool technology driven from other fields. Who'd have thought you could trap atoms with lasers and use that to witness Einstein's gravitational red shift right on your lab bench? Who'd have thought we could make telescopes so big that you can see planets orbiting stars in our galaxy?

You spent a long time in the optical sciences industry before moving to academia. What has that change been like and what's the advantage to working in academia?

I was fortunate to have always been working in environments, like Bell Labs, at the cutting edge – companies with a history of transitioning discovery into innovative products. We had Nobel Prize winners, and we usually published and participated in many of the same venues as our academic colleagues. So the change was not as big for me as one might think. But there's always an exciting adrenaline factor in getting the best product out before your competition. I think the main advantage to working in academia is the rewards of working with creative, open-minded students. In addition to fresh ideas, students have no old baggage. That really contributes to innovation because it's otherwise too easy to for us to be ruled by our experiences with previously failed approaches, not appreciating that the world has changed and new things can be brought to bear. There is also the often-touted benefit of being fully, personally in charge of your own destiny. But I frankly always felt that way and we rarely spin on a dime because the best things we do are usually in collaborative teams with others.

You hold 37 patents. Are there any that you can easily explain? Is there one that you're particularly proud of?

Many of them are related to features or methods for microscopic structures called waveguides that can pipe light around on a chip. They're used in the laser chips that power the internet, or in what we call photonic integrated circuits, which are optical systems on a chip. So, rather than a bunch of transistors and electrical connections like a computer chip, there's lots of lasers and waveguides for manipulating optical information. One patent was the first laser design that could create a large beam by counterintuitively tapering the waveguide structure to be smaller rather than larger. This concept became useful for making lasers or photonic integrated circuits that could more easily be coupled into fibers or other devices. Others relate to how to make lasers, and stabilize their frequencies, in optical communications systems that use lots of different frequency lasers simultaneously to increase the amount of information on the internet.

Links
[1] http://www.optics.arizona.edu/research/faculty/profile/thomas-l-koch [2] https://uanews.arizona.edu/story/20m-gift-ua-college-optical-sciences-largest-ever-faculty-endowed-chairs [3] http://www.optics.arizona.edu/news-events/news/press-releases/moving-speed-light-university-arizona-selected-photonic-data-link-de