

Ep3.04 - Dr. Alec Gallimore

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SPEAKERS

Announcer, Ed Clemente, Dr. Alec Gallimore

A Announcer 00:01

Welcome to The Michigan Opportunity, an economic development podcast featuring candid conversations with business leaders across Michigan. You'll hear firsthand accounts from Michigan business leaders and innovators about how the state is driving job growth and business investment, supporting a thriving entrepreneurial ecosystem, building vibrant communities and helping to attract and retain one of the most diverse and significant workforces in the nation.

E Ed Clemente 00:29

Hello, I'm your host today, Ed Clemente. And today we're fortunate to have Dr. Alec Gallimore. He's the Dean of Engineering at the University of Michigan. Welcome to the show.

D Dr. Alec Gallimore 00:38

Hey, it's great to be here. Thanks Ed.

E Ed Clemente 00:40

And I know you gave me permission to call you Alec, just so those listeners don't think I'm being rude. But I'm really excited about this, because I'm older than you. So I sort of grew up as a NASA baby a little bit. And, you know, I know we're going to talk about a lot of things. But for me, it was always a big deal. And you know, and someone that's taught U.S. history, even at a university level in different places, I really think that the history of NASA is really kind of the story of how America kind of like, created this whole new era of technology, too, in a way. But I know you'll talk about that some more. And I should mention a couple other things you are the dean, the Robert Vlasic Dean of Engineering. And I want you to explain what is it, this is a big deal, but you probably know better than me, but what is a member of the National Academy of Engineering?

D

Dr. Alec Gallimore 01:36

Well, Ed, I may call you, Ed, I assume.

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Ed Clemente 01:39

Absolutely. Trust me, I could give you my nicknames. But it would take too long.

D

Dr. Alec Gallimore 01:44

Well, Ed, being a member of the National Academy of Engineering, is often said to me, the highest honor an engineer can get in the United States. We have a very small number of engineers who get in every year, and it's based on essentially lifetime achievement and contribution to the field of engineering. In my case, my citation was about both advancing advanced spacecraft propulsion technology, that is plasma based propulsion, which we will talk about later on. But also equally important to me workforce development, I've graduated 45 PhD students, some of whom are professors, including at the University of Michigan and work in industry and government, and so on, so forth. So it was an honor for me to have been elected back in 2019.

E

Ed Clemente 02:29

Yeah, and I mean, like I said, it's sort of like, the pinnacle of like physics and science. And I know that for someone that wasn't great in either one of those subjects, but I've always appreciated the value of them, you know, I know how to drive a car. But obviously, I'm amazed by how it moves around. So I know the engineers are critical. And I played rugby quite a while for University of Michigan. It's like a club side. But I worked with a lot of your engineers, I'm sure students you might have had, and, you know, they just love the program there. And they know it's a great program. So congratulations on doing that. And, yeah, because I know, it's kind of confusing, because it's engineering. So is there a specialties within engineering? This sounds like a basic question. So could you break down like sort of the major engineering what falls under your sort of bailiwick?

D

Dr. Alec Gallimore 03:19

Yeah, so let me give context for Michigan engineering. First of all, we go back to 1854. And we're the second oldest academic unit on campus behind literature, science and arts. And we have 14 academic departments, about 17 undergraduate majors, 16 master's programs and about 30 graduate credentials, or so, a large number of programs. We have about 12,000 students, 700 faculty members and about 900 staff members and a fun fact: we are in 63 buildings in the College of Engineering. So it's, [Say that number again.] 63 buildings. We're in 63 buildings in the College of Engineering. Yep. It's a big complex. And so not only being one of the nation's oldest engineering colleges, we have many firsts. We were the first aeronautics program in the country, the first mechanical engineering, first computer engineering, first

nuclear engineering, etc. So a lot of firsts. Our latest department is robotics. So we do anything from robotics, to aerospace engineering, mechanical engineering, material science, chemical engineering, climate and space sciences, you know, nuclear naval architecture, marine engineering, biomedical, you name it, we're sort of across the board, a comprehensive engineering program.

E

Ed Clemente 04:39

As a side sort of question, I was in the legislature before but I remember when someone told me they went to the naval engineering school, you know, and I'm like, it seems kind of weird that it was a landlocked university, but you guys designed quite a few of our U.S. naval fleet, too, haven't you?

D

Dr. Alec Gallimore 04:58

Our department is, we nicknamed it NAME even though it's spelled like "naame," Naval Architecture and Marine Engineering. But yeah, we have strong programs with the Navy, we do a lot of work designing their systems, their ships, and submarines and things of that nature. We have a lot of ROTC students who are undergraduates at Michigan, and be in the Navy Department. We also recruit Navy graduate students, actually, people want to get their masters or even their PhD, and continue their service in the Navy. And it's our smallest department. But as they say, they're small, but very mighty.

E

Ed Clemente 05:39

Well, you know, why don't you also, I know, you've got sort of a, can you explain a little bit too about the plasma dynamics and electric propulsion laboratory, and then your sort of side project or not, if it's a side project, but what else you do beyond just the actually, I should mention you're an actual rocket scientist, and we're going to break that down some more later. But could you explain a little bit about the plasma dynamics part of this?

D

Dr. Alec Gallimore 06:04

Yeah. You know, I started 30 years ago, I was a graduate student at Princeton University. And then I received a call from a professor at the University of Michigan, who was a chair, Department Chair of Aerospace Engineering, saying, we have this big vacuum chamber that was built to support the Apollo program, it was built, in the early 60s It was built before I was built as a matter of fact, and they said, we want to try to figure out what to do with this vacuum chamber and a vacuum chambers you can think of as a big steel can, where you remove almost all the air from inside. So it simulates the vacuum of space. And so when you have technologies that are operating in space, you want to simulate the ultra low pressure, the vacuum of space. So this professor, this chair is very prescient, and he thought that perhaps that spacecraft propulsion, which of course needs to operate in the vacuum of space could benefit from having the chamber. Now, this chamber is 20 by 30 feet. To give you an idea, 20 by 30 inches would be a large chamber at a university. So it's quite a bit larger. In fact, it is

larger than most chambers at universities. And as a matter of fact, it is the largest vacuum chamber at any university, certainly in the country, or perhaps in the world. And so I was brought in late

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Ed Clemente 07:25

Wait again, when was it built?

D

Dr. Alec Gallimore 07:27

It was built in 1962. [And it's still viable?] It's well, you know, the whole idea was that they over-engineered things back then. Yeah, and so it was built by a Chicago bridge building company, believe it or not, an iron bridge building company. [Okay.] So it's a tank of a chamber if I can use that term. And so yeah, it was quite viable still, then what we've done over the decades, though, is we've modernized it, we've upgraded the pumps, we've made it much more capable to be able to pump out all the air and other gases there inside. We've added robotic systems and laser systems. And the reason we do that is because we develop in the Plasma Dynamics Electric Propulsion Laboratory, plasma thrusters. And you can think of, you want to explain a plasma thruster is now a good time?

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Ed Clemente 07:31

Well, yeah, so just wanna make sure I understand it, because I'm probably the average level of the listeners. So go ahead.

D

Dr. Alec Gallimore 08:24

So the name of the lab is Plasma Dynamics Electric Propulsion Laboratory. And the idea behind the name is plasma is the fourth state of matter, you can think of it as, if you take a gas and you add a lot of energy to it, so it becomes super hot, 100,000 degrees, one million degrees or so it creates this state where the gas becomes charged particles, essentially a charged state. And that's called a plasma. And once you have that state, you can actually do some amazing things with it. You can use electric fields and magnetic fields to contain and accelerate the plasma at very high speeds. And that's what produces the thrust in these devices. And electric propulsion, all that means is that we are creating the plasma in these thrusters by using the electric power that's supplied by the spacecraft. So the spacecraft might convert sunlight into electricity through photovoltaic solar arrays, we take that electricity and we create plasma and then we use electromagnetic fields to shoot the plasma at very high speeds, and that produces thrust. So PEPL Plasma Dynamics Electric Propulsion Laboratory, is actually a laboratory at the University of Michigan that works with NASA, Department of Defense, companies like Lockheed Martin and SpaceX, to develop and test these types of plasma thrusters for spacecraft propulsion.

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Ed Clemente 09:49

So does that mean NASA and Lockheed and a lot of these, you know, are in the aerospace

So does that mean NASA and Lockheed and a lot of these, you know, are in the aerospace industry, are they coming to Ann Arbor quite a bit, where they test it?

D Dr. Alec Gallimore 09:49

Yes, as a matter of fact, all those companies that I've mentioned and organizations I've mentioned have tested it by the chamber at PEPL, as a matter of fact. And in some cases, for instance, NASA and the Air Force, they may give us grant money to develop our own thrusters, if you will, with that funding, that we'll test at our chamber. In one case back in 2017, NASA gave us money to develop the world's most powerful plasma thruster that we tested both in Ann Arbor and also at their one of their NASA facilities, in Cleveland, Ohio. We set a number of world records that year in terms of most thrust and power and current for these devices, roughly 50 times the power of what's used in orbit right now. But it's a prototype for the type of plasma drive that would be used to send astronauts to Mars and bring them back safely.

A Announcer 10:52

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E Ed Clemente 11:07

I think it's time for a little history lesson too, here. So, tell people what the rocket panel was because I find that fascinating. So you told me about it just the other day.

D Dr. Alec Gallimore 11:17

Yeah. So it's interesting. Michigan was actually engaged in the space business at the very beginning of the space age, we have the laboratory called the Space Physics Research Laboratory, SPRL, that actually was doing some of the early measurements to understand the upper atmosphere, the edge of space, by taking captured German rockets from World War II, and sending them on these high altitude, elliptical trips, these missions, and collecting information about, believe it or not, plasma, that word again, in the upper atmosphere so that NASA could determine how to send payloads and eventually people into space. So the rocket panel is this group of researchers, civilian researchers, that we get together and help us think about what role the US government should play in space, especially the civilian use of space. And in 1957, they assembled here in Ann Arbor, in fact, at the Michigan League.

E Ed Clemente 12:21

Oh, yes, yeah, I've been in the building many times, yeah.

D Dr. Alec Gallimore 12:23

They assembled there in the league. And what they decided to do is, we need a civilian space agency to augment what the military was doing in space. And they looked at one agency that was developing air foils for aircraft, and so on called NACA, they use that as the basis of the model. And they came up with this concept, which eventually became NASA. So one can argue that the birth of NASA actually was in Ann Arbor, Michigan, at the League in 1957.

E Ed Clemente 12:54

So as a history nut I noticed it's 1957. That's exactly the same year Sputnik went up. Is this a reaction to Sputnik?

D Dr. Alec Gallimore 13:02

Indeed, it is, indeed it is. And the thought was, we did not want to have the presence in space only to be the Department of Defense, like the Navy and so on and so forth. We wanted civilian exploration of space.

E Ed Clemente 13:16

And could you mention, you don't have to give their names but you've had a ton of astronauts go to school or get their degrees there too, right?

D Dr. Alec Gallimore 13:24

22 and counting, living and deceased astronauts are among not only our alumni base, but actually our faculty, believe it or not. And so we've actually had two all-Michigan missions, one in 1965, which is a two-person Gemini spacecraft, Gemini 4, to be exact, which orbit the earth, both of them are Michigan alum, and one of the moon missions, Apollo 15, in 1971, all three astronauts, two would land on the moon, one who stayed in orbit around the moon. All three are Wolverines.

E Ed Clemente 13:56

Wow, that's tremendous. And I'm going to jump around a little bit on you only because I love everything. And I know I could probably do just three hours with you, but I want to also tie in a little bit too, sort of like the angle that everyone's probably seen the movie Hidden Figures. But could you elaborate that a little bit? Because I find that fascinating, too.

D Dr. Alec Gallimore 14:21

Yeah, well, it's interesting. If one reads the book, one will actually see the University of Michigan mentioned a number of times because University of Michigan was, frankly one of the early and only producers of science and technology talent among the African American

communities back in the 50s. And in fact, there's one person who is a human computer named Dorothy Hoover, for example, who the author of Hidden Figures, Margot Lee Shetterly mentions as paving the way for women who become computers, of course and NASA as we know and she, Dorothy Hoover, received her PhD in mathematics from the University of Michigan in the 1950s. And just to give you some context of what a big deal that was back then, and 1950s or so, only 16 African Americans had been awarded PhDs in mathematics in the United States [In the US. Wow.] 40% of that was that number came from the University of Michigan.

E

Ed Clemente 15:27

Yeah. And I would imagine there weren't even that many African Americans period at the university. Because I know even the sports teams were hardly integrated.

D

Dr. Alec Gallimore 15:34

Yeah, that's right. And in fact, it was kind of interesting, because back in 2017, I had the opportunity of hosting Margot Lee Shetterly, in an event here at Michigan engineering, where I had the opportunity to interview her. And I'm sure she was intrigued, just by the visual of my being the visionary, given the book and saying, wow, I guess that is the definition of progress in society.

E

Ed Clemente 15:59

Yeah, no, no, no, it's just like a that could be almost like a special just by itself just on that documentary. And, you know, breaking down just a little bit further the idea too, and this is going to sort of tie into one of your questions anyway. But you do a lot with diversity, equity and inclusion. But can you give some of the sort of neat projects you're doing? I know, you mentioned to me, but I think it's fascinating how you're working with, you know, underserved populations right now, too.

D

Dr. Alec Gallimore 16:32

Yeah. So thanks for that question. In a given year, the College of Engineering interacts with over 6,000 K-12 students. And so we have one facility at the University of Michigan Detroit Center in downtown Detroit, called the MEZ, Michigan Engineering Zone. And the MEZ is a really interesting program. We have two projects there. One in which we work with Detroit public high school students to build robots as part of the national FIRST Robotics Competition. And there we have professional engineers from the region as well as our own students. So pre-professional engineering students, if you will, working with these high school students to develop these amazing robots. We're working with the Detroit Public Schools, the Educational Achievement Authority, and of course, FIRST Robotics on this. We also have the middle schools program called Thinkabit. And to give you some numbers at any given time in the MEZ, we have almost 300 high school students and 3,000 middle school students over the course of a year that we work with at Thinkabit, again, Detroit Public School students.

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Ed Clemente 17:40

When did you, I mean is this because of STEM? Is this how it started originally? Or have you been sort of engaged in this prior to STEM?

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Dr. Alec Gallimore 17:47

Well, we've been working, the MEZ has been around, for example, and working with Detroit for over a decade, about 11 or 12 years. [Oh, wow.] But we've felt for a long time, the College of Engineering, that we needed to cast a wide net, and have a nice wide funnel, to, frankly, dispel many myths about engineering and make engineering more and technology in general more accessible to people. Show that it's there's a creative aspect of things show, for example, it's not just for one type of person who comes from one background, but it's really for everybody, frankly, show that it's people-first engineering, it's about addressing the needs of society. And that appeals to a lot of people. So we want to make sure that we brought, if you will, the humanity of engineering, to bear and to focus so that students look at this. And they say, this is a way that I can contribute and make my community, my society better by entering a field in engineering.

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Ed Clemente 18:45

Yeah, it's funny, this is a side note, but like my parents were immigrants, and neither one even went to eighth grade, and English wasn't their first language. But I wish I would have been exposed to some of these things. And I'm so glad you're doing this, you know, especially with all these different populations, you know, in this era of sort of, like Tik Tok, and a lot of other things, people still need to understand deep-dive learning, because, it's just everyone assumes your phone is going to work. But it's engineers really building all this connectivity we're having globally. And that's how we're gonna get out of like climate change and things like that is through engineers, and you know, a lot of different fields like this. But anyway, sorry, take you on a side note. A couple other things too, when you and I were talking. You also, I mentioned to you, and then you surprised me. I say again, we've got a person we're going to probably be interviewing from Orbion Space Tech. And you said, oh, yeah, yeah, I know who they are. And why don't you tell us how will you know them?

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Dr. Alec Gallimore 19:45

Yeah, so Orbion Space Technologies in Houghton, Michigan, the Upper Peninsula, so and it was founded by Professor Brad King, and I know Brad King, because not only was he one of my undergraduates here at the University of Michigan, he ended up becoming one of my PhD students and graduated, maybe my second or third PhD student as a matter of fact, that I graduated. So Orbion is a great success story for Michigan. It's sort of like when you asked the question, why would you have a landlocked state have Naval Architecture and Marine Engineering, you can ask the question, why would a state like Michigan be strong in aerospace, but it turns out, we are pretty strong in aerospace. And so what Orbion is doing, is they're building small but mighty plasma thrusters for small- and medium-sized satellites. They receive over \$30 million of funding, and they employ 40 engineers, including another one of my PhD students, Dr. Scott Hall. And Scott, it's an interesting story, Scott used to work at NASA, and left NASA to move to the Upper Peninsula to work at Orbion. And Scott worked on that 2017 world

record, Mars engine prototype that I talked about, that was his PhD thesis. So he's literally working on a thruster, that's probably about, I don't know, 500 times less powerful than what he did his dissertation on. But that's because you can scale these thrusters over a wide range. And so it's really a great story about having a high tech company like Orbion here, frankly, not only in Michigan, but in the up it's great story.

E Ed Clemente 21:25

Well, you know, just a little bit of inside baseball, but I don't know if everybody knows how a PhD works. But you have to have advisors, right? And so just can you give a quick 30 seconds about how you had to probably be an advisor for all these people, right?

D Dr. Alec Gallimore 21:40

Yeah, that's right. So the PhD is a little different than on the other fields. Typically a PhD takes about five years or so. The first two years, you're taking courses like you would for a master's degree or bachelor's degree or so but they're, of course, very advanced courses you might imagine. And then you have to study for the dreaded qualifying exam. And that varies by department. But once you pass the qualifying exam, you become what's called a candidate. And an important element of PhD education is the pursuit of research, at least in STEM fields towards what's called a doctoral dissertation. So a dissertation is a book basically, it's a 100-, 200-, 300-page book. And what it does, it details the original work that you've done in a certain area. So it's not regurgitating other people's work, you have to contribute something new to the field, if you will. And so how it works is that typically, we have funding in Scott's case, Dr. Scott Hall's case, from NASA to work on this X3 plasma thruster. And for his dissertation research, he was literally building, testing, refining, analyzing the data that came out of the experiments for this plasma thrusters, both in Ann Arbor and Cleveland, Ohio.

E Ed Clemente 23:00

And, you know, even though you start certainly said it, like three or four different ways, but you have a quick sentence or two, what you'd tell your 17-year-old self, now that you've sort of had this fantastic sort of career.

D Dr. Alec Gallimore 23:13

Oh, my gosh, well, I would say that, try different things. Also talk to a lot of different people who are doing a lot of different things and trying to understand what makes them tick. Try to find people who inspire you and try to understand how they got to where they are, and always assume good intentions in people. And I think one of the things that's helped me in my career, others can judge whether or not it's been a good career or not, so far, as I tend to have a sunny disposition, shall we say, have full view of things. And I like that. And that's maybe how I'm wired, if you will, but I think assuming good intentions and looking for the sunny side of any type of situation, easier said than done. But if one can do that, I think one comes out of situations on balance.

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Ed Clemente 24:10

So speaking of sunny side, your last question is, even though you're from New Jersey, I think originally, you've lived in Michigan now you said 30 years, right? At least. What do you like best about living in the state?

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Dr. Alec Gallimore 24:23

I love the diversity of the state in myriad of ways. I like the diversity in terms of different type of geological and geographical diversity. I mean, the lakes are just amazing. I love the fact that Ann Arbor is a small city. Detroit is a not-so-small city. I love the farms. I love the UP, go camping, they're all the time and so on and so forth. And of course, the water and the dunes and everything like that. I think that's just wonderful. But I also love the fact that the state of Michigan has a very diverse population. You have a lot of rural folks, urban folks, you have people from different backgrounds. You have a lot of transplants, especially that come to Ann Arbor, Michigan. So it's just a rich environment to be in. And I like to say the thing about Ann Arbor I like, it's got a lot of cool different neighborhoods. I say it has a lot of nooks and crannies.

E

Ed Clemente 25:21

Well, once again, our guest today was Dr. Alec Gallimore, and he is the dean of engineering at the University of Michigan. Also a rocket scientist, as you could tell, but we appreciate you Alec taking the time to do this today. And maybe we'd get you back on the show sometime in the future because I'm sure there's a ton of other projects you probably didn't get a chance to get to, too.

D

Dr. Alec Gallimore 25:43

Ed, thank you. I enjoyed myself and any time you want me back, I'll be happy to join.

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Ed Clemente 25:49

Join us next week where a guest is going to be Ray Maczik. He's the president of The Standing Company, a unique company that helps people with disabilities.

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Dr. Alec Gallimore 25:59

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