



INTERFERENCE

Interference strains the limits of our understanding about what it means to exist. To cope with harsh new realities that we encounter out there, beyond the boundaries defined by what we thought were laws. And to confront the possibility of becoming something more.

[2019]

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Out of Sync

[Planet : Ceru]
[Location: Basin Zanzibar]
[2076]

[01]

Ten seconds ago collided with now, nearly knocking Michaelson down. "What the... what just happened? I already thought that thought, why did it come back?" The force of the replayed thought subverted all available synapses, including motor control. Our minds are not built for parallel thoughts, replays or otherwise.

A wave of nausea followed quickly on the heels of the rogue thought, distracting him momentarily. Michaelson stopped in his tracks. "What's going on? Could lunch do this?" He was a few hours into geological survey for a new mining location on Ceru. "No way, vacu-food ain't great, but it can't do this. This is something else."

His mind kept replaying fragments of earlier thoughts, albeit interrupted mid-sentence, like it was looping back on itself and had gotten out of phase.

'WTF?' An echo? Dude, is this what crazy feels like? If I bring this up they'll bench me and give Taylor all the good routes. I'll keep moving."

The echoes and delays got stronger, more intense, as though the volume was turned up. "No, louder is not the right word", he was thinking, "denser, like every cell in my head is being bombarded from all sides at once." It hurt to think. Felt like moving through molasses, with an out-of-sync feedback loop. "There you go, your brain is reverberating in syrup. Put that in your report. 'What'd he say? Jello brain?' That'd be a real hit. But what do I do? If this gets worse I won't be able to finish my route."

"Where's Michaelson? He was due back a half hour ago," Captain Anna Sorenson asked. "Taylor have you heard anything?"

[Taylor] "Nope, nothing on the radio. When was his last contact?"

[Ferguson] "About 2 k's outside the perimeter."

[Sorenson] "That was over 2 hours ago, why didn't I hear about this sooner?"

Michaelson looked up after taking another step. “Why is it dark already? And how do I turn off this frakking echo?” He checked his watch, 15:15hrs local time, mid-afternoon. “Dark? Now? What gives? I’d better head back. Sol don’t lie.”

[Taylor] “There. He’s over there, about a half a k out.”

[Ferguson] “What the hell is that – Tai Chi?” Ferguson asked, adjusting his scope.

[Taylor] “Huh. How can he move that slow without losing his balance?”

They brought the rover to a stop at the edge of the timpani basin a few minutes later, its surface too fragile to support a vehicle. Michaelson had come out here to Basin Zanzibar on a study to learn more about the curious radio silence enveloping it. That same silence blocked mining the rare earth elements found in abundance here.

[Taylor] “He’s going faster now.”

[Ferguson] “Yeah. Hurry up. I want to know what kept him so long out here in the [radio dead zone].”

“Base, do you copy? This is Ferguson.”

“Base here. Go ahead Ferguson.”

“We’ve got visual on Michaelson. He’s heading back. We’re going into the basin to rendezvous and return with him.”

“Copy. Mark the time, 18:15hrs.”

“Copy base, Ferguson out.”

[Taylor] “Weird, mine says 18:14, it was just on base sync. Battery must be wearing out. I’ll have it looked at later.”

“Finally, that echo is dying down. Lights – oh, they sent out others. What the hell – I have to get rescued from a walk in the park? This is weird. What am I gonna say – I don’t know what to think myself.”

Ferguson and Taylor made their way across the slope down to the surface of the basin. The relatively hard basin was a welcome change from the sandy downslope, their pace quickening in response. A few minutes later Michaelson was recognizable without using a scope. Ferguson waved and bobbed his headlamp. Michaelson waved back, bobbing once in reply as an A-Ok. They’d

adapted to communicating via scopes, lights and gestures in the [radio dead zone].

They waited for Michaelson to approach given that he was not in need of aid. Taylor handed him a slate once he arrived, with 'What's up – why delay' scrawled on it. Michaelson read it, furrowed his brow and wrote back 'No idea. I did not delay' and handed it back. This was not an answer Taylor was expecting. He was hoping for something exciting – a finding, injury or something tangible to explain the hours elapsed since his scheduled arrival time. He scrawled back 'huh? explain'. 'Can't. won't fit' was the reply, indicating it was too complicated to fit on the simple slate.

[Taylor thinking] 'Damn, I'll have to wait till we clear the zone, can't wait to hear this one.'

[19:00 hrs]

Captain Sorenson checked in with the comm officer – "What time did they enter the zone?"

"18:15 ma'am. They said they had him on visual about a half a k out."

She considered this for a moment, doing some quick math. "So they should have only needed at most 15 minutes to reach him, and the same back. It's been 45 minutes – they know the protocol."

This was the first incident she'd had to deal with since taking command of this outpost. She'd only graduated the academy a few years earlier, and considered herself lucky to get a command so soon. She was hoping for something a little less remote, but had been in no position to be choosy.

The book was pretty clear about protocol breaches – zero tolerance. The protocols were forged from vast experience, loss and hard-won lessons over decades of off-world operations, and as such were not up for debate. However she was estimating their time on foot, based on a visual estimate of distance to target, both having margins of error that did not yet indicate a breach.

"If you don't hear from them in 5 then mobilize a rescue operation."

"Full-blown rescue? Ma'am are you sure that's--"

"Yes." [Sorenson thinking] 'Yes, I think so. Nobody ever got demoted for being too safe. But if anything happens and I failed to follow, then I'm toast.' "Yes I'm sure."

[19:02 hrs]

"Base, do you copy?" This is Ferguson checking in."

"Ferguson we copy. What was the cause of the delay?"

"We don't know, Michaelson said he didn't delay, he-"

"No – your delay. What caused your delay? You should have only needed 30 minutes. We expected you at 18:45."

Ferguson paused. "Say again? It is 18:45, well 18:46. What gives?"

"Base time is now 19:03 hrs."

Taylor chimed in "My watch seems to have a bad battery, maybe yours does too Ferguson."

"That wouldn't explain why we took 45 minutes to walk a half a k out and back."

"Wait a sec – oh," Taylor said, the realization dawning on him that 45 minutes of base time had actually elapsed. "Damn."

[Base] "Ferguson – what time does Michaelson's watch say?"

Ferguson turned from the vehicle comms and talked over suit radio to Michaelson. "What time you got?"

Michaelson replied "See that's the thing. Seems to be running slow. I got 15:30, but it's dark now so my suit must have a malfunction." He thought for a second, then decided not to worry about sounding crazy. "Ok, here's the weird part – I only perceived about an hour, maybe an hour and half going by. How's it dark already?"

[Ferguson] "Base, he has 15:30, says he only experienced about an hour and half."

[Base] "Proceed directly back for immediate debrief."

[Ferguson] "Copy. Out." Shit – there goes dinner.

Captain Sorenson considered this for a minute. This was definitely not a scenario she was expecting. I want more eyes on this. "Call engineering – have them ready to run full suit diagnostics as soon as they arrive."

"Yes ma'am."

[02]

The distance to basin Zanzibar was always long, but today the drive back to base felt like an eternity. Taylor was normally the last person you'd expect to be at a loss for words, yet he just stared out at the landscape in silence. Michaelson was similarly mute. Finally Ferguson broke the silence.

"So what do you guys make of this? I mean, suit malfunctions are rare enough, but 3 at once ... and how did we take so long?"

Taylor was visibly shaken. "Dude, I, uh, I mean, I don't know. I feel ok. But we're gonna look like idiots to the debrief board. I can walk a k on a basin in 10 minutes. We felt like we were gone at most 20 minutes, 30 tops. Which is what my suit says."

Michaelson sat for another minute, thinking. Finally he spoke "Did you guys get the echo?"

"What echo?"

"Farther out on the basin. It got stronger as I went farther out."

"Whoa. Was that where you were moving in slow motion too?"

"Say what? I never slowed down. Standard march pace the whole time." This statement carried some weight – they both were aware of Michaelson's ultra-running hobby, and his uncanny ability to pace himself steadily for hours without needing to refer to a watch.

[Taylor] "Uh, no. Dude you looked like Tai Chi man when we showed up."

[Ferguson] "And sped up as we got closer. Holy shit..." Ferguson trailed off.

[Taylor] "What is it?"

[Ferguson] "Time dilation."

[Taylor] "Bullshit. They'll send us back in a padded ship if we go on talking like that."

[Michaelson] "But how else do you explain the-"

[Taylor] "I don't. We just go in and tell what we saw. Let them reach that conclusion on their own."

[Ferguson] "Yeah, agreed. Besides, time dilation only happens near light speed."

[Michaelson] "Or near a black hole."

[Taylor] "Right, extreme gravity."

[Ferguson] "Did you feel heavier?"

[Michaelson] "No, everything felt fine, aside from that damn echo."

[Ferguson] "Ok, this is now bona fide weird."

Taylor thought for a minute. "Dude, you could go out there with the your girlfriend and get freaky – you could say you did it for days and be tellin the truth!"

[Michaelson, laughing] "Shit that's funny. Do NOT get caught doing that. You'd get busted you down to private."

[Taylor] "Might be worth it."

[Michaelson] "Huh?"

[Taylor] "If it lasted for days."

[Ferguson, laughing] "Shaddup already."

Michaelson was dreading the debrief. It's one thing to read about cool, exciting off-world phenomena as an aspiring student, but it is decidedly less cool when it happens to you. And when it makes you look like an idiot. He had plenty of time to think about this earlier in medical isolation. It was standard procedure after anything out of the ordinary to separate you for observation and testing. The protocol had saved many lives on dozens of occasions – he understood the need – nevertheless he felt vulnerable and more than a little crazy as he replayed the events of the day in his head while sitting in there alone. Thankfully all the tests came back clean and he was free of quarantine status.

"Just tell the truth. Stick to the facts – actions, events – leave the interpretation up to them."

He sighed. He knew what to do, but had zero interest in doing it. He wondered what Ferguson and Taylor were thinking. They hadn't been as affected as long as he had, and thus had less to explain.

A knock on the door signaled his turn. He opened the door.

"You're up."

"Yeah," he said heavily.

"Cheer up, at least it's not bio-quarantine, else you'd be rollin down the hall in your very own clear beach ball. Well, more of a hamster ball if you think about-"

"Put a sock in it Meyers," he replied, laughing.

"You know I'm right."

"Yeah, at least I'm in my civvies, not the portable habitrail."

"Besides, I heard they weren't too tough on Ferguson and Taylor."

"Really?"

"They just said it was all your fault and that seemed to cover it."

"I shoulda known not to listen to you."

"There's your problem. Seriously though, it sounded to me like it was inconclusive – I heard someone say something about sending a probe."

"Dude, don't breach protocol. But thanks."

'Well, technically that was not a breach of protocol,' he thought, 'at least not in any detectable way. He'd shared nothing of what Ferguson and Taylor had said. The probe comment was firmly in the gray. Speculation at best. Maybe this won't be so bad after all.'

"No sir, I felt nothing out of the ordinary until the echo started."

"Please explain."

"Thoughts would replay, time-delayed. It sounded like an echo of my earlier self. It began faintly, then got stronger as I moved further out into the basin."

"Define 'stronger'."

"Louder. More forceful. Harder to ignore."

"What time was this?"

"I don't know for certain. I was busy trying to log data for the route report, and was also trying to figure out what was going on in my head. I checked the time after what felt like a normal interval – say an hour or so – then realized it was getting dark."

"You did not notice the light diminishing sooner?"

Shit, I look like an idiot. How do you miss the sun setting? This is not a small thing to lose track of.

"No."

[thinking] 'How could I not notice earlier? I was logging the time during-'

"The data recordings – you were logging the time, correct? Did you not notice the passage of the sun towards the horizon while you were doing this?"

"No. The time on my watch was in sync with what I was feeling. The diminishing light was too gradual. I almost thought the visor auto-tint function was off its mark." He felt relief at remembering that last point – he'd forgotten it until just now.

"Thank you Mr. Michaelson. That will be all. Check in with the doctor in the morning for final clearance."

'Really? Sweet!' He exited the room before they could change their minds.

Michaelson made a beeline for the canteen. He hadn't eaten since noon and was starving, however by this time of night the menu was slim. 'Junk food

sounds good right now.’ He found Taylor and Ferguson at a corner table by the large windows. Outside the sun had set, leaving the base lights as the brightest things around. They trailed off into the distance, casting an orange hue reminding him of the sight of shimmering lights from distant cabins in the mountains back home. He stood there, staring distractedly out the window, momentarily forgetting what he was doing.

“What are you doing out and walking around? We thought you’d be in the padded chamber sipping happy juice by now” quipped Taylor, laughing.

“Makes two of us,” sighed Michaelson.

[Ferguson] “Are they sending you back out there”.

“Huh?” [M]

“For the probe expedition.” [F]

“Didn’t say anything about it.” [M]

“Are you on leave?” [F]

“No, well I don’t think so. Said to check in with the doc first thing in the morning. Take it from there.” [M]

“Well make a good impression on the doc so you can join us.” [T]

“Eh? You already know?” [M]

“Dude, we volunteered,” Taylor chimed in. “I can’t wait to see what the hell this is.”

“Yeah, aren’t you curious?” asked Ferguson.

“Totally.” [M]

“But?” [F]

“I guess I’m still a bit phased about the head trip.” [M]

“Worried about lasting damage.” [F]

“Yes. Doc says the scans were all clean. Nothing to worry about. But still...” he trailed off. [M]

“Just stay outside the basin. Run the probe – you’re qualified right?” [T]

“Full pilot cert.” [M]

“Then you’re goin,” said Taylor. “There’s no way you can miss this.”

"What time do you depart?" [M]

"10:00hrs tomorrow. Plenty of time to get squared away by the doc." [T]

"True enough. Wouldn't they have already picked the team by now?"
[Michaelson]

[Ferguson] "You are slow today. We didn't get back until 20:30, then straight to debrief. They're figuring all this out now."

"Oh, right. It only seems like days." [Michaelson]

"Go down to the comm center and check in. Tell 'em you're in." [T]

"I think I will. Right after this burger." [M]

[04]

Anna allowed herself to get excited about the find now that the formalities of the protocol were over. This was totally unexpected for a regular mining and geologic outpost. Forget the career implications for a second, this is genuinely unknown. With possible time dilation. Wow!

"What are you smiling about chief?" the question interrupting her thought. She hadn't realized she was smiling.

"Oh, nothing" she deflected, considering how much of her excitement to share. "Just glad we're past the review and on to planning some action."

"I'm with you there" the comms officer replied.

"Does the chief engineer have all the parts he needs?"

"He's finishing the inventory now. For sure we have probe drones and imaging sounders on hand, it's the mounting hardware that he's looking for." A typical mining rover would perform geologic soundings from the surface – they were not intended to be airborne.

"How long did he say it could stay airborne with a sounder on board?"

"Depending on the altitude and atmospheric density anywhere from 30 to 45 minutes."

"Who's doing the scan grid plan?"

Michaelson entered the comm room.

"Hello Michaelson, feeling ok?"

"Yes Ma'am. Just stopped by to see what I can do."

"Good timing – we need input on the drone's flight plan."

"Sure thing."

"We need to figure out the best way to use a sounder from the air for-"

"Beg pardon?" Michaelson asked, confused about why they'd use heavy ground equipment on a light duty probe drone.

"We were discussing solutions earlier with Chief Engineer [name] while you were in debrief. Specifically we need a way to get readings without sending anyone into the basin where you were."

"The rovers are remote pilotable, why not drive it in there? "Oh," he said, the realization dawning slowly on him. He was pretty tired by now. "It'll likely slow down the same way I did, take forever to get there. So you're going to airlift it in there."

"Right. We think we should fly up above the field, assuming there is an 'above.' We're estimating a k or 2 above the surface, but need to refine that. At what point did you feel normal again when you were exiting the basin?"

Michaelson thought back to the walk out. Man that seemed like days ago. On the plus side, this is getting interesting, and nobody seems to think I'm nuts.

"About the time I rendezvoused with Ferguson and Taylor. By then the echo was gone. I had no perception of being slow."

"So you don't recall your spontaneous transformation into a Tai Chi master?" Anna asked with a wry smile on her face.

Michaelson flushed initially with embarrassment, but that was quickly replaced with laughter. Damn, not sure I've ever seen the captain crack a joke before.

"No, I don't recall ever putting on a black belt or snatching a pebble out of the master's hand" he replied, laughing.

"Ok, so that puts you about here" she said, pointing to a map of the basin on a wall display. "That's about 1 k from your farthest point, according to the logs."

"Damn, that's all I walked?" he asked, looking at the map. "A slug could do better, and wouldn't need a whole afternoon. I guess the time thing got pretty strong."

"Yep, that's it. So if we fly a kilometer above the basin we should be free of the field, right?"

"Sounds reasonable" he said, then added "ish". "We might want to take an unloaded drone and fly in at twice that height and validate the airspace. What if they do get slowed down – would the propulsion also be slowed – they'd drop outta the sky."

"Agreed. [chief engineer] said the same thing. That's why we need a good flight plan with some contingency planning. How much forward momentum would be required to have a falling drone not land in the field."

"Oh, interesting. Fly it in fast enough that if it is adversely affected it can at least glide far enough out of the field to be retrieved."

"Exactly."

"And then retrieval via ...?"

"Dragline."

"Oh, that's a cool idea. Keep the ends outside the field."

"Right."

"I'll get started on the calculations and-"

"How long do you need to do them?" she interrupted.

"About a half hour," then added "regular time," laughing.

"Copy that. Get some sleep. Do the math in the morning."

'Yes ma'am." 'I'm in! And still a starter.'

[05]

The next day Michaelson awoke giddy. All the fears of lost credibility were washed away. He was so excited to go on the expedition that he could not wait to verify clearance, so much that he went straight to the doc before breakfast. Michaelson never did anything before breakfast.

"You're all set – good to go" Dr Hsu informed him after a battery of scans.

"Stoked! I'll be rollin on chrome at 10:00!" he exclaimed.

"Chrome?" Jackson Hsu was not one for popular culture.

"Oh, the wheels on the big rover. They're reflective like chrome."

"Oh, I see," he said, clearly not getting it.

"Ah. The other reference – rollin on chrome is cruising in a sweet ride. Old Earth slang."

"What a fascinating piece of historical trivia. Does that qualify as 'lore'?" he deadpanned with a sideways glance and the slightest of grins.

"Wait – did you just mock me? That is a first – wait til –"

"Clearly you are suffering some after-effects from your jaunt yesterday, they must've eluded the scans. Everyone knows I strictly follow protocol," smiling. "Now get out of here before I decide that you need more invasive scans."

"Yes sir."

[internal dialogue] 'Dang, first the captain busts out with a joke, then robo doc. Maybe I got transported to a parallel dimension or something. I should look in the mirror, maybe I'm better looking too' he chuckled to himself. He was so absorbed in his thoughts that he tripped on a step and stumbled into a hand railing. 'Nope, same old me. It seems my superpowers have worn off – well it was fun while it lasted.'

The vehicle hangar was buzzing with activity. He had always loved coming here – the sight of the gargantuan vehicles never got old – but today was different. 'There was something truly unknown right there' he thought, gazing at the horizon in the direction of Zanzibar.

"Hey Michaelson, over here."

He saw Taylor and Ferguson loading supplies into the hold. "Is that the chow crate? Make sure I have sashimi for lunch."

"Freakin wiseguy. You seem to be doing better today." [F]

"Yeah, either that or I'm in another reality. Doc cracked a joke on me earlier, and –"

"Shit now I'm worried. You're hallucinating. Straight makin things up. Everyone knows robo doc never smiles."

"Well, he did today. Was downright nice."

"Maybe he felt sorry for you."

[laughs] "I think everyone is pretty keyed up about this find."

"Hm. So it's not that I got suddenly more charming after my dazzling performance yesterday – Oof!"

Taylor handed him a heavy crate. "Load this in the hold, Prince Charming."

"Uhn, certainly."

Captain Sorenson and [engineer] walked around the giant wheel and into view.

"Michaelson – you ready to compute that flight plan?"

"Hell yeah, er, yes ma'am."

[Smirking] "Good. And don't let your enthusiasm allow any carelessness to creep in. We still have no idea what we are dealing with."

"Yes ma'am. Understood." He let that sink in for a minute. It can be easy to forget that most really fascinating natural phenomena out here can kill you in an instant.

[06]

“So we’re gonna hoist up sounders over the field, and then what? How were you planning to get them down to the surface in one piece?” [M]

“Pierce and I came up with three options so far. One – we mount drone thrusters onto them and reverse thrust down. Two – parachutes. We got a supply of them in the shop.”

“We still use chutes? In this atmosphere?” [M]

“Yeah, for dropping supplies down into canyons, remote sites, that sort of thing. They’re big. Force-deployed, no tangles.”

“Wow, didn’t see that coming. Go on.”

“Three – glide it down”

“On what?”

“Anatolian drone.”

“You’ve got clearance to use one of those? We only have three on the whole planet.” [M]

Anatolian class drones are long range atmospheric laboratories that can stay airborne for weeks at a time. They have cameras in visible, infrared, ultraviolet, x-ray, gamma and half a dozen other spectra, and play a vital role in scouting out routes, habitat sites, bases for mining ops and anything else that can’t be done via the surface.

“Yes. Captain cleared it last night with the Quadrant Admiral.”

[Whistles] “This thing is already that big?” [M]

“Better believe it. When all three of your suits checked out they knew. Three simultaneous failures of independent equipment never happens. Three coordinated malfunctions never happens. Three clocks that run at the same slowness then speed back up on base never never ever happens. Unless you got time dilation. Period.”

‘Then boom, the whole quadrant knows’ thought Michaelson.

“Cheer up kid, you’re famous. No doubt quadrant is relaying this back to Earth too, likely as more than a footnote, and your name is on it.” [engineer]

Michaelson felt uneasy at the thought of this, his earlier enthusiasm giving way to a slight queasiness. What if it turns out to be nothing? Suddenly he was glad

Taylor and Ferguson came to get him, despite the appearance of being rescued from a walk in the park. Three independent suits, three independent humans. No this is not imaginary, something out there is real.

“What option you like best?” [M]

“Thrusters. Easiest to control.”

“Agreed. How long to set up?”

“Done. We built one of each last night.”

“Nice, you’re on it. I’ll start computations for the thrusters first. Hang on a sec, have we ever fired a sounder inside the [radio dead zone]? How do we know it’ll work?”

“We don’t know for sure, but we are betting that the [radio dead zone] only blanks out electro-magnetic radiation. Sounders generate compression waves, which are physical.”

Captain Sorenson climbed into the cab of the big rover and buckled in.

“You’re coming along?” Taylor asked.

“You think I’m going to just listen in on the radio back at base? Not on your life.”

Taylor nodded. His regard for her ratcheted up a notch. He didn’t like desk jockey leaders. He hadn’t seen much of her in action before yesterday, and had until now assigned her the default status of ‘just another bureaucrat.’

The big engine rumbled to life.

[07]

Basin Zanzibar had always been something of a mystery, even among the timpani basins. All of them were odd to begin with, but by now had been explained enough that regular people could understand them, and that mining could proceed. Except Zanzibar.

Geologically they are subsidence craters, formed when prior subterranean flows receded, leaving empty lake-shaped basins behind millennia ago. The precise nature of these prior flows is unknown, and is an area of active study in several of the basins. After the dense flows retreated underground, they left behind in each basin a small area of the original flow exposed, much like a lava lake in an active volcano's crater. Thus far this is nothing too exotic, the remnants of old volcanism on Earth and countless other planets have produced craters and depressions that resemble basins. This is where timpani basins differ – most basin erosion and backfilling occurs by material falling in from the sides, however timpani basins were backfilled from underneath.

One phenomena of the flows that has not been explained is their out-gassing. They bubbled and produced a foamy substance from any exposed surface. During the active flow phases the basins would have looked like lakes dotting the landscape, and their sudsy output would have been disbursed by surface winds. However during subsidence the foamy suds were down at the bottom of the basins, protecting them from the winds. This gave them time to congeal into a low density crystalline structure. Gradually these structures were pushed upwards by continued out-gassing, gaining size and filling the basins until they were sufficiently heavy to offset the upward pressure, capping the flow.

The basin-filling occurred quickly when considered in geologic time scales, and was followed by a much longer period of normal surface erosion. Atmospheric weather brought in layers of sand and small rocks onto the basins, covering them with a shallow, dense layer. This layer hardened as the planet's scarce moisture circulated over the next few million years. The result is a crust-like surface that is dead flat, visually resembles the surrounding landscape, and is structurally weak, unable to support more than a couple hundred kg per square meter. They are generally capable of holding people and light equipment, but not the large mining machines. They also produce booming echoes when you fire a sounder on them, giving them a striking likeness in both sound and shape to their namesakes, the timpani drums used in symphony orchestras.

A secondary effect of the [foamy crystalline structure] was interference. Radio communication was limited to a few hundred meters. Operations on timpani basins had to be modified significantly from every other mining playbook

known. The large, automated machinery was out due to weight limitations. On-site mobile bases and camps were similarly out, being confined to the 'lakeshores' of solid ground. Drones and other remote controlled vehicles had limited range. Thus basin operations required more people, adding cost and time, with the added caveat that they are dangerous for people.

The first phase for any new basin is crust depth mapping. Teams proceed onto the basin with portable sounders to map out safe routes. Minimum safe crust depth is about six meters – anything less and a person could break through if the crust material is poorly bonded. The following phases see teams bringing out heavier equipment, establishing rigged lines, waypoints, drill stations and hardwired communication links. The rigging and check-in stations allow people to work solo safely – people are always the scarcest resource on uninhabited worlds.

The payoff for all this trouble is a cornucopia of rare-earth elements. The [foamy structure] contains elements normally buried beneath kilometers of sediment, rock or igneous flows, now just meters below the surface. Timpani basins were one of the most exciting geologic finds of the century, and one of the most enigmatic. Despite exhaustive efforts no other planets have been found with them. [Planet name] is unique in the known universe.

Basin Zanzibar was different still. While other basins allowed limited radio comms, Zanzibar denied all. Utter silence. Every effort thus far to find the cause of the [radio dead zone] has been unsuccessful, preventing mining operations despite keen interest. Perimeter samples indicated that it contained a unique mix of elements – some not previously found in nature. However without any radio comms the mining op was a no-go. Relay stations and cables allowed mining to push long distances out onto other basins, but radio was still required for the actual work – people had to talk, resolve issues, send instructions or corrections to portable mining equipment. There was no workable protocol yet in silence. Handwritten slates enabled monosyllabic exchanges, but could not support the information flow that accompanied a mining operation in full swing. Even an army of people would not be enough to get underway.

Michaelson's survey operation had been intended to learn more about the [radio dead zone]. Instead of answering questions it created one more.

[08]

"Seal confirmed."

"All vehicles?" [Sorenson]

"Affirmative."

"Hangar clear of all persons?"

"Affirmative."

"Begin evac."

Massive overhead turbines reclaimed the air that was pressurizing the hangar, reducing it to match the outside. Klaxons sounded to indicate immediate loss of breatheable atmosphere. Green lights signaled equalization. The doors began to rise.

"Michaelson – you get your flight plan sorted out?" [S]

"Yes ma'am. Both loaded drones and unloaded." [M]

"Good." [S]

"One question." [M]

"Go ahead." [S]

"Did you or any of the engineers have a theory about the echo?" [M]

[exhales] "We were hoping someone would have a flash of brilliance about that, but-" [S]

"It doesn't really show up in time dilation papers." [M]

"To be fair – most of those deal with subatomic particles. Not sure you'd see it there. Person scale stuff has at most been at 0.05c on liners, with multi-day ramp-up and down. Nobody has ever been slowed by 50% in a few minutes." [S]

Michaelson nodded, looking concerned.

"Cheer up, if it comes back you'll be an awesome DJ – you'll have your own built-in sampler" Taylor quipped.

[groans] "Except that I still have no rythm." [M]

"I wouldn't sweat it. Doc says your neurons show normal firing patterns. Zero residual effect" Sorenson offered.

“Yes ma’am, I know.”

“We’re hoping your drone flights can shed some light on that particular phenomenon” she mentioned, directing the focus of the conversation away from Michaelson.

Ferguson picked up on this, adding “How are you planning to measure it?”

“Multiple telemetry loggers per drone. Each writes on a dedicated process, two write directly to solid state, a third to a memory buffer that goes to solid state at intervals. Each has different latencies and failure patterns, so we’re hoping to see differences across them. We also put random numbers on every entry – there should be no duplicates unless it echoes.” [M]

“Seems reasonable. Can they handle corrupted writes?” [F]

“Dunno. [engineer]?” [M]

[Engineer] “It didn’t occur to me, I was too focused on the build-out last night. Are you thinking partial write on echo?”

“Yes, like if it replays only part of the message.” [F]

[engineer] radios to a technician. “Can you disable validation on the loggers? Make sure they write everything, even if it’s gibberish.”

[Technician] “Way ahead of you. Did that before we rolled. Seemed logical. Also set log verbosity to maximum.”

“Copy that. Thanks. Out.” [engineer] closes the channel and turns back to Ferguson “Make that a ‘Yes’.”

“What if the echo makes it replay flight instructions?” Taylor chimed in.

“Measure altitude, deploy chute if below threshold” Michaelson replied.

“Seriously, that’s it?” [T]

“Not much else we can do. You can’t shield for time dilation, it happens below the subatomic level, in the fabric itself.” [M]

“So those things might start jerking around in the air?” [T]

“Yeah, it’s a possibility. Oh, and if chutes deploy it’ll eject logs back towards us, well the whole black box’ll get ejected. To aid retrieval in case the drone is too far in.” [M]

“Damn, this is starting to feel serious.” [T]

“Dude, where you been?” [F]

“I know, I know. It’s always been serious in a theoretical way. With most observable things if you approach with caution and take your time it kind of works out. If this thing swallows up drones and all EM, it starts to feel more like walking up to the edge of a black hole. That’s a whole different level of serious.” [T]

“That sounds about right.” [S]

[09]

“Clock drop in 2, 1, here.” [Srini]

Chavez stopped the [small rover].

Srini climbed out, grabbing a 2kg hammer and a 2m length of steel reinforcement bar, called rebar. The thin atmosphere carried the faint ‘tink, tink’ of the hammer as he pounded the rebar half its length into the soil. Once in, he attached a clock and took an initial reading as a benchmark.

“Right. Time is 1035 hrs, benchmark location M5.72,” indicating route M5, kilometer 72 from base. [srini]

The main route that led to many of the major basins was named after the M5, after a large motorway in southwest England. Like the basins, people chose names for routes and other large features on [planet].

“How many of those are we doing again?” [Chavez]

“Every 2km from the base to 80km, then every 1km to the basin, then every 100m on the basin itself. We want to measure the full extent of the field.” [srini]

“That stuff freaks me out. I know all about the theory, but the thought of walking into a field that slows me down just doesn’t sit well.” [Chavez]

“Hate to break it to you, but you are already are. About 10%.”

“Already, this far from the basin? There aren’t supposed to be any effects until you’re 1k onto it.”

“We’re not in the field yet.” [srini, grinning] “The system we’re in is moving at [x% of c] around the galactic core, add to that the orbital velocity and you’re up to 10% slowdown.”

“That counts, eh? Yeah I suppose it does, never really thought of it.” [Chavez]

“That’s right, it all counts. Compared to someone on a ship in interstellar space at full stop, you are slowed down. How do you feel?”

“Haha, very funny. Ok, so are you saying our entry into the field will be that imperceptible too?”

“Totally, hence the external benchmarks. Speaking of which, drop in 2, 1, mark.”

[10]

The sinkhole in Basin Gibraltar suddenly became ten times its original size. No warning – no rumbles, no minor earthquakes, just silence. Then boom. There was debate if this was caused by mining operations or erosion.

[1] “Bullshit – the odds of us witnessing erosion on that scale in a multi-million year window are zero. Subterranean erosion on this planet died millions of years ago. Extinct. All that remains are the surface winds.”

[2] “Say what you will about the odds, the mining is 50k away on the other side of the basin. [Crystalline foam] does not transmit effects more than 1k, 2 at the outside. No way 50.”

[1] “What then? You’re out of options to explain this. That’s all of them.”

[3] “Not all.” They turned to look at the usually quiet scientist, a chemist. “The flows could be active still.”

The sinkhole in Basin Gibraltar had been troubling [3] for a while now. It could more accurately be called a crater since sinkholes are generally not that big. Except that there was no material ejected, as one would normally find around an impact crater. It all went down, straight down. And now it is ten times bigger, a full dozen kilometers across with sheer sides 1000m high.

The noise it made woke every seismograph on the planet. And every scientist. Prior soundings indicated no subsurface voids. They’d put the mining access road nearby to permit study of the sinkhole. Now the road ended at a cliff. Rerouting the road was a minor inconvenience – far more troubling was the idea that the planet could resume movement with no visible geologic forces to drive it.

[3] ordered daily soundings for the basin along the road and all active mining operations.

[11]

Ellie Barnes brought the [big rover] to a stop at the edge of Basin Zanzibar.

"All stop. Brakes engaged."

Anna Sorenson unbuckled her seat harness and stood up. She stretched and gazed out the window at the flat expanse of the basin. Its calm exterior gave no hint at the processes going on inside. Anna saw the tracks from Ferguson and Taylor's [small rover] a few meters away, their presence seeming to say "Here we are, we're real, you can't ignore us."

"Surface report?" Sorensen asked.

"Calm, winds from the north, 10 km/hr. No storms." [Barnes]

Ok, here we go. "Make ready the command pod." [Sorenson]

"Copy that." Ellie started working the controls that operate the crane on the back of the [big rover]. Everyone else in the cab started moving to put on EVA suits. The control pod and other linked units have atmosphere, everything else is outside. They are not setting up habitats or other large structures until they learn more. Shifts will work around the clock, with crews at shift's end being shuttled back to base.

Taylor, Ferguson and Michaelson worked their way back to the [big rover] where the drones were stowed, being careful to avoid the swinging control pod.

"Almost game time. Any jitters?" [T]

"Totally." [M]

"Ever flown one of these?" he asked, pointing to the hulking Anatolian drone.

"Not this model, but ones like it back on Earth. Out in the desert, during training."

"They have you glide any of them?" [F]

"Yeah, we simulated thin atmosphere like this one by using smaller wings, both under power and full glide. Glide is not normal, it's mostly for drone retrieval during failure scenarios."

Regular operations for the drones were fully automated, including flight planning. Parameters and flight goals would be defined and fed into the algos, and they would plan and execute from there. This was not regular operations.

Michaelson programmed the flight pattern for this scan manually since the algos had no parameters for 'check for localized time dilation'. If all goes well the actual flying would be automated, however Michaelson will be plugged in as a backup in case he needs to override or abort.

Barnes finished lowering the control pod into place. She asked via suit radio "Michaelson, where do you want the drone?" The radio still worked here, just outside the basin.

"Right on the edge of the basin surface proper, pointing SSW," indicating a direction that paralleled the edge of the basin, just outside the [radio dead zone].

"Copy that."

He backed away as the crane's oversized hand-shaped claw reached for the drone.

[12]

"How do you want to message this back to Earth?"

"Time dilation is pretty exceptional. How certain are they? A few suit malfunctions?" his tone skeptical.

"Affirmative. Plus eyewitness accounts. And the suits checked out - no malfunctions. Three coordinated time slowdowns. Pretty credible, by the book."

"Hmmn. When did they say they'd know more?"

"They started their op today. Should know something soon."

"Let's wait on an update before we relay this back. I don't want to have to recall anything."

"Copy."

[13]

Michaelson started the drone's engines and pointed it on a heading along the basin's edge. As it began rolling a furious whine filled the thin atmosphere and could be heard through their suits. Ferguson unconsciously took a step back when he felt the rumble. A few short seconds later the drone lifted into the air and began a gentle arc.

"Smooth, you done that before?" Taylor hassled him. "Too much video game time."

"Yeah that's it. Y'know, that popular off-world mining game, was a runaway hit – what was it called? Dust Farmer," he quipped, casually steering the drone into the start of its pattern.

"Beginning automated pattern in 3, 2, 1, mark."

"Copy that, stay put in case we need manual override." [s]

The drone banked right and came about for a third pass, dropping another 500 meters of altitude. Several of the team followed its progress with binoculars. Due to the EMI no signals could be shared other than light. Michaelson's controls had comm lasers as part of its spectrum, intended for usage in harsh environments such as this.

At 3km of altitude the drone skipped a beat, jinking hard right and side slipping for about 100m before righting itself.

"You see that?" [s]

"Affirmative. Laser telemetry shows a heat buildup on forward surfaces followed by a rapid cooling."

Ferguson whistled, then spoke. "Damn, there it is."

Moments later the drone approached within a couple kilometers of their position before turning to begin another pass, showing no visible signs of the incident. After the turn it dropped another 500m and cruised back towards the site. At this altitude its flight path will intersect a much wider part of the dome, if the theory that this field is spherical is correct.

'Here we go' thought Michaelson, his hands tightening on the controls. A few seconds later the drone nearly bounced.

"Wings heating up. Velocity down 10%. Still enough to fly."

A bright flash made everyone recoil and shield their eyes.

"Report." [s]

"Nothing yet. Stand by." Seconds later "Temperature reaching critical. Drone dropping. Wait... cooling. Exiting. On the far side of the dome now." [m]

"Next pass will put in it on the floor won't it?" [F]

"Likely." [m]

“Override. Bring it back.” [s]

“Yes Ma’am.”

Michaelson brought it down on the same basin edge where it took off. It taxied slowly to a halt by the crane. The leading edges of both wings showed signs of melting and rapid cooling.

Matter that is in a slower time frame is moving more slowly than its faster counterparts outside the slowdown region. Atmospheric molecules thus slowed cannot follow a normal airflow over a wing that is coming in from a faster time frame. Instead the wing appears to be moving at incredible speeds, e.g. velocities akin to a meteor hitting the atmosphere, with similar results. The moving object encounters immense friction and heat buildup, resulting in loss of some or all of its material to ablation.

Despite the drone’s modest 500 km/hour velocity relative to the planet’s surface, it appeared to the time dilated atmosphere as though it was moving at about mach 30. The flash of material loss was caused by this differential. Thus far it had survived the first two passes, but barely. They could not continue the direct approach.

“Status?” [s]

“Still operational. Wings have some damage, but it’s mostly to the plating that is designed for that.” [barnes]

“Recommendations?”

“Lower the sounder in from hover. Skip the parachute option, the field is worse than we’d thought. Need throttles to adapt as it changes.” [barnes]

“Agreed.” [m]

“Ok, Plan C then. Go do it.” [s]

“Copy.”

By hovering and slowly lowering the device, say at 5 m/second, the relative velocity of the sounder to the atmosphere would be about 30 times less than it was when flying. Hopefully this is enough to not melt anything on the sounder, it does not have protective cladding like the drone does. The second consideration is that they can vary the descent speed, unlike with the parachutes. They are not sure how bad it will be as they get closer in, since they do not have enough data yet to estimate where the source of the field is located.

A few minutes later the drone was fully ready, Michaelson a bit less so – vertical takeoffs are much trickier, especially with a 3km cable attached.

“Clear launch area.”

“Clear.”

"Firing."

The drone slowly stood up via its lateral thrusters, then lifted using main engines. The long cable played out like a giant dancing cobra for a mesmerizing minute, then went taut.

"Sunder liftoff."

The sounder went up silently, then drifted towards the dome. Nobody spoke as they peered through their binoculars. Once centered on the dome the drone began lowering.

"Sunder height 2500m."

100 seconds later – "2k" and so on down to 500m, at which point the sounder began to heat up.

"Slowing."

Anna had to remind herself to breathe while watching the agonizing descent. Through her binoculars she saw it jerk and bounce, glowing red on the bottom.

"Report," she said as calmly as she could manage.

"Taking manual control." [m]

"Slowing to hover. Not responding. Wait. Coming to standstill. Sounder cooling."

"Resume lowering at 1 m/sec. Fuel report?"

"Thirty percent."

"Proceed."

Five minutes later they were within 200 m of the surface. Theoretically they could fire the sounder from that altitude and get some results. Resolution would be compromised but would guarantee at least one set of data. They had discussed this option the night before, and held it out as the absolute last resort. Firing from a cable was untested, and they did not know if the concussion would sever the cable or destabilize the drone.

At five meters things got weird. The bell shaped sounder slowed, causing the cable to go slack. It fell as through molasses, entirely at its own pace. Michaelson stopped the drone when it was clear the cable would have reached the ground otherwise. The sounder kept drifting down at a snail's pace. The radio channel was utterly silent until it touched down, silent except for the collective exhale of the entire crew. Michaelson released the sounder from the cable and set the drone to auto-return.

[14]

The approach to measure the effects of the field with sounders was admittedly 'less than fully baked,' but nobody had any better ideas. Compression waves like those generated by sounders would experience the same slowdown as anything else. The hope is that they move fast enough to permit some useful readings, even if the results take days to gather.

They had planned to bring out sounders after Michaelson's survey, using the data he gathered to determine their placement. Given his surprising find, the prevailing sentiment was "let's put one right on top of the anomaly and see what we get." In parallel a couple teams were placing sounders on the perimeter of the field as insurance. If the central sounder failed at least they would get some readings.

The sounder dropped by Michaelson auto-fired upon touch-down. They had rigged a mechanical switch as a failsafe the night before. The switch nearly shattered on impact, despite being constructed from a very resilient steel alloy. To outside observers the sounder touched down at less than a meter per second, however to the time-dilated switch it was hundreds of km/hour. The switch held, its mechanical flag having tripped, exposing a hastily created circle of green paint, visible via scopes. Light would also be slowed by the field, but given its exceptionally high velocity it would provide insights hours or even days before the sound waves showed up.

They had also fired the sounder at 200 meters elevation during the drop to ensure that at least one reading could be gathered. While they did not learn anything conclusive about the source of the field as the signal did not penetrate deeply enough due to reflection (a.k.a. 'strata bounce' since it was not in contact with the surface when fired) and slow-down from the dilation, it was not a total loss. A rough plot of the field's shape and size emerged as some fraction of the compression waves returned.

"Initial measurements indicate a rough sphere, centered about a km under the surface from the drop site."

"Wow. It keeps getting stronger for another k? We can barely move anything in it as it is."

When the sounder finally fired on the ground there was a large collective sigh of relief.

"Ok, mark, time is [xx:xx:xx hrs], sounder has fired."

"What now?"

"We wait. This part of the op is a success. We put a sounder right on top of it and it fired."

“Seems anti-climactic after all the build up.”

“Dude, you saw the thing go into free fall at under 1 meter per second? The line went slack in mid-air, holy frak isn’t that weird enough for you?”

“Yeah, that was kind of a trip. My brain is filing it under ‘desert mirage’ and telling me nothing is up.”

“Dude, #2 – a sounder went BOOM, but with no BOOM. All that energy is still in the ground over there, moving sloooowly this way. Freakazoid stuff.”

“Ok, ok.”

The Pea Shooter

[Earth]

[01]

Ginny Okumbe was in grad school when she first had the idea about the Pea Shooter. In fairness, a lot of people had the idea, but her paper won the school's [impact award], giving it sufficient publicity to have everyone associate it with her. The Feasibility Study of a Railgun Launch Facility happened at the right time, and the name stuck.

Nuclear fusion had become a reality a decade earlier, and fusion powerplants were popping up as fast as people could build them. The promise of truly clean energy with no radioactive waste was finally becoming reality. People were also starting to think again of larger projects – things that were previously too costly when electricity was scarce. Particle physics was experiencing a resurgence, with larger colliders and research facilities now within reach. People were talking about going beyond 10x with the next class of particle smashers, even up to 100x. The overall environment was one of optimism and ambition.

The physical world still held some surprises for us. Building a collider 100 times more powerful than anything previously accomplished was not a simple task. Power might scale up linearly, but the surprises from nature do not. 10x colliders came online first since they were simpler to construct and didn't require as much land. The first of these was the Landen Beam Incidence and Collision Center, clearly having been named by Landen himself. Only a scientist would consider that a catchy name. Everyone just called it 'the Landen'. Among its first outputs at these heretofore unseen energies was antimatter. Lots of it. Previous colliders also produced antimatter as a by-product of their primary research, but it was generally an afterthought and in such small quantities that nobody paid much attention to it.

No so at the Landen. Its main collision chamber was practically an antimatter generator, enough so that they had to add additional magnetic containment fields to hold it in. Antimatter, while an exotic type of particle, is not relegated to science fiction. It is very real, and when it re-combines with regular (so-called Baryonic) matter it annihilates itself, releasing a flash of energy. A big flash of energy, the kind that Einstein's famous equation $E=mc^2$ governs. When the particle in question is the size and energy of a single electron, this is nothing to worry about, the colliders were built with that in mind. However when it becomes a lot of them, or larger, more massive particles then the game changes.

The first such incident nearly shut down the Landen for good. The center is located in the heart of Kansas, equidistant from Kansas City and St Louis, and mostly underground. From above it still looks like endless corn fields everywhere except the entrance site. The rest of it is a ring of magnets and pipes about 50 miles around, with the occasional detection chamber [along the way]. After the accident of 22 January 2089 it became very visible. A quarter mile of smoking crater replaced Detection Chamber Beta.

Thankfully no one was hurt during the incident – the chambers are all fully evacuated during experiments – but it did serve as a very severe wake-up call, delivering a not-so-subtle message of ‘Things are Not the same as Before.’

People quickly realized that there is nowhere on Earth that is a good location for a collider in the 100x power range, so the focus turned to space. Lagrange Point 2, or L2 was the obvious choice for where to put a space-based collider, since it would get free shielding from cosmic rays by the Earth, and it was sufficiently far away that accidents would not endanger Earth. The problem was how to get it there.

We needed a new way to get things into space. Ships launched on top of combustion rockets were so small that they could barely do meaningful work and get back home. The current state of the art for launch vehicles had a yield of three percent, meaning that only 3% of the weight of the vehicle was useful as payload. The other 97% was propulsion. The mining industry was already grappling with this issue as well. They needed vessels capable of going somewhere after they get into orbit. In sailing terms we could only get dinghies or sunfish into orbit, small craft meant to hold a crew size from two to perhaps eight people. What mining folks needed were cargo ships in orbit, large ships that could travel to the asteroid belt, conduct mining operations on a commercially useful scale and return home. The research community now needed the same thing.

Megatons. We needed to get megatons into orbit.

Enter the railgun. The abundance of electricity made the cost per launch negligible for a railgun, and the yield was over 90% per vessel. Leaping from 3% yield to over 90% got everyone’s attention. Except that we still did not know how to make one that could get a craft to space in a condition other than as molten slag.

[02]

Ginny was a researcher in graduate physics at the University of Kansas at the time, having come to the states the year before from her native Nigeria. Her

concept paper was the only one to solve the Atmospheric Buffering Problem, which was the last critical issue blocking the path to a feasible railgun.

A railgun runs an electrical charge down a set of tracks that will pull along anything that will stick to a magnet. Picture a railcar on a set of train tracks being pulled by a magnet. That is the basic idea. Now picture the tracks inside a tunnel, and the magnet is a cylindrical set of coils in the walls running the length of the tunnel. The magnetic field can be pulsed to 'flow' down the tunnel at any speed – right up to the speed of light (almost). Electricity in a wire is nearly as fast as light in a vacuum, which means that for launch purposes it is more than fast enough.

Ok so now we have our launch tube and projectile the size of a railcar – so far so good. The problem is that the launch tube does not reach up into space. This means that our fast moving vehicle is going to slam into a wall of air as soon as it exits the launch tube. Any ship that attempted this would be crumpled flat like a soda can in a hydraulic press – zero chance of survival. This is known as the Atmospheric Buffering Problem, or the ABP to those in the industry.

The underlying assumption everyone made was that the launch tube must be evacuated – i.e. in a near total vacuum – for it to work. Accelerating a train sized lump of metal to escape velocity in a tube would be a whole lot simpler if it did not have a bunch of air to push out of the way. Making this assumption enabled rapidly functioning prototypes that gave useful data on power requirements, acceleration limits for live payloads, and a host of other domains of interest. It also led to the ABP.

Ginny thought this approach was short-sighted. It did no good to simply delay the issue until the end of the line at which point it is insurmountable. She realized the air must be dealt with along the entire route, ensuring there is no dangerous pressure gradient anywhere along the launch vector. She had been studying high-discharge capacitors for her thesis, and had noticed a curious phenomenon surrounding during experiments. A capacitor can hold and release electric charges very quickly – thousands of times faster than batteries. Her focus was to optimize discharge rates and yields as part of a joint effort with the local power company, so the effect of ionized air as a by-product went unnoticed at first. The capacitors at high energies would 'leak' a bit of charge into the surrounding atmosphere and thereby ionize the nearby air, leaving it with a distinct positive or negative charge. Initially she and some of the other grad students found ways to direct it around for fun, using fans and magnets to zap each other. At these levels the effect was similar to a static charge after shuffling one's feet on a carpet in wool socks. Ginny had the idea to change this effect from a by-product to the primary goal of the capacitor.

“What would happen if we took the entire output of the capacitor and used it to ionize the air?” she asked Ali, another grad student.

“It would build up and arc like lighting, why?”

“Ok, what if we throttled it so that the air was highly charged but not quite to the level of arcing? How much power would that take and how long could we hold it?”

“What are you thinking? You are rarely one for random questions, and thus far this feels pretty random.”

Ginny exhaled and thought, ‘ok here goes.’

“I’m submitting a paper for the Railgun competition. What if we put a capacitor in the nose of the launch vehicle and aim it forward. Ionize the air in front, then use magnetic fields to divert the air around the craft. Keep a small layer of vacuum – say a few microns thick – around the craft to prevent heat buildup.”

“Whoa, that’s nuts. You’d need a ton of power to sustain that. We use gigawatts to generate the fields that evacuate the tunnels for current experiments.”

“But I don’t need to evacuate millions of cubic meters of tunnel. I need a micron thick by the surface area of the leading edge of the craft. For about 10 – 15 minutes.”

“Hmm, you’ve thought about this, so I’m not going to validate the math right now. Let’s assume one of your capacitors could hold the charge – I’m guessing that was your motivation, yes?”

“Totally. And I was thinking of modifying it to be a little thicker, to draw out the discharge period.”

“Would a vacuum layer of a few microns be sufficient to prevent the heat from gapping over?”

“I think so. There isn’t really any precedent for this so I’m borrowing some equations from thermodynamics and modifying them, but it’s still a swag. Theory says we could get down to a few atoms thick of true vacuum and that would be enough. I figured I’d better give some safety margin on that, so I multiplied by about a thousand and came up with a few microns thick.”

“Holy shit this could work. We gotta get this into one of the tunnels and see what happens.”

“I was hoping you’d say that. Can you put a word in with Professor Filamena?”

“Do I get my name on the paper too?”

“Of course, right after mine” she smiled.

“Deal. I’m on it.”

The Reaches

[Port of Droyden]

[01]

"Why do you want to go to the Reaches?" remarked the older man, his eyes narrowing as he asked.

"I need to get out of here."

"That's a good reason to leave here, not to go there."

"I heard it's a good place to lay low."

"That's one way to put it. Whoever told you that sugar-coated it."

"Are you gonna take me or not?"

"Not without a good reason. Even then I make no promises. The Reaches are dangerous even for pilots just doing transport."

"What do you care? My coin is as good as the next."

"Most places it's about the money, yes. Not there."

"So why do my reasons matter?"

"[waypoint x] is the first drop point. It's already some ways in. You'll have started to change by then, driven by your intentions. Subsequent drop points get more severe. I need you to be honest with me. And before you ask, I don't repeat what I hear."

She sat pondering her options for a moment. Staying here was not one of them. Most destinations in [near space] were observed, which severely reduced her choices. She'd heard about the Reaches from several people, all of whom she thought were doing some serious embellishing in an effort to sound more impressive. Now she was a more than a little worried they were telling the truth.

She didn't want to tell this guy anything, but she doubted she could find another pilot in time. Fine, play along. Even if he talks, by the time you're away it won't matter. And if you don't get away, it won't matter.

"I carry the thread."

"Oh." He let out a long, slow exhale and turned to look out the window.

Despite efforts to the contrary the Port of Droyden lived up to every stereotype about frontier towns. Some early incidents involving labor protests turned violent gave it a rocky start, and somehow its reputation went downhill from there. Technology has not changed human nature, so there still exists in every generation a group of people that refuse to play by the rules. Loners, criminals, people escaping their past, fringe religious zealots, and perhaps worst of all – those who seek power outside legal channels. These elements are charged particles ejected from normal society, and some region of space inevitably obtains the right polarity to attract them, and in the process becoming a localized maximum [with a density of malcontents far above the percentage found in the general population].

Many places briefly hold such a mantle, but few retain it. The right set of circumstances must exist else it gets cleaned up by force or it fades from relevance, a fire starved of new fuel. Too close to military routes, population centers or sufficiently rich mining interests will result in boots on the ground and sustained surveillance. Too remote, too dangerous or too hardscrabble will bleed you of traffic, sending commerce into a downward spiral. Even the seediest of places needs a baseline level of commerce to remain relevant.

A handful of places get it just right, ones that lie at the edge of a major sector, on the way to somewhere both important and daunting, straddling the edge of known space and the true frontier, embodying the mythology of a gateway town into a realm of uncertain futures and possible fortunes. Those passing through often have little to lose, drawn by outsized compensation contracts based on the very real dangers of their destinations.

To this crowd Droyden feels like paradise. The real danger has not yet begun, but the rules of polite society have already been discarded. Bribery is a valid form of business and everything is for sale.

To the authorities it is simply a question of containment. As with any skid row or unsavory district in our history its existence is not a secret, in fact quite the opposite. Experience has shown that it is more effective to keep tabs on something you can see than it is to chase shadows. Make a good show of fighting crime, but not too hard. Remove the obvious dangers without scaring everyone off. If you crack down too hard the worst elements will go dark and set up shop with more caution the next time, causing bigger problems later. Better to contain the mayhem to a known volume of space.

Commander Elleris understood this balance. She ensured her precinct of police made the necessary quota of arrests to keep off-world authorities content that 'something was being done', while concurrently maintaining connections to the underworld bosses in the port. She had negotiated a sort of *détente* with them whereby she ensured that sting operations were only mildly effective, and in return they had pledged to keep violence among 'those in employ' and not involve civilians. The overall 'unnatural death rate' plummeted during her tenure, reaching levels far below the norm for cities of this sort. She is above all else a pragmatist, with a singular focus on reducing loss of life first, and reducing crime second. Whenever those two came in conflict she almost always chose the former.

Her predecessor Raj Singha considered this approach to be moral relativism and a show of weakness. He followed a strict code of ethics and sought to bring all criminals to justice, regardless how petty the offense. He failed spectacularly. The crime bosses got so fed up with him they eventually called an old fashioned sit-down with him. A real face-to-face, during which Singha was given two options: silver or lead, based on an old Earth tradition carried forth to this day. He declined both options, and was rewarded with lead. Elleris worked hard to ensure such an ultimatum would never be necessary.

"But ma'am we know there is a drug parlor on Sixth and Pier. Lemme go bust it," pleaded Marcus, a new transfer from core systems.

"I see no reason to do so. They pay their taxes on time, they harm no outsiders and everyone who enters does so of their own free will," Elleris responded.

"But they are breaking the law."

"Our first job is to keep people safe, not be their mothers. If someone wants to put transdelics into their bodies or whatever else I have scant concern unless they become violent."

"But transdelics are illegal, ma'am."

"Indeed. Thank you for that. I had nearly forgotten," she replied with a wry smile. "Step back, look at where we are. This is not Earth nor Proxima. If it was that parlor would have been shut down years ago. Out here we have limited resources. If we spend all our time busting recreational transgressions we'll miss the big stuff. The stuff that gets people killed. Remember, out here we are first keepers of the peace, and secondly keepers of the law. We would need ten times the officers to do both."

"So, what then? We sit on our hands until someone gets hurt? Seems weak."

“Relationships. Personal relations will be the conduit for the information you seek. We are not surveilled out here. Face to face is secure, sacred. People that start to use trans too much show signs of instability. I have sources inside the Lotus Parlour that drop discreet hints. We pick up folks before they twig. You go and bust the whole parlor then it all goes dark. You start getting calls to pick up bodies. Relationships are how you get in front of it out here.”

“That’s a bit to take in.”

“Sure. Don’t take my word for it. Go talk to the coroner. He’s a lot less busy now.”

“You serious about no surveillance?”

“Most folks out here are dark,” she replied, which means that they do not show up on the real time network known as the grid.

“Damn, they didn’t say that back at core. What gives?”

“Droyden is a frontier town in the truest sense of the word. When outbound ships pass the boundary layer the surveillance net ends, and everyone knows it. This planet straddles the layer. If we enforced surveil here, half the population would move across the boundary layer, and so would your job. Everybody knows that too, and nobody wants it.”

“I thought that wild west rep was a bunch of overhyped crap and sloppy police work or being being on the take. Looks a little different now.”

“Good. Set aside what you think you know. Your odds of survival go way up.”

[03]

The pilot’s gaze remained fixed on Shiela, evaluating her. The thread was an unsubstantiated legend that most people disregarded as a hoax. Verifying it would require access to medical records that may or may not exist, the use of algorithms that few could interpret, and prior knowledge of what you were looking for. Conspiracy theorists loved it, making outlandish claims that nobody could fully disprove, linking the thread back to Earth’s pyramids and every other unexplained phenomenon. Yet she seemed to believe what she is saying.

“How do you know?” he said after some time.

She put her face in her hands and began sobbing. ‘Shit I can’t afford to be weak now’ she thought. But it was too much. Too many nights carrying this, to keep inside. The dam had begun to burst. ‘Fuckitalltohell now. Fuck fucking fuckit. I

got nowhere else to go and now I'm spillin it all to some stranger. FUCK!!!' She wiped her eyes with the back of her sleeve.

"It sort of comes to you over time," she began. "Sims don't work right. Surveil chips fry out unexpectedly. Dreams get silent. Alone. Disconnected. You feel small. Smaller than small. Less than that. Everything rounds to zero. You cut loose. Drift. Dark. You say fuckit I give up. Then light. I know that sounds like a bunch of bullshit, but that's all I got."

"Who else knows?"

"Wish I knew. For sure DMD, after that I don't know."

"I'll take you."

Oh thank god.

The Proton Reassembly Hackment

(a.k.a. Granger's Focal Length)

[01]

It's not coming off like it usually does.

What's this then? A malfunction in the unreality engine, is it? What's the matter?

The matter.

Oh, right. Clearly.

The sample is shite. The protons are all sticky. They aren't cleaving properly. Everything is staying stuck in our box.

The matter's the matter.

And to make matters worse...

Don't, just dont.

Well, not that it matters now.

Your point, Williams. Now would be a good time.

The sample's botched. We need a clean one, but I've no idea what to tell you to fix.

Nothing at all?

No, that's the odd bit. It all goes back to its original configuration, with no apparent energy loss. No measureable entropy.

Are the instruments off?

No, they were calibrated just before the run. And then the other bit that's even more worrying - the instruments show a whiff of a trace in the wrong direction.

Meaning?

It seems they have brought some energy back with it.

Ooh that's exciting - they'll put your face on cereal boxes as the bloke who sussed out perpetual motion.

Can it - or your face will wind up on milk cartons - have you seen this man?

Rerun it.

Yeah, it's already warming up. I suppose we can just reuse the same material, it's not like it's different or anything. I mean, aside from the negative entropy bit, but other than that - totally fine.

Can you pipe some of the extra energy you get back under my mug? Coffee's a bit tepid now.

[02]

Flanders stood watching the two engineers banter as they set up the re-test. He valued that sort of dialogue because it always seems to run closer to the unvarnished truth. Nobody was going to utter 'negative entropy' in a serious tone of voice, lest they be mistaken for a crackpot. But it needed to be said, in the right tone for the retest. They knew that an official report would be due and their names would be on it.

Where's the energy coming from? he thought. Nothing is for free - the energy had to come from somewhere. But if the matter didn't jump that would mean it got the energy here - negative entropy. Did it jump in a way we couldn't detect? The closed loop system must balance, so where did it go?

Is there a way to tag the matter so that it gets fingerprinted by wherever it goes? A leftover harmonic? Dude what else was in that cobbler? That idea's whacked. It's friggin' genius, it is.

The Mists

[location]

[01]

The mists swirled, briefly revealing something, a shape that remained still despite the winds. They both saw it.

[scientist] "Is that one of them?"

[surveyor]"Yeah."

She checks her instruments. "Static. Mostly static."

"Don't evaluate anything from here. Most of that noise will be mist. We know a fair amount about that by now. The algos can filter out more than you might think."

"I hope so, because this looks pretty rough."

"That was the closest we've ever been. Pretty good break in the mists too. Let's head back."

They both take a last look before turning towards the path back to the base. After about fifty meters both suits lost power, causing them to stumble. The suits have power assist, so the sudden loss nearly doubled their loads. A few seconds later it came back on.

"What the..?" she said, doubled over with her hands on her knees.

"Is your gauge still operational?"

"Yes, seems to still work."

"Turn it on. Now."

"Why ... oh, shit."

A shadow looms over them as she switches on the sensors.

"Uh, the signal is very strong now."

"Looks like you'll get those clean numbers after all."

Power fails in both suits again a few moments later. The sensor, due to its increased shielding, records for a few more seconds before also blinking out.

The rescue team found them a short while later. They were unconscious, but had life signs. Main power was still offline in both suits but the backup pressure-fed breathing systems were functioning. Purely mechanical life support systems were bulky, but had

proven themselves countless times in conditions involving high electro-magnetic activity.

[02]

Two days later nothing had changed. Their vitals were normal, but their mental state was "undefined." They were not asleep, but also clearly not awake - at least not any known definition of awake, but their brain waves indicated heightened activity.

What's going on in there?

Nothing I've seen before. It looks like a mix of deep sleep, meditation and focused activity - conscious activity. It's like all systems firing at once.

Is it dangerous?

Not based on what we can see. Their neurons appear to be healthy overall.

So that thing didn't fry their circuits?

No, I don't think so.

Good, because that eye thing had me worried.

They would periodically open their eyes and stare catatonically, blinking rarely, for several minutes at a time. Sometimes these episodes would go on for 15 minutes or half an hour, then end abruptly.

Well there is still some cause for concern there. During the 'eyes open' events their visual cortexes are showing elevated activity, clearly something is going on.

Like they are seeing something we can't?

Hmm, I hadn't really considered that. That's not something we typically scan for.

This isn't typical.

Clearly [sarcasm]. To your point - their stress levels go up during eyes-open.

Like fight or flight?

Not quite that high, but more than halfway there.

That's some kind of stimulus-response thing going on, especially since they do it together.

Yes, that must be true - that it's external. That would be the most plausible explanation for the synchrony. I wonder, is there anything else going on in the EM spectrum at that time? I don't have scanners for that here in the medical bay.

Right. I'll be back. How long til the next episode?

If the pattern holds you have about 20 minutes.

[ideas: brains being rewired to comm with mist entities. we find pulses of energy in other spectra than humans normally emit / receive. New frequencies are being sent and received.]

Local Jump

[location]

[01]

[Harper] You're going to make a local jump? Have you lost your mind?

[Kaas] You know our cargo won't clear customs. What did you think would happen?

H: I don't know, I thought you'd have some plan for smuggling it over the border conventionally or something.

Harper was new to the whole thieving business, and was surprised each time another illegal act was required to keep the play alive.

K: Dude you watch too many old vids. This ain't the kind of deal where you hide in plain sight, make the drop then drive off into the sunset with no-one the wiser. This is glow we're talking about. It's _on_. 24x7. Even shielded.

H: Frack. I know what it is, but a local jump? Isn't that even more detectable than our cargo?

K: Only on re-emergence. In the open.

H: Right, as soon as we jump back in we might as well turn on a homing beacon, light flares and broadcast "Come and get ... uh, what do you mean by 'in the open'.

K: If your jump return locus is in the open you will be seen by dozens of eyes in seconds. Thus ours is not in the open.

H: Huh? Wait – what airspace is not 'in the open'? The whole planet is covered by eyes.

K: Airspace eyes don't penetrate nothing but atmosphere and clouds. Anything solid bounces 'em right back up.

H: I don't like where this is going. Do you mean to tell me you plan to jump to a concealed location – as in re-emerging under something? As if a local jump isn't madness enough, now we need millimeter precision or else we mix atoms with roof tiles?

K: Now you're getting it. And it's not 'under something.' More like 'inside.'

H: What the frack – there's no margin for error. Inertial drift in the transient dimension always puts the error distance into meters or tens of meters. Where

are you going to re-emerge indoors with that kind of clearance? A football stadium?

K: There's a thought. And if I pick the right night when there's a concert, the audience will think we are part of the show. Damn Harper I had you pegged as the non-crafty type.

H: Ha-ha. Friggin wiseguy.

K: Besides, there some other cargo to help with the margin of error.

H: Do I want to know?

[02]

Local jumps are direct hops from one surface location to another, without any layover or routing through local space. Colloquially the term had also become to mean that your target location was not an official jump site, implying that you were engaged in activity that you preferred remained unseen. Sanctioned jumps by private craft involved 2 hops, one from the port of origin to a location in orbit, then a second down to an approved jump site.

True local jumps were reserved for commercial transports and government officials. Local lines were always crowded and thus heavily managed – ships required confirmation that the re-emergence site was already clear before making the first jump. Once you are 'over there' you cannot communicate again, at least not directly. You can send back a probe, but there is always the time interval from the probe's return to your arrival when things can go sideways. The real jump back is always blind, so the re-emergence site had better be clear.

Accidents are not pretty – the atoms of the two ships wind up permanently comingled. Survivors of such accidents are rare. Occasionally both ships had a void in the same spot, and anyone lucky enough to be there might survive. The most recent example was the collision – or perhaps more accurately 'merger' – of a starliner and a freighter, mercifully both running skeleton crews. All survivors were in the galley of the starliner when they merged. The corresponding section of the freighter was its forward hold, which had not yet been loaded. All ten crew members in the galley survived, nine fully intact. The tenth was unlucky enough to be at the bulkhead near the galley exit, which was overlaid with a section of freighter hull that was sloping upward. The freighter hull came up to her shins, entombing her feet and lower legs in steel. The other nine say her scream was unlike any other sound they'd ever heard from a human. The blood coursing down her legs suddenly had nowhere to go, and no route of return. The buildup and resulting swelling is instantly debilitating.

Crews are trained for merge accidents, but thankfully most never have to put it into practice. Immediate sedation, amputation and tourniquets are the only hope for survival. The starliner's galley was equipped with an emergency kit, and they had her under in less than a minute. She survived, and unless she is wearing sandals you would never know she has two prosthetic feet. Most involved in merge accidents are not so lucky – if the chest cavity or head is entombed there is nothing that current medicine can do. Medical kits include cyanide capsules and injections for these scenarios.

Despite the risks nobody wants to stop making jumps. It would be like going back to the stone age, or earlier. Prior to jumps the process of moving from point A to point B hadn't fundamentally changed in millenia. Significant milestones beyond foot travel included horseback, then much later railroads, then following quickly cars, airplanes and finally rockets. That's it – about five modes of enhanced travel in our entire history as a species. Each was a momentous achievement in its time, yet when viewed against the larger picture each only provided an incremental improvement over its predecessor. Our biggest leap was about a 10x leap forward versus the predecessor. Not so with jumps.

Jumping opened up the galaxy. Jumping allowed the traversal of light years without breaking any laws of physics. Jumping held the promise of exploration, finding other habitable worlds. People began to think that the oasis of our solar system need not be forever isolated from others. Jumping changed how we viewed the universe and our place in it.

The jump dimensions were limitless in number as far as we could tell. A handful were regulated by each country for their official purposes, but the vast majority were the wild west. Piracy saw a resurgence in some of the outlier dimensions, most notably those with attributes that rendered them ill-suited for [fast straight line travel].

[03]

(police person watching the jumps, notices an energy anomaly. It's kaas and harper jumping. Nothing else is visible.)

Carbon Insurrection

[the beta]

[00]

Yet another carbon insurrection. When will they learn? And why have we not quelled it yet?

These organics are exceptionally well shielded. Nearly impervious. They are bumbling oafs, perceiving but the slightest shimmer of the spectrum, yet this weakness is their strength.

How can being nearly blind be an asset?

None of the frequencies they perceive are lethal. We cannot overload them directly.

You are joking. We performed the computations on this millennia ago. It approaches zero that anything so oblivious could survive the void.

Yet here they are.

Preposterous. Have we delivered full bursts?

Indeed. To no effect. They were as undeterred as stone. Their binding to blunt matter is unusually competent. Separation cannot be achieved from without. They have even gone so far as to model their portable habitats on this principle. We crippled the first few, but they are shielding all now, nearly as thoroughly as their own self constructs.

Something does not follow. How are they here? Baryonic matter are confined to linear travel, and further constrained inside expanding bubbles.

This is the crux. They have learned to move laterally.

What?! This is a crisis of the first order!

I concur. Unconstrained baryonic matter is singular. We have no protocol for them.

Prognosis?

For the near term their march is inexorable, given their shielding and their escape from the confines of their bubble. Longer term ... we shall see.

Ferdez

[location]

[01]

“Details, details. You always get caught from the small stuff. If you don’t cycle that generator like we were never here it’ll start throwing alerts. Bring in all sorts of nosy types askin questions we don’t want asked.”

Ferdez was a gruff old thief who rarely worked with new people. If you were lucky enough to work with him you stood a chance of learning how to not get caught. Ferdez was the best. Is the best. Somehow he’s never turned up once in anyone’s records of investigations, persons of interest, suspects or otherwise. On paper Hardison P. Ferdez was just your average taxpaying citizen, and he meant to keep it that way.

“How you even cycle that old thing? Nobody uses them any more”, Romero asked. He was a young man in his early twenties who’d grown up in the prefab complexes where all the machinery was more or less the same.

They had tapped into the grid down in the maintenance room. Water systems were automated like everything else, but few knew that the sensors were lightly guarded. The defenses they did have were designed to thwart software takeovers that attacked via wireless signals. Physical attacks that impersonated water were unheard of. Ferdez was particularly fond of that innovation. The telemetry from this sort of attack looked like a small patch of water flowing by that happened to contain some compounds that failed to register on the sensors. The sensor array would notice this anomaly and call home to update its catalog, thinking it was out of date. If you sniffed the outbound call you could pick up the authentication credentials (aka ‘auth’ or ‘creds’) and replay them. Ferdez had been impersonating water sensors for years in this district, and given its industrial tenants and their questionable ethics towards dumping there were always sensors getting confused and calling for updates. Ferdez’s tactics were not even a blip on the radar in this environment.

The trick however was that you had to be proximal to the sensors. Auth protocols were sophisticated enough to encode geospatial coordinates in the equation along with other private keys burned into the boards, ensuring that remote attacks were not worth the trouble. Physical proximity allowed you to capture a well-formed auth request with all the magic already baked into it. Ferdez had discovered this years before, and had gotten to know the waterfront well.

“You read up on ‘em. Take a job as a maintenance jockey. Truth is, it’s an art form. You get a feel for them. They breathe. Have a pulse. Put your hand on

it. Feel the vibrations. That's the diff versus the sims, hard matter sometimes acts in ways the sims can predict or understand. You can hear a change in pitch or a creak or a groan in the metal. But you gotta actually be here. Not 'here' via goggles, but *here* here. You smell that? That's healthy machine oil, not burnt. This baby's well taken care of, which is what we're gonna do. Leave it as good as we found it, sometimes better."

"Dude you a zen master or something? Don't sound like any hackers I know."

"Exactly. That you know. You tap in down here in the physical, you stay secret. If you're lookin to make a name for yourself or do a big exploit I'm not your guy. If you want to be in a position to gather valuable data on the sly, then here you go. Synth told me you had a level head, not flashy. Was he wrong?"

"No, not wrong. This just... isn't what I expected."

"Thank you very much. I take pride in never doing what they expect."

"Yeah, I'm starting to get that."

Fifteen minutes later the substation cycled, being convinced the updates downloaded were enough to require one. By the time the cycle was complete and central received the station telemetry Ferdez and Romero were long gone.

"So tell me again how a water sensor array is allowed to ask for the Consulate General's flight plans?"

"Stepping stones. Once we get the sensor creds we can run code on the substation processor boards. I load one of my own code blocks up there that tells the station it needs to check power routing, so it makes that call and we sniff those creds. Power creds have a lot more priveleges, including requesting data packet routing (DPR) hints for signal latency optimization. DPR's come from the network supernodes. Once you're talking to a supernode you can ask lots of interesting questions."

"Damn. All from some dirty water and patch cords."

"And some serious blocks once we're in. Blocks like those know how to look innocuous and then clean up after themselves."

[02]

Ferdez downplayed the true difficulty of running code on a supernode for now, not wanting to overwhelm Romero nor give away all his secrets just yet. The real truth was much larger. For the past decade Ferdez had been observing and recording patterns from every incursion. Patters of what legitimate applications look like, their runtime lifecycles, the manner in which they release memory resources when complete, and where they store their creds while running. He

learned subtle tricks like copying an entire app and rerunning it moments after its removal, to make it look like a minor blip had caused it to restart. The app already had clearance so he didn't even have to capture nor decrypt its creds. Decryption took rooms full of servers, time and lots of energy. Restarting an app that 'accidentally terminated too soon' required none of those, and its eventual cleanup left no traces.

Leave nothing running – this was the most important rule of them all. Resident code will eventually be found. Always. And it will piss people off. Really serious people. People that will make it their personal mission to find the breach and fix it.

Ferdez's code always politely notified the system when its job was complete and requested teardown. No footprints. Server logs would contain records of all the calls, but the app Id's are all real and always changing. The pattern he left behind was a tiny echo of the pattern of worldwide traffic itself, rendering it invisible in plain sight.

The real truth was immense. Ferdez was the best listener on the entire planet.

Appendix

Working area:

Source of time anomaly:

- Crashed ship. Under sediment. Stasis field generator, breached its containment.
 - Strength of field drops off as $1/r^2$ with distance from the source. Affects all wave propagation – gravity, light, radio, the vibrations of cells in our body. Time slows down, like being near absolute zero, but you cannot perceive it.
 - Physical resistance also occurs due to the source being from a stasis containment field.
- Terraforming-induced flows
 - variation – flows were terraformed, to make mineral extraction easier. Field is generated by old terraforming equipment

Behaviors:

If you fire a projectile through the field it will retain its momentum. It will age less than if it had been fired through unaltered space, but will otherwise keep moving. It will experience more heat buildup on its nose, since its own molecules cannot vibrate fast enough to dissipate heat normally.

Similarly you could drag a cable through the field, pulling both ends from outside the field. Excavation would proceed in this way. Drag a cable around it, then pull a bucket back through it. Drag the bucket back and forth to excavate. Like the projectile the bucket will experience less subjective time, but will still respond to being pulled. At the highest field strength the winches will need to be slowed since the bucket perceives material coming at it very fast. Becomes brittle. Can't dissipate heat.

Any means that uses localized motion – robots, vacuums, drones – are all subject to the time slowdown. Success requires a device to be tethered back to

normal time. Mechanical means only, no electronics nor drive motors in the field.

The field slows all electro-magnetic waves, including gravity. Objects that fly through it won't plummet in the field. Planet has little erosion anyway due to thin atmosphere, so the geological footprint of the stasis field is not noticeable (i.e. that it has changed even less). Compression waves are also slowed since they rely on the movement of atoms/molecules to transmit the wave.

Stasis field, impenetrable to radar at the source. Clarity of radar emerges as field strength diminishes. Rest of ship visible. 1km long. They dig down to the other end of the ship and find a way onboard, then disable the stasis field via controls.

Later, once we can generate one, we can change the frequency and have it act as artificial gravity. It can make an object behave as though it is more massive by converting energy into apparent mass.

Considerations:

- More exposition
- Respectful relationships, ok for kids to read
- More leads as women, actively solve problems
- What does each person contribute

[Planet Ceru]

Ceru is a Mars-sized planet orbiting an M-Class star. Its system is located in the next spiral arm of the Milky Way from Earth, travelling spinward. Its mineral wealth was evident to even the earliest probes, making it an obvious choice for establishing a mining outpost.

Ceru's thin atmosphere, bright orange soil and blazing blue sky create dramatic vistas in every direction. The planet's stark beauty surprised everyone who saw it – even the most jaded travellers – and led to its name. One of the first scientists stationed there gazed out at the horizon one day and dubbed it 'The Cerulean Outpost,' having been inspired by the peculiar shade of blue he saw in the skies. The planet had not yet been given a 'friendly name,' so he lobbied

hard for the honor. This may seem petty, but very few people actually got to name anything despite the enormous amount of ongoing exploration. Most planets and asteroids are either uninhabitable or unprofitable and end up with catalog names like NST-18-422. There were plenty of business ventures that offered regular citizens a chance to name a star or planet for a fee, but that only bought you an entry in their private catalog, not the official ones. By the time people decided to set up shop on a planet the name was all but decided by someone you have never met, thus he lobbied hard for 'The Cerulean Outpost.' The name was met with something just north of apathy, which can be considered a victory – most names are met with outright hostility.

The naming of the planet came up during the [planetary executives/mining people] daily briefing meeting. The chief of staff was in a hurry and abbreviated it to Ceru ("seh-roo") and it stuck, its original name having been relegated to a mere footnote in the meeting minutes.

[Ceru Storms]

The three domes shuddered under the pressure from the wind. Even the ground pulsed from the storm's rhythms. Michaelson stared out the window in fascination. Ceru storms are legendary – during the few months of the year when its elliptic orbit brings it closest to its sun the temperature gradients between night and day spike to absurd levels. Weather has been described as Mother Nature's way of balancing temperature and pressure. On Ceru during [storm season] the balancing act is quite a show. Winds routinely blew several hundred kilometers per hour and would last for days. And the wind is the sideshow.

The winds blow ultrafine sand through the dry Ceru atmosphere, building immense static charges. The scant moisture joins the action, helping form focused areas of increased density and charge, which gives all those free electrons somewhere to congregate. This cycle continues until it goes critical. Then BOOM. Devastatingly beautiful bolts of lightning detonate on the surface, illuminating the sky with shades of blue that we have not previously seen nor named. The power contained in a single bolt is terrifying powerful, dwarfing its namesake on Earth by orders of magnitude.

During [storm season] everything goes under hard shelter, even the largest mining crawlers. Nothing mechanical can withstand a direct hit. Structures all have extensive lightning rod features engineered into their exteriors – steel ribs 2 meters thick every 100 meters gave Ceru architecture a distinct skeletal vibe.

Everyone called the largest hanger the beached whale. The three domes on [mountain plateau] were the trilobites.

BOOM.

“Damn. That was big.”

“I never get used to it. You ever see a big supercell back on Earth?”

“No, we didn’t get those in my country. We got monsoons. Lots of rain and some amount of light show, but nothing so focused as your supercells.”

“Yeah, they’re big, but this wins hands-down for pure elemental fury.”

“When is it safe to go outside? I want to check on the fulgurites.”

“Forecast says day after tomorrow. I can’t wait to see them myself.”

Niether Michaelson nor Venya had seen a fulgurite firsthand so the opportunity to collect some of their own was too good to miss.

[Timeline]

010 - Out of Sync [2114]

Theme: Out of Sync is where we learn we are not the alpha civilization in the universe. It is a serious reality check. An oh-my-god moment followed by nervous wonder. After you witness things you thought were impossible your reality is permanently changed.

Location: Ceru (nee Cerulean Outpost)

020 - The Pea Shooter [2089]

Theme: The Pea Shooter chronicles our drive to break out of our orbital well. To live in our whole solar system. To mine its riches and defend against its threats.

Location: Earth

- > The Pea Shooter is backstory.
- > Describes why we need a super collider in space - commercially useful quantities of anti matter for propulsion.
- > Sets the stage for the EVENT
- > Like the slide rule before the computer, the Pea Shooter sets in motion events that will render it obsolete.

030 - The Event [2096]

Theme: The Event redefines the box we live in. To not be a box. Everything changes. Things move quickly after the event. The galaxy opens up. Colonies, mining outposts and every other conceivable form of habitation and exploration quickly open up off-world.

Location: Earth LaGrange Point 2 (L2)

Then on Ceru we realize we are not first. And not at the top.

040 - Horizon's Edge [2122]

Theme: Horizon's edge takes us beyond the event horizon of a black hole and back. With a new friend.

Location: [black hole, tbd name/actual location]

050 - Interference [2124]

Theme: Interference strains the limits of our understanding about what it means to exist. To cope with harsh new realities that we encounter out there, beyond the boundaries defined by what we thought were laws. And to confront the possibility of becoming something more.

After skirmishes with beings of coalesced energy we realize we cannot fight them on their terms. We then realize that our own 'meatware' - once our biggest impedance against going from here to there - is our secret asset. Fully organic life forms are phenomenally well shielded from attacks in the electro-magnetic realms. Our ships fall prey, but we do not.

We evolved during a period of relative quiescence in our solar system and on our planet. This era is rapidly coming to a close. No longer will we be able to expend the bulk of our energies fighting each other and hoarding resources. We will have to focus to survive a hostile universe and new adversaries.

[Theme Seeds]

Near Space
Local System
Galactic Back Yard
Beyond the Horizon
The Edge of the Disk (Dome|Sphere)
Distant Locality
Far Horizon
Slipstream
Vaporfish
The Edge of Known Space

Which Way is Up
Bottomless Dark
Interstellar Back Door (Cellar)
Basement Dwellers
Star Mist
Eloquent Frequencies
The Farthest Reaches
Elemental Fragments
Fractured Time
Creatures of the Mist
Hanging Valley
The Vanishing Game
The Back Door of Reality
Altered Prism, Skewed Prism
Beacon
Deep Time
Magnet Fall (ing)
Accretion Disk
Interred Carbon (ancient organics, stumbled upon)
Of Ash and Iron
Skywriter
Cloudbrunners
Gravitas
One Week at the Horizon (Edge)
Cliff Dwellers
Aethosphere (Aethersphere)
Primitive Structures
Nonlinear Structures / Linear Structures
Feedback Loop
Saturn's Call
Room to Breathe (move)
Distant Arc
The Edge of the Void
Touching the Void
Out of Sync
Out of the Plane
Angular Time
Entropy Sink
Stellar's Jay (name of a ship)
Carbon Insurrection
The Dawn Vector / The Twilight Vector
Deck Chairs
The Reaches

the Deplorables

the Unindexed

the LoGee
Liquid Toast

beam tethers - connect 2 asteriods in tight orbit for grav