

Marvin L. Cohen Transcript

00:00:40:28 - 00:01:08:29

Alex Zettl

I'm Alex Zettl I'm a professor of physics emeritus at the University of California at Berkeley. It takes me great pleasure in participating in this Legacy Project interview of Professor Marvin Cohen. Marvin and I have known each other for many decades, almost 40 years. We've worked closely together. And Marvin is a is a theorist, a condensed matter theorist. I'm an experimentalist.

00:01:09:11 - 00:01:14:14

Zettl

So I do experiments and Marvin does theory. And we've worked closely together for for those times.

00:01:14:21 - 00:01:41:17

Marvin Cohen

I'm Marvin Cohen, University professor of physics and professor at the graduate school in the department here at Berkeley. And as Alex mentioned, a theoretical, condensed matter physics. That means I work on materials, but I don't go in the lab. All the good stuff is done by Alex, and I try to explain his results or predict new results.

00:01:42:02 - 00:01:54:16

Cohen

And as he said, we work very effectively together over the years, and I appreciate him interviewing me today and I appreciate all the people who are participating in this project.

00:01:55:20 - 00:02:22:14

Zettl

The first time I met Marvin, I'd known about Marvin because I was an undergraduate at Berkeley while he was a faculty member, but I actually didn't take any courses from Marvin. The first time we formally met. I was interviewing for a job at Berkeley, a faculty position, and Marvin was on my committee, the interview committee and the professors I had met earlier in the day.

00:02:23:00 - 00:02:48:25

Zettl

They asked me really hard physics questions and, you know, to see if I really knew my stuff. And I got to your office, Marvin, and you didn't ask me any hard questions. Instead, you showed me what you were doing and it was wonderful. It was a breath of fresh air. I was really impressed with what you were doing and I thought, this is the kind of place I want to be as a faculty member.

00:02:48:25 - 00:02:54:10

Zettl

And so that was sort of the beginning of our relationship, got off on a very good start.

00:02:54:24 - 00:03:14:28

Cohen

By the time you got to my office, I was convinced that we had to do everything we could possibly do to bring you into our department. So if I remember right, I started telling you about the problems on campus. They were parking problems. I said, outside of that, everything's fantastic and you really have to come. And you did, right?

00:03:15:08 - 00:03:16:14

Zettl

You were very effective.

00:03:16:19 - 00:03:17:16

Cohen

You worked well.

00:03:18:15 - 00:03:24:15

Zettl

Marvin, when you introduced yourself, you said you were a university professor. What is that?

00:03:25:24 - 00:03:52:12

Cohen

A university professor is supposedly a member of all of the campus of the university. And at the beginning, one of my duties was to go around to all the other campuses and look at what's going on. And I presumably had the opportunity to stay at each of the campuses or even teach there. But I chose to be at Berkeley.

00:03:53:11 - 00:04:20:23

Cohen

The other thing is that university professor and I'm still considered a university professor even after retiring from teaching. It's a title I can retain for life, which is very nice. On the other hand, you report to the president of the University, not to an individual chancellor. And the president always has a committee that the President wants to put you on.

00:04:21:13 - 00:04:56:22

Cohen

So at the beginning, I was very conscientious and talked to the various presidents and I ended up on a lot of committees. So I sort of stopped talking to presidents after a while and focused more on local things because the kinds of things that the university as a whole is interested in is 50 year plans and those are very difficult and take a lot of time and they're not always that effective.

00:04:57:08 - 00:05:02:25

Cohen

So I felt sticking to the campus and the business of the campus would be a better role for me.

00:05:03:03 - 00:05:25:05

Zettl

Well, it's quite an honor and I know there are very few university professors in the entire University of California system. So it's it's wonderful that you have that title. I also know you have your own parking space. And you mentioned parking was a problem. Many years ago and it continues to be a parking. So that that shows your stature.

00:05:25:21 - 00:05:46:21

Zettl

Tell me about your your your childhood. I know you grew up in San Francisco, California, just across the bay from Berkeley. But I understand you were born and as a young child lived in Canada. So you're you're a Canadian by birth. Tell us about your childhood in Canada and then moving to the United States.

00:05:47:11 - 00:06:13:03

Cohen

Well, I was born in Montreal in part of my family. My uncles and the rest, moved to San Francisco. My parents decided to move to San Francisco. And I did when I was 12. And I was really looking forward to it. I had built a Golden Gate Bridge out of toothpicks, and I expected beaches and all those things, the California image.

00:06:13:29 - 00:06:41:09

Cohen

So it came out at age 12 and in San Francisco, enrolled in school. And the teachers there, and particularly the counselor, felt that since I was an immigrant, I was sort of behind in social things. They told me my skills as far as a student in class work was very good that I should try very hard to catch up socially.

00:06:41:28 - 00:07:13:20

Cohen

Now, if you tell a 1213 year old that they really don't know what to do. So I went around smiling at people and I didn't quite know what to do. But I did continue in that mode for the next ten years. And as an undergraduate of Berkeley in a fraternity and the social try to catch up socially, it was not the best for my academic career and I didn't really work hard until I got to graduate school at the University of Chicago.

00:07:13:26 - 00:07:34:26

Zettl

But was there a big cultural difference between Canada and the United States, Montreal and San Francisco? I guess Montreal was very international as well, and primarily English speaking. So you didn't have a language barrier, you know, knowing only French or so on. But what what impressed you the most when you came to California?

00:07:35:14 - 00:08:05:03

Cohen

Actually, I was surprised when they were treating me like someone who came from a backward place, because Montreal was much more cosmopolitan. And San Francisco larger, it was more activity. Although I really love San Francisco, but it was a surprising welcoming in the sense that they had no feeling for the fact that I came from a large city.

00:08:05:24 - 00:08:09:14

Cohen

But I loved San Francisco and I loved being here and I always have.

00:08:10:09 - 00:08:32:15

Zettl

So you mentioned building a model of the Golden Gate Bridge out of toothpicks. That sounds like the realm of an experimentalist more than a theorist. So were you interested in science and mathematics at a very early age? And you were tinkering. Tinkering around or when did that develop for you, that interest in in physics or science in general?

00:08:32:15 - 00:08:33:10

Zettl

In mathematics?

00:08:33:21 - 00:09:01:01

Cohen

Yeah, I tinkered from a very young age. I built all kinds of things. And there were things that you

would associate with someone who was going into a career of experiment. I liked science, and I was so blessed by the fact that from a very young age, I always knew what I wanted to do. Soon as I figured out what physics was, that's what I wanted.

00:09:01:21 - 00:09:35:14

Cohen

And I switched from your area of experimental physics to theoretical physics when I was around seven or eight years old. My grandfather had a farm outside of Montreal and we were playing catch. Another young lady, another child. And I and a high school student came over and he said, When you throw the ball in the air, I just learned in school that I can calculate exactly where that ball is without measuring anything.

00:09:36:02 - 00:10:05:23

Cohen

And I couldn't believe it. And that concept that you could explain things that happen in nature with just mathematics or physical feeling. That was it. That was my idea for life. And I still am amazed that people can tell exactly where the ball is, exactly when we have an eclipse, exactly where those rockets go. And so my fascination began then.

00:10:05:23 - 00:10:07:27

Cohen

So I always knew I wanted to be a physicist.

00:10:08:13 - 00:10:20:16

Zettl

And so aside from quantum mechanics, I guess you were learning about classical physics, because now you're an expert in quantum mechanics now, and you really can't tell where the ball is exactly at a certain time.

00:10:20:27 - 00:10:21:16

Cohen

That's right.

00:10:21:16 - 00:10:44:17

Zettl

But that came later. So were you able in junior high school and high school in San Francisco to pursue science sort of seriously? Or were the classes invigorating, instructive, or were you sort of way ahead of everyone? And it was boring. What was it like to be in a in, you know, pre-college school here in California?

00:10:44:24 - 00:11:16:21

Cohen

Well, it was enjoyable, but the physics class, basically, we just made a chart of the weather every day. So if a student is going to take physics classes of that kind, I think they'll be turned off from physics. I think it's just it was not very inspiring. Math courses were pretty good and they were taught by the coaches, mostly of the basically the rigorous and the math was good and the classes were good.

00:11:16:21 - 00:11:34:14

Cohen

I went to George Washington High School in San Francisco, and it was a very good high school. But my focus became music and I spent most of my efforts in the area of music. This was part of

my socially catching up.

00:11:34:14 - 00:11:37:04

Zettl

And so what what instruments did you learn to play?

00:11:37:25 - 00:12:13:29

Cohen

I started on the clarinet and then played the saxophone. So at that point, I played the saxophone a lot because I got into jazz bands and as a teenager I was playing all around the Bay Area and at one point Johnny Mathis was actually in my band, so he was pretty active. Nowadays, I play the clarinet exclusively and I play every day, but I play classical music and my teacher plays for the San Francisco Symphony.

00:12:14:16 - 00:12:22:07

Cohen

And during this period we're doing it on Zoom. So when my tone isn't that good, I blame it on my laptop.

00:12:22:26 - 00:12:57:17

Zettl

So so music is, you know, very artistic and so on. And some might say it's very different from physics. There is sort of an esthetic quality to it. And physics in a sense, as you said, very precise, predicting things. Is there any disconnect between music and physics or do you think they go hand in hand? Does physics enhance your playing or your playing enhanced your ability to be a good theoretical physicist?

00:12:58:06 - 00:13:28:09

Cohen

I sort of keep them separate, although people claim that and individuals with skills in mathematics and also physicists tend to like music and to play musical instruments. The peculiar thing is sometimes I can play a piece that I really worked on and I go into some automatic mode and that could be going along extremely quickly on the clarinet.

00:13:28:28 - 00:13:46:26

Cohen

And at the same time, I can do a calculation there. It seems to be disjoint. The fact that once you get things in the muscle memory, you can still think about other things. Now, I know there are a lot of people who can think of more than one thing at a time. My wife is one of those.

00:13:47:02 - 00:14:15:18

Cohen

I can only really do one thing at a time. I do things serially. I just do one thing at a time. I don't bundle, I don't push things together, but I can play music and think about other things. So I ask how the brain is constructed with respect to these things. But and I don't know if there's a connection, except that in music you really have to count.

00:14:16:11 - 00:14:35:25

Cohen

It's very important. And one of my teachers along the way was saying that I was having difficulty when I was having difficulty with a piece. She would say, Here I am teaching a theoretical physicist how to count, and it's just the way it is, is not so easy to do so.

00:14:35:28 - 00:15:03:24

Zettl

So you mentioned playing around the Bay Area with different clubs and so on. That sounds interesting. Was that also in college? I mean, tell me about your Berkeley undergraduate experience. You were at Berkeley as an undergraduate as well, a physics major. And did you continue playing the saxophone during that time or just were you taking mostly physics courses or music courses or what was that like?

00:15:04:00 - 00:15:30:02

Cohen

I didn't take any music courses. I took physics courses. Then the physics requirements were very easy, so you could take psychology and philosophy. So I took all kinds of things, but I didn't really work that hard. This was in the 1950s. It was very different, a very different time. The main thing was getting the decorations up for the dance.

00:15:30:02 - 00:15:57:08

Cohen

on Saturday night I was in a fraternity. I ended up being president of the fraternity, and it was just not an atmosphere of tense competition the way it is now and I had enough time to do all these other outside things. Like physics courses were good, but just in general, I didn't have to work that hard.

00:15:58:04 - 00:16:21:22

Zettl

It sounds like you had a good time. Were there any people of mentors or faculty members while you were in undergraduate that had a particular particularly strong influence on you, that took you under their wing or tutored you, or that you looked up to, that helped in your development as a physicist?

00:16:22:06 - 00:16:45:04

Cohen

I didn't really I didn't really seek mentorship and so we were required to go to our advisors and advisors. Some of them were very kind. And would get you out of a class. If you didn't if you didn't like the class or whatever. And one of those was Art Kip in our department, and he passed away years ago.

00:16:45:22 - 00:17:18:16

Cohen

And then I didn't really have a good understanding of the various areas of physics, what area I was going to go into. I thought I would just go along and find out what's happening. And so I didn't seek mentorship. That's a lot better now. We really do pay much more attention to our undergraduates and try to give them a good idea of what the future is for them and what the various fields are.

00:17:18:16 - 00:17:45:04

Zettl

Well, it's interesting that you mention Art Kip. My parents were baby sitters for Art and John Kip while they were graduate students at Berkeley. So they've known Art for for many, many years. Does it seem odd to be in a fraternity? You said you're president of the fraternity and so on. And that's when I was an undergraduate. The frat boys, they were just partying all the time.

00:17:45:04 - 00:17:51:29

Zettl

They couldn't possibly be physics majors at the same time. So is that unique for you or just a

different time?

00:17:51:29 - 00:18:30:24

Cohen

Yeah, I think different time. Uh, the fraternity had very high, uh, grade average in general, there were a lot of pre-med, that's why. And several of my fraternity brothers went into law. One friend who was in physics won the Nobel Prize a couple of years ago for the discovery of gravitational waves. This is Barry Barish. He and two other people received a Nobel Prize and it was it was not just play all the time.

00:18:31:03 - 00:18:37:01

Cohen

And people did really pay attention at the university. So it was it was a good balance.

00:18:37:01 - 00:18:52:23

Zettl

And you went to Chicago as a graduate student. That's where you got your Ph.D. What was Chicago like? Was it different from Berkeley? You know, how how do you contrast it and how did that influence your life? Going to Chicago.

00:18:53:07 - 00:19:19:27

Cohen

It was radically different. First of all, in Berkeley during the fifties, you could leave your door open. It was just as far as I knew, no crime. It was very casual with it was certainly nothing like it was in the sixties. Chicago students were getting accosted. They were being murdered. It was a terrible neighborhood. But the university is a fine university, has great traditions.

00:19:20:12 - 00:19:45:27

Cohen

And for graduate study there, it was great for training someone like me because I had, as I said, I had been fairly loose fraternity playing in bands. I did do some playing when I was an undergraduate at Berkeley. And so I really focused and focused on physics and and I liked it, but it was very, very different.

00:19:46:11 - 00:19:58:18

Zettl

And could you tell us sort of in layman's terms what you did as a PhD thesis project? What was your specialty? What problems did you solve as a graduate student?

00:19:59:10 - 00:20:25:22

Cohen

Well, it was curious because I started work with I was thinking of going into a field called particle physics, where you look at the very elementary particles. And one of the professors there told me that there was a new professor that came in, and he's in condensed matter physics, which is the physics of materials. And I should just go talk to him.

00:20:26:15 - 00:20:47:05

Cohen

When I went to talk to him, he thought I was coming to do work under him. And it was a question whether he was going to be my supervisor. It was not my intention, but that was the understanding. So before he gave me a chance to talk, he just gave me assignments, books to read, and I went off.

00:20:47:05 - 00:21:10:28

Cohen

And after a couple of weeks I realized he was running my life much better than I was. And his name is Jim Phillips. So I decided that I would go into that field with very interesting and there was another person there, no relation Morrel Cohen and they were very inspiring. And then Jim Phillips gave me a problem and I worked on it.

00:21:11:18 - 00:21:45:23

Cohen

And then he gave me another problem and he went off to Cambridge on sabbatical. The problem he gave me was to look at how electrons move in semiconductors. But while he was gone, I got interested in the field of superconductivity. Superconductivity is fascinating because if you have a superconductor and you make a ring of it, if you allow electrons, put electrons in to go around the circle, they will essentially go around forever.

00:21:45:29 - 00:22:15:27

Cohen

No resistance. And I came up with the idea that even though previous to that time, only metals could do that because metals are very conducting, my theory said that you can have a semi conductor be a superconductor. So I went off and calculated all this and then the day appeared when he was coming back from Cambridge and I hadn't done this other problem.

00:22:16:17 - 00:22:29:00

Cohen

And so the faculty Morrel Cohen and other faculty members thought the thing I had done on my own was good enough for a thesis. And they said, stay home for three days and we'll talk to him.

00:22:29:12 - 00:22:59:08

Zettl

And in fact, that's one of the things you're very famous for, is solving that problem and making those, you know, theoretical predictions. I remember a number of years ago and you've maintained an interest in that field superconductivity throughout your career, and you were helping make a film or video of superconductivity, and you were trying to do it with modern dancers.

00:23:00:18 - 00:23:19:06

Zettl

And I recall, you know, in that in one of the theories of superconductivity, these electrons they pair. And so you were pairing dancers, modern dancers with with each other. And they were dancing around the floor and then pairing up. Was that sort of your idea to to put that into the into the film?

00:23:20:01 - 00:23:53:05

Cohen

Yes. It was done on campus and it was done with people from Dramatic Arts, and it was filmed by Nova. And it was wonderful because, as you say, the reason the superconducting superconductor is that electrons that normally repel each other in a super conductor, they attract each other. And this dance that I choreograph, they have students here, dance students.

00:23:53:18 - 00:24:18:05

Cohen

And the peculiar thing about it is your dancing partner is about ten feet away from you. So it's not like the usual close dancing. So the couples mix with each other. And I sat on a stool and watched it and they said, okay, we're lowering the temperature, go superconducting. And I watched the



students move into this phase and it was really great.

00:24:18:14 - 00:24:43:00

Zettl

It's a very visual way of presenting that. And Marvin, you mentioned that Chicago high energy physics was sort of a big deal. It was at Berkeley, too, you know, with with Lawrence making discoveries with the cyclotron and the Lawrence Radiation Laboratory being established and so on. And how was condensed matter or materials physics viewed at that time?

00:24:43:00 - 00:24:46:28

Zettl

Was it sort of at the level of high energy physics in terms of stature?

00:24:48:12 - 00:25:18:16

Cohen

I think no, I think what happened was physics went through a period where people felt that there was a hierarchy. And the more you got down to fundamentals, the more important it was. And fundamentals got confused with getting down to smaller and smaller numbers of particles, like we're made out of atoms, the atoms are made out of other things.

00:25:18:25 - 00:25:51:29

Cohen

And so if you kept going, you'd get down to particles. And the idea that the collective motion of particles and atoms was just as important didn't really come out until years later. So when I got to Berkeley, there was sort of a hierarchy, but it changed. In fact, now condensed matter physics is the largest branch of physics. And the nice thing about it, it's right in the Goldilocks spot for sizes of things that it deals with.

00:25:52:18 - 00:26:15:03

Cohen

So it does deal with some very small things and very large things, not as large as astronomers do, but you can use the theory for applications. And the theory also has a big influence on fundamentals, fundamentals of physics in all branches, right? So it's a very nice feel.

00:26:15:11 - 00:26:43:29

Zettl

And so after you received your Ph.D. from Chicago under Jim Phillips, you went to Bell Laboratories and Bell Laboratories in Murray Hill, New Jersey at the time was sort of the preeminent scientific laboratory in the world, and not just for doing telephone research, but fundamental physics research. So tell me about going to Bell Laboratories and what that was like.

00:26:44:11 - 00:27:10:20

Cohen

Bell may have been the best that particular laboratory may have been the best physical laboratory of all time, the number of experimentalists doing different things and inventing things and invented the transistor, the solar battery, and then later on computer languages. And I was in the theory group as a postdoctoral in the theory group, and I remember showing up the first day and they said, This is your office.

00:27:11:05 - 00:27:38:24

Cohen

And they told me that was the only instruction I was going to get, except we don't usually come in

when it's really snowy and we like to play chess after and before lunch and play go after lunch. And the only thing you want to be sure of is to show up at tea because in those days we didn't have the internet, so people who traveled would come to tea and they would tell us what's going on in the whole world.

00:27:39:17 - 00:28:06:28

Cohen

And I just had a wonderful time. I wandered down. I wandered around the halls of physics, talking to people, working with absolutely extraordinary people. And I was able to get experiments done. But then I was asked by Berkeley, Stanford and UC San Diego to come give a talk. And I went out to give talks at these few places.

00:28:07:03 - 00:28:30:12

Cohen

And I came back to Bell and when I got to Berkeley, I didn't realize these were recruiting talks. And when I got back, I said, Berkeley has made me an offer in Bell Labs postdocs were supposed to stay two years and I don't even be there a year. And I said, I'm going because I want to go back to Berkeley.

00:28:30:26 - 00:28:36:10

Cohen

My family's in San Francisco. I'm an undergraduate with Berkeley, and I'm in Berkeley.

00:28:36:10 - 00:28:53:27

Zettl

But Bell Labs also had staff scientists who were there their entire career. Yes. And that must have been a huge draw for you, too. So was it a difficult decision to leave Bell Laboratories, or were you just dying to come back to academia or go into academia and come back to Berkeley.

00:28:54:02 - 00:29:28:28

Cohen

Or from the professional point of view, I realized staying on at Bell, I was really productive there and things were going great, would have been a great thing. And they talked to me for hours and at the end of those sessions I would say everything you're saying makes sense, but my decision is an emotional one. I want I want Berkeley and and, you know, sort of logic, logic sort of my religion.

00:29:28:28 - 00:29:35:27

Cohen

But then I put logic aside and I just that's what I wanted to do. And it was a very good choice.

00:29:36:03 - 00:29:48:17

Zettl

How did how did that work to give you an offer? Were you recruited by someone or a committee or are they just said, you know, you should apply and you came? Or How did it really work?

00:29:48:17 - 00:30:27:12

Cohen

I just came in and they sent me to see Charlie Kittel. Charles Kittel was a preeminent condensed matter theorist. He developed a group at Berkeley. Some of them ended up getting Nobel Prizes. And he's the one who elevated condensed matter physics at Berkeley to a level of particle theory and Charlie said, you're giving a department colloquium to make sure it's a good one, but be careful because at the end, Steven Weinberg is going to ask you a really hard question, and it's very

important that you do well.

00:30:27:23 - 00:30:29:09

Cohen

I had no idea what was going on.

00:30:29:23 - 00:30:31:27

Zettl

Did did Steven Weinberg ask you a hard question?

00:30:31:27 - 00:30:40:05

Cohen

Weinberg asked a hard question, which turned out to be easy and but I made it sound hard. So how did how did

00:30:40:05 - 00:30:56:23

Zettl

it feel to return to Berkeley, your undergraduate institution as a faculty member? Did you party as much as you did as an undergrad or had you matured and you know, were a bonafide faculty member? Or how how how did you feel coming back?

00:30:57:01 - 00:31:23:04

Cohen

I matured at Berkeley, went the other way. This was 1964. So when I arrived, Mario Savio was on the police car. Well, when I was in the department, it took me a while to adjust because Emilio Segre was a very formidable person and he had worked with Enrico Fermi, who was my real hero, and it was so hard for me to call Emilio.

00:31:23:04 - 00:31:45:14

Cohen

Emilio and I had been in one of his classes. I think I dropped that accent and then he asked me if I would work on a problem that Fermi and Teller had worked on for him. But they had worked on it. It wasn't it didn't didn't seem to work very well. And he asked me if I would work on it.

00:31:45:25 - 00:32:07:26

Cohen

Turned out that I wasn't that interested in the problem, but I worked on it and I solved it. But my goal was to be near Emilio and find out all these stories about Fermi and hear all the stories about that period in Rome when it really Emilio was working on just great physics. Now on the campus, everything was going crazy.

00:32:08:19 - 00:32:18:10

Cohen

I mean, the difference between Berkeley in 1964, then in the late fifties when I was an undergraduate, was really dramatic.

00:32:18:16 - 00:32:30:27

Zettl

So you mentioned Mario Savio on the steps of Sproul Hall and Sproul Plaza packed with students. Were you there on the steps with him grabbing the microphone or where were you?

00:32:31:06 - 00:33:02:14

Cohen

I was in the audience. In the audience and I was watching him and I was just amazed. The curious thing is to give you insight into the mind of a physicist is that they had an anniversary, I think 40th anniversary, whatever of the event. And so I went down to see that. And all the students around I realized weren't born at the time.

00:33:02:14 - 00:33:25:19

Cohen

When the real event happened. But I saw the enactment of the Mario Savio thing. And then I really felt good about myself because I realized that I was standing there watching this scene and I was thinking about the same thing I thought about 40 years earlier that I really have a lot of work to do. I had to get back to my office as soon as I can.

00:33:25:23 - 00:33:55:03

Zettl

And, you know, Mario Savio became a physics professor later in life as well. So kind of interesting. In your own research, you know, as a theorist, you you need money to support post-docs and graduate students. And how did that work early on in your career? What organizations funded your research and how has that continued to today? How has the funding worked.

00:33:55:27 - 00:34:38:25

Cohen

That's worked out very well for me. Kittel put me on his National Science Foundation grant and I still have that grant, and it turns out it's the oldest National Science Foundation grant in the country from what I can tell. And I talked to heads of the NSF and they say that's true. And then after about a year, I got involved with people at the Lawrence Berkeley Laboratory, which is financed by the Department of Energy and created connection and got other people in condensed matter involved.

00:34:38:25 - 00:34:45:16

Cohen

Lawrence Berkeley Laboratory. So over the years I've been financed by the National Science Foundation and Department of Energy.

00:34:45:24 - 00:35:10:27

Zettl

And interestingly enough, the Lawrence Berkeley National Laboratory started off as a high energy physics lab. But now it it does a lot of work in condensed matter biological sciences, climate change, science and so on. It's really quite diversified and different from the way it was in its, you know, Lawrence Radiation Laboratory days when our Ernest Lawrence founded it.

00:35:10:27 - 00:35:12:17

Zettl

So it's really branched out.

00:35:13:07 - 00:35:45:05

Cohen

Yes, I think we made a big difference in spreading out the interests of people up there. And I remember Louie Alvarez when I was first came here, asked me to give a lecture at his house because he had a special seminar. And I talked about working on high temperature superconductivity, where you've made great contributions. I was probably showing your data and afterward you said, you know, I really have to pass the torch to you guys.

00:35:46:05 - 00:36:01:06

Cohen

And so the idea of the Lawrence Berkeley Laboratory being a center for particle physics was changing. And that probably came or began around the time that I arrived.

00:36:01:12 - 00:36:34:20

Zettl

So today, Bell Laboratories really doesn't exist anymore, as it did when you were there and preeminent research labs like at IBM or Exxon or Xerox, Palo Alto Research Center, they've they've all gone away a way. I guess the national laboratories and universities are taking their place. Do you think they're they're a good substitute or is it sad to have those research institutions gone from our you know, from the United States?

00:36:34:20 - 00:37:09:24

Cohen

I think it's very sad. I think Bell Labs was a national treasure. It was run by a monopoly, AT&T. And then they broke it up and they said we'd still do as well. They were wrong. IBM gave up a lot of its fundamental research and moved into software, and although they do still do some good research on Xerox down in Palo Alto, started off doing wonderful research and Steve Jobs came by and saw all those wonderful things they had developed in the computer area.

00:37:10:08 - 00:37:44:02

Cohen

And that was essential for the creation of Apple. So nowadays the old labs like Westinghouse, RCA, General Electric, Bell Labs, IBM and so forth and so on, and they have they're just not doing fundamental research and things have changed. So the question is, where do our best graduate students, well, always they went to universities and the Berkeley graduates populating the best universities in the world.

00:37:44:02 - 00:38:14:17

Cohen

And they are tending now to also go to places like Google and Facebook and companies that want them, because in physics, we're taught how to solve problems. So they want problem solvers and they're usually very good with computers. So in addition to being able to handle big data things of this kind, they are very useful for some of these other companies.

00:38:14:17 - 00:38:45:17

Zettl

So I've seen a list of your graduate students, the students who have gotten PhDs under your supervision, post doctoral students who were trained in your in your laboratory, your theoretical laboratory. It's really an impressive list. And you must take great pride in having these people be you know, they really have stellar positions throughout the world. They're their leaders in theoretical physics.

00:38:47:04 - 00:38:52:22

Zettl

Do you still stay in touch with them. Or what's your relationship with with your former students and post-docs?

00:38:52:22 - 00:39:27:00

Cohen

Very strong relationship. And first of all, I have the greatest appreciation of the fact that I had

access to these brilliant people. The students have been wonderful. I've had just incredible students who make me look good, and they have gone on to careers that are very impressive and their students are excellent. One of them got a Nobel Prize and they come from around the world.

00:39:27:29 - 00:39:48:01

Cohen

For example, I have several students from Korea that have started off wonderful groups and I remember visiting one of my students in Korea and he said to me, come here, I want to show you your grandchildren. And there was a line of Korean students who were the students of my students.

00:39:48:18 - 00:40:03:03

Zettl

So so some people say, well, we're training these foreign students, and then they go and they become our competitors in the foreign countries. Do you see that as an issue or what are the advantages for us to be training these brilliant people?

00:40:03:18 - 00:40:36:20

Cohen

Well, I tell you the story. When I was president, American Physical Society and talking to people in Congress and President Bush at the time, there was a feeling that we had to be very careful about visas and these foreign students. And one of these people from Congress said, well, you said here you are developing these foreign students. They're going back, they're competing with you, and you're asking us for money to compete with the people that you created.

00:40:37:19 - 00:40:59:28

Cohen

And what have you got to say about that? I said, you're right, but I knew that logic would not work with them. So I just used the following. I said, When we have good foreign students, many of them stay here and they do incredible things. And when they go back to their home countries, we usually have a friend for life.

00:41:01:07 - 00:41:19:05

Cohen

However, if you want to change the way we do things, I want to tell you that right now, the international language of physics is broken English and it will change to broken Mandarin if we don't pay attention. That worked.

00:41:19:11 - 00:41:33:02

Zettl

You mentioned your stint as president of the American Physical Society, and that's an important position. What challenges and opportunities did you encounter as as president of that organization?

00:41:33:18 - 00:42:01:10

Cohen

Well, as I mentioned early earlier, I, I, I served my time on committees. I've been a good, responsible faculty member, but I didn't seek committees or or a lot of administration. So I was pulled into this kicking and screaming, but I learned a great deal and it was really a good experience. You start off, you go through four years, basically in the third year you're president.

00:42:01:10 - 00:42:36:12

Cohen

And fourth year, you're you're past president. And you get to do a lot in the way of telling the world

about physics and also in administrating things. And it just so happens that when I was president of the American Physical Society, it was the world year of physics. So I traveled all around the world and talked about Einstein because the world year of physics was 2005 and Einstein in 1905 did incredible things in the little patent office all by himself.

00:42:37:01 - 00:43:16:25

Cohen

And so I able to tell the world about Einstein and to discuss many of his achievements. And from China to Africa, it was really an incredible opportunity for me to speak about physics and how much I love physics. At the same time, I was telling everybody about Berkeley, and so it it was a good experience. The other thing is, like some institutions like here, like the group taking care of this, we had very good support

00:43:16:25 - 00:43:33:09

Cohen

people and so I didn't have a lot of homework and I could really make decisions and I didn't have to answer it. Once I got to the third level in the series traditions and as president, I could make decisions.

00:43:33:27 - 00:44:02:19

Zetl

So one one, one thing the American Physical Society is focused on right now is increasing diversity in physics. There are very few women, for example, in physics, and they're trying to change that. Your own view from my experience has been very diverse. I mean, sort of a model of what physics groups could be was not a challenge already when you were president of the American Physical Society?

00:44:02:19 - 00:44:07:10

Zetl

Was that already being discussed then and or is that more recent?

00:44:07:10 - 00:44:35:28

Cohen

Yes, you serve. I served on many committee that involved women in physics. And it turns out because I do theoretical physics and this is a field where women can work in and also during childbearing years continue to work in without having a lab to watch. I had I don't know about now, but when I was active with graduate students, I had the largest group of women students in the department.

00:44:35:28 - 00:45:11:18

Cohen

And over the years I had also a large group of foreign students. So the point was, once we got into the room and went to the blackboard, it was mathematics and the cultural differences and the gender differences and the rest were not major. The only difference I found between my male students and my female students were that the male students always had a higher opinion of themselves than perhaps was warranted, and the female students perhaps always had a lower opinion.

00:45:12:00 - 00:45:20:03

Cohen

And so it was part of my job. I felt, to really tell these young women how good they were. And they've done very, very well.

00:45:21:13 - 00:45:42:15

Zettl

The awards you have won are many I've seen your CV is just pages long of the awards you've won over the years. And there's one I'd like you to tell us a little bit about, and that's the National Medal of Science. Can you tell us what that award was about and how it was awarded to you?

00:45:43:12 - 00:46:05:26

Cohen

Yes, that was a wonderful experience. I had it awarded by the president of the United States. And you go to the White House and they have a lot of good food and my wife is in the art world. And so she was going around telling me how much each of those paintings cost. And so that was a good experience.

00:46:05:26 - 00:46:40:13

Cohen

And then President Bush put the medal around my neck, and then he sat and talked to me for a while and we had a very interesting exchange. He was talking about his family wanted to know about my family. And my wife was not a fan of his and I had mixed feelings, but he was very congenial and seemed to know about what I had done.

00:46:40:29 - 00:46:43:07

Cohen

And so it was a great experience.

00:46:43:07 - 00:47:11:26

Zettl

I think he valued, you know, good science and the people who are driving it. And so recognizing people like you was a good thing. So we've we've talked about your research a bit here, but not so much your teaching. So you were an active professor, teacher teaching physics courses for over 40 years. And how was that like? What were the the challenges and rewards for being a teacher?

00:47:11:26 - 00:47:19:25

Zettl

I you were teaching mostly undergraduate solid state physics courses. But, but how was that?

00:47:20:21 - 00:47:46:13

Cohen

Well, I enjoyed teaching a lot and it was not a big effort for me. I know I have colleagues who are really good teachers, put in a lot of time and they find it difficulty, the difficult, There's the old joke. If you walk into an undergraduate class and you say good morning, they say good morning. And if you walk into a graduate class and you say good morning, they write it down.

00:47:47:28 - 00:48:17:26

Cohen

So the difference between undergraduate and graduate was quite different. So the undergraduates asked questions. They didn't believe the special theory of relativity. I remember some guy saying Einstein was working with trains, but we should work with airplanes and all kinds of things of that kind. So I preferred graduate teaching because these, was in the these cases were where people were going to do research.

00:48:18:20 - 00:48:48:18



Cohen

And so I taught graduate research in particular one course. I sort of instituted this here and it went on and is still going on. And it was a graduate course in my field, condensed matter physics. And after many years I coauthored a book based on that course and I saw just fantastic students. But you couldn't tell in the class who was nodding and saying yes.

00:48:48:26 - 00:49:02:26

Cohen

And some near the back of the room reading the Daily Cal who really got it. But you could tell when they wrote their research papers and when they wrote their their exams. So it's very different in graduate class.

00:49:02:26 - 00:49:14:29

Zettl

Did you did your teaching style change over the years or were you always sort of a blackboard person or did you end up using PowerPoint the last few years? Or how did your method of teaching change.

00:49:14:29 - 00:49:17:15

Cohen

All chalk and Blackboard.

00:49:17:28 - 00:49:39:04

Zettl

And that's equally effective today as it was in the 1950s, and that's same before that. Marvin There's a beautiful new modern interaction center in the physics department at Berkeley called the Marvin Cohen Condensed Matter Physics Interaction Center. Tell me how that came about.

00:49:40:07 - 00:50:11:28

Cohen

Well, it came about through generous contributors who wanted to honor me, and I greatly appreciated. And it's a place where we can sit and talk. And also, thanks to you have a plasma screen so we can plug a laptops in. And it's always active, always people in there and they're talking physics. And I hope it'll be a place where great discoveries are made.

00:50:12:23 - 00:50:59:05

Zettl

Yeah, it's it's very popular with students, faculty and postdocs alike. So congratulations on putting that together. You you mentioned some of your research, but I know in the in the 1960s, you were working on semiconductors, which are central to the electronics industry, and you worked on silicon making predictions of what the electronic properties of silicon were like. And I think it's fair to say that without your work, Silicon Valley would not exist as a technology hub and so I imagine you must be very wealthy personally, having patented all those computer programs and approaches that you developed in the 1960s.

00:51:00:10 - 00:51:26:27

Cohen

Thank you. You've being really generous. But I should tell you that Charlie Kittle would corner me and say pattern, pattern, pattern. And for me pattern was not it wasn't a dirty word, but it wasn't the way to go. And so I never patented anything. And so I'm afraid it's just my university salary allows me to live the lifestyle that I'm living.

00:51:27:14 - 00:51:57:01

Zettl

Truly, truly dedicated to science. So in your research and in condensed matter physics research in general, supercomputers are absolutely essential. So, you know, tell me the role they play today are they as important as I've said or just sort of a useful tool you don't really need them? Or how important are really powerful computers today in research.

00:51:57:13 - 00:52:22:07

Cohen

They're very important and just to give you a quick idea of how things changed when I wrote these first programs to compute electronics, structural semiconductors, people really thought that this was not the way to go. And I remember that at a conference, someone said it's just mindless research. And I said I could do mindless research without a computer.

00:52:22:23 - 00:52:52:02

Cohen

And that was the beginning of just talking back to the skeptics. The Russians were particularly against using computers. Nowadays, the computer programs are so much more sophisticated than the things that I developed in fact, I was in a meeting in Paris and somebody was selling computer programs. Somebody wanted to sell me my old computer program for \$300. And I complained.

00:52:52:02 - 00:53:15:18

Cohen

I said only \$300. You know how much work I put into that? Anyway, nowadays computers are very important, but you have to be careful because there are computer programs that are sort of canned programs that you buy and you put in numbers and then you accept what comes out. If you don't understand what's going on, you can make some big mistakes.

00:53:16:03 - 00:53:27:09

Cohen

So there are people who are doing wonderful things for supercomputers and some people do not really have a deep understanding of what calculations mean.

00:53:27:09 - 00:53:44:21

Zettl

Right, it's not just the computer, but you have to have the formalism that you've developed that goes with it. And the computer becomes a tool for doing large calculations. Very quickly, I have a last question for you. Tell me about Popoki, who is Popoki?

00:53:46:04 - 00:54:11:04

Cohen

I had I had a cat named Popoki and he he I got a license plate with the Popoki name on it and it was on my little VW bug and I would drive it to the campus and people would ask me about the Popoki to. Popoki was born in Hawaii when I was on sabbatical and the way theoretical physicists can take sabbaticals in Hawaii and work on the beach.

00:54:11:26 - 00:54:43:19

Cohen

And so I brought Popoki back from Hawaii and Popoki means Cat in Hawaiian. And when we moved or when we visited Hawaii years later, I actually met the governor and I said, I have someone who was born in Hawaii. I'd like to bring him back for a while because we're going to take this sabbatical or whatever. And the governor said, of course, and then when I said it was a cat, he

said, no way they have these strict laws there.

00:54:44:00 - 00:54:46:03

Cohen

So anyway, Popoki was a great cat.

00:54:46:15 - 00:54:50:06

Zettl

I understand Popoki had a bar mitzvah as well, right?

00:54:50:25 - 00:55:01:23

Cohen

Yeah. Every summer all of the visitors that we had in the physics department would come to Popoki's his birthday party, and it would be a great event.

00:55:02:02 - 00:55:23:23

Zettl

So does you're sort of a cat person? I mean, I've never known you to have a dog. Is that, you know, somehow connected to your personality? You can't really train cats or heard them, though. They're on their own and they're probably deep thinkers. Does that match your personality more or why are you a cat person?

00:55:23:24 - 00:55:39:12

Cohen

I think they're philosophers. I think I now have a cat called Faucet and he is gray. He looks just like the Popoki. And both my wife and I are cat people and a lot of our life is focused on Faucet.

00:55:40:28 - 00:55:59:01

Zettl

Right. And if you had to be an undergraduate today and starting at Berkeley today, would your lifestyle be the same as it was back in the fifties, or do you think it would be different? Have things changed that much that you could, you know, no longer function in the same way?

00:55:59:01 - 00:56:42:05

Cohen

Well, first of all, I don't think I'd get in the requirements are really hard. Second thing, I was able to wash dishes and work at the music store and completely paid for everything. My semester cost only \$37.50, so \$75 a year, whatever I paid at the fraternity to live there. Once I wash dishes and worked in a record store, I had enough money so that I could be an undergraduate and focus if I did get in and I did have the wherewithal to finance being here, I think my life would not be the same.

00:56:42:05 - 00:56:47:13

Cohen

I think I would probably be like these other students running around and working a lot harder.

00:56:49:04 - 00:56:56:10

Zettl

Marvin Did you ever think of leaving Berkeley as a faculty member? Were you recruited by other places?

00:56:57:10 - 00:57:20:22

Cohen

I was recruited by a lot of other places. Well, what happened was when I got tenure, I took all those moving boxes that Bell Labs had given me to come to Berkeley. I took them to the Berkeley dump. I burned them, and I said I would never leave. And over the years, whenever I got an offer, I would say, no, I'm going to die in Berkeley.

00:57:21:04 - 00:57:27:10

Cohen

And I've been very, very comfortable having made that decision quite early. And I've never regretted it.

00:57:27:24 - 00:57:51:26

Zettl

Well, it's been fantastic for collaborators to have you at Berkeley. I think you and I have published over the years over 90 research together and in the last couple of years, something like 15 papers. Well, Marvin, thank you for the absolutely fascinating interview and best wishes for your continued long career in condensed matter physics.

00:57:52:28 - 00:58:13:02

Cohen

Okay. Thank you for the interview. Thank you for the questions. As you can see, I'm really a lucky person who knew what they wanted to do and an opportunity to be where they wanted to be and got to interact with people like you, which really made my life here at Berkeley a wonderful period.

00:58:13:07 - 00:58:20:10

Zettl

And I'm glad we're able to memorialize some of your experiences for the Legacy Project. So thank you again.

00:58:20:11 - 00:58:20:26

Cohen

Thank you.