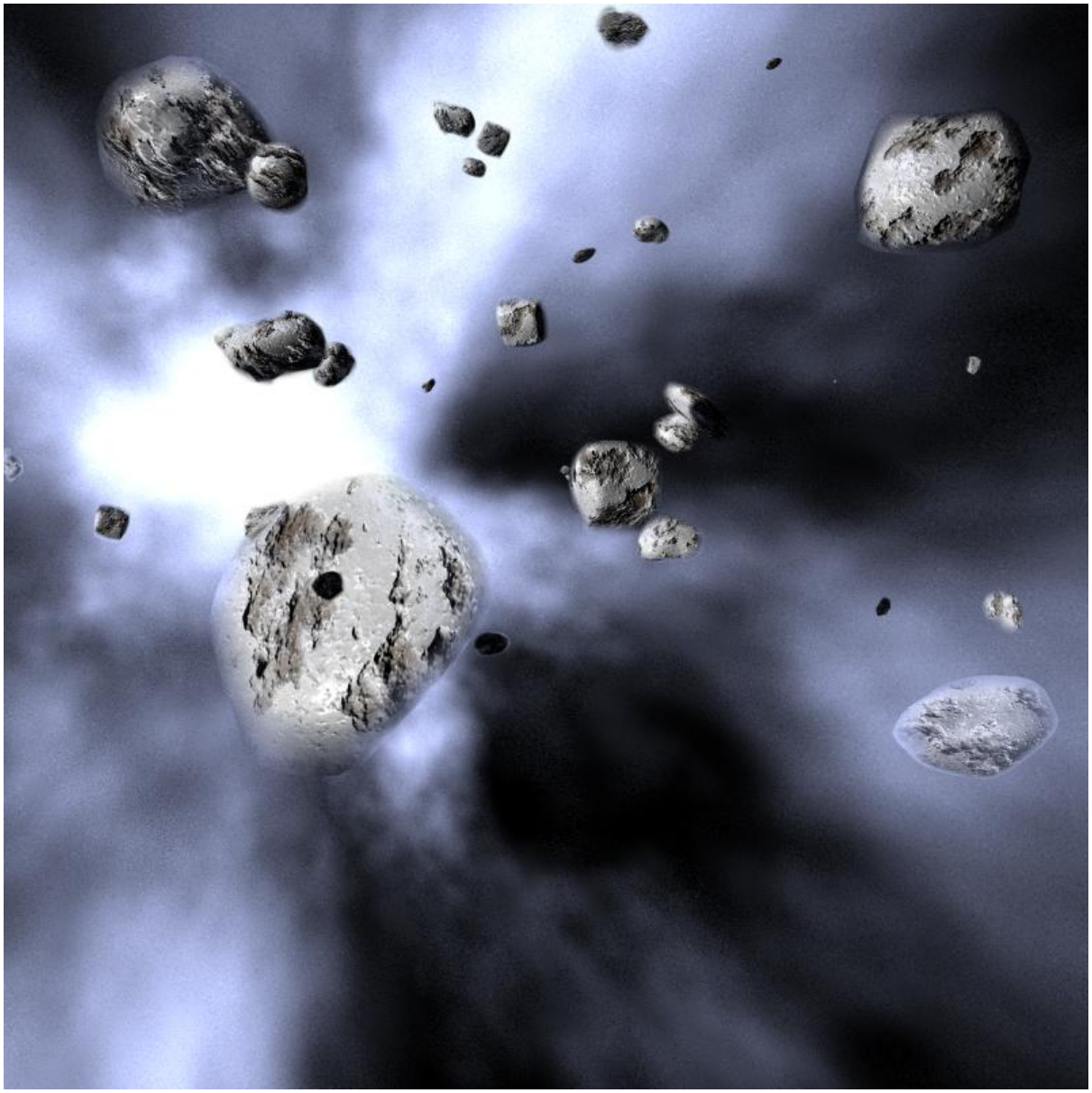
Comet running

By Anders Sandberg



Doing a comet run is a mixture of luck, opted hardware and some limited skill. In space everything is either immobile or fast enough to kill you, and near an active comet there is so much going on that no predictive software and sensors can fully keep track of it. Still, being nimble and prescient helps reduce the chance of death from certain to merely large.

There is plenty of old-fashioned macho aesthetics to it. It would be trivial to sleeve into a heavy metal penetrator and just railgun into the comet - so there is no point to it. Human-sized morphs, EVA bikes (often fitted out to look like motorbikes - remember those?) and no excessive armour. Plenty of

opinions about whether synthmorphs are cheating or not, but in my book their higher acceleration tolerance is outweighed by the extra care biomorph owners show with their bodies.

Finding the right comet is also a bit of an art. Fresh long-periodic comets look grand, but are fairly "clean": mostly ice, with a gradual evaporation that makes the run uneventful. Except when they do have an unexpected eruption - suddenly you find yourself surrounded by tumbling pure icebergs in a white mist. Nothing like it. Jupiter or Halley family ones are far less visual, but the crustiness makes for some challenging navigation. The organisers typically aim for having the run just after a big eruption or even better a breakup. Some of my best experiences have been just off Jupiter, with tidal shearing turning the coma into a labyrinth of shards. And once I did a sungrazer: we honestly did not know if the core would make it, and if the winner would go down with it. Seeing the corona through the flaming coma, photosphere reflected in sublimating ice... we did not care whether we would live or die.

Suit up, boot up the control network, rev up your bike and wait for the organiser to signal (in our race the Nick detonates a plasma warhead). The first part is simple and boring - just getting close to the comet. You can accelerate a lot, but that will make the approach too dangerous. But you don't want to hold back too much either - there is nothing worse than seeing the others far ahead. This is where you can start to see the personalities of your competitors.

Coma approach is just dodging dense clouds, avoiding getting hit by pebbles and abrasive ice. Mostly luck and not too interesting unless there is some odd space weather. Some strategizing for getting a good angle - it is at this point the jockeying for advantage really starts. Then things pick up as you approach the core. By now you need to slow down to avoid overshooting it, so getting shot by a pebble is less of a danger. Instead the icebergs start showing up, especially if it is a good breakup. It is at this point pure luck is replaced by skill, precognition and tech.

There is no way of expressing what you are doing. It is not just dodging incoming projectiles and avoiding hitting tumbling blocks, but finding a path through the many dimensions of velocity, position, angle and fuel reserves as the comet throws surprise after surprise at you. Some comets are fair - P/2087 Seung-Resnick seems remarkably regular - while others are black balls of maliciousness and bad luck. There is a reason why we speak in hushed tones of P/2018 Albeverio. It is not just respect to the people it has claimed - remember, this was the one that got Olivia Blitz for real - but because there is something downright intentional in how it is throwing everything it got at you. You dodge a curtain only to find yourself in front of a small reef of shards. You select a fast and clear approach, and just as you are committed to it there is a surface eruption filling it with the fastest and most fractious bergs you can imagine. A friend had his automation crash on approach and I know two people who have had their nano act up inside the coma: Albeverio is evil.

Finally you reach the core. If you have been lucky and skilled there is nobody ahead of you launching their victory flares. Just you and kilometres of pure comet. Land, crash or touch down. Enjoy the kiss of a conquered piece of heaven.

Comet running

Comet running, races down to the surface of a comet, is a small but noticeable sport or hobby. This is one of the ultimate challenges for daredevils, pitting themselves against the merciless laws of physics and chance in a grand environment.

It is exclusive: runners have to pay for getting to a suitable comet, a bike to ride to it… and likely a new morph. Mortality among runners is very high: the sport has been described as surfing combined with Russian roulette. The description is apt: practitioners have their own tiny subculture, enjoying the close contact with the universe, and death often arrives suddenly and with no regard for skill.

The sport began with Roman Corsini and Olivia Blitz, two asteroid prospectors from Ceres. Theywere the first humans to attempt a manned landing on a comet surface. Ostensibly they were prospecting for Evolo Habform Corp. but their landing turned into a wild race with Olivia eventually winning. Roman demanded a rematch, and a sport was born.

Back in the early days backups were not available which limited the interest to the suicidal risktakers. As backups appeared interest widened among the ultraextreme sport people. It has the right blend of luck, skill and drama to appeal. Even if the only penalty for dying is waking up from backup to a party where somebody else is celebrating their win (and screens may be showing your past incarnation turning into a brief red cloud in the comet tail) it still stings enough to motivate.

Afficionados can be found across the solar system, most who just vicariously run XPs from the real runners or play simulation games. Most fans love commenting on runs as they are broadcast, endlessly analysing strategy and events – was Monferrat's choice of going in via the plasma tail cowardly cheating or a smart guess about the boulder field? How good would Saenz do against the classic 8AF P/2067 Kwee-443 eruption? Are synthmorphs cheating? And of course, as soon as any fan culture emerges, marketers and memeticists flock to try to use it to sell something. Comet running is big enough to bring in real money.

Comet McNaught 2007.

The *Kalokagathos*

If comet running has a headquarter, it is this ship. The *Kalokagathos* is the base ship used by The Nick and the Mjolnir group to visit comets on the verge of interesting eruptions and launch runners. It is a heavily refurbished and remodelled personnel transport, turned into equal parts bodybank, factory, observatory, and luxury sports club.

The *Kalokagathos* consists of a series of rotating sections surrounding a microgravity complex, housing the reactor, drives, docking equipment and bike bays. It has a fairly extensive repair/recycling/manufacturing bay that is used both to maintain the bikes and to mine captured asteroid boulders – the ship often needs to totally replace equipment and morphs lost. It also has a well-equipped bodybank and egocasting facility where new morphs are cultured by bodyfarmers for runners and visitors. At the "front" of the microgravity section there is a launch bay where the runners start, equipped with big diamond windows for those who want to watch in person.

The rotating sections house crew, visitors and what can only be described as a luxurious combination of athletics club and hotel. The ship makes a significant profit from the spending of visitors, who often demand not just good service but extravagant (or excessive) parties before or after runs.

The ship itself is capable of modest but sustained acceleration: enough to move around in the inner system and out to Jupiter and to reach comets, but not enough to get anywhere truly fast. This means that between runs it can often spend a few months in "downtime" as it is going to a new promising location. During this time the ship is fairly empty and only the die-hards remain onboard. Typically it hangs out around Jupiter, Mars or near the Sun, trying to catch spectacular comets when they get close: the bigger the breakups the better.

The Mjolnir Group

The Mjolnir Group is the co-op that owns and runs the ship. They are a fairly informal set of spacers, ranging from crusty old Chang tending the reactor to the bright young sensor-genius Mikka the Cloudy (a new arrival from Venus). Politically they are all over the place: they don't care much for traditional battles over nanofacturing or economics. They want things going smoothly, preferably with credits pouring in and the occasional adventure.

Legally the ship is its own polity within the Planetary Consortium, a micro-nation among micro-nations. This has proven useful when dealing with Experia: while the hypercorp can deal with them using consortium law it cannot wrest control from the co-op even if it wanted. Conversely the ship can get paid in lovely credits rather than rely on transactions via lunar banks.

While The Nick is the leader of the runs, the actual Captain is Pratap L. Krishna, a very quiet technocrat who prefers to run things from the background. He is helped by Bob Vidal, chief of hospitality, chief engineer Ronald Andrade and finance officer Tanya Lyubomirsky. Still, The Nick has plenty of influence in the leadership group: after all, he is the one running the core attraction.

The Nick

"Oh, I can be fair. To those who deserve it. This run has a weight limit of 230 kilogram equipment. Deal with it, or stay out."

The Nick was originally known as Nicholaus Birgenberger, but few remember that name. He was one of the earliest runners, but after a near-death experience he found his calling as arbiter and organiser. He affects the persona of an eccentric, almost sinister cruise captain: upbeat, an air of authority, yet with a tinge of sadistic glee. His word is law in the run.

Deep down he envies the runners. He reviews their runs in meticulous detail, maintaining the fairness and purity of the sport… while also doing his best to prick them, to add cruel but interesting little complications. His put-downs are legendary.

He has to a large degree sold out to Experia: to maintain the running costs of the ship he sells the XP rights of the runs. He has an excellent relationship with them: he understands that what he is delivering is not just occasional runs and XPs, but an ongoing reality drama as the different runners jockey for position, fight, fall in love and generally behave larger than life. There is of course always some degree of kayfabe in the competition: people even subconsciously pose for the media format these days. But a good director can nudge things onward with a few subtle touches.

Shishir Nagarja – "The Lion"

"Take that, hybrid!"

One of the top runners in the solar system (like all the others he would say he is *the* best, of course). A proud citizen of the Jovian Republic, Shishir is a loud nationalist and bioconservative. He loves to show just how much an unaugmented human can do.

Shishir got his money from a very successful surveillance brokerage startup he founded at an early age. He still has a bit of the image of a young Callisto entrepreneur with a taste for danger: his parties are fabulous. Since he doesn't egocast he also spends much time on the *Kalokagathos,* usually shuttling in and out when it is close to Jupiter. The crew knows him well, and he has his own suite onboard.

Shishir doesn't run any mnemonic augmentation, so his runs are documented using normal suit recorders instead. Despite this he is a popular runner, especially in the Republic. The fact that he risks his life adds to his reputation: if he were to die, he would not come back. He has had a few serious run-ins in the past, forcing massive regeneration of his body (and, according to his enemies, his brain). In runs he often start out playing a prudent, cautious game but soon shifts to his famous death-defying courage – especially if Li Wu starts getting ahead of him.

Shishir is sponsored by numerous Jovian companies. While people often joke that he is a republic PR employee, the government has studiously avoided any entanglements except sending congratulations on notable wins.

Li Wu – "Silver Surfer"

"'Dressed in the lion's skin, the ass spread terror far and wide.' I'm quaking, Shishir."

Li is Shishir's exact opposite. A lunar transhuman of no gender and with just a formal membership in the human species, Li loves to annoy the Jovian and vice versa: they have a truly epic rivalry.

Li, a scion of a wealthy family, has been an extreme sports enthusiast since a young age. Reinventing itself repeatedly – as everything from an explorer of inhospitable environments to a forkball champion – it has drifted ever further from baseline humanity. It is a favourite among mercurial and the lunar synthmorph movement, although Li usually never talks politics directly. As a person it is quick, precise and has a very dry wit.

Sleeved in a Steel synthmorph and proud of it, it fends off accusations that it is cheating by pointing out how tricked-out the morphs of other runners. It usually tries to make the best of its acceleration tolerance by running very fast and dodging crazily: sometimes it works, sometimes it doesn't.

It has a very lucrative sponsorship deal with ComEx, which helps pay for its morphs and bikes.

Sergei Kuniavsky – "Red Wolf"

"Do you believe in the hereafter? Well, then I guess you know what I'm here after."

Sergei is a classic macho playboy. Hailing from an old money Putingrad family he has managed to embarrass his staid lawyer family with a long stream of gossip-worthy adventures. His current occasional interest in comet running is probably a relief to them: at least it keeps him away from Elysium, where he *really* managed to cause trouble.

Sergei is a hunter. When he sees somebody he likes – and he has a very broad taste in partners – he pursues them single-mindedly until he has gotten them in bed. He can be very ingenious, but also pushy: there have been a few hushed up cases where partners afterwards disagreed on how much consent was involved. On the positive side, once he has conquered someone or something, he becomes very protective of it. He might be instantly looking for new partners or new comets to conquer, but he will not forget the old ones. He is a loyal friend and protector. This is why he started the Caput Lupinum club to protect comets from excessive industrialisation: he was outraged that the TTO used one of "his" comets for terraforming.

He has clear Reclaimer leanings and happily promotes their agenda; this has put off sponsors (together with some of his adventures). However, someone in Experia seems to like him, and he is usually surprisingly good at money-making deals: there is always some strange way he manages to not only get by, but making a small killing. Opponents sometimes whisper about triad money, but nothing can be proven – and Sergei will gladly boast that he robbed the Quian-9 triad when he was on Luna last time.

Despite his gregarious and outspoken personal style, he is totally focused on the game when running. His approach is methodical, willing to suffer small damage that can be shrugged off if it allows him to get closer to his goal. Unlike Shishir and Li he doesn't care for japes and insults during a run: he systematically hunts towards the nucleus, ignoring everybody else.

Tien S. Kiu – "Silent Wing"

> *"Look out for what? Oh,* that*."*

An up-and-coming runner. Originally a space worker from Hyoden, she won several simulated championships and later sponsored runs. She just recently graduated enough wins to become a serious contender at *Kalokagathos.* The other lead runners are still trying to figure her out, both as a person and as a competitor.

Tien is a quiet, reserved person much of the time. But once she loosens up she can party with the best. Yet she rarely reveals anything of herself, instead goading others into doing something amusing or embarrassing. What is actually going on is a case of Fall trauma and internalised survivors guilt: she has a death wish a mile wide, nonchalantly taking enormous risks. This makes her an unpredictable and very tricky opponent.

She is sponsored by Omnicor.

Dr Scott P. Raeder

> *"This is the destination: L/Colomba-457… D"*
>
> *The runners looked surprised. They had expected a run towards the main nucleus of the just broken up comet, not a secondary nucleus.*
>
> *"It is a 2 km, prolate snowcone. Inhomogenous tholins, slippery L-crack patterns. And The Nick sends his greetings: it will be surrounded by a type X debris field."*

Chief astronomer of the ship. His main role is selecting suitable comet targets and when to launch for maximum entertainment.

Dr Raeder started out as a normal cometary astrophysicist, mapping their properties and eruptive dynamics. Just before the Fall he encountered the Nick, who invited him to help. He rode out the Fall on the *Kalokagathos* and became part of the crew. He still maintains extensive research links and is a fairly respected member of the community. Yes, he might have sold out, but at least he sold out to the coolest place possible. He is also getting a lot of interesting data from the runs, allowing him to publish very respected "hobby" papers on cometary dynamics.

Component B of 73P/Schwassmann–Wachman.

Game rules

The run starts at a safe distance from the comet, typically a million kilometres. The velocity is usually matched with the comet.

The basic challenge is to find safe paths through the cometary eruptions while decelerating right: high velocity will make impacts deadly and prevent a landing, slowing down too early means getting in late.

Each bike has an acceleration stat, denoting how much velocity it can maximally add or remove per turn. A typical acceleration is 5G, producing roughly 3 hour runs.

Each turn each runner decides how much to speed up and slow down, and reduces their distance by their current velocity. The first one to reduce it to zero (and with a survivable impact velocity) wins. It is possible to overshoot (negative distance) and return: slightly embarrassing, but sometimes a smart move.

Since much of the run is fairly uneventful at the start, the length of turns can be made variable. A 10 minute turn allows runners to move 600*V km, and change velocity by 6*A km/s (measuring velocity V in km/s and acceleration A in Gs). A 1 minute turn allows move 60*V km and velocity change 0.6*A. 3 second turns for the most dramatic parts allow 3*V km move and 0.03*A km/s velocity change.

After the move, the GM rolls for the density or nature of cometary debris in the vicinity, and the runner rolls Fray to avoid getting hit. The roll gets a modifier depending on the distance to the nucleus and the difficulty of the comet.

Roll (1d100)	**Debris**	
1-50	Vaccum	No risk.
51-75	Dust	Minor ablative damage.
76-100	Low density grains	Roll Fray +10 to avoid.
101-125	Mid density grains	Roll Fray to avoid.
125-150	High density grains	Roll Fray -10 to avoid.
151-175	Low density chunks	Roll Fray to avoid.
176-200	High density chunks	Roll Fray -10 to avoid.
201+	Bergs	Roll Pilot to avoid.

If the dice come up equal, roll twice and roll Fray for each outcome (this can include further doublings). Alternatively, the comet has an eruption and *all* future rolls (for everyone) are at +10 (cumulative).

Distance:

- Outside coma: -20 (more than 600,000 km)
- Outer part of coma: 0 (300,000-600,000 km)
- Inner part of coma: +20 (10,000-300,000 km)
- Near nucleus: +50 (0-10,000 km)

Difficulty:

- Quiescent periodic comet: -20
- Active comet: +0
- Comet undergoing breakup: +30

Impacts do damage depending on relative speed and size.

- Small grains act like railgun bullets. They do 2(V^2)d10 + 4 damage (AP -3), where V is the velocity in km/s (rounded up; the minimum damage is 2d10+4). For example, with 3 km/s velocity difference the damage is 9d10 + 4. Ouch. A hit has 60% chance of hitting the bike rather than the rider (can be increased to 80% if the rider uses it as a shield).
- Bigger chunks act as fragmentation grenades: it doesn't matter much where they hit, since fragments will spray the vicinity. They do 3(V^2)d10+6 damage (AP -2).
- Finally, hitting bigger boulders or bergs acts as falling damage. The damage is 1d10 per 6 m/s – anybody moving at km/s speeds will be splattered.

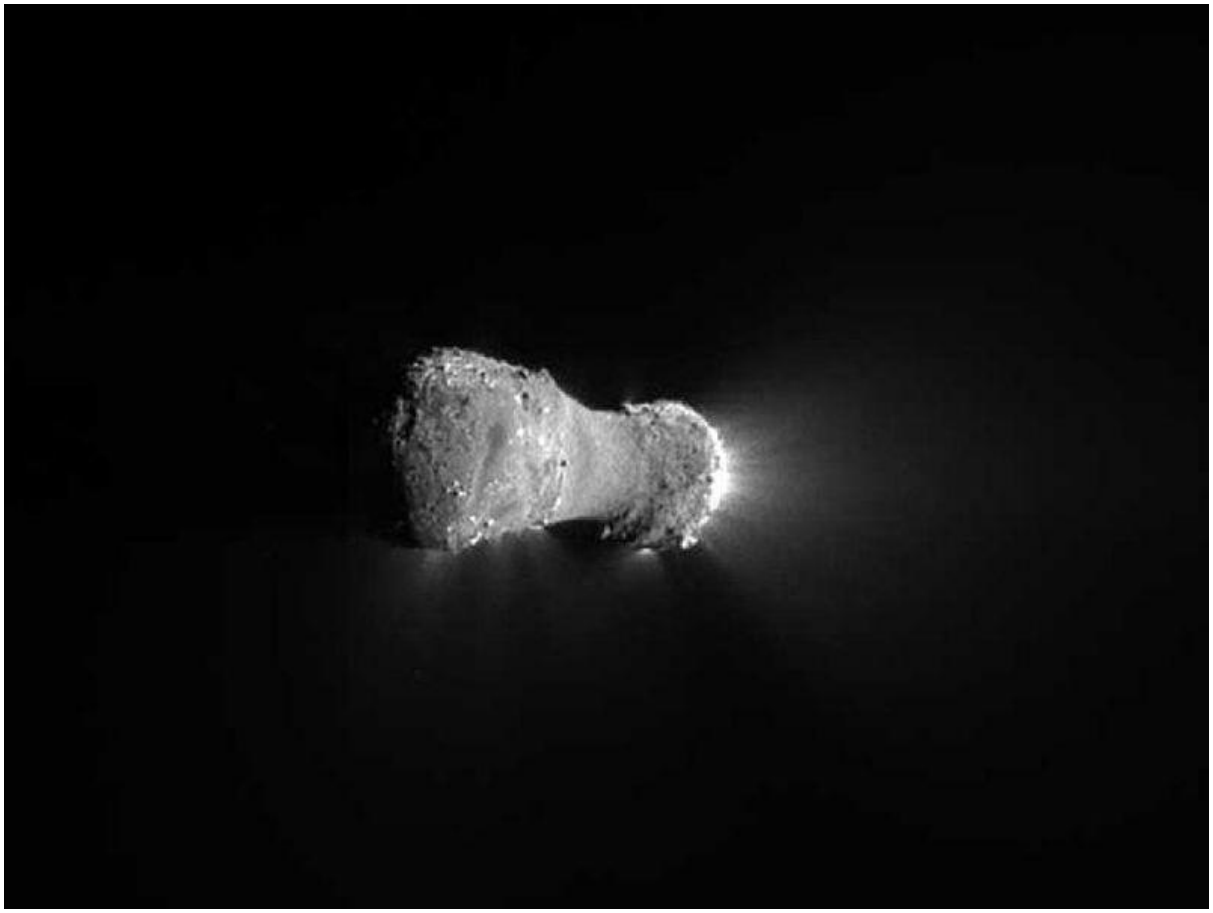
Runners who are not busy with evading can roll Sensors to try to get a better position. A success with MoS less than 30 gives a -10 on next debris roll. A 30+ MoS gives a -30 on the next roll, or -10 on the next three rolls (cumulative). A critical success gives -10 on all future debris rolls. A critical failure on the other hand adds +30 to the next roll.

Psi and running

Obviously asyncs would have an advantage in running, and it is not unlikely that some of the runners are secretly or unknowingly asyncs.

Ambience Sense, Instinct and Predictive Boost are useful for evading. Time Sense might allow sensor monitoring and planning while evading. And clever asyncs might make taunts or distractions that mess up the runs of the competition.

And what about those rumours of "bad" comets? Maybe asyncs can detect that there is indeed something sinister about P/2018 Albeverio. Maybe there is something in it that wants privacy.



Comet Hartley 2, taken by Deep Impact.

Adventure possibilities

A smallish space habitat filled with thrillseekers, their hangers on and media types: what could possibly go wrong? There is plenty of potential reality soap going on here, subtly directed by The Nick. Many runners have extensive and interesting personal lives when they are not running, and they might encroach on the runs.

The media games can be rather cutthroat: losing sponsorship is a big deal, since it might force runners to get out of the competition. So some sponsors dictate more than just what ads to show on the suits. But runners are also notoriously free-spirited, often subverting demands in clever or outrageous ways. Meanwhile the real games deal with the sale and editing of XPs.

Some rivals think Shishir is far more augmented than he lets on. If he were to be outed as a transhuman it would likely destroy him (and be an embarrassment for the Republic). Is it possible to convincingly prove his hypocricy? Or manufacture evidence?

Interstellar Intelligence memeticists find Li or Sergei to be a problematic source of memes for the planetary consortium: it would be very useful to have them discredited. Ideally subtly – would it be possible to lure them to some other pursuit?

The runner community is worth monitoring for exceptional people. Successful runners might be secret or unknowing asyncs various fractions want to recruit – or keep the opposition from getting.

The egocasting and resleeving facilities might allow all sorts of shenaningans: secret identity swapping, sabotage of morphs, attempts to steal blueprints of custom morphs or darkcasting to somewhere else are all possible with some help of the crew. Or maybe Dr Gunay is using the quiet downtime for some experiments that nobody ought to know about.

The suite and offices of Shishir are pretty safe thanks to their location – access to the *Kalokagathos* is easily controlled, especially in the downtime. This allows him to be himself, but also makes them a good place to hide interesting secrets. Just what could a surveillance magnate discover that he might want to hide away? And how many would be willing to kill to find out?

In Ken MacLeod's *Astronaut Keep* it is discovered that cometary nuclei not just contain life but ancient godlike superintelligence. Maybe this is true in Eclipse Phase too: maybe comets are home to alien intelligence? Maybe the true form of ETI is nanobacterial rhizomes in Kuiper belt objects across the galaxy, a vast distributed network of intelligence. Comet runners might actually be on to something about their superstitions about "good" and "evil" comets, and might one day find something unintended.

Of course, beside alien finds there might be other things buried in comets. Ancient wrecks from the beginning of spaceflight – perhaps with frozen crew. War-machines from the Fall. Hidden redoubts for separatist groups, Argonauts, megacorps or TITANs that have been lost until now.

Comet 17P/Holmes.