

# SAGITTARIUS EYE

ISSUE **24**  
August 3305



Also featuring:

Lagrange points • Straight Lines

Life on Airless Worlds

The Rochester Family

Mawson Dock

Carina Constellation



# SAGITTARIUS EYE ISSUE 24

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SAGITTARIUS EYE

Two years ago, Commander Whitman and his small band of collaborators released Issue 1 of *Sagittarius Eye* to the Galaxy. It was to be a bright “supernova of news” — the first monthly magazine by, and for, members of the Pilots’ Federation.

This editor was just returning to the flight seat after nearly a year away. While not having much to do with Issue 1, he remembers frantically checking the design proofs of Issue 2 while on a work trip on the other side of the Earth-like world he calls home. It could have been last week.

And now, two years later, we’ve released twenty-four shiny issues. Where to now?


We’ve covered the largest Pilots’ Federation groups, the biggest events, the knottiest aspects of spacefaring science, the best ships, and the histories of the entities that affect our lives in the flight seat. We’ve produced professional-quality ‘cockpit listening’ versions of every issue, beautifully brought to life by our stellar voice actors. Looking back at the contents of our twenty-four issues, we are confident that they represent the most comprehensive account of what it means to call oneself a commander in the thirty-fourth century.

Many of us have been around, perhaps not since Issue 1, but since Issue 5 or 6 — and a few of us, much longer than that. Keeping to a regular, monthly release schedule is a punishing workload, and we haven’t released an issue late since Issue 2.

So, from Issue 25, we’ll be moving to a new release pattern of quarterly, rather than monthly, releases. Doing this, we are certain, will result in both a higher-quality, more polished and beautifully-crafted product, as well as less-stressed writers, editors and designers.

Expect a brief lull while our newly-liberated writers blink in the unfamiliar sunlight and gambol about joyfully, before we corral them back to their typewriters. But you can expect Issue 25 of *Sagittarius Eye* in the fourth quarter of 3305.

Our video team continues to release outstanding documentaries twice per month, and our Breaking News service broadcasts to more than a hundred online communities. Both these formats have tremendous room to grow, so you can expect more focus — leading to more quality — from both of those.

We’re taking a step back, for now — but we’re going nowhere, Galaxy. 



Souvarine



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# THE ROCHESTER FAMILY

Jordan Rochester is now a household name throughout the Empire, though few were aware of him prior to his engagement to Princess Aisling Duval. In the Federation, the Rochesters have been associated with success for over two hundred years.

In June 3304, the announcement of a Federal Ambassador's betrothal to an Imperial Princess sent shockwaves across the Galaxy. The Empire was alarmed that the heir to the throne had abandoned tradition in favour of romance, opening the way for a dangerous collaboration with its rival superpower. Federal citizens saw things differently: Aisling Duval was probably just an acquisition for Jordan Rochester, a business deal, a political scheme... A way to make a lot of money. For he is the scion of a dynasty that can already claim two centuries of notoriety.

The Rochester family exemplifies the capitalist ideals of the Federation, where acquiring authority, wealth and power is a way of life. Individually they have become experts in their chosen fields, and collectively they have as much influence as the largest corporations. The family name can be traced back to Apollo Rochester, a successful tycoon on Biggs Colony in the Altair system.

By 3100 he had become the biggest land-owner on the planet. There are

no records of the Rochesters prior to this, and it's possible that Apollo was a self-made man in every sense, including inventing his own name. Over the following decades, as his children and grandchildren gained enormous affluence and status, the family name became a byword

**The Rochester family exemplifies the capitalist ideals of the Federation.**

for achievement. It's now part of Federal culture to refer to someone who has done well to be 'as rich as a Rochester'.

The genealogy of Apollo's descendants suggest that the Rochesters always had a keen eye for public perception. As far as is known, the names of each generation's mem-

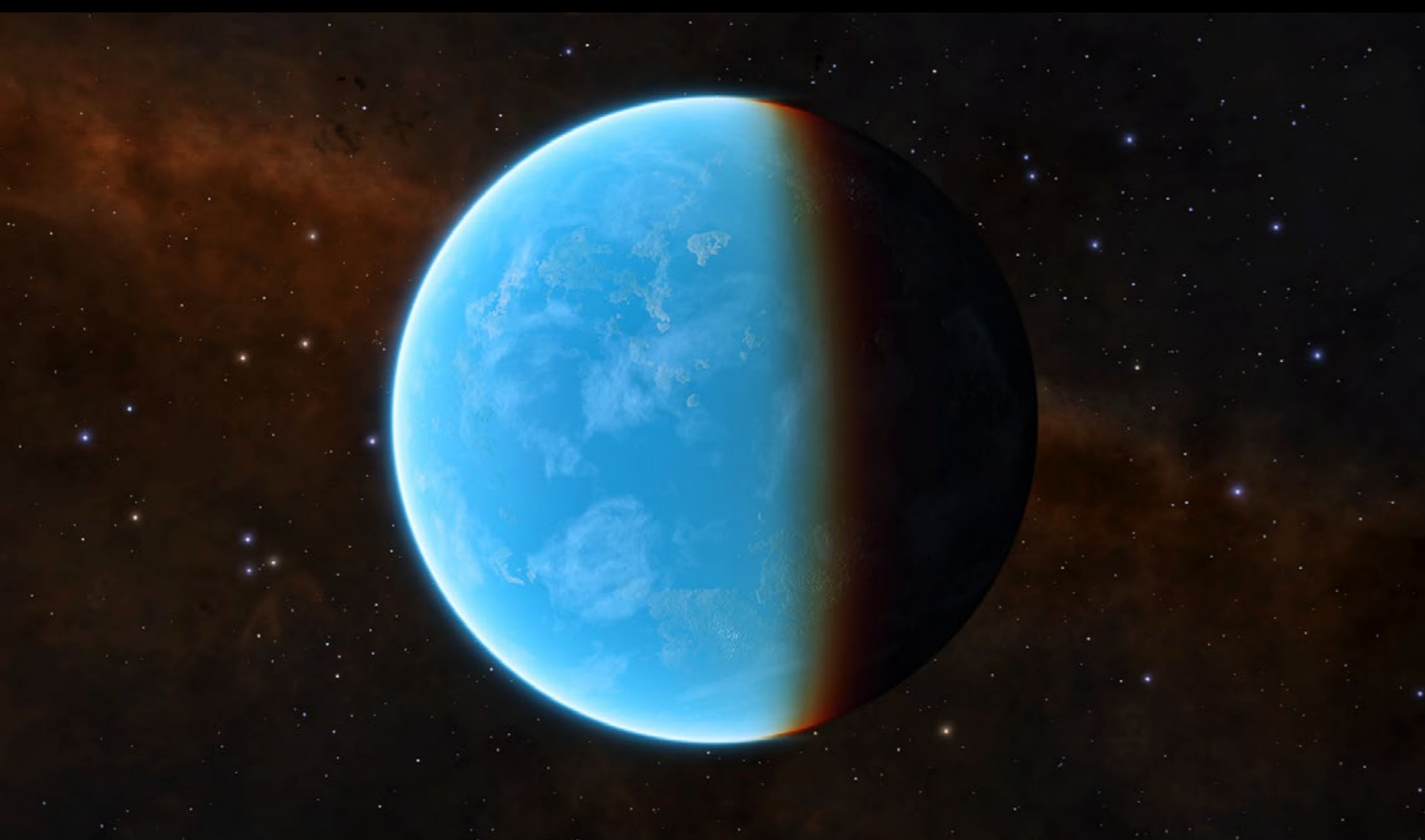


bers start with the same letter, and the generations work through the alphabet. This supports the idea that Apollo Rochester gave himself a name starting with A that had mythic overtones, as befits the progenitor of a family line. Eight generations later, we have Isolde Rochester, who followed convention by naming all of her children using the letter J. Her son Jupiter, so far the only one to have children, followed suit by naming them starting with K. This strict adherence to Apollo's legacy may be to instil a sense of identity and structure in the life of each family member – whether they like it or not.

It also appears consistent that, despite marriage or partnership, the name Rochester is always restricted to descendants of Apollo. Only offspring adopt their surname, not husbands or wives – for example, Jupiter's husband is Tomas Turai rather than Tomas Rochester. It seems that the Rochesters are unconcerned about genetics, since Jupiter's children were all either adopted or surrogates. Perhaps what matters more to them is management of their brand.

The modern Rochesters have a diverse range of interests and careers, but all typically involve money and power.

Isolde Rochester is the current matriarch of the family. She is a long-serving Member of Congress and a loyal supporter of Felicia Winters. Her most recent achievement was winning the role of deputy leader of the Liberal Party, thus becoming Shadow Vice President. Should



President Hudson lose the next election, a Rochester would become the second most powerful individual in the Federation. It is clear that Isolde is a political strategist and a master at playing the long game.

Jupiter Rochester, the oldest of Isolde's five children, is a businessman who has become CEO of starship manufacturing giant Core Dynamics. Not only is his personal wealth measured in the billions, but his influence in corporate and military circles is colossal. He has been described as 'one of the Federation's bedrocks'.

enth generation of the dynasty. Kali is a student at Olympus Village University, with her own private security detail on campus. Kalen has so far been kept completely out of the public eye, but there can be no doubt that he and his sister will dominate the media in years to come.

Juno and Jocasta Rochester, Isolde's daughters, both chose military service for their careers. Juno has risen to the rank of vice admiral with in the Federal Navy, commanding a Farragut-class battlecruiser. Little is known about Jocasta, save that she

have abandoned his responsibilities to seek a carefree, hedonistic life? Or is one of the more respectable Rochesters boosting their fortune with high-stakes games of deadlock poker?

Jordan Rochester, Isolde's middle child, followed his mother into the political arena. By the age of 34, he had a notable career as an envoy with the Federal Diplomatic Corps. It was Jordan's ambassadorial duties that brought him into contact with Aisling Duval, when he was stationed on her home planet Emerald.



Jupiter's marriage to the famous actor Tomas Turai fifteen years ago could only have boosted his standing. This was damaged when Turai's affair with Olympic athlete Reagan Lord was exposed during the Mars Tribune scandal in 3304. Despite denials and talk of legal action, the matter was expertly glossed over after the newsfeed collapsed. Although some believed that the infidelity had been faked, others theorised that it was the marriage that was manufactured, purely to portray Jupiter as a respectable figure.

Jupiter's teenage children, Kali and Kalen Rochester, embody the elev-

serves as a post captain, suggesting involvement in more clandestine naval operations. Jonah Rochester, Isolde's youngest child, is the exception to all of their rules. He has no title, no career and no wealth – in fact he is a complete mystery. Commonly referred to as the black sheep of the Rochester family, he lacks any public presence and even his location is unknown. Despite his mother's tight rein on her offspring, Jonah seems to have slipped the leash. Naturally, this has invited widespread speculation. It's rumoured that at least one Rochester is a regular attendee at Jokers' Deck, an infamous and secretive gambling circle. Could Jonah

Media reports from that time paint a romantic picture of the two of them strolling around art installations and dancing at diplomatic functions. The 'people's princess' already had a reputation for flirting with potential suitors, so this was seen as typical publicity-seeking behaviour – until Jordan announced:

*Representing the Federation has been my life's work, but meeting Her Highness – Aisling – made me realise that being by her side means even more. We hope that our betrothal will usher in a new era of cooperation between the two superpowers.*



The Galaxy was caught by surprise, and reactions were divided. Some saw it as a joyful pairing with exciting ramifications for the future. Others viewed it as an outrageous insult, or at least, as Senator Zemina Torval put it, "a reckless political manoeuvre". Notably, there was no official response from either President Zachary Hudson or Emperor Arissa Lavigny-Duval, suggesting that neither had been informed in advance. The two rulers seemed reluctant to express either approval or opposition. Prime Minister Edmund Mahon offered cautious congratulations, while former president Jasmina Halsey was enthusiastic about the opportunities for peace. Another senior

**The Galaxy was caught by surprise, and reactions were divided.**

figure offering public support was Isolde Rochester, whose comments contained more than just maternal pride:

*I support my son's relationship with Her Imperial Highness, and I consider this a positive step for all parties. The potential benefits of stronger ties between the Empire and the Federation are incalculable, particularly in the areas of trade and defence.*

It is telling that Isolde specifically mentioned trade and defence, fields in which her two eldest children – the Core Dynamics CEO and the Federal Navy admiral – might take the lead if the doorway to Imperial territories and business were opened. This raises the possibility that Jordan's relationship with Aisling was no random affair, but had been coordinated by Isolde, as perhaps Jupiter's and Tomas Turai's marriage had been.



*According to Toredó, the princess claimed not to have any romantic feelings for Ambassador Rochester, and insisted that the marriage was merely a means to advance her political plans.*

Aisling Duval immediately refuted this, stating that Toredó was being used by those who wanted to rekindle Federal-Imperial aggression. There was no public comment from Jordan, but within days Isolde Rochester stated that the wedding had been cancelled, alongside the shut-down of all “related projects”. There was a palpable sense of anti-climax amongst the superpowers’ citizens, half of whom were ready to welcome a new golden age and the other half were prepared to go to war to prevent it. Whether this had been a grand scheme to unite the House of Duval and the Rochester dynasty, or simply a story of two star-crossed lovers following their hearts, Toredó’s testimony brought it to an abrupt end.

Many specifics remain unknown. Did Jordan call it off in a fit of pique, furious that his princess was dallying with a commoner behind his back? Was Aisling betrayed by Toredó, or was she innocent, her infidelity merely a fabrication by her enemies?

Many assumed that much more was going on behind the scenes. The cancellation was not announced by Jordan or Aisling, neither of whom have made any public comment about it since. Instead it came from Isolde, implying that she had been stage-managing the entire thing. Perhaps Toredó was too much of a random factor for Isolde to tolerate, or maybe she calculated that Aisling herself could no longer be trusted. Either way, the ever-cautious matriarch had decided not to risk her family any further.

Despite the failure of this attempt at inter-superpower union, the future for the Rochester dynasty looks as bright as always. Isolde is still a power to be reckoned with in Congress, Jupiter ensures that Core Dynamics dominates the market, and Juno and Jocasta continue to forge ahead in the Federal Navy. Meanwhile, although Jonah remains an enigma, young Kali and Kalen wait in the wings to inherit their legacy.

As for Jordan, it’s likely that he will forever be associated with the most controversial marriage of all time. But if nothing else, as The Imperial Herald observed:

*Even more so than his predecessors, Jordan Rochester has already ensured that history will remember his family’s name.*



It is also an unlikely coincidence that Vice Admiral Rochester’s battlecruiser, the *FNS Pioneer*, was chosen to serve as Jordan’s consular ship. Juno herself was invited to visit Aisling’s palace, which in hindsight looks less like meeting a future sister-in-law and more like part of the conspiracy. If the marriage was indeed orchestrated, then this was a staggering effort to alter the Bubble’s political landscape. For rival tribes to end hostilities via marriage is a strategy dating back thousands of years, but here it was being applied on an interstellar scale. Enmity between the Empire and the Federation is constant, and not even joint efforts to combat the Thargoids have changed that. But if Aisling and Jordan were to wed — and to have children who were both Duvals and Rochesters — the barriers between superpowers might start to come down.

**The only certainty is that much more was going on behind the scenes.**

However, the Rochesters’ ambitions saw them face greater criticism than ever before. Isolde was challenged by congressmen who feared losing influence to the Empire. The value of stock in Core Dynamics dropped, with its shareholders lambasting Jupiter for his brother’s actions. Jordan’s niece Kali became a target for anti-Imperial protests by her fellow students. The family might have weathered these storms, but a thunderbolt was about to strike from an unexpected direction.

Jarl Toredó was already a significant figure in Aisling Duval’s orbit. A passionate anti-slavery activist of humble origins, his charity had merged with hers to form Unchain. Mere months after the merger, Toredó resigned from the organisation, confessing he could no longer bear working alongside Aisling, with whom he had secretly been in a relationship. This in itself might not have derailed the long-anticipated royal wedding, except for one specific claim:

### The Rochester Family

**Text:**  
Coriander Salamander

**Design:**  
Donald Duck

**Images:**  
OrangePhoenix, NickWeb85, Donald Duck





**A mysterious art thief has become famous for a series of stylish crimes that remain unsolved to this day.**

The thefts, which took place between June 3304 and February 3305, always followed the same broad pattern: a valuable piece of artwork on public display was somehow spirited away, without witnesses and despite advanced security measures.

There is no evidence to explain how these heists were accomplished. The thief's identity remains equally unknown, with no clues as to gender, origin, or motivation.

This has made the Winking Cat one of the most notorious criminals in the Galaxy – and as much a part of modern culture as any of the art treasures that were stolen.



The first robbery occurred at the Garden City Gallery on Turner's World. A unique interactive piece by cyber-artist Barclay Uxor vanished on the day of its auction. It had been stored in a titanium vault protected by plasma grids, proximity alarms and thermal sensors, so this announcement no doubt surprised many:

*This morning we found the vault door open and all security systems disabled. On the wall was a spray-painted graphic of what looked like a winking cat.*

To leave a form of 'signature' at the crime scene suggested a cheeky confidence, which in this case was justified. This visual calling card must have been galling for local police, who were baffled by the lack of leads. It certainly goaded Barclay Uxor, who expected to make millions of credits from the auction. He raged

that replacing his work with common graffiti was "the ultimate insult".

A few months later, the thief moved from the Alliance to the Empire. Lal Candromir was a celebrated sculptor from a thousand years ago, whose New Dawn Collection was the pride of the Imperial Museum of Culture on Eotiensens A 3. These exquisite historical artefacts commemorated the planet's early settlers, and had been admired for centuries.

This didn't stop them vanishing into thin air, just like Uxor's artwork had. The circumstances were so similar that even the news report was almost identical:

*This morning, visitors found the entire exhibit empty, with every single one of the Candromir statues gone. Painted onto the wall was a graphic of a winking cat.*

Despite forensic analyses and wide-ranging interviews, the Imperial Internal Security Service was as perplexed as Garden City's police had been. Although they claimed there was no connection between the two thefts, the use of the same motif suggested otherwise. The phenomenal skills required in both incidents also made it a very unlikely coincidence.

Several more months passed before the Winking Cat – as the thief was now commonly known – struck again. It could not have been in a more public time and place: the New Year celebrations at Olympus Village, capital of the entire Federation.

The work of art here was far greater in scale. A gigantic holo-sculpture, inspired by the Federal Insignia, was to be projected into the skies of Mars to herald the new year. Millions of people in the city, and billions more

via the Federation's media networks, eagerly watched and counted down until the stroke of midnight...

*But upon activation, the image that materialised was a gigantic cat's face, winking repeatedly. The original holo-sculpture code was later discovered to have vanished.*

This time, the Federal Security Service was convinced that it could only be the work of the same thief. But that furnished them with no more leads than the Alliance or Imperial investigations. All that was certain was that the rulers of the Federation began 3305 with those familiar whiskered features smiling mischievously down at them from the heavens.

Having pulled off heists in three different systems, it was anyone's guess where the Winking Cat might appear next. But when the fourth incident occurred six weeks later, it became clear that the thief hadn't left Mars.

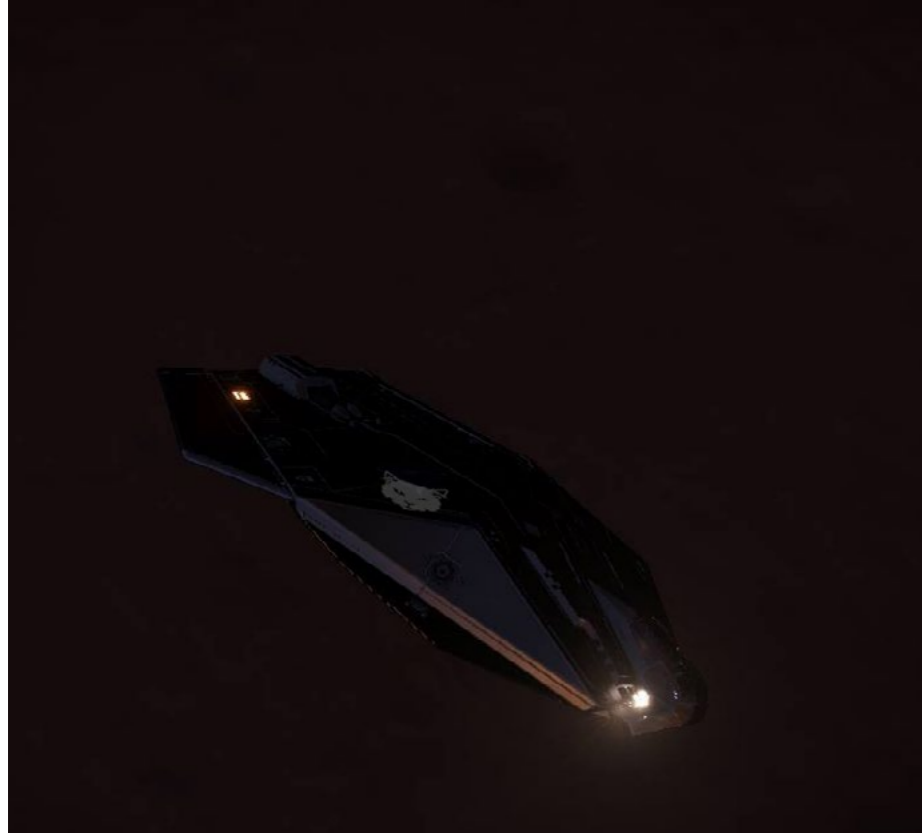
The items that were discovered stolen from the Museum of Civilisation were even older and more valuable than the Candromir statues. They were paintings from Earth that, like many precious artefacts which survived World War III, had been transported to Mars but never returned. And now it seemed they never would be:

*The stolen pieces include Rembrandt's Self-Portrait with Two Circles (17th Century), Guernica by Picasso (20th Century) and Terra Absentia by Zoe Okeke (23rd Century). Each of the works was replaced with the image of a winking cat.*

Earth historian Dr Imogen Ryang described the loss of these pieces as "incalculable" and the culprit as a "despicable criminal". It seemed the thief made no distinction between ancient and modern art, or between digital holography and oil paintings on canvas. If it was priceless and heavily guarded, then it was fair game.



“It's clear that there is an insouciant attitude to authority, as well as a theatrical sensibility.”



“ A combination of preparation, sophisticated technology and near-superhuman stealth succeeded without bloodshed.

This was the last time that the Winking Cat’s activities were reported. It is possible that further incidents were kept quiet by the authorities, but this seems unlikely considering the high visibility of previous thefts.

Will this infamous criminal remain an enigma? Although concrete facts are few, some deductions can be made. We may never see a face or learn a name, but nevertheless, a distinctive personality can be glimpsed.

To begin with, choosing to be identified by a humorous graphic infers a flippant approach and devil-may-care quality, despite the detailed planning the robberies required. It’s clear that there is an insouciant attitude to authority, as well as a theatrical sensibility.

Ironically for a thief about whom nothing is known, there is a desperate need for recognition. Only famous works of art were stolen, guaranteeing publicity of their loss. Using the same feline motif at the scenes of the crimes ensured that it would be featured in the news reports, contributing to the Winking Cat’s legend.

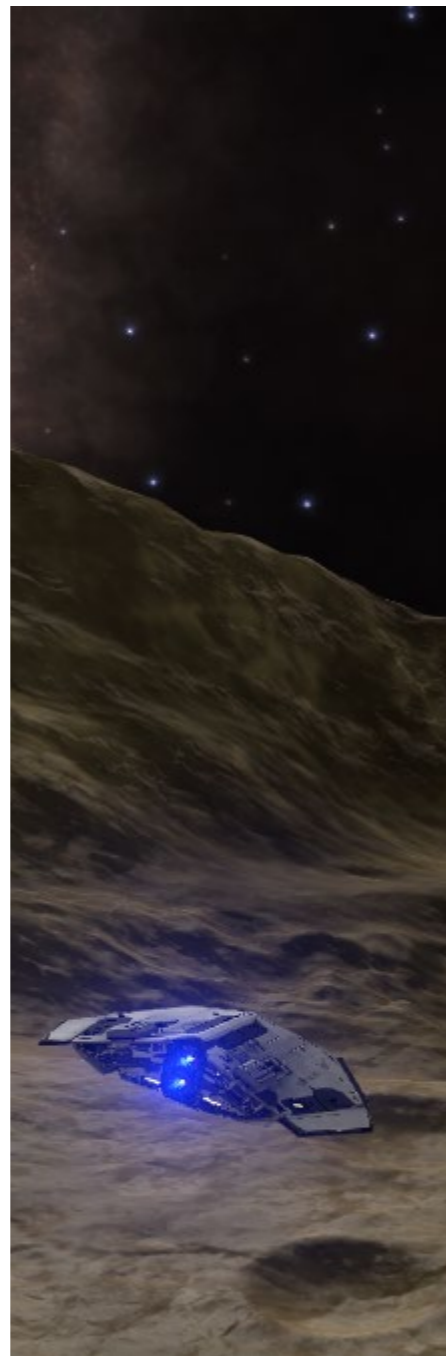
Initially, it seemed that this was the work of a single person with genius-

level skills in bypassing security. But the second and fourth incidents suggest the work of a team since shipping so many statues and paintings would require logistical support. Therefore, it is possible that the Winking Cat is not an individual but a group of thieves, pooling their collective experience under one banner.

Another option is that a solitary mastermind has access to the resources of a large organisation. Whether such benefactors are a criminal cartel, a wealthy family or a legitimate corporation remains open to speculation.

Does what was stolen reveal anything about the stealer? It may be significant that cultural centres for the Alliance, Empire and Federation were robbed in succession. The thief evidently has no loyalty to any superpower, so may originate from an independent system. Although Mars was targeted twice, the latest thefts were of pieces that pre-dated the Federation’s formation in the 23rd century. Perhaps this was a statement: no artist is safe from the Winking Cat, not even those long dead.

It is unlikely that the four reported larcenies were the only ones ever undertaken. These were not the work of an amateur. Ergo, there must have



been multiple thefts on a smaller scale – and perhaps some failed attempts – prior to those that made the news.

However, as yet we have no way of knowing what else was stolen before that now-familiar graphic was first used. There may be dozens of unsolved crimes that served as practice runs until the thief was ready to go public.


The fact that nobody came to harm suggests that this is a lawbreaker with a moral code. Criminal heists usually involve violence, often leaving dead or injured security personnel in their wake. But the Winking Cat went to great lengths to avoid such blunt methods. Instead, a combination of preparation, sophisticated technology and near-superhuman stealth succeeded without bloodshed.

Where are the missing art treasures now? Typically, operations to steal high-value items are financed by a backer with connections in the relevant industry. Alternatively, the item is put up for auction on the black market to attract collectors. Either way, this leaves breadcrumbs that can be tracked down – except the combined efforts of three intelligence agencies have failed to do so.

Perhaps the stolen artefacts were never sold at all, and remain in the thief’s possession. Could the criminal also be a connoisseur of the arts? This raises the enticing possibility of a hidden vault containing everything the Winking Cat has ever stolen, a gallery of rarities that nobody else will ever see.

We may never discover who was behind these grand-scale robberies, but they will never be forgotten. It’s often the case that flamboyant criminals – especially those who were never caught – acquire celebrity status. In this case, the Winking Cat has become an icon of modern culture, synonymous with rebellion and individuality. As observed by The Federal Times:

*High-profile crimes such as this have resulted in the ‘winking cat’ motif becoming a popular anti-establishment symbol, appearing in advertising, graffiti and music. Ironically, the calling card of an art thief is now itself a culturally significant work of art.*

And so as the Winking Cat replicates itself across a thousand systems, the question arises of what comes next. Has the thief retired, content to admire the spoils of past crimes? Or is something bigger and more daring being planned even now? 

The Winking Cat

**Text:**  
Coriander  
Salamander

**Design:**  
McNicholl

**Images:**  
McNicholl

The Buckyball Racing Club presents

# Hot Off The Press

In association with *Sagittarius Eye*

**Do you have what it takes  
to become a photojournalist?**

As a member of our highly skilled photojournalism team, not only do you need to be able to take excellent photographs, but you also need to be able to use your investigative skills to know where to get the perfect shot and be capable of getting to those locations quickly and efficiently. After all, today's news is tomorrow's history, and you're not applying for the role of history correspondent!

To begin the test, dock your ship at the Print Works in the Millese system, appropriately outfitted for the task ahead but carrying no cargo. When you're ready to go – and have completed all necessary research – return to the surface and take a screenshot which clearly shows the clock at the Station Services screen. Now, as fast as you can, head out to locations providing photo opportunities for one item from each of the following six groups, in whatever order seems best to you:

#### Group #1

- A Federal or Imperial capital ship
- Another ship using lasers to mine an asteroid
- Flying through a Buckyball holo-ad

#### Group #2

- In the SRV at an altitude over 250m
- Inside a burning station
- A brain tree, space pumpkin or bark mound

#### Group #3

- Something Thargoid
- A ship exploding
- An asteroid explosion

#### Group #4

- Something Guardian (not human hybrid technology)
- A Coriolis with "noob hammers"
- A black hole

#### Group #5

- A shipwreck (human)
- A geyser or fumarole
- Some form of space-bound Stellar Phenomena

#### Group #6

- An outpost ship showroom
- An abandoned or wrecked SRV
- An INRA logo

Once you've got the shots, return to The Print Works and take another screenshot of the clock immediately upon landing. This is your closing time.

All screenshots must be in-cockpit with the HUD clock visible. Note that it may be possible to satisfy several objectives at the same location. Creative thinking is encouraged.

When you have completed the task, submit your portfolio of screenshots to the adjudicator who will assess your performance and rank you alongside the other applicants.

**The test runs from 00:00 Saturday 17th Aug 3305**

**until 23:59 Sunday 25th Aug 3305 UTC.**

For full details of the test (including detailed regulations, full instructions on how and where to submit your portfolio, and for an opportunity to ask any additional questions) please visit the [Pilot's Federation Forum post](#).

**Best of luck, Commander!**

**Please note:** this is not a real application to join the *Sagittarius Eye* team.

Sincere photojournalism enquiries should be made to [photography@sagittarius-eye.com](mailto:photography@sagittarius-eye.com).



# Understanding Lagrange Points

We travel the stars in our ships with impunity, almost unbothered by gravity as we hurtle forth at superluminal speeds. We might notice a slight pull on the odd occasion when a gravitational gradient bleeds through near a black hole, or when we drop into conventional flight over a planet. While one could be forgiven for forgetting all about gravity during travel, it is not to be ignored, and the physics at play in an orbiting system is something ancient humans rightly saw as powerful and profoundly majestic.

## The music of the spheres

When you were young, did you ever stop and wonder: “is there a pattern to the orbits of the planets?” Humans are good at finding patterns and in the case of planets and gravity, the patterns tell us something very important about the universe. Namely, three very simple but profound truths: systems seek their minimum energy state, the influence of gravity is inescapable, and everything rotates.

Let us look at an example in our birthplace before getting into the topic at hand: Jupiter’s moons Io, Europa and Ganymede. Their orbital periods are 42, 85 and 172 hours respectively. Humans looking for patterns will notice that these are close to a ratio of 1:2:4. What does this mean?

While the ancients couldn’t observe the moons of Jupiter, they could observe the planets out to Saturn with the naked eye and saw similar

mathematical patterns. Lacking explanations, they even went so far as to draw parallels with the harmonics of vibrating strings and postulate a “music of the spheres”. It turns out that their idea of resonance and harmonics was on the right track. They just lacked two vital insights: the Copernican heliocentric model and Newton’s theory of gravity.

## Orbital resonance and ejection

As science developed, our observations of orbiting systems became more refined and revealed that these ratios are not perfect, but are nonetheless evidence of the statement made above: gravity is inescapable. Despite Jupiter's overwhelming gravitational dominance, the interplay between Io, Europa and Ganymede cannot be ignored. Io orbits faster than Europa, and each time they pass each other, gravity acts to pull them together and reinforce the 1:2 resonance. Likewise for Europa's resonance with Ganymede, for a 1:2:4 resonance in total.

This celestial dance transfers momentum — a conserved quantity. Over time, these transfers in orbiting systems can act in two ways: either to stabilize the system or to scramble it — in the latter case, resulting in the ejection of bodies. The space programmes of the 20th and 21st centuries commonly used the scrambling aspect of this mechanism as a 'gravitational slingshot' to push lightweight probes into the outer reaches of Sol's system, cleverly conserving their minuscule supplies of propellant.

On the other hand, when orbits stabilise, given enough time, they fall into the kinds of resonances we see in the moons of Jupiter. Stabilisation can be observed even above the Earth, when an artificial satellite is placed in a low orbit. As the slight drag of the thin atmosphere pulls the satellite from orbit (assuming it doesn't have thrusters to stabilise it) the satellite passes through stable periods while reaching specific harmonics relating to the rotation of the planet beneath (while this is also an indication of the imperfect sphere of the Earth, it is still the same principle).

## Newton in a rotating frame of reference

So, Lagrange points: what are they, and how are they relevant? As noted above, gravity is inescapable, everything rotates, and physical systems tend towards their minimum energy state. The latter is echoed in the human desire to simplify concepts. If one draws a one-dimensional diagram showing Jupiter and Sol, and the gravitational force on a unit test mass, one position becomes quite interesting: the point where the gravitational force from Sol cancels that from Jupiter. This is now known as the L1 point. That is as far as the one-dimensional case goes.

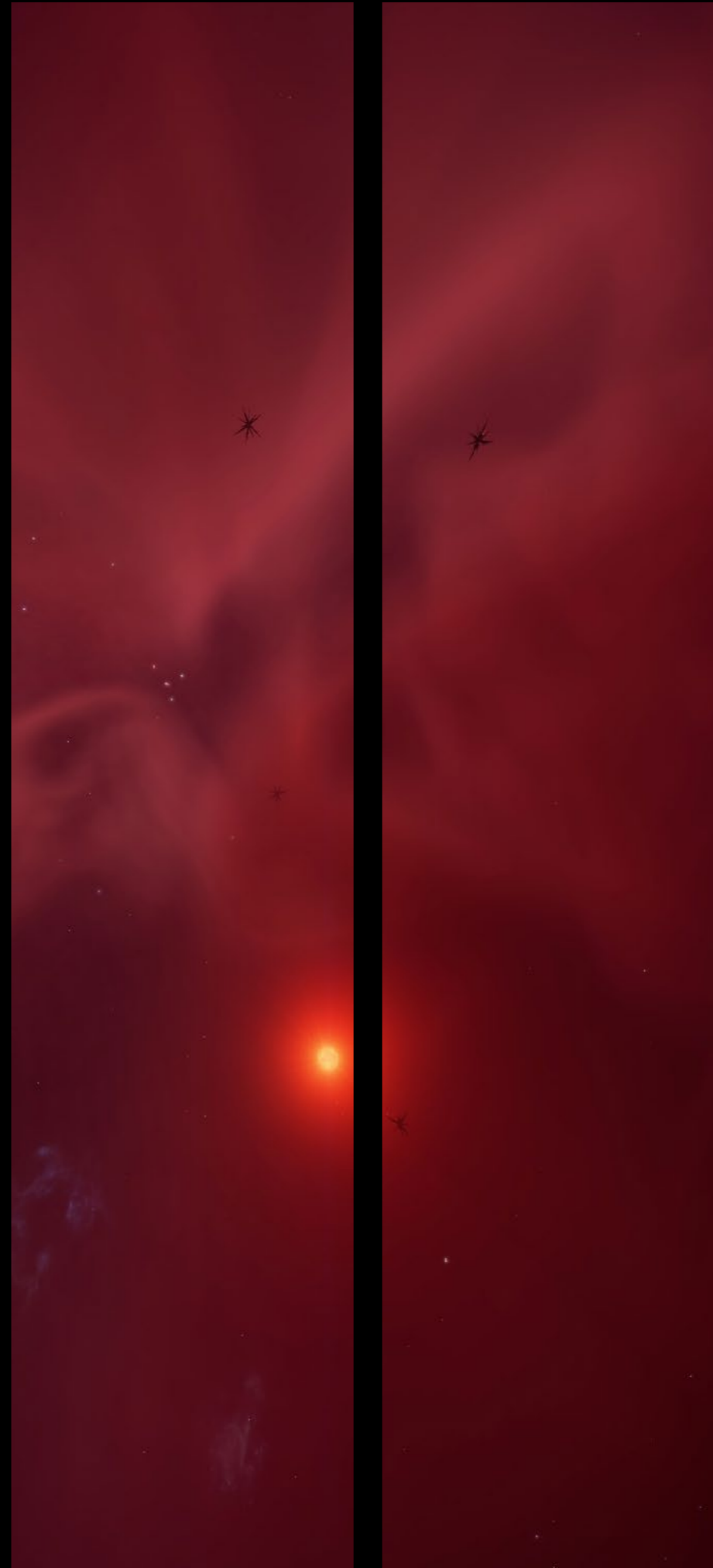
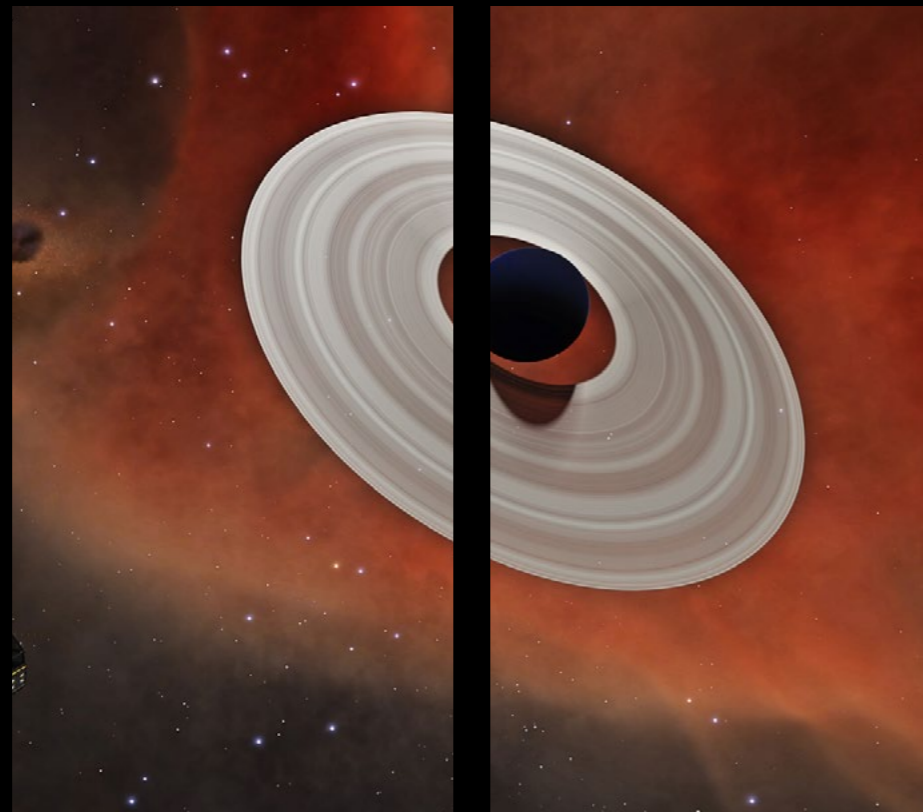
In order to treat the system in three dimensions and understand its resonances and stabilisation, one needs to work in a co-rotating frame of reference and therefore take account of orbital angular momentum and the so-called 'centrifugal force' that it introduces. (In school, when students are told that 'centrifugal force' isn't a true force, but a pseudo-force, this is really the teacher trying to discourage the student from calculating in non-inertial frames of reference before they have learned the necessary mathematical tools.) The following equation is the so-called

Roche potential and is the combined gravitational and rotational potential energy of a unit test mass in such a co-rotating frame of reference:

$$\Omega = -G \underbrace{\left( \frac{M_1}{s_1} + \frac{M_2}{s_2} \right)}_{\text{Gravitational}} - \underbrace{\frac{1}{2} \omega^2 r^2}_{\text{Orbital}}$$

The first term is the gravitational potential energy that the test mass receives moving from infinity to a position at respective distances  $s_1$  and  $s_2$  from the two massive objects in the system ( $M_1$  and  $M_2$ ). The second term is the potential energy that it receives from the orbital motion of the system, where  $\omega$  is the angular velocity of the reference frame (versus an inertial frame), and  $r$  is the distance from the system's centre of mass (or 'barycentre').

The gravitational potential creates two gravity wells in the potential map. We find a flat point between the two gravity wells and this is the L1 point again; however when we do the full 3D calculation we find that this is an unstable 'saddle point' (imagine a saddle with peaks fore and aft and valleys left and right where you could slide off to either side).



## Euler's insights

Still looking along the line through Jupiter and Sol, we notice two more locations of interest. The first is located outside of Jupiter's orbit and is the location at which centrifugal 'force' cancels the combined pull of Jupiter's and Sol's gravity. This is the L2 point.

The other is known as the L3 point and is located on the opposite side of Jupiter's orbit, a bit outside the same orbital distance. This point occurs because Sol, although enormous in mass compared to Jupiter, is itself rotating around the system's barycentre. L3 is another point where centrifugal 'force' cancels the combined pull of Jupiter's and Sol's gravity, except that this time Jupiter is on the far side of Sol.

**The influence of gravity is inescapable.**

L1, L2 and L3 were discovered by the legendary mathematician and physicist Leonhard Euler, who published his findings in 1765.

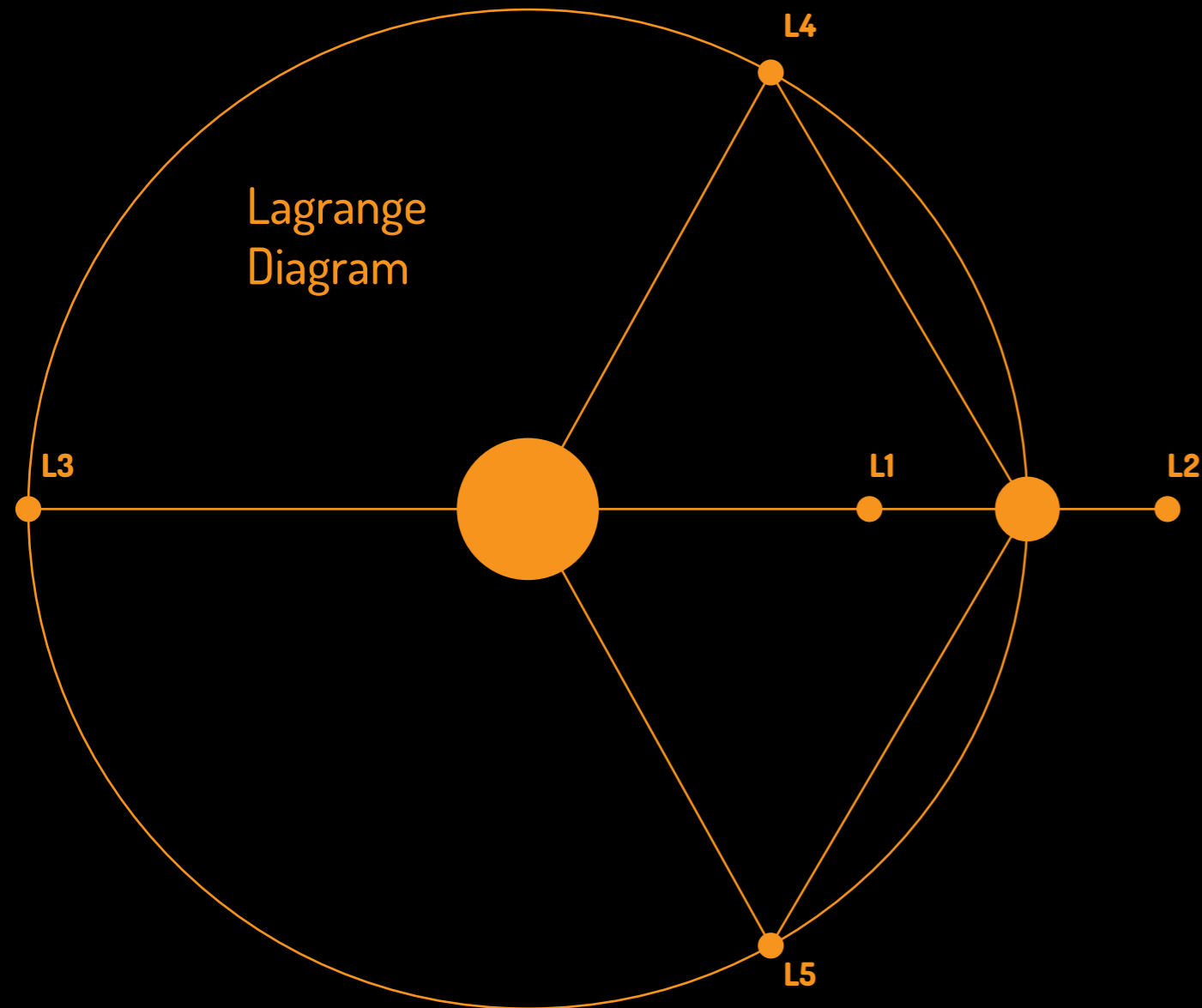
## Enter Lagrange

The Roche potential is a potential and not a force: the force is given by the gradient of the field, and each of these points occurs where the field is locally flat, meaning that the net force is zero. The formidable mathematician Joseph-Louis Lagrange built upon Euler's work, solved some difficult differential equations, and found two more stable points which are now known as L4 and L5. His solution is now accepted as complete, and all five points are now named in his honour.

L4 and L5 are two stable locations in which an object may orbit with minimal disturbance from the primary and secondary masses. In a system where the primary greatly outweighs the secondary, L4 and L5 are roughly 60° ahead and behind on the secondary's orbital path. However, this angle depends on the mass difference and can go up to 90° in the case of equal mass.

So this might seem like a peculiar feature of a rotating system, but what are the consequences?

The most important thing is that unlike the other Lagrange points, L4 and L5 are stable, meaning that material in developing systems tends to coalesce there to form clouds, planets or moons. Planets, moons and clusters of asteroids that form or stabilize at Lagrange points are often known as 'trojans' after the traditional naming of such clusters of asteroids at the L4 and L5 of the Sol-Jupiter system.



## Lagrange clouds

The term 'Lagrange cloud' inherits its name directly from the observation of clouds of material at Lagrange points. Dense clouds of gas are rare on such small scales, and require the material within them to be of very low energy or entropy – or otherwise be attracted to something in the region by another force. Such clouds are typically low density molecular or highly metallic clouds, are very loosely bound and easily perturbed, and are thought to be transient phenomena. These are interesting locations, as material bound within a Lagrange point gives rise to the potential of growing very large and near-perfect crystals – and can even allow for the development of space-borne lifeforms. This life would be evolved for survival in the extreme environment of the cloud, and would be very different from life that appears on a planet.

Explorers have found and identified many unique things in Lagrange clouds, some of which share similarities with systems many hundreds of light years distant. This commonality is not fully understood given the vast distances and lack of faster-than-light travel found in nature. Could this point to contamination of these clouds from ancient explorers such as the Guardians, or perhaps the Thargoids? It is entirely possible that human explorers will contribute to future curiosities found in Lagrange clouds.

**Transfers in orbiting systems can act in two ways: either to stabilise the system or to scramble it.**



## Trojan worlds

Translating between theoretical and real world observations is key to proving the usefulness of any scientific model. In our home system, we observe trojan asteroids; and as far back as the 20th century, humanity successfully positioned space based observatories at Lagrange points. The model does work, and we observe one extreme of the local stability in the form of low energy gas clouds – but what about something more special? Do we observe trojan worlds?

Early explorers with frame shift drives asked this question. They began searching for these improbable, but possible, configurations. Cohesive searches were performed by pooling the orbital data of millions of systems, and algorithms were applied to identify features of interest. Soon after this, one by one, potential trojan worlds were predicted in the data. Pilots were then dispatched in order to survey and confirm findings. These locations are rare, but each one is another important breakthrough in solidifying the model as valid. Ancient science is still science! The core Newtonian mechanics remain applicable.

### Systems seek their minimum energy state.

For commanders who would like to see one of these systems for themselves, a trojan world can be found in the system Acrux, planets 4 and 5. The next obvious question follows that, observationally, these systems are rare, so what makes them so rare if the state represents a favourable configuration?

The answer is that young stellar systems are rather chaotic, and the model is also very hard to apply to multibody systems. Remember that the model discussed is the potential on a test mass, which by definition is too small to affect its surroundings. The predictions, when applied to a protoplanetary disc, show either that

trojan systems form at near identical times by pure chance, or – more likely – trojan worlds are captured or formed into their locked locations after the formation of the larger mass object.

These two theories come from the observation that proto-planets accreting material from the protoplanetary disc quickly begin to clear their orbital line of material. When this begins, it starves other proto-planets along the same orbit line of material. Initially, the proto-planet's mass is insufficient to have a significant gravitational influence. It suggests that this origin is unlikely.

One possible way to get around this comes from the chaotic state of a protoplanetary disc. An object kicked out of its initial orbit by a rogue body could result in the stabilisation of the rogue or transient object at a Lagrange point, while allowing the main object to accrete material and clear the orbital path.

The probability of a trojan world's existence is also dependent upon the formation of other stellar bodies in the system. In the next simplest model, a 3-body system rather than a 2-body system, a trojan world is less likely to form or be stable around a

body of lighter mass. In a system such as Sol, we observe many trojan asteroids for the Sol-Jupiter system, but not the Sol-Earth system. The L4 and L5 points for Jupiter are more stable due to its much larger gravitational influence.

Mathematicians do however provide an idea of the ratios required for a trojan world to be stable and the orbiting system to be long lived:

$$M_{\text{star}} > 100M_{\text{Planet}} > 10000 M_{\text{Trojan}}$$

So for example if our solar system were to have a trojan world coupled to Jupiter, the maximum mass could be no larger than 1/100th that of Jupiter; roughly 3 Earth masses.

We can predict from all of this that trojans should be quite rare, but thanks to the near 400 billion stars in our galaxy, we can play those probabilities and turn up many – and even some of the less probable situations which break the above ratios. For commanders who want to search for them, all indications are that they are more commonly found in stellar systems with a low number of objects, systems that are of high mass, or those having very large-mass planetary objects.

Are you an intrepid explorer who thinks you have seen everything? Put those explorer's eyes to good use and help map the Galaxy's rare jewels in the form of trojans and Lagrange clouds.



Understanding Lagrange Points

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For most of its existence, humanity did not know whether there was life on planets besides Earth. The exploration and colonisation of interstellar space led to the discovery of many primitive life forms. In this article, we take a look at the various extremophile life forms that can be found on planets without an atmosphere.

# Life on airless worlds

Until the end of 3304, finding life forms on landable planets was a slow and tedious task. First, pilots had to fly to a planet to scan it, without even knowing whether it in fact had any life. Thousands of square kilometers had to be scanned visually without the help of specialised mapping tools or night vision. Even the method of using the scanner on minimum zoom while stretching the supercruise glide for as long as possible was slow and unproductive: what one gained from the glide speed, one lost by having to repeatedly re-enter supercruise to initiate the next glide. If a site was found, its coordinates had to be written down by hand. Many hypotheses were put forward as to where life could best be found, but it was suspected that these were largely the product of confirmation bias rather than the actual truth. With the introduction of mapping probes, most of these theories were ultimately shown to be incomplete or false.

With the new exploration tools introduced by the Pilots' Federation in December 3304, search processes changed drastically for the better. The presence or absence of biological and geological sites can now be determined from anywhere in the system using the new Full Spectrum Scanner (FSS). Once a planet with one or more sites is found, it is now only necessary to fly reasonably close to the planet then fire off a few mapping probes. Once this is done, every surface site of interest shows up on the target panel, making biological sites easy to locate and visit with your ship and SRV.



## Anemones, or 'space pumpkins'

Initial sites included HIP 18077 on body 6 C, a mere three kilometers outside of Mahon Research Base. Because of their appearance, they are commonly called 'space pumpkins' by the galactic community, as they resemble the fruit from Earth. The variant found on HIP 18077 6 C is catalogued as 'Luteolum' by the Codex.

Anemones have been found in systems with stars at the larger and brighter end of the spectrum, namely O, B and A-type stars. They are

found on rather hot planets in general; in fact, all variants but one are found on rocky, metallic or high metal content worlds. Only the Punicum variant can be found on rocky-ice or icy worlds. The other bioluminescent variants (Blatteum, Prasinum, Roseum, Rubeum) are found either on high metal content or metal-rich worlds.

They show similarities to fungal life forms found on atmospheric worlds, in that they seem to form a fungal mycelium and a network of string-like hyphae stretching through the ground around them. These hyphae are similar to roots in plants, as they collect nutrients for the fungus and anchor it to the ground. However, they are the main part of the fungus, in contrast to plant roots. Only the fruiting body is visible above the ground.

**They emit an almost continuous repeating sound.**

This leads to the question: is a colony of these life forms really a colony of many organisms, or is it one gigantic organism covering several square kilometers above the ground and maybe even more below the surface?

**Is a colony of these life forms really a colony of many organisms, or is it one gigantic organism?**

## Amphora plants

Only one variant of this life form is known. The name is derived from ceramic containers used during Greco-Roman times on ancient Earth, and is a reference to this organism's shape. Not much else is known about this elusive and rare life form: they grow on metal-rich bodies orbiting A-type stars, in systems that typically also contain Earth-like worlds, water worlds, or gas giants with water-based life. This could be a hint that this life form could have emerged from these planets and been distributed through the system by asteroid impacts.

## Bark mounds

First discovered on Colonia 3 C a, this life form has since been found on many other places in the Galaxy, one of the most prominent locations being Mic Turner Base on California Sector BA-A E6 4. They are brownish mounds found on planetary surfaces, resembling mounds of tree bark. They emit an almost continuous repeating sound that's difficult to categorise. How these sounds are produced is still a mystery.

Bark mounds are typically found in systems with small to medium-sized stars (A, F, and M) on either rocky bodies or high metal content worlds that contain mainly iron, sulphur, nickel, and carbon. As with the amphora plants, bark mounds occur in only one variation throughout the Galaxy.

## Brain trees

Brain trees are without question the most popular sites to visit among life forms on landable planets. They are bizarre, tree-like organisms with structures resembling human brains at the end of their 'branches'.

Brain trees were first discovered in relatively close proximity to Guardian ruins in ejecta craters. This led to the conclusion that Guardians and brain trees had some kind of connection — however, they have since been found on many planets without any known Guardian presence. It seems more likely that the Guardians sometimes used materials produced by the brain trees to build their bases.

They have also been the focus of intense study by Canonn Interstellar Research, and independent commanders can contribute by installing a special tool on their ship's computer to automatically register the system, planet, and coordinates of any brain trees discovered.

All the known variants of brain trees are found on planets with active volcanism. The Viride Brain Trees are the only ones preferring colder temperatures — between 100 K and 270K — and as a result they can only be found on rocky ice worlds. The other variants can be found on either

**In December 3304, search processes changed drastically for the better.**

rocky or high metal content worlds, with temperatures ranging between 200 K and 500 K. The odd ones here are the Ostrinum and Puniceum strands: they like it hot, and are not found below 450 K. The upper limit for the Ostrinum strand seems to be 1,100 K, while for the Puniceum strand it is an astonishing 1,600 K, a temperature at which many structural metals will melt.

## Sinuuous tubers

This life form resembles tube worms, variants of which are often well known to the inhabitants of Earth-like worlds. Roseus Sinuous Tubers are the only currently known variant and can be found on rocky worlds or moons with silicate magma volcanism, caused by tidal heating due to orbiting very close to the host body. Sinuous tubers in general thrive in moderate temperatures of approximately 200 K to 300 K. Thus, the bodies they can be found on orbit smaller, colder stars like M or L types, or even neutron stars.

## Crystalline shards

These are not life forms themselves, but are the product of subsurface microorganisms. They are sharp, crystalline forms that apparently grow out of the ground, many metres high.

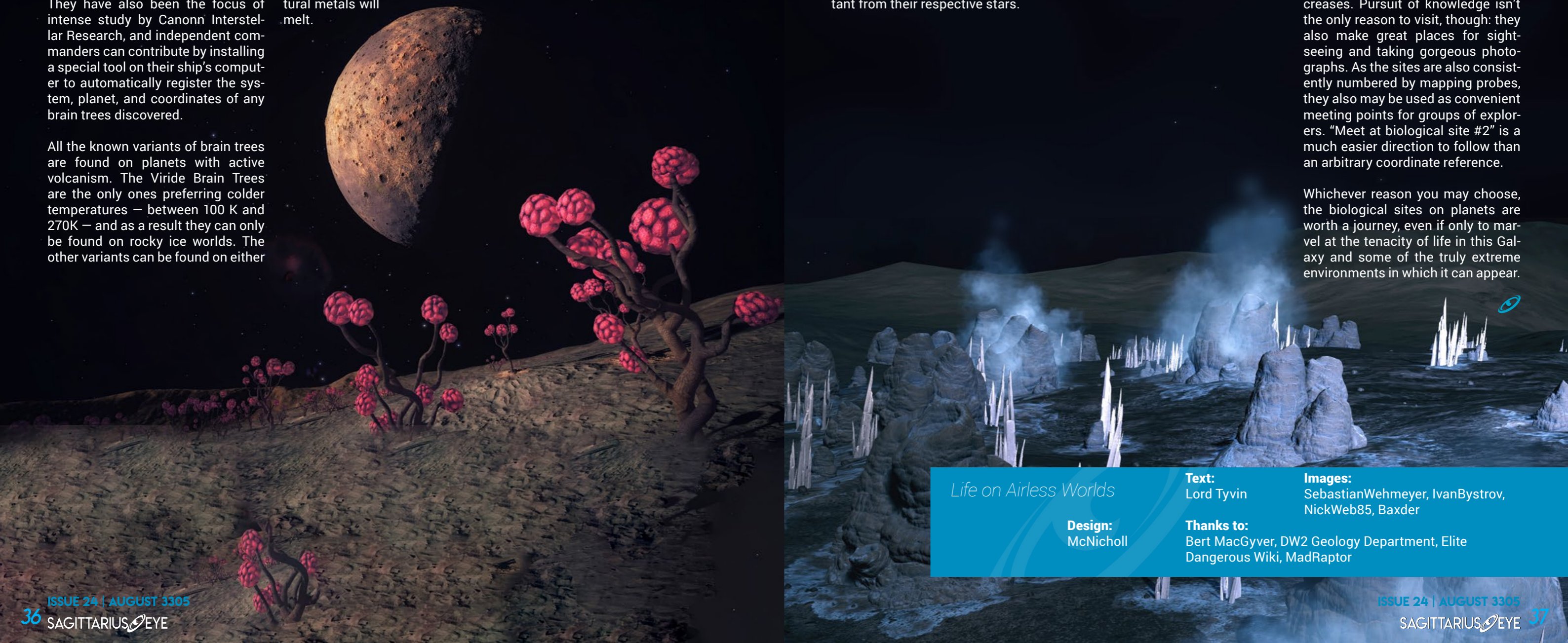
Crystalline shards were first discovered in the Sanguineous Rim region, around 1,500 light years away from inhabited space. The planets on which crystalline shards can be found typically orbit medium to smaller stars, the largest and brightest being A-type stars. Crystalline shards are found on either icy or cold rocky worlds, the temperature never surpassing 200 K. As a result of this, they tend to be on planets more distant from their respective stars.

## Always worth a visit

One thing common to the life forms found on landable worlds is that they all produce outgrowths rich in materials useful for synthesis and engineering, much like the deposits found in areas of volcanic activity. As with volcanic sites, the grade of the materials can vary, but large quantities are concentrated in a small area and the type of each outgrowth indicates the grade of materials that can be harvested, making time spent there much more efficient than roaming the surface chasing pings on the wave scanner.

Many explorers have already visited these sites, and with each visit our knowledge about these life forms increases. Pursuit of knowledge isn't the only reason to visit, though: they also make great places for sight-seeing and taking gorgeous photographs. As the sites are also consistently numbered by mapping probes, they also may be used as convenient meeting points for groups of explorers. "Meet at biological site #2" is a much easier direction to follow than an arbitrary coordinate reference.

Whichever reason you may choose, the biological sites on planets are worth a journey, even if only to marvel at the tenacity of life in this Galaxy and some of the truly extreme environments in which it can appear.



*Life on Airless Worlds*

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# When a Straight Line isn't Shortest

In the early years of human space travel, pilots aspired to a seemingly unattainable holy grail of navigation: just point. Point the nose of your spacecraft at your destination, start your thrusters, and sit back and enjoy the ride.

In those days, the limited availability of energy and power was such that this was simply impossible. Chemical rockets had very limited supplies of propellant — using most of it just to reach Earth's orbit — and early ion thrusters were feeble. Complex mathematical terms now only remembered by space historians abounded: Hohmann transfers, gravitational slingshots, delta-V, and seemingly endless strings of algebra. All of this jargon was focused on making the most of extremely limited propellant.

Nevertheless, mankind managed to send spacecraft to nearly every part of the Solar System using these methods, even though the need to use tiny amounts of propellant made these journeys incredibly slow. We complain today about having to travel 300,000 light seconds to a station, but in those days it took months just to send a robotic lander from Earth to one of its nearest neighbours, Mars.

Some missions required even more elaborate (and unintuitive) flight paths: for example, the Cassini robotic mission required the spacecraft to initially fly away from its destination — inwards to Venus and then back to Earth — to make the two gravitational slingshots required to build up enough momentum to reach Jupiter and Saturn. It took Cassini seven years to make a journey we now make in minutes.

In these days of the frame shift drive, this is all thankfully consigned to the dustbin of history. You can just point your ship at your destination, engage your supercruise assist, kick back, and enjoy the ride. A 21st century rocket scientist would be envious of our ability to just point at our destination, and not engage in painstaking planning and calculation followed by years of travel.

## Given this, why would you want to do anything other than just point?

It turns out that pointing at your destination may not necessarily be the most efficient (or most fulfilling) way to approach space travel. The frame shift drive does not free us of the influence of matter, and this (at least in respect to supercruise in relation to stellar-sized objects) was recently quantified in a paper titled *Optimal Supercruise Flight Paths* by Cmdr Heisenberg6626 of the Canonn Institute for Galactic Research. The paper describes mathematically the relationship between supercruise speed and the proximity of stellar objects.

Unfortunately, most pilots are not of a mathematical bent, and our manual ship controls don't really lend themselves to precisely calculated flight paths described in the paper. However, that is not to say the paper is not of value: now that we have a good mathematical analysis, we can draw some qualitative observations of what this means, allowing us to make practical use of this knowledge. Indeed, on its first page the paper has some very easily digestible and straightforward advice on supercruise efficiency:

*Rule 1: Leave the region where  $v=0.33c$  as directly as possible!*

*Rule 2: It is almost never recommendable to fly directly towards one's target in a straight line. Rather, give the nearest star a wide berth.*

So when and why would commanders want to follow this advice to actively pilot our ships in supercruise, when it's more comfortable to kick back, crack open a Tanmark Tranquil Tea, and watch the latest episode of *Fangs* to pass the time? We'll consider the activities that will benefit most: exploration, and trading/mission running, and how to best put this knowledge to practical use.



## The explorer

Despite the recent availability of the full spectrum scanner (FSS), which allows commanders to do a lot of surface scanning work from the warmth and comfort of the hyperspace drop-in point near the star, any explorer arriving at an interesting system will want to do more than this. In particular, explorers still need to visit individual bodies in order to map and photograph them. For the landable planets and moons, surface exploration may be indicated. Over a long expedition, the more systems are visited, the more the time saved from plotting optimal courses will begin to add up.

Any explorer should immediately pay attention to Rule 1. The paper explains that there are five identified supercruise zones, based on distance from a system's star. Commanders can imagine these regions as if they were layers of an onion around a star, and as a ship increases its distance from the star, each zone has a higher maximum supercruise speed compared to the

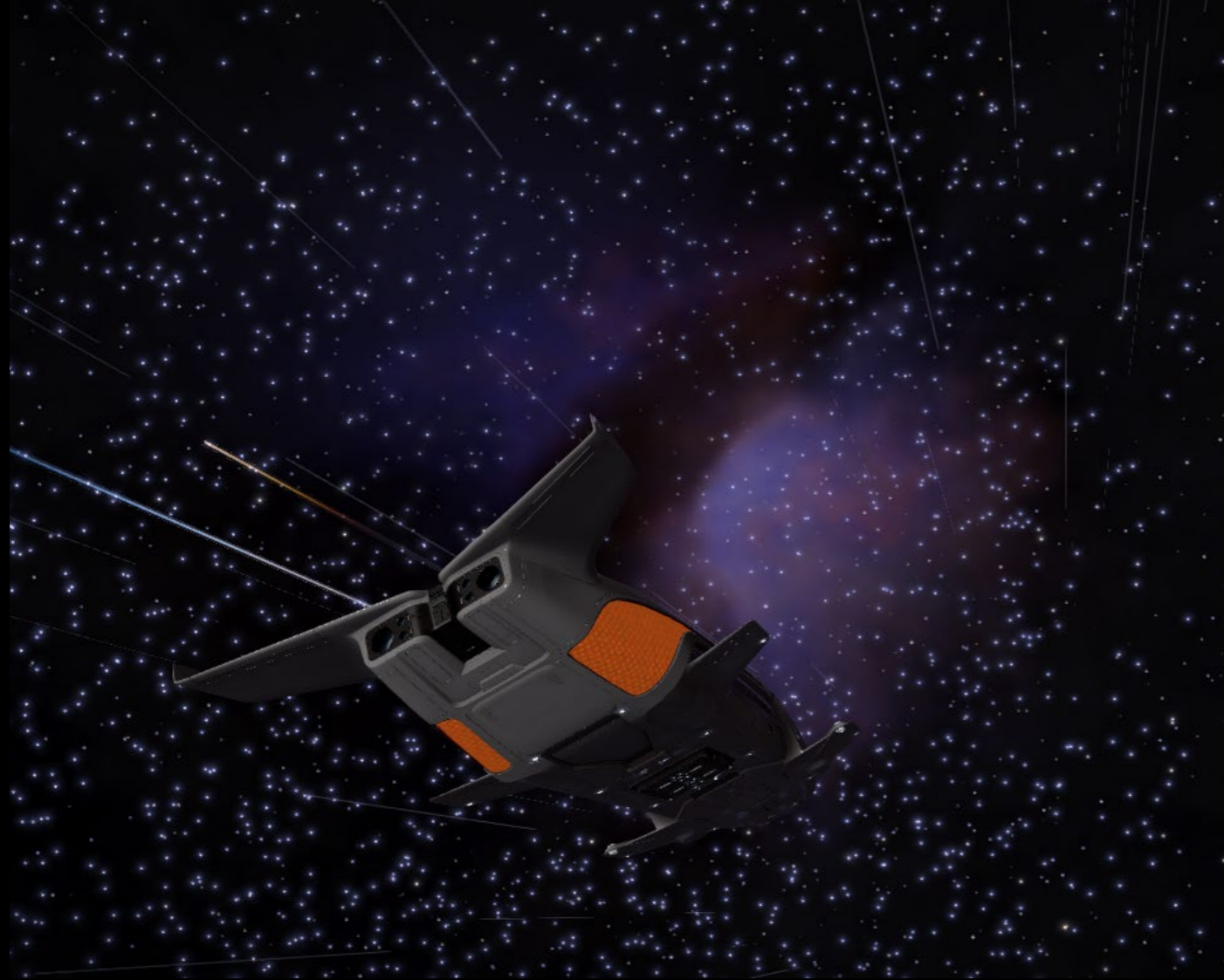
previous one. Upon reaching zone 5, maximum supercruise speed reaches 2001c. The radii of these supercruise zones depend on the mass of the system star.

Rule 1, which concerns supercruise zone 1 (the closest to the star), is particularly important. The maximum speed here is only 0.33c. Linger in this zone will add most to the time commanders spend travelling to their target, so once fuel scooping is complete they should fly directly away from the star until out of zone 1, regardless of their destination. For example, if the planet an explorer is interested in happens to be exactly on the other side of the star, it would be very slow to crawl around the star in zone 1 until they can see and point at their destination, even though it would be the shortest path through space. Pointing directly away from the star until exiting zone 1, and then spiralling out until lined up with the destination will result in a much faster transit. The bigger the

star, the more time is saved.

The other great time saver for an explorer again involves passage around a star. Many times, a system will have two or more bodies to be mapped, and frequently – despite checking the orrery and picking an efficient itinerary – this requires a flight from one side of the system to the other, passing the star. Just pointing the ship at the destination will result in a severe slow down as the star is approached (and the unlucky might end up back in the 0.33c zone 1 for a time).

At this point, the paper's Rule 2 applies: It is almost never recommendable to fly directly towards one's target in a straight line. Rather, give the nearest star a wide berth. To avoid having to spend time making calculations, a good rule of thumb for the explorer is to take a path that looks suspiciously like the Hohmann transfer of the old days: an arcing path through space that smoothly



travels between the orbit lines of the two bodies in question. For example, if the next body you need to visit is further from the star from the body you're at, gently spiralling outward from your current body's orbit line towards your destination's orbit line will do the job. You will fly a curved path that will keep you away from the star, which is both an efficient path as well as straightforward to fly.

This is, by the way, an argument for leaving the orbit lines switched on in your heads-up display (HUD). Some explorers turn them off to see the majesty of the Galaxy unimpeded. While the lack of HUD orbit lines is great for photography, it does make efficient navigation trickier.

What about the planets themselves? Good pilots know that a planetary body also limits your speed in supercruise. In some ways, planets you're not visiting (or the planet you're leaving) should be treated like stars — except the avoidance distances are smaller. When leaving a planet

— regardless of destination — travelers should keep Rule 1 in mind, and put the planet directly behind them until they've largely left its most severe influence on their supercruise speed. Then they can start changing course for their next waypoint.

Gas giants (or smaller planets with many moons) can also result in low supercruise speed if a commander flies through the plane in which the moons orbit. Travelers should look at where the moons currently lie, and plan a course that keeps them as far away as possible. Many times, this can involve departing the gas giant system perpendicular to the orbital plane of its moons before resuming course towards the next waypoint. There may also be planets that sit somewhere along the route towards the next waypoint. Commanders should adjust their course to avoid them; preferably this course adjustment should also be away from the nearest star, too — otherwise it's out of the planetary frying pan and into the stellar fire, so to speak.

**Pirates, gankers and murder hobos alike tend to loiter near the shipping lanes.**



### The trader and missioner

Traders have a number of maxims they like to live by, most famously: buy low, sell high. Another important trader's maxim is: time is money. Therefore, efficient travel is required to maximise profits. Many (perhaps most) traders are a little slack in observing this second maxim: many may prefer to sacrifice a little saved time on the trade run so they can do something else (such as watching the latest holo-vid drama) while their ship's supercruise assist takes them to the destination station. Unlike explorers, traders very seldom travel from one body to another in-system: it's more common for a trader to jump in, fly to the destination station, sell their current load and pick up the next, then jump to the next system and so on.

So where does this navigation advice fit in for the trader and the mission runner? Again, even if commanders will watch the latest holo-vid on the long haul out to Longomontanus Dock in Phra Saman, they should still follow Rule 2. If they just go for the shipping lane, they will still likely cross the orbits of several other planets, and maybe find themselves slowed down by one or more of these. The time savings might only be marginal in avoiding these planets, but there are other considerations: being pirated, for example. Or perhaps, having the misfortune to run into a murder hobo. Being more efficient than just pointing one's trade ship at the destination station often saves more than time.

Slowdowns caused by planets are risky for traders, especially when a community trading goal is in progress. Pirates, gankers and murder hobos alike tend to loiter near the shipping lanes, following hapless traders and pulling them out of supercruise as they go by. Slowdowns caused by planets allow them to catch up and execute an easy interdiction.



Furthermore, in busy systems such as these, many traders and mission runners drop into the system and just point at their destination. Scanners are cluttered with targets, thanks to so many ships doing the same thing. The pirates and murder hobos lie in wait, knowing that they are not easily distinguishable from the general flow of traffic. Picture this:

You enter the system and turn towards the station. Although you are alert, nothing really looks suspicious, and there are perhaps a dozen Pilots' Federation commanders apparently doing the same thing. As you pass the gas giant, your FSD shows 'SLOW DOWN'.

Then it happens. "INTERDICTION DETECTED". That Imperial Cutter that looked like just another trader turns out to be a well-heeled pirate. You are forced into normal space, and three Fer-de-Lances drop in too, accompanying the Cutter. Stand and deliver — your cargo or your life!

You realise trying to low wake out is pointless, and high waking isn't guaranteed, either. At best it'll cost you

time and you get to run the gauntlet all over again... so you begin dropping your cargo of low temperature diamonds.

Now instead imagine that you take a curving supercruise route, off the shipping lane, high above the system's orbital plane.

You follow your curved flight path, high above the ecliptic. Your supercruise speed quickly increases as you remain far from any system bodies. The central part of your scanner is uncluttered by the busy shipping lane.

Then you see it — the hollow square of the Pilots' Federation ship breaking out of the shipping lane, heading towards you. This is obviously suspicious, and your pursuer can no longer hide who he's after... Instead of slowing for your destination, you choose a flight path that curves around the backside of the planet the station orbits, as if you are flying the 'loop of shame', keeping your speed far higher than is usual. At this point you intend to be slowed by a planet — you plan to skim the exclusion zone.

Then it happens.

"INTERDICTION DETECTED". But this time, it happened when you're almost at your destination, and the planet already large in your forward view. You force your ship to fly right at the planet, on a collision course and you hit the exclusion zone at right angles. This violently wrenches you out of supercruise, but also throws the interdicting ship thousands of kilometers from your position. You allow the FSD to cool down, gather your wits, then continue, and laugh while the pirate sends you frustrated and salty messages...

Clearly, for the trader or mission runner, there is a strong safety case (for both life and profits) to be made for flying a curved path in supercruise, off the orbital plane, and away from the shipping lanes. It makes it easier to observe suspicious ships, and plan action accordingly. While it does not guarantee safety from the Galaxy's undesirables, it does make it harder for an interdictor to line up behind their target, and more obvious that they are attempting to do this.

## Summary

In summary, then, curved paths in supercruise can be both more efficient and safer than straight routes. It engages the pilot more actively than simply pointing at the destination, and an engaged pilot is also an alert pilot. If you are of a more mathematical persuasion, we highly recommend that you read the [cited paper](#), which is available from Canon — even if you never intend to stand on the bridge of your ship, E6B flight computer in hand, calculating a precise path. If you're not of a mathematical persuasion, simply referring to Rules 1 and 2 will, in nearly every case, be sufficient. Make sure to use the system's orbit lines to assist you in this task.



Rule 1 is particularly important.

*When a Straight Line isn't Shortest*

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**Thanks to:**  
Heisenberg6626



ELITE  
COMMUNITY  
COMBAT  
EVENTS

Right now in a system pretty close by...

L'INTOUCHABLE

SISTER KATE

HARRY POTTER

FEATURING MESAFALCON

# WYRD WARS

EPISODE I

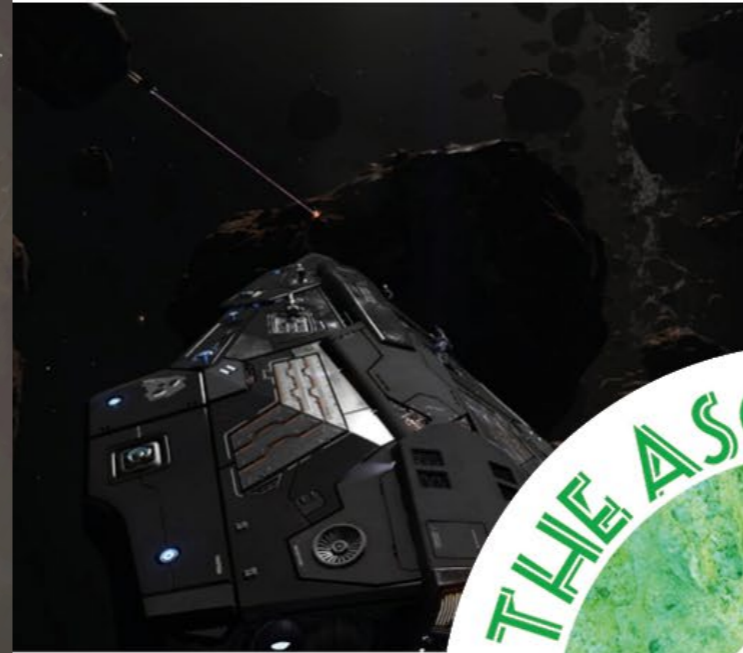
ELITE COMMUNITY COMBAT EVENTS  
PRESENT

WYRD WARS - EPISODE I: THE REVENGE OF THE KATE

THE RENEGADE FORCES - UNDER ORDERS FROM THEIR EXILED QUEEN SISTER KATE EXECUTE A DIABOLICAL ASSAULT ON WYRD. WITH THE SUPPORT OF HER MASKED LIEUTENANT L'INTOUCHABLE, THEY SPREAD TERROR THROUGH THE SYSTEM. AS THEIR STRANGLEHOLD TIGHTENS, THE INVADERS CONTINUE WORK ON A MALEVOLENT CORONATION CROWN FOR THEIR DARK QUEEN.

UNDER THREAT OF COMPLETE ANNIHILATION, THE CIVILIANS FIND THEMSELVES LOCKED IN A DESPERATE STRUGGLE AS THEY EVACUATE THEIR YOUNGLINGS THE ONLY SUPPORT COMES FROM AN UNLIKELY ALLIANCE OF GALACTIC HEROES INCLUDING HUMAN RIGHTS ACTIVIST HARRY POTTER AND PIRATE-LORD MESAFALCON. THIS SCRAPPY COALITION STANDS AS THE LAST BASTION OF HOPE WHILE MALEVOLENT CLOUDS GATHER ON THE HORIZON OF WYRD...

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The Ship's Keel:  
*the Carina*  
constellation

The Carina constellation once belonged to a far bigger constellation in ancient times, the Argo Navis. The Argo was the ship of the legendary Greek hero Jason and his crew, the Argonauts. They went on one of the most famous exploration voyages of all time in their search for the Golden Fleece.

In relation to the epic's prominence in the old days, the Argo Navis once occupied a significant portion of the heavens, nearly one quarter of the southern sky. When astronomy began to emancipate itself from mythology in the 19th and 20th centuries, the constellation was ultimately split up into its three contemporary constituents: Carina (the ship's keel), Vela (the sail) and Puppis (the poop deck, which refers to the roof deck of the aft cabin on a ship, and not a place for performing bodily functions). All three constellations were thoroughly scrutinised in the following centuries and found rich in a vast range of stellar phenomena, so it was only a matter of time before manned space expeditions would follow.

To this journalist's knowledge, the Carina constellation was one of the very first – if not the first – constellations visited by a large group of intrepid explorers: beginning in May 3301, the First Great Expedition (FGE) was launched with the aim of exploring the Sagittarius-Carina arm of the Milky Way, which of course led them deep into former Argo Navis terrain.

Although the FGE took a slight detour at first, it opened up the constellation's jewels for generations of explorers to come.

To get an idea of scope and direction, look up **Canopus** on your galaxy map. In ancient mythology, Canopus was the chief navigator of king Menelaus of Sparta. The lesserknown name of this bright giant star is Alpha Carinae, making it the most luminous star in Carina. It's a 'blue loop' giant star that is currently burning helium in its core, which means it has al-

ready been a red giant. Despite its mass, it is shedding its weight quickly, so it likely won't end up in a supernova.

Fitting for a constellation steeped in mythology and ancient legends, Carina holds many more giant stars of note. Two of them form the binary system of **Upsilon Carinae**. They are hot supergiants that have burned all their hydrogen and are shifting away from the main sequence. Eventually, they will become red giants and, quite likely, contact binaries. They have reached 77 and 218 times the size of Sol already, making them exceedingly bright and luminous. A lone and densely baked high metal planet orbits these twins along with two minuscule T Tauri type protostars. However, the planet has proven to be too difficult to land ships using current technology. Scientists speculate that, in the end, Upsilon Carinae will explode in a thermal runaway supernova after a period of mass accretion of one star by its twin.

As with so many other permit-locked areas it spawns speculation and conjecture.

When travelling along the Orion Spur Shallows, the first larger nebula a traveller will come across is the **Statue of Liberty Nebula (NGC 3576)**. Its shape was compared to that of its namesake statue in the Earth's metropolis of New York, which was a crowned woman holding a torch upright in one hand and carrying a large book in the other. This intricate pattern has long since changed, but the nebula has never lost its name. Although its surroundings seem to be devoid of the more active elements commonly found around star forming areas, the nebula is still well worth a visit.

In its vicinity explorers can also find another truly impressive giant star: **X Carinae (aka V382 Carinae)** is a good example of a rare class of yellow hypergiants. Its radius is nearly 700 times that of Sol, which would place its corona between the asteroid belt and Jupiter in a hypothetical Sol system. Over the next few million years it will inflate further to a red giant before 'looping back' to a blue phase when its core starts to burn helium.

After X Carinae, the route through the constellation runs through NGC 3293, a young open cluster of massive and luminous stars that is in the process of mass segregation. The cluster has a chainlike shape, which indi-

cates that the stars are already migrating into the spiral arm's stellar stream. It is an excellent example of the highly dynamic environment an active star forming region creates.

One system of note is **CPD-57 3520**, which explorers have dubbed 'the Spiderweb'. It is a trinary system that contains an M-type star with an expansive ring structure that, due to its thin layers, is nearly impossible to detect. It stretches out as far as a staggering forty-eight light seconds,



which makes it a serious navigation hazard for ships in supercruise.

The cluster is a very rich area in discovery terms, which also makes it a prominent gateway to one of the largest and most outstanding nebulae for explorers to visit:

The **Eta Carina Nebula (NGC 3372)** is also known as the Great Nebula in Carina, and that's no exaggeration. It is literally hundreds of light years in diameter. In fact it is less a single nebula than an assortment of diffuse nebulae and interstellar dust clouds, punctured by young and energetic clusters of stars. Much like Orion, the whole area is labelled a molecular cloud complex with active and inactive areas of star formation. The Carina molecular cloud is one of the largest known examples of its kind in the Milky Way, spanning thousands of light years and even reaching deep below the galactic plane.

Within the Eta Carina Nebula are two exceptionally luminous deep sky objects, namely the Carina OB 1 and OB 2 associations. OB associations refer to the O and B spectral classes of stars, young stars that were born out of the same dust cloud. They have short life spans but their radiation is more than enough to 'burn holes' into the surrounding clouds, thus making them the creators of the fantastic irregular shapes of nebulae we see often. The most massive and well-known structures inside the Carina complex are Trumpler (Tr) 16 and 14. The Pilots' Federation has named entire sectors after them. Finally, we have the constellation's most prominent star system: **Eta Carinae**, one of the most unusual surveyed star systems to date. It has been classified as a 'luminous blue variable', an especially rare and volatile family of massive stars that is prone to frequent outbreaks and gigantic eruptions. It was once thought to have a mass of more than 200 times that of Sol, which would have jeopardised models of star formation by a long shot. Later it was found to be a compact binary star with a very high

It opened up the constellation's jewels for generations of explorers to come.

orbital eccentricity, which explained some of its unstable characteristics.

This exotic orbit is the reason for its variable luminosity and frequent violent outbreaks. When the two massive stars come close, they move inside their Roche lobes where the matter of two bodies becomes gravitationally bound: Eta Carinae A begins to accrete mass from its companion star, forming a dense accretion disk around the two bodies that gets dragged along as its companion star moves past. This, coupled with a high rotational period, creates exceedingly energetic solar winds that literally blast away the material along the stars' equators in waves, forming an hourglass-shaped cloud that astronomers have called the Homunculus Nebula.

In a geological analogy, Eta Carinae can be considered an extremely active, bubbling, extinction-event level supervolcano ready to catastrophically explode any second. Because of its high mass and volatile solar winds, it has been postulated that it will eventually shift into a brief Wolf-Rayet phase in the not-so-distant future (astronomically speaking), before dying in a supernova.

In fact, many scientists have speculated over the centuries that the star must have gone supernova already in the past. Frame shift drive (FSD) technology proved them wrong, though, when the first explorers returned with 'good news' from their trips to that star. They also found out that the famous Homunculus Nebula and much of the accretion disk around the star have already been dispersed by the exceptionally high x-ray and gamma radiation the binaries generate.

If you would like to know what these energy monsters are capable of, you can read more about Wolf-Rayet stars in issue 21 (May 3305) of *Sagittarius Eye*.

For those explorers who are still looking for traces of old mythology or at least a good conundrum, the

Carina constellation also has a few surprises. Not least among them are the Guardian ruins discovered in and around the Carina Nebula in late 3303. What drove these aliens there remains unknown. After this discovery, scientists and more esoteric members of the community once again linked it to Jason and the Argonauts. Their search for the Golden Fleece had two major implications.

First, the Golden Fleece has often been described as a possible progenitor to the divine shield Aegis, wielded by Perseus in his fight against Medusa and Cetus. It's fitting then that the Aegis organisation named one of the most dangerous Thargoid vessels after this ancient nemesis, and that they succeeded in reverse engineering Guardian (read: divine) technology in their struggle against that foe, a foe that also waged war with the Guardians in the past.

The second implication is Avalon, and — possibly — the fabled Raxxla. It is argued in some tinfoil circles that Jasmina Halsey's encounter with the 'caretakers of the galaxy' could be related to Arthurian legend, where a heavily wounded King Arthur was eventually taken to a sacred island. And interestingly, the Argonautica's Golden Fleece has been linked to Arthurian legend's Holy Grail on more than one occasion. What better way to think of this location than as a 34th century Colchis, Avalon, Camelot or ultimately the 'door that is also the key': the fabled Raxxla? That planet has often been linked to some sort of physical or metaphysical portal and the Guardians are known to have mastered instantaneous communication and transportation. However vague this theory may be, it still has its proponents, showing how much humans — for all their technological advances — still crave for mystery, myths, and the unknown.

Past the large Carina cloud complex lies the diffuse **Smile Nebula (NGC 3199)**. It is located deep below the galactic plane and is thought to be mainly the result of the extensive

**Eta Carinae can be considered an extremely active, bubbling, extinction-event level supervolcano ready to catastrophically explode any second.**

solar winds and eruptions of at least one Wolf-Rayet star: WR 18. The nebula's size of about 80 light years in diameter evidences the enormous force of these bow shocks.


Oddly, the Wolf-Rayet star itself seems to have gone. Possible explanations are that it either has returned to an 'ordinary' O or B-type spectral class or that it has gone supernova already. Due to the lack of neutron stars or black holes close by, the first explanation seems more likely.

Another astronomical conundrum is the remote NGC 3603 open cluster and its surroundings. In the 21st century, scientists thought they had observed a super cluster of massive young stars in this location some

20,000 light years away from Sol. 'FSD astronomy' proved them wrong, however, as there are no closely packed groups of young stars to be found anymore. Quite likely, they have already dispersed or exploded.

Whatever the reasons for this old but serious survey error may be, as of July 3305 the entire sector is locked down to traffic by the Pilots' Federation. As with so many other permit-locked areas, it spawns speculation and conjecture, one of the more prominent theories suggesting a possible discovery of an alien, possibly Guardian presence. However, the region is just too remote and sparsely explored to give one theory more credit than another.

Coverage of this last star system is dedicated to all explorers who really love travelling far and wide. It is the clunkily-named **Pla Aick GA-A e1** system. The Explorers Association have dubbed it Ostium Tenebris, which is old Latin meaning 'the door into the dark'. It is an extremely remote black hole system in the Perseus arm of the Milky Way, roughly 35,500 light years distant from Sol and about as far as a commander can get travelling through that stretch of space.

Beyond that lies the fringe of the Milky Way's disc and the small dot of the Carina Dwarf Galaxy, which is some 300,000 light years away. It is one of hundreds of satellite galaxies that orbit the Milky Way at various distances, and will very likely be consumed by it in the far, far future. 

*The Ship's Keel:  
The Carina Constellation*

**Text:**  
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**Design:**  
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**Thanks to:**  
The Galactic Mapping Project



*Stations You've Not Visited:*  
**Mawson Dock**

Depending on who one asks, the men and women of the Pilots' Federation are either heroes or villains. ▶

Depending on who one asks, the men and women of the Pilots' Federation are either heroes or villains.

The guild is an oddity among human organisations, neither wholly a business — though rivers of credits run through its coffers — nor wholly a government — though it has famously owned and administered the mysterious system of Shinrarta Dezhra for centuries. Its members are unique, representing the apex of the entire profession of piloting. A ship flown by one with the wings of the guild on their shoulder is a private possession, with few restrictions on either the choice of hulls or the modules with which they are equipped.

These infamous pilots don't simply spawn from the void. Each man or woman, whatever path they choose, starts as a novice in the trio of career paths in which they might build expertise — or, as the Pilots' Federation calls them, 'Harmless', 'Aimless', and 'Penniless'. In an era of crisis and political upheaval, demand for freelance pilots is at an all-time high — and so is the number of new recruits into the fabled guild. So great has this influx been that the Pilots' Federation itself has taken the unprecedented step of acquiring entire star systems to serve as training grounds.

One of these new training facilities is Mawson Dock, located in the Dromi system. It is a Coriolis station, its form ubiquitous to those who commonly travel among the stars yet a titan of human achievement to those who do not. Dromi itself is new, or at least newly-named. This system, formerly known as Manu, is one of those that comprise the misleadingly-named Pilots' Federation District, star systems that are permit-locked to all members of the Pilots' Federation except those of the lowest ranks. These systems were acquired with the blessing of all three superpowers, and are now a peculiar inversion of Shinrarta Dezhra: a Pilots' Federation-owned and operated system which can only be accessed by

its most inexperienced members.

On the face of it, Mawson Dock is no different than any other Coriolis: a massive cuboctahedron with a jaw-droppingly large docking tube. It is only when looking at the details that one notices the difference between it and other destinations.

Mawson is not unusual in and of itself, but the vessels that come and go around it are. Visiting ships are basic, even to this correspondent's untrained eye. Sidewinders constitute a clear majority, with Haulers and the occasional Eagle seen as well. None of the more prestigious or expensive ships are to be found, for none of the newly-winged pilots who frequent the station have yet attained them.

It is a reminder of the new paradigm of hyperspace travel: the frame shift drive, revolutionary in its ability to allow dozens of light years of travel within seconds, yet centrally controlled. System-lock permits, almost unheard of a generation ago, serve as a reminder of the Pilots' Federation's ultimate control over pilots' ability to travel. No members who have advanced through the ranks may access District systems like Dromi, which makes it the closest thing to a safe haven that fledgeling pilots will ever know.

Many of the pilots in Dromi are fresh-faced and eager to speak to the media. There is an energy to the place, an optimistic hope that gleams from new flight suits and new ships. One of the first to speak to me was a young man, his wings only days old and his Sidewinder a gleaming white. Darian Kase has bright eyes and dark skin, is youthful and has a smile that never quite leaves his face. His Sidewinder, named the *Morning Star*, is landed nearby.

*I joined the Pilots' Federation to make something of my life. I'm the youngest of six children, hailing from a dead-end*

*indy world. I love my family, but I had to see the stars and seek my fortune. And now I've got my wings, running my first missions and seeing some real money in my pocket for the first time in my life.*

When asked what his plans were for the future, Kase simply doubled down on his enthusiasm.

*I've heard that the guild has some problems with its reputation. It's my intention to do my part to mend those rumours. I came from nothing, and I'm going to use my ship to pay my good fortune forward. If there's a distress beacon, I'll be there with a repair drone. If there's a famine or outbreak, I'll be the first to show up with a hold full of food or medicine.*

When asked how one can build a career out of aiding others, Kase paused.

*It isn't about the credits — or at least, not only about them. Local governments pay well for emergency supplies — so no worries there — and authority almost always pays a reward for salvage. That's good enough for me.*

The pilots' lounge is a busy place, and it wasn't difficult to secure another interview, this time with a young woman. We settled down over a drink, one eye of hers ever upon her dataslate, keen to accept a lucrative job— or at least, as lucrative as they can be in the District.

Saia Zand is of indeterminate ethnicity, dark-haired with piercing eyes. She is far more sombre than her brother-in-wings Darian Kase, and already the commander of an Eagle. Her time within the District is nearly at an end, and this correspondent is fortunate to have caught her when he did.

*My family was taken from me during the Kumo incursions into Imperial territory. I was a teenager, spared only because I hid in a creaking foundation while my township was rounded up. Authority didn't save them. That pompous fool Patreus didn't save them. On*

None of the more prestigious or expensive ships are to be found.

Demand for the freelance pilots is at an all-time high.

*that day, I learned that the only one you can count on is yourself. That's why I'm here.*

Zand spoke with the surety of a woman on a mission. When asked if she hopes to one day see her family, a look of pain was quickly concealed with one of resolution.

*There is always hope – but Pegasi is a big place, and...*

She shook her head, one fist clenching.

*...And it isn't looking good. But I can dedicate my life to bringing scum like the Kumos to justice. I can prevent what happened to me from happening to others. And that all starts here, on Mawson.*

Commander Saia Zand has already claimed a bounty in her pursuit of justice, a fellow recruit who turned to piracy in lieu of honest trading.

Finally, there is a different sort: a young man with pale skin and a shock of orange hair, falling awkwardly over his freckled face. Eye

contact seems difficult for him, and he speaks as though each word is carefully rehearsed. James Tucker is young, but not as young as the two pilots interviewed before him. We walked down a corridor together, away from others. Words came only with difficulty, spoken at a halting, awkward pace when they finally arrived.

*I've never... never fit in, you know? With people. I just can't read them. I never know if they're joking or being serious, though everyone else always seems to. Like your interview. Are you really a journalist, or are you just playing a prank? I've been pranked a few times before. In school, at a few jobs... by people who I thought were my friends...*

He briefly paused, then went on.

*So I figure that if I get away, like really away, thousands of light-years out, then I won't have to deal with it any longer. Stars don't play games with you, and those scans can be worth a lot of money. Some people seem to go a little crazy if they're away from others for a month or two. Me? I think I'll go crazy if I'm not.*

Tucker's Sidewinder is laden with fuel tanks and scanning equipment. It is clear that he intends to leave the Bubble as soon as he is able. At the sight of his ship, the young man's features relaxed and brightened. Truly, he is the unique sort who yearn to make their home among the stars.

The story of Mawson Dock is the story of those who learn their space-faring trade within its bulkheads. It is not a destination, but a beginning. It is an incubator of hopes and dreams, the nest from which young hawks and doves alike take flight. It is striking to stand amid so many with the knowledge that one is in the company of future heroes, villains, and leaders. It is sobering to realize that many of the fresh faces in new flight suits will at some point meet their end due to the cruelty of the void – or their fellow human beings.

*Stations You've Not Visited:  
Mawson Dock*

**Text:**  
M. Lehman

**Design:**  
McNicholl

**Images:**  
Punkydrummer01



## Co-Pawlots

Commander name: **Halofanatiks**

Co-Pawlot name: **Simba**

Co-Pawlot designation: **Chief Morale Officer**

Commander Halofanatiks' co-pawlot Simba passed away on the night of Saturday 27th July, after a long and hard battle.

Simba's role aboard the Asp Explorer *The Antilles* (later renamed *The Resting Dog*) was Chief Morale Officer, as the commander struggles with depression and PTSD.

He was sort of a therapy dog in everything but training and name, and managed to get Halofanatiks out of his episodes almost every time.

Upon a trip to Maia, Simba started barking at the Thargoid vessel that dragged *The Antilles* out of hyperspace. It scared Halofanatiks to face one of them for the first time, but Simba still did his best to defend the ship by trying to scare the alien away.

He was a brave dog, always ready to face whatever adventure they had. It never mattered where they went or what they did — he always had a good time.

**Text:**  
Halofanatiks

**Design:**  
McNicholl



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