

# **HEAVY METAL JUPITERS – WEDNESDAY**

**edited by Heather Clitheroe and  
Jessie L. Christiansen**



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*edited by Heather Clitheroe and Jessie L. Christiansen*

*Aedan Gardill, Erin Anderson, Howard Tayler, Sylvia Spruck  
Wrigley, and Laurence Datrier*

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# SUPER-EARTH

HOWARD TAYLER

“I’m not really trained in xeno-negotiations. I’m a linguist.”

“Nobody is trained in xeno-negotiations. A terrible oversight, because despite the fact that the delegation from Kepler-218ob spent forty years getting here, they’re about to pack up and leave over something we said.”

“Am I supposed to convince them to stay?”

“That would be wonderful, but we’ll settle for finding what we said wrong.”

“Then you should be telling me what you actually said.”

“It was mostly historical stuff, about how the Kepler program discovered their planet, and how excited the previous generation of Earth’s astronomers were to find a super-Earth that not only could support life, but which was also emitting radio in the water hole.”

“Mm-hmm. Have you considered that Earth’s claim to have ‘discovered’ their planet might perhaps be offensive?”

“I am told that we translated ‘discovered’ as ‘learned a great secret through meticulous observation.’ The alien delegation seemed to like that. They hold their planet in pretty high regard, which makes sense.”

“You’re translating into their language, then? You’re not saying anything to them in English? And *please* tell me you’re not using the word ‘alien.’”

“We compose everything in English, and then one of our synthetic intelligences translates it into the alien language.”

“Oh dear.”

“Sorry, the ‘visitor’ language. And, it was going fine until we started into the technical stuff, like how we knew their world’s orbital period and its mass.”

“I can see how ‘technical stuff’ might be a problem. English is a terribly ambiguous language.”

“I’m not a linguist. I’ll take your word for it.”

“I misspoke. I said ‘terribly ambiguous.’ I should have just said ‘terrible.’”

“I assume that is why we are translating, rather than letting our visitors do it.”

“Have you refined your dictionary for contextual differentiation between, oh, say, the name of our world, the words from which the name originates, and the unit of measurement you use in your broad-brush descriptions of the ‘super-Earths’ found by Kepler.”

“I just told you I’m not a linguist. That’s why we need you.”

“I’ll help you compose an apology.”

“Was it something we said?”

“I’m guessing, but I think things ran off the rails when you told them how surprised you were to find intelligent people living on a too-big dirt.”

# Orion Nebula

AEDAN GARDILL

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# The Missed Connection

SYLVIA SPRUCK WRIGLEY

Rocky the asteroid trembled and shook as it returned to the belt to report its failure.

“What do you mean, you missed?”

Rocky shivered, as if he were made more of ice than mineral. “I mean, the planet was there one minute and then gone the next.”

“Gone? GONE? It was in *orbit*. How far could it possibly go? A gas giant, no less. We couldn’t make it any easier for you.”

“It was spinning so fast and...I don’t know. I swear I’ve been studying my planetary dynamics and orbit variations. There were six planets in the system and I waited and watched them and then aimed for the inner planet. But it just...swerved out of my way.

“You are telling me the planet, which has been in orbit for millennia, swerved out of the way when it saw an asteroid bearing down on it.”

“It did! I saw exactly where it was and braced myself ready for impact and then I was out the other side and the



planet was on the wrong side of the sun, totally out of sync with the other five planets.”

The weary voice of the belt echoed through the soundlessness of space. “We just want what’s best for you,” it said. “A quiet life on an unpopulated planet, buried deep. You don’t want to end up being mined for rhodium, now do you?”

“No.” Rocky struggled not to sound petulant. “I didn’t *mean* to miss. This planet was not like anything I’ve ever heard of.”

“What did we teach you? Use the outer planets for visual checks. Check the plane, predict the orbit, plan your trajectory.”

There was nothing left to say. Rocky stared balefully at the star, catching only dim glimpses of the six planets orbiting it.

The belt’s voice was soothing as he prepared for another go. “Just trust in yourself,” the belt told him. “It’s not rocket science.”

The audience laughed as Rocky the Asteroid faded to black. It was silly, sure, but Leisha had enjoyed it. And she was glad she’d watched it with George. They strolled together through the floating park to a drinks unit, where George keyed in his code. Red wine appeared.

Leisha liked him. Maybe even liked him a lot. The evening was warm and balmy and the conversation flowed and the wine was delicious: a perfect evening out. That is, until she mentioned where she was from.

“266b,” she said.

“Nice.” George nodded, as if he knew it, which impressed her. He refilled her glass and then looked into her eyes, his own twinkling in the moonlight. “I’m from Maakond.” He used the colloquial name rather than the designation,

which she thought was rather sweet. Later she could look up where, exactly.

“This is lovely.” She took another sip and he smiled, leaning just a fraction closer towards her.

“It seems that our stars are aligned. The heavens themselves, the planets, and this center...” His voice trailed off as he stared into her eyes and then glanced down to her lips.

So. Apparently he did not actually know 266b. Leisha appreciated the attempt at being romantic but nevertheless gave him a factual answer which was, she thought, much more interesting than Shakespeare. “Actually, 266b is famously mis-aligned. It’s on a different plane from the rest of the system. Out by twelve degrees.” She smiled back at him. “It’s a USP.”

“Unique selling point,” he said, nodding to show that he understood her, although he clearly had no idea what she was talking about. “I believe it!”

“Ultra-Short Period,” she said. “Like Rocky’s planet.”

“It swerved,” he said.

Leisha stared at him for a moment and thought hard about how to explain her home to him. “Right. OK, have you ever read the Little Prince?”

He had not. He leaned closer to her. “You are a princess though, I think. A planetary princess. You are out of this world!” He beamed at his own joke. She leaned back. It was a shame. He seemed like a nice man: handsome, friendly, good teeth. If only he didn’t talk so much.

She tried again. “How long is a year, on Maakond?” She wished she knew its designation, as his understanding of the universe was starting to seem rather suspect.

“A hundred and seventeen days.” He leaned closer to her. “And every year would be a joy to spend with you.”

If only he would stop hurling hyperbole at her. “Right, but for me, a year is over in an instant. The sun rises and sets and another year is gone, sometimes two. On a Monday, it’s usually two.”

He smiled winningly again, flashing those fantastic teeth. “So when someone says they will love you for a hundred years, it doesn’t make your heart beat faster?”

“A hundred days would be longer,” she said. She let go of her wine and a small drone appeared to hold it in place. Too long either way, she thought.

“Really! So in that case... how many years old are you, really?”

“Well, that’s a very old fashioned question. I don’t think I could answer it. Thousands of years.” She laughed but it was strained. Clearly it was time to call it a night. “I’m afraid I might be too old for you.”

She was considering how to make her goodbyes when she noticed he was no longer trying to look deep into her eyes, or indeed look at her at all. His attention was on a pretty brunette on the far side of the park.

“Well, yes, you may be at that. You’ve watched the changing of the seasons for centuries where I am only just beginning.” He stood. “Let’s call it a night,” he said. “Call it a missed connection.” And a moment later, he was standing next to the brunette, pointing at the drinks unit as an invitation to join him.

Leisha watched for a moment. A missed connection. Maybe it really was because she was from a mis-aligned planet. Maybe she was just slightly out of sync with everyone else, just like Rocky’s planet, always at the wrong place at the wrong time. She picked up her glass of wine and walked to the edge for the zipline back to the main deck. Or maybe it was just a lucky escape.

# The Rogue Planet

ERIN ANDERSON

Strapped into the seat of the cockpit the pilot grimaced as the radio continued to beep. Taking one hand from the main controls, she punched the call button with the automatic muscle memory born from months of training.

“Captain Russell,” bleeped the radio in a tinny parody of her commanding officer’s voice. “Are you sure about this? I know what the exobiologists say, but there’s no reason that this can’t be an unmanned probe.”

Russell rolled her eyes. The press must be crowding him pretty thick to make him call her ‘Captain.’ So much for a quiet launch. Sedna 5 was a small world on the edge of human space and the alien fleet towing a rogue planet was all anyone wanted to talk about. She should have known that there was no way she would get off the planet without at least a dozen news agencies trying to get an interview.

“Do you want me to quote my official statement or do the vultures need something fresh?”

There was a garbled argument on the other end of the line. Russell caught the phrase “I told you she wouldn’t like to be bothered during checks,” before her commander took

his hand off the microphone again. “Stacy, listen. This isn’t about the press, I just... Everything we know about this rogue planet tells us that it is dangerous. We have no reason to think that a manned ship will do anything to convince them to change course, hell, they probably won’t even if we packed the president in there with you.”

“With respect sir,” Russell said for the sake of the microphones pressing in around the Commander, “I’m not some maiden sacrifice here. If anyone’s got the interspecies relations training and piloting skills, it’s me.”

“You know it’s not a matter of qualifications,” the Commander groaned into his microphone. Even from the cockpit of her ship, Russell could imagine him rubbing at his mustache the way he always did when he got worked up. “If it comes to war, we’ll need you here.”

Her hand hesitated over the preflight checklist as she considered how to respond. In the months that had followed the first sighting of the approaching giant rogue planet she’d heard plenty of experts, politicians, and news shows calling for war with the alien world, but she’d never heard her Commander say the word aloud.

Back on Earth, that distant human homeworld that Russell had never seen, people were blaming everything from dying suns- to an overcrowded homeworld- to intergalactic conquest for the aliens’ mass migration towards Sedna 5. Even Captain Russell had to admit that bringing a whole planet seemed like a poor way to travel.

“Sir,” she said carefully. “I know that this is a long shot, but if these aliens can be reasoned with – I know – I know sir, it’s a big ‘if’ but I can’t miss this chance. This is our last window before the rogue planet enters orbit. It’s now or never.”

Static crackled over the radio as her Commander put his

hand over the microphone again. Russell took the time to finish her last few checks and adjust the straps that would hold her in place for the launch into space.

“Well it’s too late for this argument anyway,” grunted her Commander. “Do what you have to, we’ll be right behind you.”

For the first time since boarding the ship, Russell felt her gut tighten. The thought of the warheads already aimed at the rogue planet, but the thought of her corresponding flightpath and their shared target was enough to make her stomach clench. Russell shook herself and went back to her preflight checks.

“Acknowledged.”

“You are cleared for launch, Captain,” he hesitated and Russell could imagine the press leaning their microphones closer. “Good luck, Stacy.”

###

Blasting through the planet’s atmosphere, the sleek little ship streaked away from Sedna 5. It zipped past the small moons of the lonely little world, glittering with settlements, and into the blackness of space. It was a lonely system, just the one planet with its little moons. On her viewscreen, Russell watched her homeworld fade into the black until it was little more than a single glowing point in the stars. Despite her time in the intergalactic navy, she had never been farther than the outer ring of this system, let alone seen Sedna’s 1 through 4 or Earth, and to be honest, she didn’t need to. So long as she could come home to Sedna.

Now that she was safely out of orbit, Russell entered the sequence to activate the Autopilot. It would be good to go over her speech to the aliens one more time. For weeks

scientists from various universities had blasted datastreams and radio signals laden with basic images and sound bites to make a basic translation packet for the aliens. No word had come back from the strange planet or its entourage. Russell's own stripped down ship had originally started life as a probe to try and communicate with the aliens, that was until the government found out there was room for a passenger.

The engine rumbled under her as Russell turned the autopilot off for her final approach and piloted the ship towards the approaching extrasolar planet. The gigantic migrating world grew steadily in her viewscreen and she adjusted her rate of approach. At some point the surface of the strange planet had been stripped to a barren layer of rock, all sickly gray and brown so that the whole thing looked about as habitable as a graveyard.

Around the dead world a fleet of ships swarmed like minnows circling a corpse. Puny by comparison, the alien ships must have been the size of the biggest interplanetary shipping cruisers. Rather than the obvious top and bottom of human designs, these ships had a radial symmetry that reminded Russell of a starfish pointed at her. It was a good thing that they were in space as their bulging limbs and squat hulls looked about as aerodynamic as a potato.

Adjusting the speed of her approach, Russell maneuvered her ship into a non threatening cruising speed alongside one of the bigger ships and turned on her broadcast system with the flip of a switch. It was impossible to know how advanced the strange alien's communications were, but if they had managed to move a behemoth world like that they must have something.

Russell cleared her throat for the moment of initial contact. "Uh, Hello?" She asked lamely. "This is Captain

Stacy Russell, from the Planetary Council of Sedna 5, broadcasting on all signals. Can you understand me?"

She could see herself in the video display and hoped that, if her homeworld remembered this moment in history books, that no one included her stupid face. She felt silly. Even if the aliens had translation software there was no way the program included English. They might not even use sound to talk to each other.

Still, the nerds back home assured her that it was the attempt that mattered and she pressed on. "We know you've brought your own world, but it won't survive capture by our sun's gravity. It's going to break up."

Background static continued to buzz fitfully back at her from the empty screen, all the while the massive extrasolar planet continued its steady march towards the solar system. She checked her communication array where the prerecorded animation of the rogue planet's destruction was playing. Even if the aliens couldn't understand her, surely they would be able to make the connection between the images of their world and the physical planet they were towing.

"Come on," Russell grumbled, "Put it together."

Hanging in the dark, Russell waited. Then through the speakers on her control board a garbled, bleating sound that made her hair stand on end followed by a familiar voice. "Goodnight. Friendship."

Russell knew that voice. She'd heard it in her briefings for the mission. The aliens were playing back the same sound clips from the translation package.

Her heart racing with excitement, Russell leapt to her com. "Hello, ExtraSolar Planet. Can you understand me?"

Again that harsh gibberish noise followed by "Friendship. Home. Bring."



“I can see that,” Russell said into the microphone. “But your home isn’t going to make the trip. It won’t survive capture in our sun’s gravity and if we don’t break it up soon, it might affect our homeworld. Do you understand?”

“Give. Thank. Bring. Home. Friendship. Take.”

“We’ll only be firing at the planet, not your ships,” Russell tried. “But your home can’t come here. No planet. No planet.”

“Thank. Friendship. Planet. Bring.”

“Do you understand me? No planet!”

But if the aliens could understand her messages they weren’t slowing down. If anything the ships seemed to be speeding up. A scowl formed in Russell’s brow and she took the helm to steer her ship closer to the ships. She was right; the thrusters on the alien ships had increased their output. The fleet was speeding up.

“Stop!” Russell called into the comms, “You’re going to be blasted to bits!”

“Friendship. Have. Bring. Home.” The aliens weren’t listening. Like sheep following each other into the slaughter pen, the ships and their massive cargo raced each other towards the star at the center of the solar system.

The light on her radio to ground control beeped patiently to itself, but Russell didn’t have time to chat. “Listen to me!” She begged into the microphone. “It won’t survive the gravity anyway! Even if we hold our fire, your planet can’t survive this close to the sun!”

It had been a long shot from the start. She shouldn’t have been so surprised when the aliens failed to understand her.

Growling in frustration, Russell slapped a hand over the flashing comms alert with one hand and seized the controls with the other. The little ship rocketed to the front of the

fleet, twirling up and around in an impressive display of piloting, trying to block all of the ships at once.

“Ground control to Captain Russell,” bleeped the voice comm. She couldn’t see the screen without looking away from the flight controls but she could recognize Commander’s voice. “Stacy, can you hear me?”

“They’re not slowing down!” Russell snarled. “We need more time to make some kind bridge for communication.”

“You know their planet doesn’t have that kind of time,” the Commander’s voice echoed from the radio. “If we don’t break up that gigantic planet they’re toting, we’ll be putting our planet at risk too.”

“I need more time!”

“Get out of the way Stacy. You know the arrangement!”

Growling a curse, Russell punched the comm controls hard enough to hurt her knuckles through her gloves. The voice signal flicked off as she blasted her little ship around to face the rapidly approaching planet.

“Go back!” She screamed, flashing the destruction animation on every signal she could. On her view screen the little scene played out again and again. The extrasolar planet breaking up into chunklets, scattering around the sun, and flickering back to start all over again. “Go back!”

It was too late. Either from the strain of the engines propelling it forward or from the cruel gravity pulling it apart, the rogue planet began to shatter. In horrible silence, Russell watched pieces of the rogue planet begin to break off like dust being blown off a forgotten book. Pieces began to tear themselves from the sides of the planet, huge chunks of stone ripping free as the gigantic world began to disintegrate. Silent explosions tore through the rogue planet as it broke apart. By the time the warheads hit the planet, it was just a formality. Speeding up the natural

process of termination, her planet's defense force ripped into the rogue world, blasting it into rubble. Dust and rubble streamed behind the disintegrating world in a long train of destruction as what was left of the planet crumbled into a ring of broken pieces.

"Damn!" Cursing alone in the void of space, Russell pounded her fists uselessly against her forehead. If they only had more time to establish contact.

And through her comm system came the familiar recording play with the same horrible monotone. "Bring. Have. Planet. Home."

Something flashed on her viewscreen, breaking Russell from her frustration. In the wake of such destruction, she had entirely forgotten about the alien planet's fleet of ships. Without the central planet to rally around the smaller vessels looked confused, zipping around in the rubble like lost children. It hurt her heart to watch them circle the broken pieces of the planet, already forming a protoplanetary disk around the central star.

She watched the little ships, picking out bigger pieces of their former world and towing them sadly behind them into clumps. Russell frowned. This didn't look like mourning. It looked like construction.

Metal ants in a celestial picnic of crumbs, the alien ships zipped and swooped through the rubble, collecting the broken pieces of their former world and speeding up the natural process of planetary formation. Already two or three masses were collecting in the ring of debris left behind from the extrasolar planet.

Groping blindly, Russell fumbled for the voice line. "Ground control, come in. This is Captain Russell."

"This is Ground Control. Are you okay, Stacy?"

"Yeah, yeah, I'm fine." She could hear the sigh of relief

from her Commander all the way in space. “But I don’t think the aliens were bringing that rogue planet all the way out here to live on.”

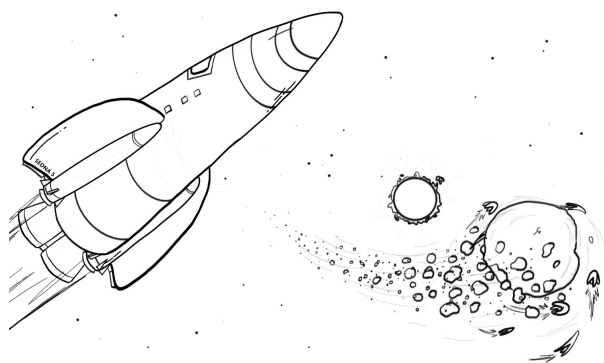
“They weren’t?”

“No,” her eyes glued to the construction fleet, Russell watched the rocky bodies growing in the disk of debris. “It wasn’t an old world they were trying to bring with them. It was material to start building new ones.”

Outside her ship, Russell could see the alien fleet, diligently bringing the pieces of raw material together, new planets forming in the debris of the old one. Planetary embryos and mini-Neptunes, growing around her sun. New neighbors for her lonely world.

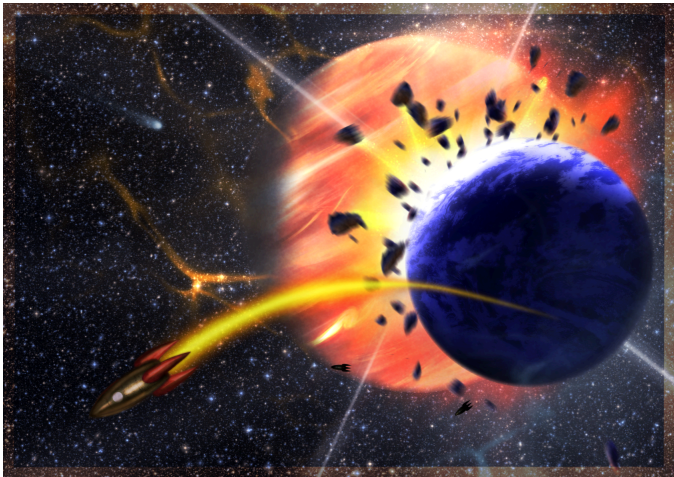
# Rogue Planet

ERIN ANDERSON



# Untitled

LAURENCE DATRIER



# About the Contributors

**Cathrin Machin** is one of Australia's fastest growing contemporary artists, with a reputation for boldly engaging the primal questions covering the basis of reality and existence. Born in Newcastle-Under-Lyme, England in 1986 – the youngest child of an inventive hard-working couple who ran a small clothing business attached to the family home. From an early age, Cathrin spent countless hours contemplating the stars and watching science documentaries, leading to a life-long obsession with science, reality, and the depths of space.

After studying mechanical engineering at Loughborough University, England, she embarked on a decade-long career in the video-game industry, culminating in her leading a project that won “Best Australian Video Game 2015” in the IGN Black beta awards. Shortly after she chose to follow her ambitions to become an artist. Having started painting in 2016, she has gone on to host a solo gallery exhibition in Sydney Australia, has hosted the highest crowd-funded painting project in the world, and holds the record as Australia's highest crowd-funded artist of all time. This has allowed her to develop a

huge client list that stretches to every corner of the globe and includes several prolific scientists, science communicators, and chief officers from top fortune 500 companies.

Always starting from a black canvas, the artwork uses prime coloured oil paint and phosphorescent pigments in bold gestural strokes combined with subtle smooth gradients that explore a sense of flow, density, and luminosity. They allow the viewer to contemplate the sheer scale of the universe and how we as individuals fit within it. Ultimately, Machin's work strives to ask the biggest questions one can – “Why are we here, where did we come from, and what does it mean?” In addition to her abstract space forms, she works with several astrophotographers and compiles images that are then painted to represent real outer space phenomena.

Cathrin's artwork is featured on the cover of each of the 'Heavy Metal Jupiters' zines.

**Howard Tayler** is the writer and illustrator behind *Schlock Mercenary*, the science fiction comic strip (now concluded, after two decades of daily installments). He also co-hosts the Hugo and Parsec award-winning “Writing Excuses” podcast, a weekly 'cast for genre-fiction writers, with Mary Robinette Kowal, Brandon Sanderson, and Dan Wells.

He is currently on sabbatical, allowing him to participate in exoplanetary sorts of things while re-tooling for his next big project.

SUPER-EARTH is inspired by Martin Schlecker's 'A Compositional Link Between Warm Super-Earths and Cold Jupiters' presentation abstract. *Recent demographic studies have suggested a positive correlation between the occurrence rates of inner super-Earths and outer giant planets, challenging some*



*established planet formation theories. Using global simulations that model the evolution of a protoplanetary disk and planetary growth via core accretion, we have produced a synthetic population of 1000 multi-planet systems that qualitatively confirms this observation. A peculiar trend emerges when we associate the disk initial conditions with the bulk composition of the resulting planets: in disks of moderate solid content (~100 Mearth), super-Earths form from icy material beyond the water ice line and migrate to observable distances. No giant planets are formed. On the other hand, in massive disks (~>200 Mearth), dry super-Earths form on close orbits and are frequently accompanied by an outer gas giant. This results in the testable hypothesis that high-density inner super-Earths are proxies for cold Jupiters in the same system. I will discuss how a confirmation of this prediction would constrain central open questions in contemporary planet formation theory, ranging from efficiency of pebble accretion to planet migration behavior.*

**Aedan Gardill** is a physics graduate student at the University of Wisconsin Madison, studying solid state defects in diamond. He is also a two-dimensional artist, working in paint, printmaking, and mixed media, and creates artwork that highlights the life and work of underrepresented scientists. You can find more of his sketches on his Instagram [@AedanGardillArt](#) and his artwork at his website [www.aedangardill.com](http://www.aedangardill.com).

**Sylvia Spruck Wrigley** obsessively writes letters to her mother, her daughter, her accountant, as well as to unknown beings in outer space. Only her mother admits to reading them. Born in Germany, Sylvia spent her childhood in California and now lives in Estonia. Her fiction has been nominated for a Nebula and her short stories have been

translated into over a dozen languages. She has been writing full-time since 2016, including bespoke near-future science fiction for Thales and NATO. You can find out more about her <https://intrigue.co.uk>.

‘The Missed Connection’ is inspired by Juliette Becker’s ‘The Origins of Multi-Planet Systems with Misaligned, Nearby Companions’ presentation abstract. *Ultra-short period planets provide a look at the inner edge of the allowed parameter space for planetary orbits. One particularly intriguing geometry of system containing ultra-short period planets is high multiplicity systems where the ultra-short period planet and the outer planets exist in two different dynamical states. This has manifested in the observational data as a small number of stars hosting systems of tightly packed coplanar inner planets as well as an ultra-short period planet, where the orbit of the latter is misaligned relative to the mutual plane of the former. We describe two different mechanisms that can produce an ultra-short period planet that is misaligned with the rest of its compact planetary system: natural decoupling between the inner and outer system via the stellar quadrupole moment, and decoupling forced by an external companion with fine-tuned orbital parameters. These two processes operate at different timescales, and can thus occur simultaneously or independently within a single system. We use the K2-266 system as an example to illustrate the dynamics of these two processes. We will also discuss the possibility of placing constraints on when ultra-short period planets in multi-planet systems arrive at their final orbital locations using the results of this work.*

**Erin Anderson** is an author, illustrator, and compulsive tea drinker. After studying marine biology and scientific communication in college, Erin started her own

illustration business and has illustrated several monster manuals. Since then, she has signed on with Chandra publishing as an author and Director of Communications. When she isn't working on art commissions, writing sci-fi novels, or running her own webcomic Erin also plays Dungeons & Dragons on the marine science podcast Dugongs & Seadragons. You can see her work on her Twitter at [@ErintheZ](https://twitter.com/ErintheZ) or at [ErinZAndersonIllustration.com](http://ErinZAndersonIllustration.com).

'The Rogue Planet' story and artwork is inspired by Nader Haghighipour's 'Architecture of Systems: The Role of Giant Planet Migration on the Formation of Systems with Multiple Rocky Planets and Super-Earths' presentation abstract. *We report the results of a major initiative on understanding the role of giant planet migration on the formation and orbital architecture of systems with super-Earths and terrestrial-class bodies. The goal of our project is to determine the connection between the type, number, and rate of the migration of giant planet(s) and the mass, frequency, size distribution, and orbital assembly of the final super-Earths and rocky bodies. We have carried out several hundred simulations for different values of the mass and migration rates of giant planet(s), different mass distribution and surface density profile of the protoplanetary disk, and different masses of the central star. Results indicate that, as expected, multiple rocky planets and small super-Earths form in systems where giant planet migration terminates at distances away from the central star interior to which the protoplanetary disk can maintain its material to accommodate planet formation. Capture into resonance of migrating giant planets does not play a significant role as long as the increased influence zones of these planets still allows the protoplanetary disk to maintain planet forming material. Our simulations indicate that chain-resonance small, rocky bodies are*

*results of the migration of planetary embryos, and close-in large super-Earths (mini-Neptunes) are the failed cores of giant planets that migrated out of their birthplaces. We discuss details of our simulations and present an analysis of the frequency of rocky planets and super-Earths in multi-planet systems in comparison to the outcome of planet formation models in our solar system and some of the extrasolar planets.*

**Laurence Datrier** is a PhD student at the University of Glasgow (in the most beautiful country in the world – Scotland!), working on multi-messenger astronomy with gravitational waves and kilonovae, with some side gigs in gravitational wave cosmology and the calibration of the LIGO detectors.

Her work is inspired by Sivan Ginzburg's presentation abstract about metal-heavy hot Jupiters from planetary mergers.