



# ASTEROID HUNTERS

AN IMAX ORIGINAL FILM

## PRODUCTION NOTES

What if science could save Earth from a cosmic threat? The IMAX® original film *Asteroid Hunters* will show audiences how by transporting them into deep space for a fascinating look at asteroids, their cosmic origins and the potential threat they pose to our world. Narrated by Daisy Ridley (*Star Wars*), *Asteroid Hunters* introduces asteroid scientists -- the best line of defense between Earth and an asteroid's destructive path -- and reveals the cutting-edge tools and techniques they use to detect and track asteroids, and the technology that may one day protect our planet. The effects of an asteroid impact could be catastrophic and while the current probability of an event in our lifetime is low, the potential consequences make the study of asteroids an incredibly important area of scientific research. Witness the latest in planetary defense and how science, ingenuity and determination combine to explore the world's most preventable natural disaster.

65 million years ago, a six-mile wide asteroid slammed into our planet, ending the reign of the dinosaurs. Luckily, in today's age we have the technological advancements and scientific progress paired with the bold vision and creative thinking of the planetary defense team showcased in the film, as they work to help prevent and protect our civilization from a possible catastrophic impact from space.

Whipping around the sun at an orbital speed of 67,000 miles per hour, our planet isn't the only object zooming through the galaxy at supersonic speeds. There are also asteroids -- pieces of planets that never fully formed together due to gravitational pull -- soaring through the Solar System that pose the threat of striking Earth.

With over 200 impact craters discovered throughout the world, scientists believe it's not a matter of if, but of when a rare, large asteroid will enter our atmosphere.

Through state-of-the-art CGI, the film depicts a hypothetical asteroid as never before seen. Audiences will witness what an asteroid impact would look like on an evacuated city. The impact would cause a flash so bright it would set trees on fire miles away, shake the ground so powerfully buildings would topple, blast out a shockwave of air so intense it could knock houses off their foundations, and launch cubic miles of earth to the uppermost reaches of our atmosphere. However, this doesn't have to be the case as the planetary defense team has multiple methods to track asteroids and preventive measures to knock any rogue rock off course with our planet.

Utilizing awe-inspiring images and heart-pounding audio for a fully immersive experience, IMAX's *Asteroid Hunters* will engage audiences with the exploration of our solar system and impart how science, knowledge, and communication can be powerful enough to save the planet.

*Asteroid Hunters* has a run time of 38 minutes and is presented by IMAX in association with Huahuang Pictures

## ***Combining the power of IMAX immersion with science on a mission.***

### BRINGING ART AND SCIENCE TOGETHER:

- Nearly a decade of research went into the development of *Asteroid Hunters*. The planetary defense team's formation and discoveries happened in conjunction with the production of the film itself.
- To capture the real world of planetary defense, filming took place at restricted locations, including Goldstone in Mojave Desert, CA, Vandenberg Air Force Base outside Lompoc, CA, Haleakala atop the island of Maui, and the Aerospace Corporation in El Segundo, CA.
- The film features scientists from NASA, Jet Propulsion Laboratory, Sandia National Labs, and Aerospace Corporation. Dozens of scientists were consulted in the writing and reviewing of visual effects for authenticity.
- *Asteroid Hunters* was filmed in IMAX and mixed in immersive IMAX 12.0 channel sound. The subject of asteroids and the potential threat they pose to our world requires the largest screens and immersive, ground-shaking audio. The IMAX Experience® will whisk audiences to the ends of our Solar System to the world of planetary defense.
- The visual effects for *Asteroid Hunters* were designed and rendered under the rigorous review from experts in the field in partnership with SPIN VFX in Toronto and Shade VFX in Los Angeles. Complex aspects of astrophysics and the explosive effects of an asteroid impact had to be designed and rendered in such a way so general audiences could intuitively understand the science.
- The Delta IV Heavy is amongst the largest rockets ever filmed for an IMAX documentary. For its launch from the Vandenberg Air Force Base, two camera positions were located on the launch pad itself.
  - The Delta IV Heavy was originally scheduled to lift off on December 7, 2018. It did not go up until January 19, 2019. There were several scrubs (delays due to technical issues) and slips (delays due to weather issues). Each time we needed to return to the launch pad to breakdown or build up the heavy camera platforms and shelters, barely over a hundred feet from the rocket.
  - When the rocket finally lifted off, our cameras lost all external power and control. At some point during liftoff, the glass portals of both camera shelters were shattered. Fortunately, the launch was still captured from both cameras.
- Along with the consultation of many scientists from around the world, the film features four scientists in the film, each representing the four key aspects of planetary defense – Detection, Assessment, Impact Mitigation, and Prevention:
  - **Kelly Fast, Ph.D.** of NASA's Planetary Defense Coordination Office in Washington, D.C., represents the crucial first step in finding asteroids. You can't prevent a threat you can't see.

- **Marina Brozović, Ph.D.** of NASA’s Jet Propulsion Laboratory explains how we use radar signals, from the Goldstone Deep Space Communications Network dish antenna in Mojave Desert, CA, to assess a potential threatening asteroid.
- **Mark Boslough, Ph.D.** of Sandia National Labs and Los Alamos in New Mexico uses computer simulations generated from super computers to show the consequences of an impact, and how they are needed to plan for disaster.
- **Nahum Melamed, Ph.D.** of the Aerospace Corporation explores, through the collaboration with other scientists, concepts for methods by which we might keep an asteroid from hitting our planet.

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## **Q&A with the Principal Filmmakers of *Asteroid Hunters***

W.D. Hogan, Director  
Phil Groves, Producer/Writer  
Jini Durr, Producer

### **Q: Why did you make this film?**

**A: *WDH*** – I wanted to explore asteroid impacts and planetary defense on a canvas worthy of the scale of the subject matter and the only format that’s possible in is IMAX 3D.

I love the field of space and the natural world, but I was particularly drawn to the notion that these scientists had identified potential dangers (and opportunities) through their research and are acting *now* to prevent future disasters.

This topic is inherently dramatic, so it was exciting to have science drive the narrative. Filming in IMAX allowed us to utilize all the tools of cinema – large screens, exciting visuals, immersive 3D environments, surround sound and an orchestral score – to give audiences an unforgettable experience.

**A: *Phil*** – The science of planetary defense is a very young one, that most people don’t know about. I felt *Asteroid Hunters* was needed to show that the most *preventable* natural disaster was in fact the worst one possible, an asteroid impact.

**A: *Jini*** – I am not a scientist, but I have always been interested in science. As a lifelong learner, I cannot help but be interested in topics such as this and anything space related. For me it is a dream come to true to work on projects like *Asteroid Hunters*. I get to wake up every day and learn something new.

### **Q: What motivated or inspired the film’s creation?**

**A: *WDH*** – Phil Groves wrote the film while overseeing global distribution for IMAX. He not only wanted to shine a light on this field of science but also recognized the need for IMAX documentaries to fully embrace every aspect of the large screen experience.

**A: Phil** – When I became aware of a scientific movement to protect Earth from an asteroid threat, I felt an IMAX documentary was the best – and only – way to tell the story.

**Q: How was it to work with the featured scientists?**

**A: WDH** – They were like your favorite teachers in school! They made every detail, no matter how complex, easy to understand and come alive with their enthusiasm. I think I learned more in the hours I was with them than the years of research I did before we filmed!

**A: Phil** – Working with our featured scientists was an absolute joy. These are completely self-actualized individuals, whose “day job” is in fact their dream job.

**A: Jini** – Our scientists represent the top of their fields and not only have a passion and dedication that is inspiring, they all had the ability to take often complex ideas and share them in a way that allowed us to make them accessible and relatable to everyone.

**Q: How did you make the science of asteroids understandable for non-experts?**

**A: WDH** – The point of every film is to give the audience an experience they’ll never forget more than information they’ll likely never remember. In narrative fiction, we have the luxury of dramatic license but in documentaries we must be true to the subject matter. If information is critical but not necessarily dramatic (or even interesting), that’s where creative challenges and opportunities lay.

We approached every complex concept with a creative brainstorm on how it could be shown, heard – even felt. The stranger the idea, the more we explored it! So much of the film was realized by asking ‘*How can this be shown?*’ then figuring out ten different ways of doing it.

One example was ‘*How big are the dangerous asteroids?*’ We could have shown a graph, a chart or, worse, have someone *tell* the audience, but we thought it would be exciting (and worthy of an IMAX screen) to have large asteroids floating over massive landmarks. It’s not only a stunning and unforgettable scene, you leave having a crystal clear idea of how big they are.

**A: Phil** – A key component of scientific research is observation. The immersive power of IMAX and giant screen cinema turns abstract science into a universally relatable experience, which leads to understanding. IMAX is the next best thing to putting boots on an asteroid.

**A: Jini** – Our scientists! They had the ability to take often complex ideas and share them in a way that allowed us to make them accessible and relatable to everyone. Combined with the talents of our writer Phil Groves, Director W.D. Hogan and VFX Supervisor, Antoine Durr, we were able to create imagery that explained not only the science, but keeps audiences engaged.

**Q: How did you confront the challenge of creating an asteroid impact, something no living person has ever seen?**

**A: WDH** – It was very complex! As with everything, we began with the science.

The script laid out a specific scenario: *a 350 meter asteroid will hit barren land 100 miles from a city center*. This is in line with what real scientists and disaster agencies model as they develop emergency responses (similar to exercises at the Planetary Defense Conference).

Armed with the facts of the impact, we visualized the event with graphs, drawings, real and 3D models and a ton of storyboards. Next we figured out how best to capture the event so it was clear and understandable. Then, we explored how to utilize the IMAX format to capture the experience in a fresh and unique way.

Finally, working with our VFX company we refined the details over 18 months to ensure the science was consistently correct.

**A: Phil** – Our portrayal of an asteroid impact could not have happened without tons of study and consultation with our science advisors. We also had computer models and simulations to help us envisage this rarest of natural events.

**A: Jini** – The visual effects involved in simulating not just an impact, but a scientifically accurate impact was a long process. We started with actual scientific simulations from Dr. Mark Boslough and Brad Carvey at Sandia National Laboratories, which was a big asset. The rest was the result of hundreds of hours from computer animators, programmers and digital artists.

### **Q: What experience stands out during filming?**

**A: WDH** – There were so many incredible moments during the filming of *Asteroid Hunters*! One thing that stands out are the lengths we went to get the science right. If it wasn't a fact, it didn't make the film. If we pushed a shot into "Hollywood territory" for dramatic reasons, the science could only be *nudged*, not disregarded. It was very demanding but ultimately very satisfying.

Other moments that stood out were filming the Mission Control scenes on a spectacular set designed by Production Designer Amy Brewster. Filming an *actual rocket launch*, the Delta IV Heavy at Vandenberg Air Force Base, felt illegal it was so much fun – and is the largest rocket EVER captured in IMAX!

Finally, scoring the film with John Debney and recording our Narrator, Daisy Ridley. After assembling the film for *over* four hard years, Daisy's brilliant and compassionate voice merged with Debney's heartfelt, inspiring score to give our film a soul we only dreamt of achieving.

**A: Phil** – If I were to pick an exceptional day during production, it would have to be the filming of our Delta IV Heavy rocket launch. It's the largest rocket ever filmed for an IMAX documentary; and to be so close to this gigantic and amazing technology was an otherworldly experience.

**A: Jini** – We had an extraordinary creative and technical team. In addition, we got a tremendous amount of support from so many scientists and organizations dedicated to this new science. Our production team was just as committed as the scientists. It was a pleasure to work with people dedicated to achieving the right level of detail and accuracy.

### **Q: When did you begin the journey of making this film?**

**A: WDH** – 263 years ago. (Kidding!).

I first met with Jini Durr and Phil Groves on January 30th, 2015. They wanted to make an IMAX documentary about asteroid impacts and wanted to step outside the usual directing pool. I loved the script and leapt at the opportunity of working in IMAX 3D. I made pitch books, animatics,

storyboards, posters – anything I could think of to land the job! I’m eternally thankful to the producers and how they responded to my interpretation on the material. I believe wholeheartedly we created something special with this film.

**A: *Phil*** – Over ten years ago, I read an article about a European Space Agency mission meant to test a basic approach of planetary defense, which never got off the ground. That it died without a whimper made it clear this subject had to be better understood by the general public.

**A: *Jini*** – I think the first call from Phil was in 2008. I was intrigued from the very beginning and the topic was not new to me, I quickly realized there was a lot more to learn and this was a film that was really missing in the informal science education markets.

**Q: Was there an experience you had when making this film that stands out?**

**A: *WDH*** – Hands down, seeing the first test screening in IMAX 3D. All the intuition that went into designing large screen 3D visuals, multiple edits of the story, pushing the pace and length of shots, hoping what we were doing would work on the big screen, until finally... seeing that it *DID* work – wow, it was beyond my wildest dreams!

**A: *Phil*** – For me, the most impressive part of the film’s production was how its topic motivated everyone involved. When people realized they were playing a role in telling the world how it could protect itself from a cosmic threat, their work immediately became more than just a job.

**Q: How does making this film for IMAX screens make a difference in its design?**

**A: *WDH*** – Technically, we had to frame a considerable amount of headroom and sky so that your eye lands in the “sweet spot” of the lower half of the IMAX frame. The large screen was thrilling to play with – so much so I don’t know how I’ll go back to regular film! The 3D, however, was considerably challenging. Shooting native 3D meant we had to design our edits carefully so the audience could handle the speed of objects in the frame *and* handle cutting from shot to shot. We kept the point of interest center-punched so we could cut faster, allowing us greater flexibility in the edit. Combining 3D with large screen IMAX meant a great deal of pre-planning for each and every scene.

Narratively, I think it’s easy for documentaries to have voice-over explain a story while showing pictures in the background. Yet, audiences can only remember so much information. If they have an *experience*, especially one that hits them on multiple levels (sound, vision, music and intellect), they make it their own and never forget it. So the trick is to teach while entertaining. The challenge directing *Asteroid Hunters* was how to present information so that it’s interesting, stimulating, epic, emotional and informative. IMAX is unrivaled in this context. In a darkened theater, on a screen that extends past your periphery, sound that consumes you – suddenly you’re in an environment that informs *and* inspires.

**A: *Phil*** – When designing a film for the IMAX screen, you don’t compose the images as if inside a picture frame. You are creating an experience where the screen’s edges melt away.

**A: *Jini*** – I think we were very challenged with making it too real, if you will. We wanted audiences to get what was at stake but also understand that this is a completely preventable natural disaster. I think we managed to achieve a good balance between the science and the experience of witnessing something that has never been seen by humankind.

**Q: What do you want audiences to take away from this film?**

**A: *WDH*** – More than a series of facts about space rocks, I want audiences to have an unforgettable adventure as they learn. We stuck to the science at every turn and pushed the large screen format to provide an experience only possible in IMAX 3D. I hope *Asteroid Hunters* shows the world what’s possible in IMAX documentaries. And I hope IMAX continues to push the envelope to offer audiences movies they can’t get anywhere else.

**A: *Phil*** – In 2015, Bill Gates saw the future when he did a TED Talk about humanity’s need to prepare for an inevitable global pandemic. I want audiences to see *Asteroid Hunters* as an actionable chance to be ahead of the curve against the inevitable asteroid threat.

**A: *Jini*** – We as a species are remarkable and we can overcome anything together.

**Q: How might this film make the world a better place?**

**A: *WDH*** – *Asteroid Hunters* shows that anyone in the world can contribute to the health and safety of the Earth and that having a fact-based view of life is how we’ll survive in the centuries to come.

**A: *Phil*** – For the foreseeable future, Earth is humanity’s only home. *Asteroid Hunters* reminds us that we have the power to protect her when we work together.

**A: *Jini*** – Of all the things I could do with my life, I make documentaries because of my commitment to inspire and motivate people to be interested in science and technology. Science will save the planet!

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**NARRATOR**

**DAISEY RIDLEY** is an English actress best known for her breakthrough role as Rey in the 2015 film, *Star Wars: The Force Awakens*. She reprised her role as Rey in *Star Wars Episode VIII: The Last Jedi* in 2017 and was most recently seen in the final film in the trilogy, *Episode IX: The Rise of Skywalker*, directed by JJ Abrams. The film marked the final chapter in The Skywalker Saga and was released on December 20, 2019. Her other film credits include *Ophelia*, *Peter Rabbit*, *Murder on the Orient Express*, *Only Yesterday* and the upcoming *Chaos Walking*. She also served as an executive producer on the documentary *The Eagle Huntress* and will be an executive producer on the television adaptation of the Maggie Hope book series.

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**FILMMAKERS**

**W. D. HOGAN** is the director of the IMAX original film *Asteroid Hunters*.

Collaborating with Oscar® and Emmy® winning filmmakers as an illustrator greatly influenced Hogan in the art and design of storytelling, helping craft unique visuals and performances in a variety of formats.

Beginning in music videos and documentary, Hogan broke into features with the independent film *Soldier of God* (2005) and has since worked with Fox, NBC/ Universal, HBO and Netflix.

Hogan is a member of the DGA, IATSE and the ADG (Art Directors Guild).

**PHIL GROVES** is the writer and producer of the IMAX original film *Asteroid Hunters*. Prior to becoming a film producer, he was the EVP of Worldwide Distribution for IMAX Corporation. While at IMAX, Phil brought IMAX's slate of Hollywood event films to IMAX screens around the world, beginning with the very first day-and-date release of an IMAX DMR® title, *Matrix Revolutions*. In 2016, he was honored with the CinemaCon Passepartout Award for his "dedication and commitment to the international marketplace." Additionally, he increased the reach of IMAX documentaries to more IMAX screens worldwide. Previous to IMAX, Phil was Vice President of Film for Loews Cineplex, spending over 20 years buying film for this national exhibition chain as well as Cineplex Odeon, and General Cinema.

Before his executive film career, Phil earned screenwriting credits or storyboarded a number of films including the comedy classic *Airplane!*, created on-screen graphics for television's *Wall Street Journal Consumer Newsline*, and published comic books as writer and illustrator. During his childhood in Maryland, he was a passionate fan of space exploration.

**JINI DURR** is a producer of the IMAX original film *Asteroid Hunters*. Durr is an award-winning producer with over 25 years of experience in the giant screen and special venue production. Her passion is bringing state-of-the-art technology to storytelling. Her credits include producing several ground-breaking films for National Geographic Studios including *Mysteries of the Unseen World*, *Sea Monsters: A Prehistoric Adventure*; *Robots 3D* and *Wildest Weather in the Solar System* for the fulldome. She was also supervising producer on Tom Hanks' *Magnificent Desolation: Walking on the Moon*, produced *Roar: Lions of the Kalahari* for National Geographic, co-produced *Siegfried and Roy: The Magic Box* and was VFX Producer on IMAX's *T-Rex: Back to the Cretaceous*. Durr is currently the producer of the first show for Madison Square Garden's Sphere, the largest spherical venue in the world, opening in Las Vegas in 2021. She holds a Bachelor of Arts in Rhetoric and Film from the University of California, Berkeley and is a member of the Director's Guild of America. She resides in Culver City, California with her husband and daughter.

**DONALD K. YEOMANS, Ph.D.** is the principle science advisor for the IMAX original film *Asteroid Hunters*. Dr. Yeomans was a Jet Propulsion Laboratory (JPL) Fellow and Senior Research Scientist before his retirement in 2015. Starting in 1998, Yeomans was the manager of NASA's Near-Earth Object Program Office at JPL, now called the Center for Near-Earth Object Studies, an office that is responsible for providing predictions for future close Earth approaches and impacts by comets and asteroids. Yeomans other professional achievements include being the Radio Science team chief for NASA's Near-Earth Asteroid Rendezvous (NEAR) mission, the NASA Project Scientist for the successful Japanese mission to land upon, and return a sample from, a near-Earth asteroid Itokawa and a scientific investigator on NASA's Deep Impact mission that successfully impacted comet Tempel 1 in July 2005 and flew past comet Hartley 2 in November 2010. He also provided the accurate predictions that led to the recovery of comet Halley at Palomar Observatory on October 16, 1982 and allowed the discovery of 164 BC Babylonian observations of comet Halley on clay tablets in the British Museum. More recently, Yeomans co-authored a book draft on NASA's Near-Earth Object Program – a work that will be released as a NASA history book. Asteroid "2956" was renamed asteroid "2956 Yeomans" to honor his professional



achievements and in 2013, Yeomans was named as one of the 100 most influential persons by *Time* magazine.

**JOHN DEBNEY** is the composer for the IMAX original film *Asteroid Hunters*. An Academy Award® nominee (Best Achievement in Music Written for Motion Pictures, Original Score: *The Passion of the Christ*, 2004), Debney has created a variety of works across many genres and as a highly collaborative artist, has worked with an array of top-level producers and directors across Hollywood films, video games, television series and documentaries. Debney combines his classical training and a strong knowledge of contemporary sounds to easily adapt to any project.

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## **FEATURED SCIENTISTS**

**KELLY FAST, Ph.D.** is the Near-Earth Object Observations Program Manager for NASA's Planetary Defense Coordination Office. She earned her B.S. in Astrophysics from UCLA and her M.S. and Ph.D. in Astronomy from the University of Maryland. She investigated ozone and atmospheric chemistry on Mars, winds on Titan, and the effects on Jupiter's stratosphere of small body impacts as an astronomer at NASA's Goddard Space Flight Center before coming to NASA Headquarters in 2011. Previously a visiting astronomer at NASA's Infrared Telescope Facility (IRTF) on Maunakea, Hawai'i, she is also now the IRTF Program Scientist. She served as Program Scientist for the MAVEN mission to Mars and led NASA's Solar System Observations, Planetary Astronomy and Planetary Atmospheres research and analysis programs.

Main-belt asteroid 115434 (2003 TU2) was renamed "Kellyfast" in honor of her contributions to planetary science. Known for belting out a song and producing YouTube's "Hotel Mauna Kea", she also enjoys Star Trek, Space:1999, crochet, and ham radio, holding Amateur Extra license class callsign N3XUJ.

**MARINA BROZOVIĆ, Ph.D.** received her B.S. in physics at the University of Zagreb in Croatia and a Ph.D. in physics from Duke University. She was a postdoctoral scholar at the California Institute of Technology. She has been working as a radar scientist and an orbital dynamicist at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California since 2007. Dr. Brozović observed more than 200 near-Earth asteroids with radar, and she was involved in the discoveries of a dozen binary and three triple asteroid systems, fourteen moons of Jupiter, and several Trans-Neptunian Objects. Dr. Brozović worked on the NASA's New Horizons mission to the dwarf planet Pluto as a part of the Hazards Team, and she is currently on the Investigation Team for a planned NASA's infra-red space telescope called Near-Earth Object Surveillance Mission (NEOSM) that will search for asteroids and comets that can endanger Earth.

**MARK BOSLOUGH, Ph.D.** is the Chair of the Asteroid Day Expert Panel (ADXP). He received his B.S. in Physics from Colorado State University in 1977 and his Ph.D. in Applied Physics from Caltech 1983. He was member of the technical staff at Sandia National Laboratories from 1983 until 2017. At Sandia, he worked on many aspects of planetary impact physics, including Comet Shoemaker-Levy 9 impact models, formation of the Libyan Desert of Egypt, the 1908 Tunguska explosion, the 2008 TC3 airburst over Sudan, and impacts on Jupiter in 2010 and 2012. He now works on planetary defense at Los Alamos National Laboratory and serves as a research professor at the University of New Mexico.

Boslough served on the asteroid mitigation panel and coauthored the NRC report “Defending Planet Earth” in 2010. He was the first US scientist to visit the site of the 2013 Chelyabinsk airburst, as a participant in a NOVA documentary. His simulation of that event appeared on the covers of Nature in November 2013, and Physics Today in September 2014. He provided information and simulations of airbursts for disaster scenarios for FEMA tabletop exercises in 2013, 2014, and 2016, and helped develop impact scenarios for every Planetary Defense Conferences since 2013.

**NAHUM MELAMED, Ph.D.** is a project leader in the Embedded Control Systems Department in the Guidance and Control Subdivision at The Aerospace Corporation. He joined Aerospace in 2003. As a technical lead in Launch Vehicle Software, Melamed coordinates and guides a team of interdepartmental technical experts, and supports independent validation and mission readiness certification of the flight software and mission parameters for the Interim Cryogenic Propulsion Stage (ICPS) on top of NASA’s Space Launch System (SLS). He serves as the management, program office, and contractor FSW point of contact on the program.

During his tenure at Aerospace, Melamed has demonstrated a corporate educational standard for knowledge and competency in space systems engineering. He conducts planetary defense technical and policy studies, co-chairs planetary defense conferences, serves on exercise organizing committees, and speaks at these venues.