

Up Close With A Prof

An Interview With Dr. Vipul Kheraj



So, firstly, how's quarantine treating you, and how has it influenced your life?

The quarantine has been an unprecedented event. It has affected me in a lot of ways, just like everyone else. In the mid-march, when things started escalating in India, I somehow foresaw an extended lockdown and prepared accordingly. Personally, it has been an enriching period so far. I got some fantastic time with my family, completed some long-pending dues in my 'to read' and 'to watch' lists, and nurtured my hobby of singing in this excessive time I got at home. Professionally, too, this has been a rewarding period. I could stay back and had a critical look at what we have been doing in our Optoelectronic Materials and Devices (OMD) research lab these days. I could re-analyze our research activities and plans. Also, I have been working on a small development at my lab these days, that can help us deal with the COVID-19 pandemic and post-pandemic mitigation phases in a way. It is a low-cost sanitization box using UV and hot air oven, hence named 'yoUVen' by me. Mobile phones are one of the nastiest carriers of the virus. I feel one of the reasons the Coronavirus has managed to spread so extensively is our over-dependence on mobile phones in almost all activities we do outdoor. Like, even in lockdown, we use our phones to pay from e-wallets when we go out to buy essentials, use them while standing in queues to surf through social-medias and internet, take photos and videos, and then we sanitize our hands but not the phones. The virus can easily enter our homes through these contaminated surfaces of our phones. So, from the beginning of lockdown, I wanted to find a way to sterilize the phones, while entering the home. Eventually I managed to develop small equipment to sanitize mobiles and other such kinds of stuff using UV-c radiation along with hot-air circulation if required. Currently we are working on the feasibility of the up-scaling of this prototype made at our lab. But then, the picture is not so rosy when we rise up beyond this personal enrichment. A pandemic that has already claimed more than a couple of lakhs of lives worldwide is obviously a nightmare. To add to the misery, this long 'pause' to the economic activities has been causing devastations to a lot of people,

particularly the economically weaker section of the society, and hence, I don't feel happy about the time I got to enrich myself personally. The thoughts of unending struggle to just survive by lakhs of poor migrants and daily-wage workers are not letting me sleep peacefully. It's been a time of strange emotional paradoxes for me.

What was the stimulation behind choosing Physics as a career option? Specifically, what intrigued you to do your PhD in High Power Laser Diode?

Well, to be honest, I didn't choose Physics as a career option to start with. It came to me by chance, and I am glad it did. The seeds of love for science in my mind were sown in summers of my early phase of primary schools when we cousins used to meet in summer vacations and sleep on the terrace of my home at Botad, my hometown. Those were the nights of clear sky with no light pollution and those mesmerizing night skies used to fascinate me. I used to ask a lot of questions about the stars and planets and galaxies and so on to my elder cousins. The curious questions triggered by those night-sky observations were partly getting answered by reading Safari and Scope magazines in those hot summer days. And that's when I started thinking about scientific research more and started fantasizing myself as a scientist. I had no idea about the sub-branches of sciences in those days though, nor had I any clue about the process to convert academic learnings into a career. The only push I got from there was in the form of my decision to choose the 'Science' stream after 10th. But then, by the time I seriously started thinking about career options, just like other kids of '90s, I, too, ended up wanting to become a doctor. During my higher secondary school days, I couldn't imagine myself in any professional role other than a doctor. I thought I would become a doctor and do research in medical science. I wanted to be a combo of a scientist and a doctor that way. But then, I was a big fan of Sachin Tendulkar and coincidentally he scored his maximum runs in a calendar year when I was in 12th. And as a hard-core fan, I

did not miss watching any of his great innings on TV in those days. That showed up in my 12th results and I couldn't get admission in any medical college. I was devastated, frustrated, and almost depressed. I was getting admission to engineering but I didn't want to settle for anything other than being a doctor. Now that doctor was not possible, I explored the possibility of going for my childhood fantasy of becoming a scientist and somehow I found out that one can become a scientist after doing B.Sc. So, to give it a chance, I took admission to Sir P P Institute of Science in Bhavnagar in BSc course instead of engineering.

After this setback in 12th, my dream of becoming a 'doctor' was shattered but not my love for doing medical science. So, to pursue it through a parallel path, I opted for biology group in BSc. However, the path was blurred and I had no clear vision of the future. Also, I was struggling with the language issues as the whole of my schooling was in Gujarati medium and this was the first time I was exposed to English as a medium of instruction. So, the post-setback depression was getting deeper. At that point in time, a few of the teachers in the Physics section of the Institute came as saviors for me and that became a turning point in my life. I feel, I was very fortunate to get those teachers in Physics at that phase of my life. They not only helped me come out of that frustrating state of mind but also motivated me to pursue science with greater interest. They re-established in me the sense of self-confidence and inspired my almost dying ambition. They made me believe that my career in science could be as scintillating and exciting as in any other field and certainly as in medical science. So, in the second year of BSc, I opted for Physics as a major with Chemistry as a subsidiary. That's when my love affair with physics started. There has been no looking back since then. I started reading Physics, not as a subject but as a passion. I started enjoying my study and that, consequently, rewarded me in the form of my academic performances. I received a silver medal in BSc (Physics) and Gold in MSc. It also worked well for my self-development. I subsequently got research fellowships of the Department of Atomic Energy to pursue my PhD at the M. S. University of Baroda, Vadodara. The fellowship

allowed me to pursue my PhD with great zeal, keeping me free of financial concerns. Also, as the project was collaborative in nature, I could get exposure and experience to work at some of the best research labs of the country. I did parts of my PhD work in three different institutes, namely the Faculty of Technology and Engineering at MSU in Baroda, Tata Institute of Fundamental Research (TIFR) in Mumbai, and Raja Ramanna Centre for Advanced Technology (RRCAT) in Indore. After my PhD, I got selected here in SVNIT as Assistant Professor in the Department of Applied Physics in 2009. I want to emphasize here that it was my teachers in Sir P. P. Institute of Science, Bhavnagar, who made me bounce back after that huge jolt in 12th, and that also taught me how important a role a teacher can play in students' lives. I keep my friendly, motivating, and energetic teachers as role-models in my mind while dealing with my students here in SVNIT.

Given that there are a galore of career options out there. What enticed you to join the field of Teaching, and what obstacles did you overcome?

I always felt, at least from my second year of BSc days, that I can be a good teacher. I enjoyed teaching. Even during MSc, I used to be an 'echo' teacher for my classmates in after-classes. I felt very natural while explaining concepts to my friends and that made me believe that Teaching is a good option for me. Later, during my PhD I realized the other perks of being a teacher. I understood the freedom and autonomy one gets in research at a teaching institute, particularly at the institute of higher education. So, I decided to go ahead with Teaching as my career path already when I was doing my Ph.D. I encountered a crossroads after my PhD when I had an offer of post-doctoral research assignment in USA and appointment order from SVNIT and I had to choose between the two. I preferred a teaching job at SVNIT over a postdoc in the USA and I have never regretted my decision. It has been a dream career for me so far. Teaching is one of the rare

professions, where I get a chance to surround myself with young, bubbling, energetic, and enthusiastic minds full of ideas and ambitions. They never let me age! They never let me feel low! They never let me down! Particularly, Teaching at an Institute of such a high repute as NIT offers me a unique opportunity (and challenge) to interact and deal with some of the best students of the country (as well as neighboring countries). I am lucky to have taught very talented students, both, at UG as well as PG/PhD level. There is a lot to learn from everyone around, be it a student, a colleague, or an administrator. And as long as there are new things to learn, the fun continues.

Also, being a faculty in an Institute of National Importance, I get all the necessary infrastructure and freedom to pursue research in the area of my interests. Nobody is a boss and no one interferes in my academic autonomy here. I feel privileged and at the same time committed to work harder to do justice with my role as an educator.

Your knack and penchant for physics are well known among the students! Can you share an instance which made you like more?

At some point, Physics becomes a passion. As I said earlier, I have been lucky to get some very brilliant students here at SVNIT. And it gives me a chance to discuss my ideas about Science in general and Physics in particular, more freely with students here in SVNIT. Until I joined SVNIT, Physics was my personal thing. I used to enjoy planning, designing, and doing experiments but at my personal level, be it for my PhD or for my research lab back in Baroda or Indore. But after joining SVNIT, it has become a joint venture with students. And it has a completely different flavour altogether. I still recall an incident when I was new in the Institute and started taking classes in the first year of BTech program. One fine day, a couple of students in their second year of BTech approached me with an idea,

rather a calculation, about how magnets should deviate light beam and asked for my permission to test their idea. Although I realized a mistake in their calculation at the very first instance, I allowed them to perform the experiment and managed a magnet (which I took out from a Hall Effect experiment in our lab) and a laser for them. I saw them doing the experiment with such an amazing dedication and after their untiring efforts for days; it was a task for me to explain to them why their experiment didn't work. But that small incidence taught me a great lesson about how different and interesting it could be to deal with students when it comes to basic science and particularly experimental Physics. The two students continued working in my lab on a couple of other projects, these times assigned by me, with the same dedication and it has been a great reward to see them reaching skies after passing out from the Institute. It's one of the most pleasant things for a teacher to see the students trained by him or her achieving great heights. And I have got a chance to work with such enthusiastic students every year, irrespective of their branch or year. Such students keep me alive and my passion for Physics intact.

We are sure you have done a plethora of experiments in your flourished career, so what if any of the theory forms the basis of an experiment is found to be incorrect later?

Isn't that one of the beauties of Science? That's what makes Science exciting and progressive. The readiness for criticism and openness to get proven wrong are the foundations of science. It has happened with some of the great scientists of the world. And that's how our understanding about everything improves. So, yeah, on personal level, I keep myself ready for it. However, generally most experiments are designed carefully and executed with enough precautions to avoid such consequences. We do simulation with as much complications as we can, to get a sense of outcome of experiments before we execute them in reality. This is important also as we generally perform experiments with limited budgets and

cannot afford and experiment going wrong. But the bottom-line is; yes, it is possible that the theory that forms the basis of an experiment can be found incorrect later and we have to accept such consequences. Also we take care of such things when we report our results and make sure to explicitly mention that our conclusions are relying on certain assumptions or hypothesis so that the readers in scientific community don't get misled.

As a physics professor, what in your idea is beyond the observable universe?

To be honest, I am not the right person to comment on this as my field of research is completely different. However, from the popular reading, all I can visualize, or rather imagine, that exist beyond the observable universe is just the extension of the same observable universe. The limit to the observable universe is due to the limit on speed of light itself and there are no physical boundaries as we know so far. So, to me, it seems that the universe beyond our observation limit should not be drastically different. Our observable universe has been found to be more or less isotropic and homogeneous throughout its radius of about 46 billion light years and we have trillions of galaxies within this observable sphere. The space that lies beyond this sphere lies there just because we cannot receive signals from there. Eventually some more part of this unobservable universe at the moment will come within our observable range and the volume of sphere of our observable universe will increase to some extent. However, there is no known reason (at least to me) why there should be deviation in nature of the unobservable universe from the nature of part of the universe we can currently observe, unless we get answers to some of the open questions, particularly about the dark energy and the inflation theory. However, this is just a naïve guess and it would be very unscientific to

believe it to be true. We cannot claim anything until we scientifically ‘see’ it and collect evidences. We currently do not even know how big the Universe is beyond our observable part! There are some really interesting claims research and subsequent claims thought. When there are some calculations which claim that the size of the entire universe could be as large as 10^{23} times that of the radius of the observable universe, there are also claims that the actual size of the universe could be smaller than that of the observable one. Yes, smaller than what we are observing right now. It relies on a hypothesis that we are seeing multiple images of the same galaxies at different distant locations because of circumnavigation of light in finite size of the universe. The images look different because they are from different times. Interesting, isn’t it? Well, that’s what Physics is all about. Think out of box, but with support it with logic, reason and mathematics. And then prove that it is correct. Or not correct! In both case, the Physics wins.

Provided that, there is a strong possibility of Multiple Universes, Aliens, and other mind-boggling stuff, it seems like that one life is not enough to explore all this. What is your take on this?

Yes, certainly there are a lot of things which are waiting to be discovered and one life is not enough. As far as ET life is concerned, I feel we (the human civilization) shall one day get a ‘hi’ from some part of the universe. Again an unscientific intuition, but not an illogical one. The Fermi paradox is a thing! And it will be resolved one day, hopefully, with a ‘ping’ from our co-tenant in the universe. By the way, on a lighter note, probably they are seeing us but not talking to us after noticing that we have divided ourselves by means of nationalities and religions and

race and have our weapons pointed towards each other. Probably we are too immature and unintelligent for them to talk to!

More than a physics professor, as a physics enthusiast. How does your perspective differ for small things in our life from the rest of the world?

Critical thinking is the key. As a physics enthusiast, I keep asking ‘why’s and ‘how’s to almost everything I see or encounter. The only difference between a normal person and a physics enthusiast is the level of curiosity. It doesn’t take formal education to be a physics enthusiast. All it takes is the eagerness to know, apply logic and reason to our day to day activities. Use scientific temper as a way of life. That’s all.

For all the budding physics enthusiasts out there, what books would you recommend to fuel their fire for physics or any other courses you would suggest complementing?

As far as the courses are concerned, I would suggest to go for the courses that offer some value-addition to your curriculum vitae. However, I have some suggestion on books which I have read and enjoyed. I would recommend Sagan first. He is just a magic. His ‘The Demon Haunted World’, ‘Cosmos’ and the ‘Pale Blue Dot’ are all must read for all Physics enthusiasts. Feynman’s ‘Surely you’re joking, Mr. Feynman’ is also a wonderful read. I would also recommend reading Hawking’s ‘The grand design’ and ‘The brief history of time’ as starters. And those who don’t mind reading a little intricate physics should also read Brian Green’s ‘The fabric of the cosmos’ and ‘The elegant universe’. Here I have

assumed that most physics enthusiasts would have already read 'Wings of Fire' by Kalam. If not, it's the first one to start.

Any advice for engineers who strive to pursue physics?

To me, engineering and physics are pretty much convoluted. Gone are the days when we used to have boundaries between different branches and fields. Now we know that the real research and developments take place at the interfaces of these branches and subjects. I wish all budding engineers see Physics as their own subject, the foundation of technology. Good engineers can be very good physicists. And vice-versa. In fact if we want to become technologically self-reliant, we need to have more engineers who are really very good scientists and more scientists with a good understanding of engineering. I did my formal education (BSc, MSc, and even PhD) in Physics. But for my post-doctoral project, I worked as a visiting faculty in the Department of Electrical and Computer Engineering at the University of Utah, Salt Lake City, USA, without any formal hiccups. In fact the combination of science and engineering worked really well for me. To all my budding engineers, I suggest, rather insist, that take interest in Physics and make it a strong foundation for your engineering or technocrat career. Also join our national scientific research and development labs as scientists and engineers and give your services and expertise to the society.

So, your impeccable skills in cricket at MMNCT, is well known. So is cricket your leisure activity, which you do to take time off your packed schedule? What are your other leisure activities?

Cricket is my childhood love. Although the hectic schedules with multifold responsibilities don't permit me to play cricket regularly, I eagerly wait for MMNCT every year and keep myself fit enough to make the most of those five days. Apart from cricket, I like photography. I love my camera. These days, particularly in the lockdown period, I have been trying my hands on food-photography. It's fun. And I am learning new features almost regularly.

Lastly, as students of SVNIT, admire, acknowledge and venerate you. What advice would you like to give them? And how should students productively use their time during this pandemic?

Advice to students: Rather than advice, I would convey some traits that, I think, have worked well for me and can work for students, I believe. They are the following:

1. Keep yourself updated, be it about technical knowledge in your profession or general knowledge in personal life. Keep learning and never think you know enough. Let the knowledge drive you. विज्ञानं सारथिः नः स्यात् ॥

2. Never let your curiosity die. Be curious. Stay eager to know. About anything and everything.

3. Nurture scientific temper in your life. Submit the things you read or see anywhere (and particularly on internet/whatsapp) to the scrutiny of logic, reasoning and common sense!
4. Keep humanity above everything else. Human approach, involving the compassion, love, and respect for everyone around, is the key trait that has helped us in the process of evolution.
5. Enjoy whatever you do!

Anything you would like to add on?! Any thoughts on CEV?!

CEV has been doing a wonderful job. It is very important to keep students aware about the peripheral developments and CEV has been taking care of that. I am looking forward to more activities and programs by CEV with wider horizons and wish CEV the best. Also I would be available for all the help and support it needs. To all the students, stay safe, stay calm and learn as many new things as you can. Thanks a lot.