

Bringing the Right People Together

Keck Institute for Space Studies

The Keck Institute for Space Studies (KISS) was established at Caltech in January 2008 with an eight-year grant from the W. M. Keck Foundation totaling \$24 million. The institute is a “think and do tank” whose primary purpose is to bring together a broad spectrum of scientists and engineers for sustained technical interaction aimed at developing new space-mission concepts and technology. *ENGenious* sat down with the two leaders of this unique institute to understand the secrets of their great success. The KISS director is Thomas A. Prince, who is also a Caltech physics professor, and the managing director is Michele Judd.

ENGenious: What has been the primary purpose of the Keck Institute for Space Studies?

Judd: Our goal is to have a positive impact on future space missions. We do this in three very different ways. The first and foremost is holding small and intense studies/workshops and then following up on any great ideas generated; this follow-up takes the form of investing technical development funds that can flesh out the idea to a point where it can be picked up by NASA or some another agency. The second way is identifying and supporting the development of the future leaders (grad students and postdocs) in the field. Finally, we want to keep the public engaged and excited about space exploration, such as through our lecture series and symposia.

Prince: In addition to space missions, we want to come up with new concepts for broad areas of space science and engineering. This includes looking down from space at Earth and looking out into space from the ground. As one example, we’ve funded the development of telescopes and observations on the ground of small near-Earth asteroids. Another example is supporting measurements of greenhouse gases in the Los Angeles basin. Space exploration means both going out there and doing observations from the ground. Critically

important in all of this is bringing the right people together to investigate the concepts. If you have the right team, it’s just magic. We try to bring together people who wouldn’t normally be in the same room together. Again and again, we have seen that by engaging people from different backgrounds in the creative process, we get totally new results that would not have happened any other way.

Judd: We work really hard to create this collaborative environment. For example, each study or workshop starts off with a short course where each discipline presents its fundamentals, so there’s an early sharing and establishment of a common vocabulary. The problem we are investigating needs to be framed specifically enough that we can get something out of it, but broadly enough that we can have different ideas to solve it. Then we encourage highly interactive discussions with the group as a whole, small subgroups, and between individuals.

ENGenious: What makes KISS unique?

Prince: All our studies involve people from campus, JPL, and the external research communities. Therefore, if a new idea arises out of one of our studies or workshops, it’s jointly owned by all of those people, and that’s very powerful. That mix of

people allows new ideas to come out but also to be followed up on. One of my criteria as director is that I want to see a path forward after our study ends. For example, we did a study of the advantages of using a high-altitude airship to do science that would normally go on a satellite. One such advantage is that you can retrieve it, and these are airships that can maneuver. The workshop participants took the ideas from the study and went on to make a successful NASA Centennial Challenge proposal for a demonstration of high-altitude airship observations.

ENGenious: How do you know that you’ve been successful?

Prince: Number one is if the group of people that we brought together feels like they’ve had an excellent experience in investigating the topic. The next level of success is if a plan emerges for how to implement the ideas that came up in the study. Lastly, although we don’t require it, we are extremely happy when an entirely new idea comes out of the study, an idea that would not have happened without KISS.

Judd: The most common comment that we get back on our study evaluations is, “You brought together people that would never have spoken to each other.” People are very happy they had that opportunity.

Prince: Quite a few people also have said that they were thoroughly spoiled by going to a KISS workshop because it’s so different from most other conventional workshops.

Judd: Our job is to make it the most pleasant experience with the least burden logistically for the study participants. We’ve put so many processes in place to enable the col-



laborative effort. A KISS workshop is a workshop, not a conference. You’re not shopping your idea around. You are leading discussions. You are asking provocative questions that challenge the people in the room and the person leading the discussion, and then somebody stands up and says, “I think you’re wrong.” And it’s that ensuing debate, that collegial yet pointed debate, that really gets to the heart of the issues.

Prince: We have tried to think through in detail how to encourage deep and substantive interactions, so that in four or five days you can go from not knowing each other and being from diverse fields to having a brilliant new idea that’s going to change the future of space exploration. This requires different approaches, such as setting 50% of the workshop time for talks—but even those are supposed to be people leading discussions—and 50% for unstructured discussions, to the dinners and lunches we have where people mix in different ways, to having a poster session where the more junior researchers present their results. Every single person in that room should be comfortable with saying what they want to say at any time during the workshop.

Judd: Tom comes into the end of every session and silently observes

from the back of the room. If 50% of the people are not fully engaged in the summary of the workshop and the findings, we do not feel very good about the workshop. That rarely happens.

ENGenious: What are the elements of this success?

Judd: I think a hallmark of our success is that we try new things all the time. We find out not only what doesn’t work, but also what works better than we could have ever expected.

Prince: If you are afraid to fail, it means that everything you’re doing will be fairly mundane, and you pretty much know it’s going to work. But the really new advances come when you risk trying something that you don’t know is going to work. Picking topics that are high risk and high return is a critical but challenging part of what we do. A very important aspect of our approach is that we have a steering committee that’s composed roughly half of campus faculty and half of researchers, scientists and engineers at JPL. It’s that group that will say, “Yes, that’s the right concept at the right time.” The technology and the science are such that there’s a definite possibility of something really new and interesting developing out of the program.

Judd: When we send out proposals for review, my favorite reviewer remark is, “This is crazy, but if you could do it, it would fundamentally change the field.” That’s what we want to be doing.

ENGenious: How do your very distinct roles complement each other?

Judd: I like to joke that if we had a Venn diagram of our various skills, the only overlap we would have is respect for each other’s opinions. Tom’s a scientist. I’m an engineer. But we’re such a great team. You have to treasure those rare moments when you love and respect the people you work with and you feel like you’ve built something together that you honestly don’t think would have happened had the other person not been part of the equation. Tom handles the large-scale strategy of KISS, continually challenging the institute and the steering committee to move in new and creative directions. Once I have the broad scope of the direction we need to go in, I’m really good about finding ways to make what Tom has envisioned happen.

Prince: Michele and I sit down together and map everything from the very detailed aspects of how we do things to the strategy and how we best get concepts. We approach it from very different directions, but Michele is absolutely on-target about our big-picture objectives and how we get to them. While we have definite ways of carrying out our programs, I often say we have guidelines but no rules. And guidelines can always be changed or ignored if you have a good reason or a new idea.

ENGenious: How is KISS serving the JPL community and the Caltech community?

Prince: We’ve been very successful in establishing substantive collabora-

tions that would not have happened otherwise between campus and JPL. We're almost like a retreat center for our JPL colleagues. It's a different place, a different atmosphere, where they can be away from their everyday work and just be blue-sky about things. Also, we can provide a forum for JPL people to interact with their colleagues and especially foreign nationals. ITAR (International Traffic in Arms Regulations) must be respected at all levels, but the interaction between individuals on things that are not ITAR-controlled allows that. From the campus perspective, as director, I want to help campus investigators achieve their research goals by providing opportunities for new collaborations and by providing seed funding for new research directions. We've certainly seen it happen where a campus investigator has come into a workshop and said, "How about this idea?" And all of a sudden, the group, including JPL and Caltech participants, is off and running and investigating it and then developing plans to make it happen.

Judd: One example that ties both campus and JPL together is the first Mars study that we did in 2008, focused on understanding the history of Mars through rocks. Professor Ken Farley had not been involved with Mars at all, but he was in that study and got excited about the possibilities of actually age-dating a rock on another planet. He was able to convince the Mars Science Laboratory, which is now called Curiosity, to try to do the first age-dating of a rock on another planet, and they succeeded. This fundamentally changed the direction of his research, also impacting both campus and JPL and the wider scientific community.

ENGenious: What have been some of the pivotal or magical moments for KISS so far?

Prince: Space missions take a decade or more to develop, so I had no expectation when the Keck Institute

started that we would be having the kind of real-time impact we've had so far, with things like the first in-situ dating of a rock on another planet, having an impact on the selection of the 2016 Mars lander, and NASA adopting a version of the asteroid redirect mission. We are thus already achieving our goal of significant impact on the US space program. On a completely different scale, we are investing in the next generation of leaders in space exploration by involving students and postdocs in all of our programs, and we are reaching out to the public through our programs at Beckman Auditorium and other venues in which we have brought prominent current leaders of space exploration to Caltech, including leading scientists, policy makers, entrepreneurs, and astronauts.

Judd: Tom and I were walking down the Olive Walk one day soon after KISS was up and running. We were finally hitting our stride, and he wanted to mix it up. He said, "We've just spent two years setting up all the right processes for the faculty and JPL and the external people to hold studies. We should allow students to propose their own studies." And the very first of those was the 2011 Caltech Space Challenge, which continues today and is probably one of the most representative examples of how KISS works. If we start something and it's good, somebody else will pick it up. In this case the Engineering and Applied Science Division's Graduate Aerospace Laboratories (GALCIT) picked up the Space Challenge, and its impact continues today.

Prince: Our greatest impact, period, could be bringing together the best and brightest students from around the world for their first experience in designing a space mission. A fairly large fraction of those people will be the international leaders in space exploration 20, 30 years from now.

ENGenious: What do Caltech alumni need to know about KISS?

Prince: We strive to continue the best traditions of Caltech by doing absolutely cutting-edge science and engineering. Another is that we require students and postdocs to be part of every single one of our studies. We want to solve problems now, but we also focus on the social and human nature of research, not just the content.

ENGenious: What's next for KISS?

Prince: There's been a new space innovation council formed, and one of its goals is to support KISS in its way forward. We are very grateful for the eight years of generous support from the W. M. Keck Foundation, who were willing themselves to take a risk and allow our institute to thrive. We will now take KISS forward, building on our past success with a new base of support. I also see this transition as an opportunity to pursue new approaches and directions. As an example, we will certainly want to be substantively engaged in encouraging the rapidly developing private/commercial/public partnership in space exploration. At the same time, we have an opportunity to explore other dimensions. One is the evolving relationship between media, science, and engineering. The basic way that science is being communicated to the public is changing. I don't think that's going to be a core focus of ours, but it's an area that we can play in and be creative about making a contribution to.

Judd: I want KISS to continue changing space exploration, finding the emerging leaders, and keeping the public excited about opportunities to explore space. That's what we do best.

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Thomas Prince is Professor of Physics, Jet Propulsion Laboratory Senior Research Scientist, Director of the W. M. Keck Institute for Space Studies, and Deputy Executive Officer for Astronomy. Michele Judd is Managing Director of the W. M. Keck Institute.

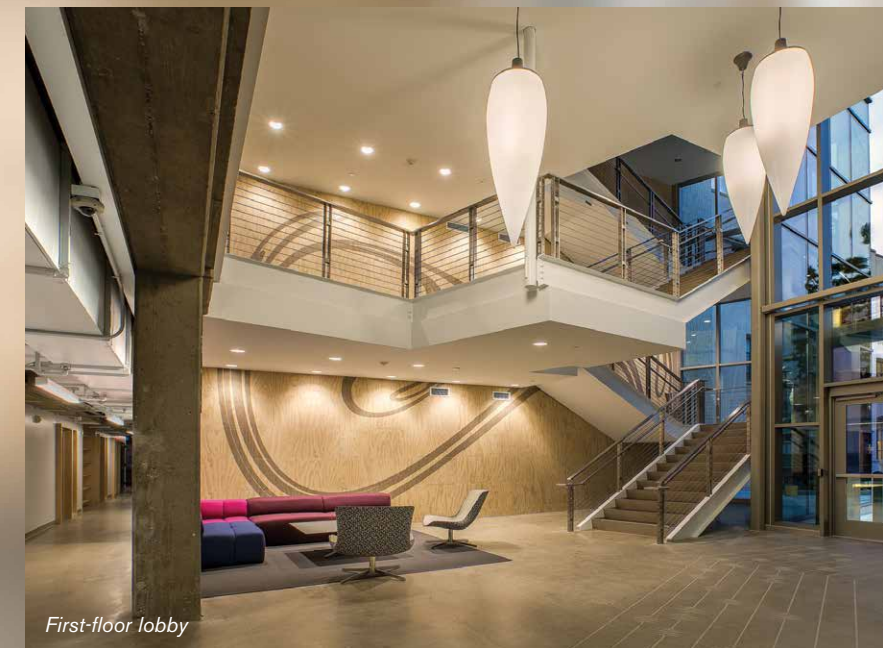
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Housner Lounge

Charles C. Gates Jr.–Franklin Thomas Laboratory

The renovation of the former Franklin Thomas Laboratory of Engineering has thoroughly modernized the facility while honoring the building's storied past and the people who helped advance mechanical engineering, civil engineering, and applied mechanics at Caltech. The original structure was completed at the close of World War II, when human space flight was still years in the future and the idea of nanotechnology had not yet been conceived. The updated Gates–Thomas Laboratory of Engineering provides new, bright open spaces where scholars and students can better collaborate and engage in experimental and computational work undreamed of when the building first opened its doors. The laboratory is named after two devoted stewards of the Institute: Charles C. Gates Jr. (1921–2005), businessman, philanthropist, and longtime Caltech trustee, and Franklin Thomas (1885–1952), civil engineering professor, division chair, and dean of students.



First-floor lobby

