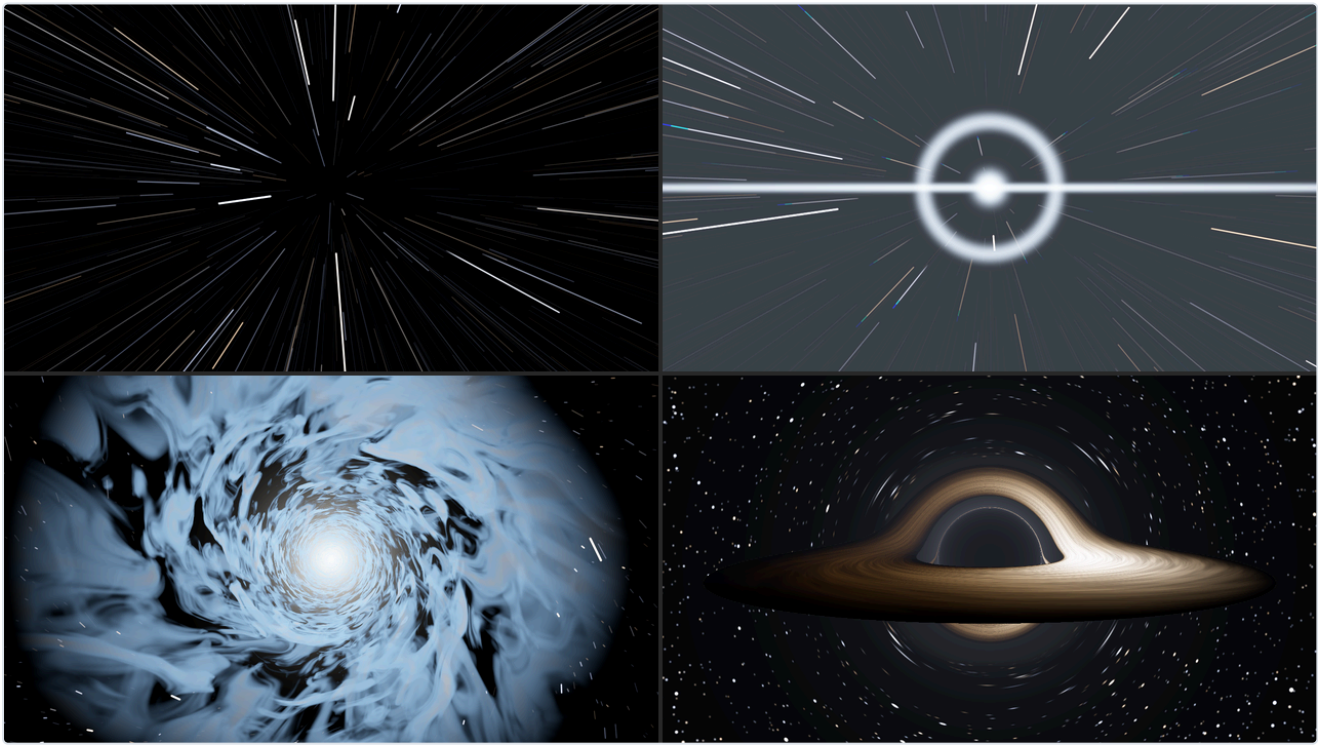
Slipstream user guide

Slipstream is **jumps to hyperspace, warp jumps, a wormhole and a black hole, for Resolume Arena and Avenue**, as two FFGL plugins in one download: **SW Slipstream**, a source (space, with stars in it), and **SW Slip Over**, an effect in which your clip is the view out of the front window. (A slipover is also a knitted tank top. FFGL gives a plugin sixteen characters for its name, and the sensible ones were taken.)

Nothing in it draws a streak. It's a camera flying through a field of stars with its shutter open, and the streaks are what a real camera would record: each star's image running outward from the vanishing point for as long as the shutter stays open, longer the faster you go. Speed up from rest and the points stretch into lines, which is the jump to lightspeed every space film has done since 1977, and it turns out to be nothing more mysterious than acceleration, photographed. On top of that camera sit four scripted trips, the four **Looks**: Hyperspace, Warp, Wormhole and Black Hole. The black hole is the physics one. Its shadow, the bent sky round it, the disc lensed up over the top and the thin bright ring on the shadow's edge all come from light following the paths general relativity says it takes round a black hole that isn't spinning.



SW Slipstream's four looks at its defaults, rendered by `sliptest`, the offline harness, rather than captured from Resolume. Top left, Hyperspace a third of the way in (Journey 0.35). Top right, Warp a moment after the snap (0.35). Bottom left, the Wormhole's mouth of cloud swallowing the frame (0.20). Bottom right, the Black Hole held in transit (0.5), its right-hand side, which is coming towards you, the brighter. Each panel is a whole 1280 × 720 frame at half size.

> **Before you rely on this:** it's at **v0.1.0**, the first release, and early days. Everything below was measured offline by a harness (`sliptest`) that drives the plugins' own classes in a headless GL context, and `tools/verify.sh` passes on macOS 26.4.1 on an Apple M4 Max, running its picture checks at 1280×720 and 320×180 on the GPU and again on Apple's software renderer. A star's streak lays its light along its length to within 1% of a simulated open shutter, and a star's whole light is the same at rest as stretched into a line. The black hole's shadow lands within 0.06 px of Synge's formula for its size, a dot straight behind the hole becomes an Einstein ring within 0.03 px of where the harness's own ray tracer puts it, and the corona's brightest ring sits on the shadow's edge although nothing draws it there. As a hole comes in from far away, the Over's clip matches the clip itself to within a level in 255 on average wherever the hole bends it by less than a tenth of a pixel. Twenty models broken on purpose and twenty-three one-character changes to the shipped code are all caught, and all 67 controls (32 in the source, 35 in the Over) change the picture. The only host it's been run in on a Mac is the fleet's own test host, `oxbow` , so it has **never been loaded into Resolume on macOS**.
>
> **On Windows it has been in Resolume.** In Arena 7.27.1 on win-lab (a virtual machine with software rendering and no GPU), both plugins load and register as `SW Slipstream` and `SW Slip Over` , every control is as declared, both render, and Arena's log stays clean: all of the fleet's Arena checks that can run there passed, three times, the last on this release's own Windows download. Each control is measured against a still picture, so the ones that only act over time (Engage, the four times and Flash) can't show there, and others need the right look or moment of the trip first: 18 of the source's controls changed the picture outright and 21 or 22 of the Over's, with the rest needing a precondition the gate sets or too close to call in a still. Software rendering says nothing about a GPU, or about speed.
>
> The looks were judged by eye on the harness's renders, not compared with anyone's footage, and the only clip the Over has been measured on is the harness's own test card. The Wormhole's clouds flicker at the frame's edges in transit at the default Top Speed; that and the other things I know it doesn't do well are under *Known limits*. Try it on a spare layer before you put it in a show.
>
> This codebase was created with AI assistance, directed and reviewed by a human author.

Installing

Every download has both plugins in it: **SW Slipstream** (a source) and **SW Slip Over** (an effect), as `Slipstream.bundle` and `Slipstream Over.bundle` on macOS and `Slipstream.dll` and `Slipstream Over.dll` on Windows. Get them from the `v0.1.0` release on GitHub or the project page, drop both into Resolume's effects folder and restart Resolume:

```
macOS    ~/Documents/Resolume Arena/Extra Effects/
Windows  %USERPROFILE%\Documents\Resolume Arena\Extra Effects\
```

Avenue uses the same layout under its own folder name. SW Slipstream shows up among the sources and SW Slip Over in the effects browser.

The macOS download is a universal build (Apple silicon and Intel), as a `.dmg` or a `.zip`. It's **Developer ID-signed and notarised** by the release pipeline after publication, so the bundles just load. If macOS refuses a download, it's from before the signing, so download it again. The Windows download is an x64 installer (`-setup.exe`) or a `.zip`. It isn't code-signed, so the installer trips SmartScreen once: **More info** → **Run anyway**.

Start here

1. Put **SW Slipstream** in a clip slot and trigger it. Stars drift slowly towards you, and three seconds later comes the first jump: the points stretch into streaks, there's a flash, and you're in hyperspace, steady radial lines inside a mottled blue tunnel. Three seconds after that you drop out with another flash, and the lines shrink back to points. It goes round every nine and a half seconds, because **Drive** starts on *Loop*.
2. Change **Look** to *Warp* and wait for the next jump. Space is drawn in towards the middle, then snaps with a flash, a ring and a horizontal streak, and the stars fly past one at a time.
3. Change **Look** to *Wormhole*: the stars twist into a whirlpool, a mouth of cloud opens and swallows the frame, and you leave through a white-out at the far end.
4. Change **Look** to *Black Hole*: a black hole comes in from far away, its golden disc fading up as it arrives, sits there for three seconds, and then you fall into it and come out of a white hole.
5. Set **Drive** to *Fader* and move **Journey** by hand: 0 is normal space, 0.5 is in transit, 1 is normal space again, and you can scrub either way. It's the quickest way to see what each look does, a bit at a time.
6. For your own footage, put **SW Slip Over** on a clip. Your clip is the view out of the window, and every look does its trip to it.

A camera with its shutter open

The source is a box of a few thousand stars at random places and depths, repeating along the line of flight forever, and a camera flying through it. As the camera moves on, each star's image runs outward from the vanishing point, and the shutter, open for half of each frame at the default 180°, records that run as a streak. That's all that's going on, and the rest falls out of it:

what you see	why
points at rest, streaks at speed	a streak is as long as the distance the camera flew while the shutter was open
streaks as bright at the tail as at the head	a star's image speeds up as it nears, spreading its light thinner, and the star brightens by the inverse square as it nears, putting the light back; the two cancel
streaks dimmer than the stars were	a star lays the same light along a longer line; the brightest stars, burnt out white at rest, are the ones that stay bright as lines
steady radial lines in transit	once the camera flies through the repeating box more than once per shutter, every star's line is filled end to end every frame and stops changing with speed
white cores with coloured edges	the picture is developed the way film is, so a star's middle burns out white and its colour shows at the fringes

The harness holds the second and third rows to measurements: the light along one star's streak is within 1% of a simulated open shutter, and a star's whole light is the same at rest and at three speeds to about a tenth of a percent.

Because everything is added up as exposure and only developed into a picture at the end, a flash over a star field washes it out the way an overexposed frame does. A clip in the Over is turned into exposure on the way in and back on the way out, so with nothing happening (and Stars at 0) it comes out as it went in.

The trip

Every look runs the same trip, and **Journey** is where you are on it: 0 is normal space, 0.5 is in transit, 1 is normal space again. Each look has its own script for the way there and back, so the same point on the trip is a different moment in each (the tables under each look say what's where). Going in, 0 to 0.5, takes **Entry Time**. Leaving, 0.5 to 1, takes **Exit Time**. In between you can stay in transit as long as you like.

Drive decides how you get round:

- **Hold**: switch **Engage** on and it goes in and stays in transit; switch it off and it comes back out. Change your mind halfway in and it carries on into transit and straight back out, rather than running the film backwards.
- **Trip**: each press of **Jump** is one round trip: in over Entry Time, **Transit Time** there, out over Exit Time. A press while a trip is under way does nothing.
- **Loop** (the default): round trips forever, with **Cruise Time** in normal space between them. At the defaults that's three seconds cruising, two going in, three in transit and a second and a half coming out, so the first jump starts three seconds in and it's home at nine and a half.
- **Fader**: **Journey** is the trip, scrubbed by hand, either way, as fast as you like.

Engage only does anything under Hold, Jump only under Trip, Cruise Time only under Loop and Journey only under Fader, and in Fader none of the times apply: you're the clock. Under Hold, Trip and Loop the trip only ever moves forwards. Under Fader it follows Journey wherever you push it, forwards as far as you like and backwards up to half a trip, flashes included: drag Journey back through a flash point and the flash fires on the way back, too. A move back of more than half a trip counts as going on round, since 1 is the same place as 0. So a ramp on Journey that loops from 1 back to 0 carries straight on into the next trip, and Journey set straight from 0 to 0.76 flies forwards through the entry, transit and both flashes in one frame.

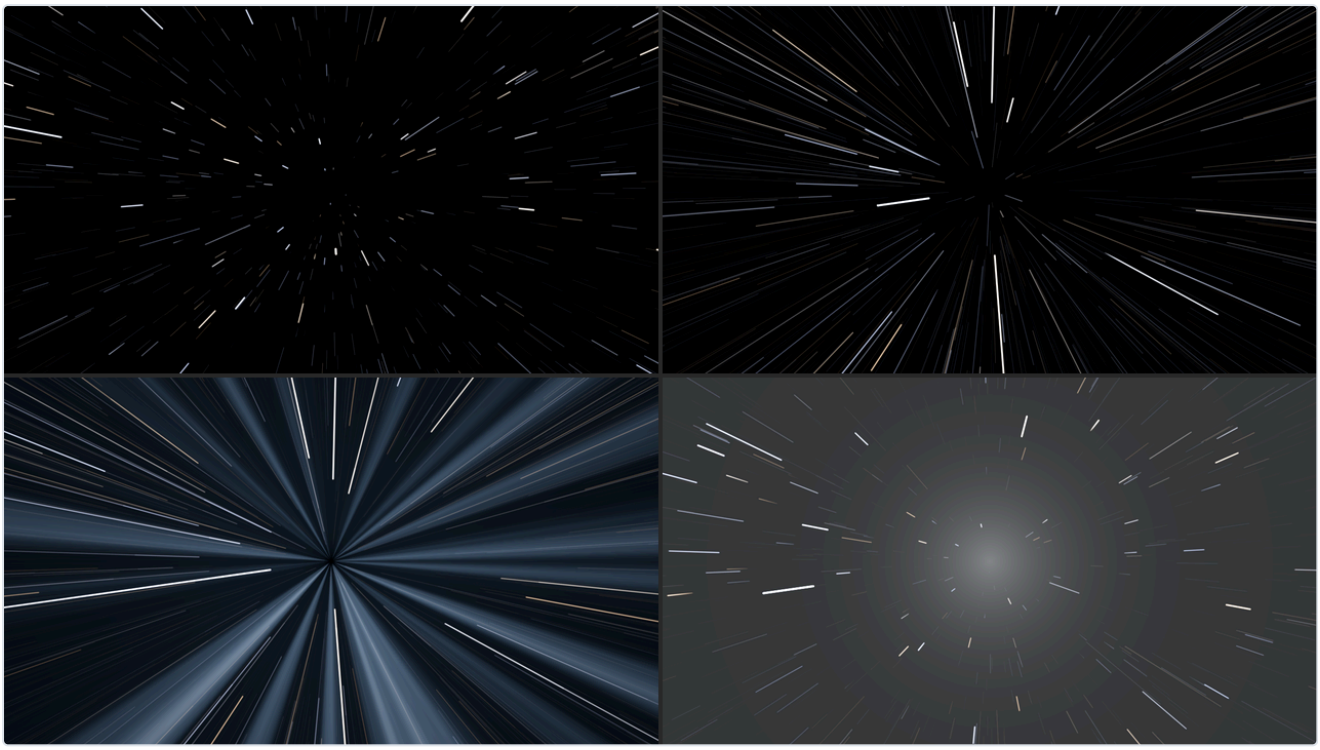
You can change **Look** at any point, and the new look picks up at the same place on the trip, which in transit is a straight cut from one transit to the other. **Changing Drive** carries on from where the trip is: switch from Fader to Hold with Engage off while you're in transit, and it leaves.

Hyperspace

Stars as points, then the camera accelerates, slowly and then all at once, and the points stretch into streaks. At full speed there's a short flash and you're in transit: steady radial lines and, with **Tunnel** up, a mottled tunnel round them, smeared along the line of flight by the same shutter. Dropping out is the same backwards, but more abruptly: another flash, the speed falls away at once, the last of it bleeds off, and the lines shrink into points.

Journey	what you see
0	normal space: stars drifting at Cruise Speed
0.05 to 0.4	the camera accelerates and the points stretch into streaks
0.375 to 0.5	the tunnel fades up
0.4	full speed, and the first flash
0.5	in transit: steady lines and the tunnel
0.5 to 0.575	still at full speed, the tunnel fading
0.575	dropping out: the second flash, and the speed falls
0.575 to 0.775	the streaks shrink back to points
1	normal space

At 180° and 60 fps the camera flies through the box of stars one and a half times per shutter in transit, which is what keeps the lines steady. With **Top Speed** below about 0.41 they break into separate streaks with gaps between them.



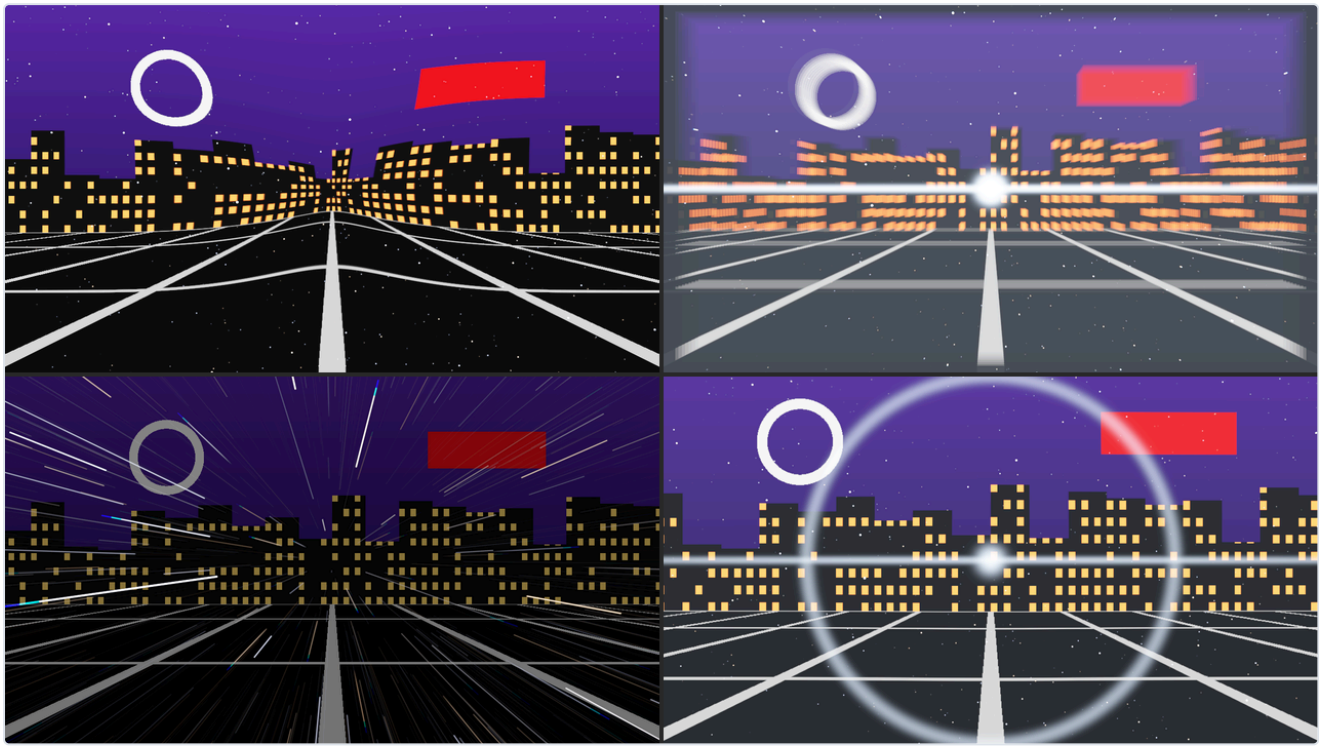
Hyperspace, SW Slipstream at its defaults, rendered by `sliptest` rather than captured from Resolume. Top left, Journey 0.25: the points have become short streaks. Top right, 0.35, a moment before the flash. Bottom left, 0.5, in transit: the steady lines and the tunnel. Bottom right, 0.66, dropping out: the streaks shrinking back to points under the fading drop-out flash. Each panel is a whole 1280 × 720 frame at half size.

Warp

The rubber band. Space ahead is drawn in towards the vanishing point, the middle first and the edges held, harder every moment. Then it snaps: a flash at the vanishing point with a bright core, a ring running out from it and a horizontal streak across the frame, and you're at warp. Warp is slower than hyperspace, so stars fly past one by one rather than as steady lines, with their colours split along them. Arriving is the flash again and the picture bursting back out of the vanishing point to full size, overshooting a bit and settling, like something on the end of a spring.

Journey	what you see
0 to 0.325	the rubber band: the middle of the picture drawn in, harder and harder
0.325	the snap: the flash, the ring and the streak, and the speed jumps
0.325 to 0.345	in the Over, the clip shrinks away into the vanishing point
0.35 to 0.65	at warp
0.65	arriving: the flash, and the speed drops to nothing
0.65 to 1	in the Over, the clip bursts back out, overshoots and settles

In the source the rubber band is only the stars crowding in towards the middle, which is subtle. It shows properly in the Over, where it's your picture being pulled.



Warp in SW Slip Over on the harness's night-city card, at its defaults, rendered by `sliptest` rather than captured from Resolume. Top left, Journey 0.30, the rubber band. Top right, 0.33, the snap: the city shrinking into the vanishing point under the flash. Bottom left, 0.5, at warp, with a quarter of the clip still showing (Clip Through 0.25). Bottom right, 0.76, arriving: the city overshooting to a little bigger than the frame. Each panel is a whole 1280 × 720 frame at half size.

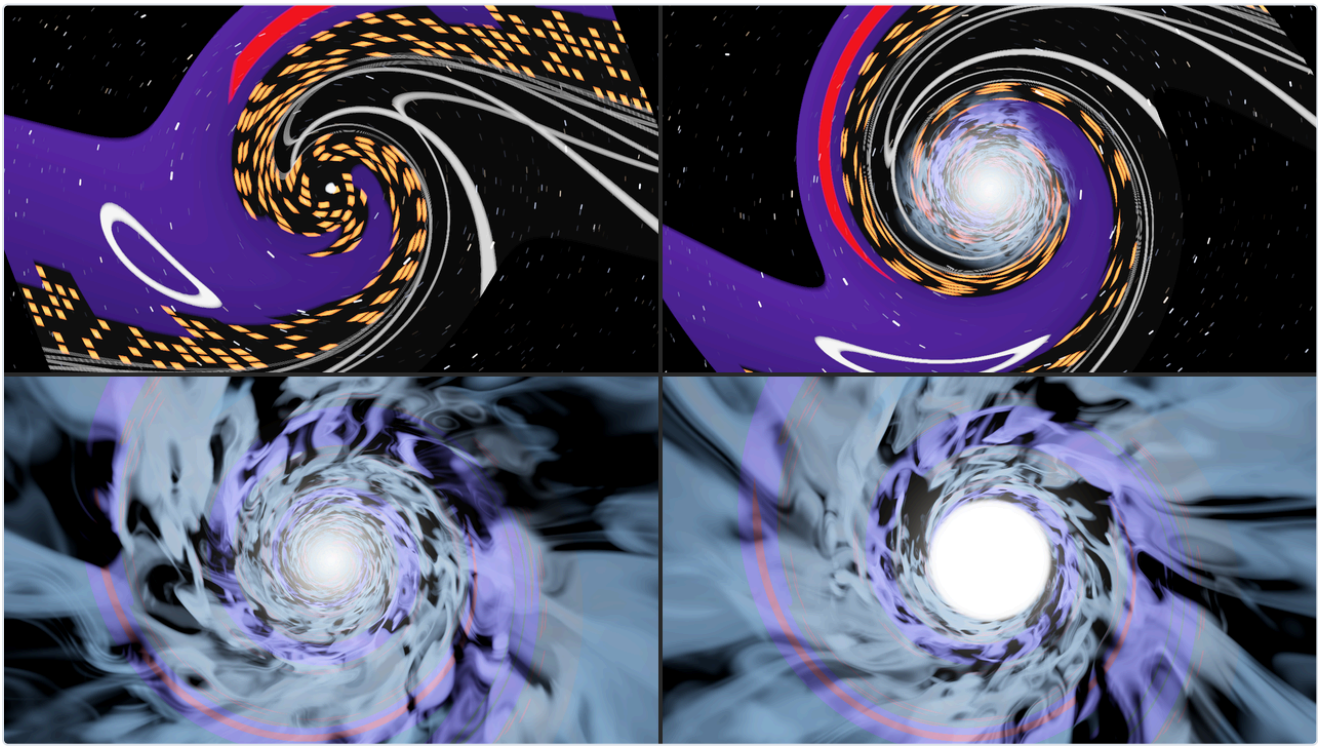
Wormhole

A whirlpool of cloud. One fondly remembered British sitcom's model unit made its wormhole from whipped-up cloud footage (their own effects guide says so), and that's the look here rather than a neon tube. The picture twists into a vortex round the vanishing point, a ragged mouth of cloud opens in the middle and swallows the frame, and three layers of swirling cloud rush past, lit from the far end, with gaps showing the layer behind and, behind the last, the dark. Towards the end of transit the light at the far end grows until it fills the frame, and you leave through the white-out: a flash, then the white fading evenly away as the picture unwinds out of the whirlpool and the speed falls.

Journey	what you see
0 to 0.3	the picture twists into the whirlpool
0.075 to 0.325	the mouth of cloud opens and swallows the frame
0.15 to 0.4	the speed comes up
0.5	in transit: the clouds
0.575 to 0.75	the light at the end of the tunnel grows to fill the frame
0.75	the white-out: a flash, and the clouds are gone
0.75 to 0.85	the white fades evenly away (about 16 frames at 60 fps, at the default Exit Time)
0.75 to 1	the picture unwinds, the speed falling to nothing by 0.9

The clouds are coloured by **Tint** and, in the Over, by your clip as well, as much as **Clip Through** says. The whirlpool pulls in picture from beyond the frame's edges, and there isn't any there, so in the Over the corners of a twisted clip are space: black, with stars.

The stars are the Wormhole's one cheat. A streak is drawn as a straight line between where the star was when the shutter opened and where it was when it closed, each end turned by the whirlpool. Where the whirlpool turns the two ends a long way apart, that straight line would cut across the frame nowhere near the star's real, curved path, so those stars fade out instead. It mostly happens fast and near the vanishing point, going in and coming out.



The Wormhole in SW Slip Over on the night-city card, at its defaults, rendered by `sliptest` rather than captured from Resolume. Top left, Journey 0.10, the city twisting into the whirlpool. Top right, 0.15, the mouth opening. Bottom left, 0.5, in transit, the clouds taking a quarter of their colour from

the city. Bottom right, 0.66, the light at the end of the tunnel growing. Each panel is a whole 1280 × 720 frame at half size.

Black Hole

A black hole that doesn't spin (a Schwarzschild black hole, for the physicists), done properly.

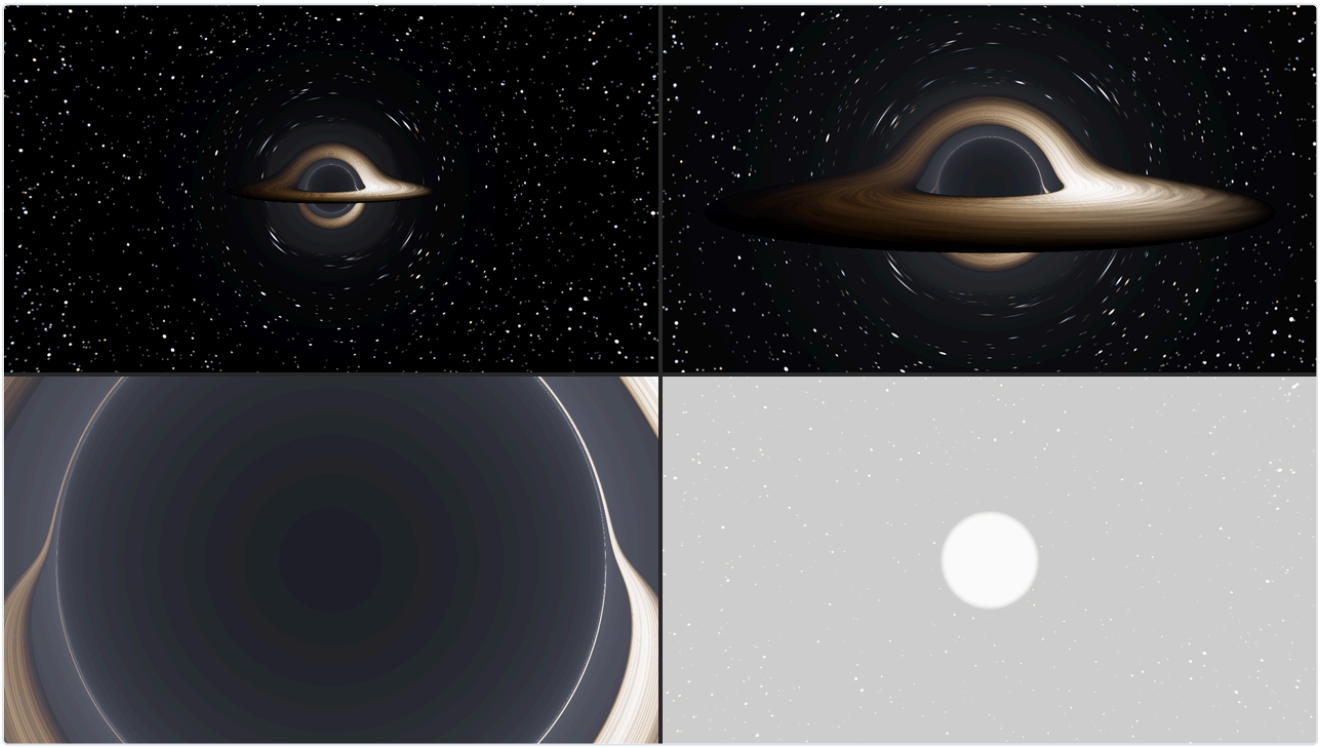
You can't see an event horizon. What you see is its **shadow**: the patch of sky where any light reaching you would have had to come out of the hole, so none does, about two and a half times the size of the horizon itself. Light from everything else is bent round the hole, so the sky behind it (stars in the source, your clip in the Over) is pulled into arcs, a point straight behind it becomes a ring, and every star appears twice. The camera holds still, and the sky is at infinity rather than the box of stars the other looks fly through, so Cruise Speed, Top Speed and Shutter make no difference here.

The **accretion disc** is a thin, hot disc of gas going round the hole, faster nearer in. Its far side is lensed up over the shadow and under it, which is why it looks like a hat brim bent round the hole. Its light is a blackbody seen through two shifts, the Doppler shift of gas moving towards you or away and the shift of light climbing out of the hole's gravity, so the side coming towards you is bluer and far brighter (eighteen times the brighter, in the harness's check). The makers of one well-known black hole film switched the Doppler part off for theirs (James, von Tunzelmann, Franklin and Thorne, Class. Quantum Grav. 32 (2015) 065001), and **Doppler** at 0 does the same.

The **corona** is a faint glow round the hole, added up along each bent ray. Rays that skim the hole wind round it, sometimes more than once, and pass through more of the glow than any others, so a thin bright ring appears on the shadow's edge with nothing drawing it: the **photon ring**.

The trip brings the hole in from a long way off, its disc fading up as it arrives. Leaving is the plunge: the shadow grows until it's the whole sky, the picture fades to black, and you come out of a white hole, a disc of light opening out of the vanishing point. The plunge past the photon sphere and the white hole are cheats. What's on the other side of a black hole is not, as far as anyone knows, your next clip.

Journey	what you see
0	normal space: the sky (or your clip, untouched), and no hole
0 to 0.5	the hole comes in from far away
0.15 to 0.45	the disc and the corona fade up
0.5	held, with the shadow at Hole Size
0.5 to 0.8	the plunge: the shadow grows to fill the frame
0.71 to 0.8	the picture fades to black
0.8	the white hole, and normal space



The Black Hole, SW Slipstream at its defaults, rendered by `sliptest` rather than captured from Resolume. Top left, Journey 0.40, on its way in. Top right, 0.5, held. Bottom left, 0.61, the plunge: the shadow nearly fills the frame, lit faintly by the corona in front of it. Bottom right, 0.82, the white hole opening. Each panel is a whole 1280 × 720 frame at half size.

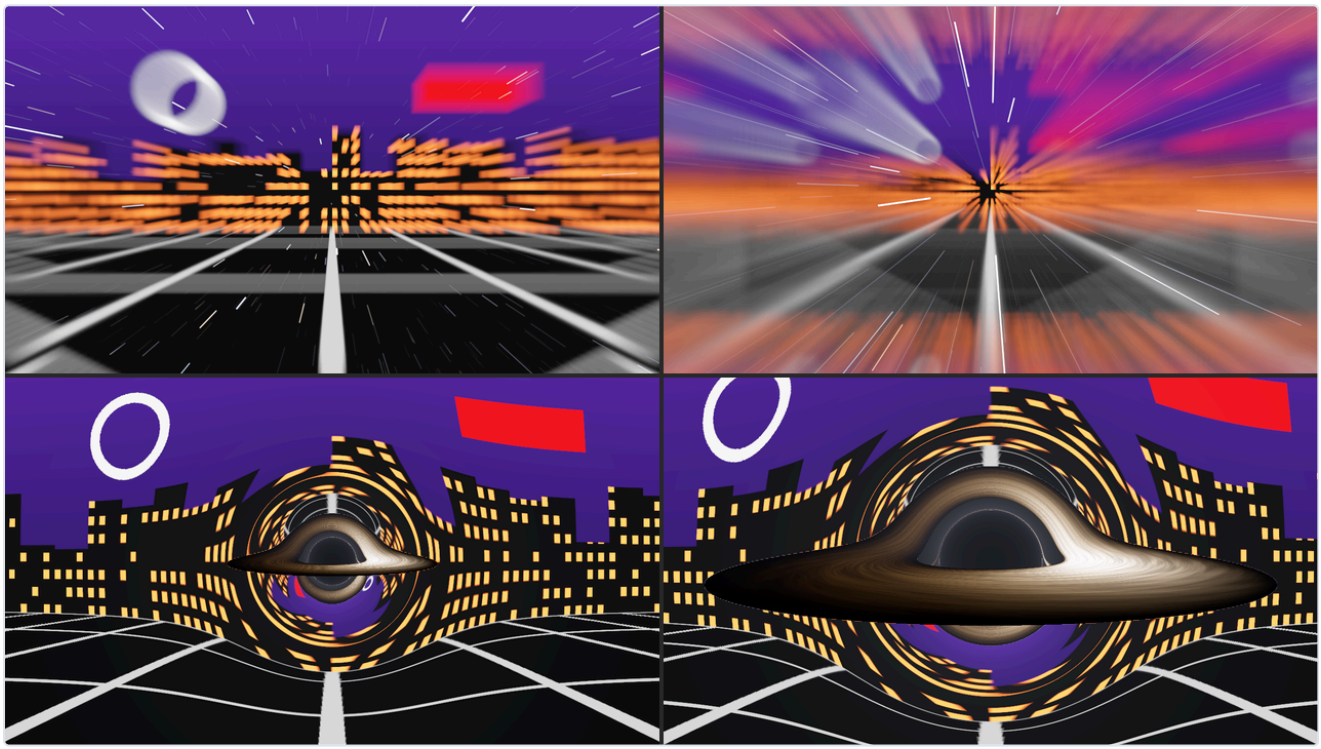
SW Slip Over: your clip is the view ahead

The Over runs the same trips with your clip as the view out of the window:

- **Hyperspace.** The clip is a picture riding ahead of the ship, **Clip Depth** away, and its light smears inward towards the vanishing point the way a star's does: a bright point becomes an evenly lit line, and the whole picture streaks into hyperspace with everything else. (The one

cheat is that it never gets any nearer, or it would fly past the camera and be gone. It cruises along with you, too, so Cruise Speed doesn't smear it; only a jump does.) Beyond the frame the picture carries on in mirror image, so the frame's own edges never get drawn into the streaks. As the tunnel comes up, the clip fades to **Clip Through**.

- **Warp.** The rubber band pulls your picture in, the snap shrinks it away into the vanishing point, and arriving bursts it back out. While it's gone, Clip Through's worth of it stands still behind the streaks.
- **Wormhole.** Your clip twists into the whirlpool and, inside the mouth, colours the clouds.
- **Black Hole.** Your clip is the sky. Wherever a bent ray lands inside the camera's own view you see the clip there, so it's pulled into arcs round the shadow and a ring of it forms round the hole; a ray bent so far that it comes from outside the view shows stars instead.



SW Slip Over on the night-city card at its defaults, rendered by `sliptest` rather than captured from Resolume. Top, Hyperspace at Journey 0.25 and 0.35, the clip's light smearing inward, more as the camera speeds up. Bottom, the Black Hole at 0.40 and held at 0.5, the city bent round the shadow. Each panel is a whole 1280 × 720 frame at half size.

In normal space the Over is your clip with the star field over it. With **Stars** at 0 it hands your clip back untouched, to the last bit of every pixel: the harness checks that in every look at the default Cruise Speed, and I checked it at the fastest Cruise Speed too. The Black Hole has no stars over the clip in normal space anyway. **Exposure** doesn't touch your clip: it's the light of the stars and everything else the plugin makes.

The Journey group

Resolume shows every slider as 0 to 1, except Stars, which is a whole number. The ranges below are what the slider positions mean.

Look (*Hyperspace*, *Warp*, *Wormhole*, *Black Hole*; default *Hyperspace*). Which trip.

Drive (*Hold*, *Trip*, *Loop*, *Fader*; default *Loop*). How the trip is driven; see *The trip*.

Engage (a switch, off by default). Under Hold: on goes in and stays, off comes out.

Jump (a button). Under Trip: one round trip, if you're in normal space when you press it.

Journey (0 to 1, default 0). Under Fader: where you are on the trip.

Entry Time, **Transit Time**, **Exit Time** and **Cruise Time** (0.2 to 20 seconds each; defaults 2, 3, 1.5 and 3 seconds). How long going in takes, how long Trip and Loop stay in transit, how long coming out takes, and how long Loop waits in normal space between trips. The sliders are geometric (each quarter of the way along multiplies the time by a little over three):

seconds	0.5	1	1.5	2	3	4	6	8	10	16	20
slider	0.199	0.349	0.4375	0.5	0.588	0.651	0.739	0.801	0.849	0.952	1

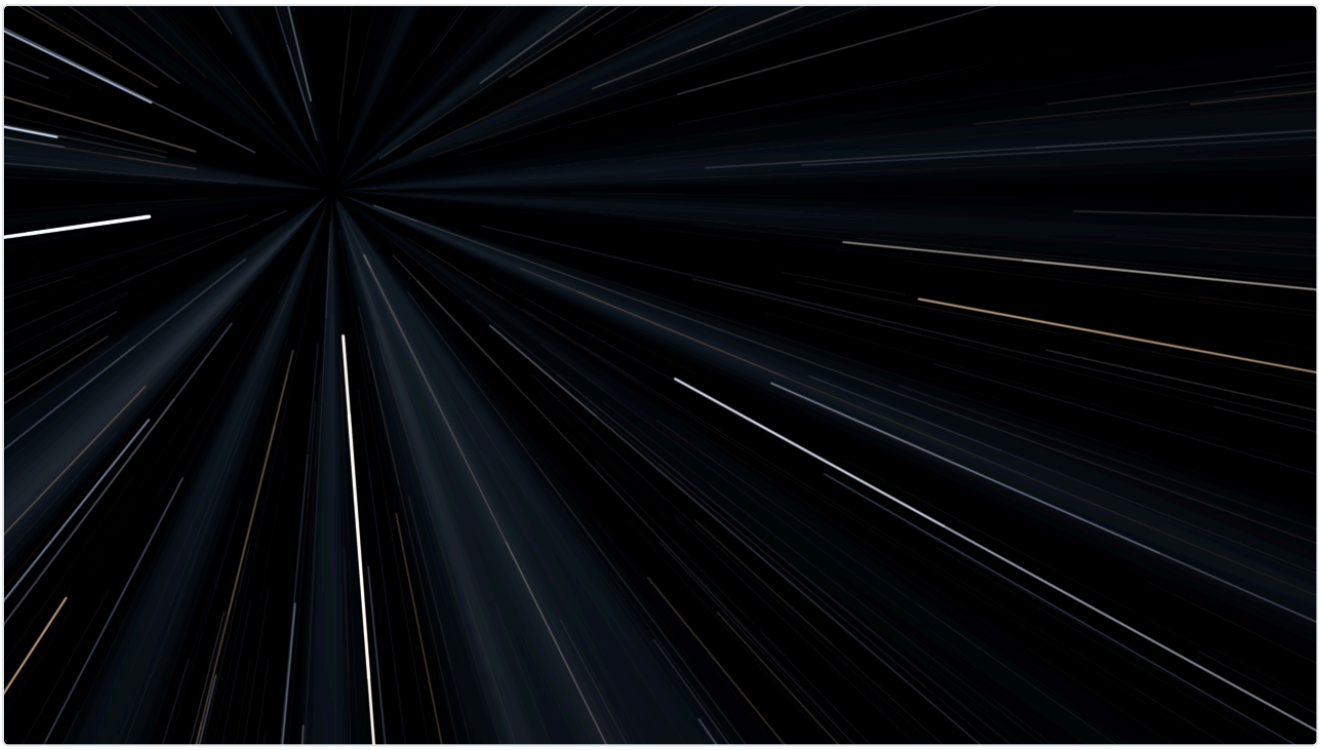
The scripts stretch to fit the times, so a longer Entry Time is the same entry, slower. The flashes keep their own fade times whatever the trip's.

The Flight group

Cruise Speed (0, then 0.005 to 2 field depths a second, geometrically; default 0.08, at 0.463). How fast the stars drift towards you in normal space. At the default the camera takes twelve and a half seconds to fly the depth of the box of stars. At 0 they stand still, and a jump still works, from rest. In transit it's added to the look's own speed.

Top Speed (a tenth to ten times the look's own transit speed, geometrically; default 1, at the middle). Hyperspace's transit is fast, Warp's under a quarter of that and the Wormhole's a sixth. Turn Warp's right up and it's faster than Hyperspace at its default, steady lines and all; turn Hyperspace's down and its lines break into separate streaks.

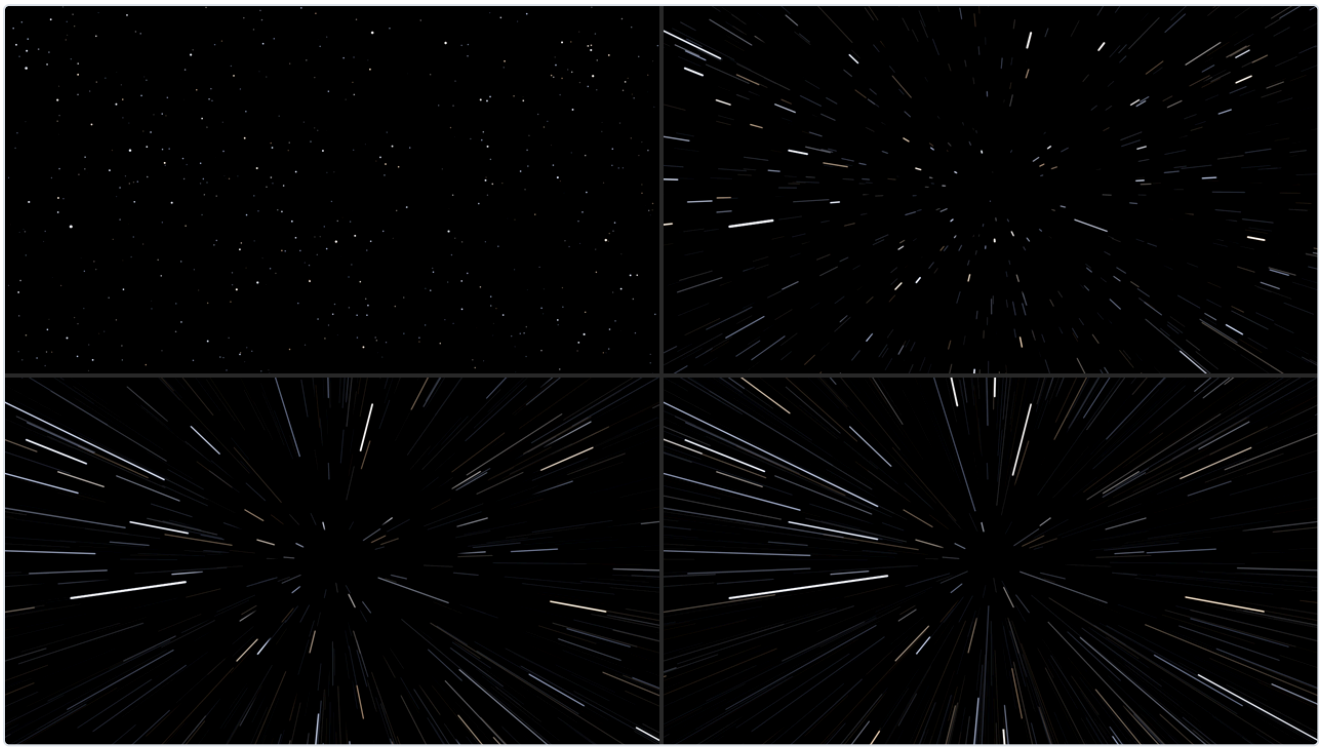
Heading X and **Heading Y** (0 to 1, default 0.5 each). Where the vanishing point is: 0 is the left (or bottom) edge of the frame, 1 the right (or top), 0.5 the middle. Everything follows it: the streaks, the flashes, the rubber band, the whirlpool, the tunnel and the black hole.



Hyperspace at Journey 0.40 with Heading X 0.25 and Heading Y 0.75. SW Slipstream, otherwise at its defaults, rendered by `sliptest` *rather than captured from Resolume.*

Field of View (20° to 120° from the top of the frame to the bottom; default 60°, at 0.4). The star field is built to fill whatever view you pick, but a wider view spreads the same stars further out, so it's dimmer: at rest, the average pixel at 120° is about 40% darker than at 20°. It also changes everything with a shape: the tunnel's and the clouds' perspective and, above all, the Black Hole. Hole Size is the shadow's share of the view, so a wider view keeps the shadow the same size on screen by putting the camera nearer the hole, and the disc and the bent sky round it fill much more of the frame. At wide views the black hole's sky is soft, each star spread over a bigger patch.

Shutter (0° to 360°; default 180°). How much of each frame the shutter is open for, as in a film camera. Longer streaks, same light: a star lays the same light along a longer line, because the exposure follows the shutter the way a camera on auto exposure would. At 0° there are no streaks at all, even at full speed, only points jumping about from frame to frame. The shutter is a share of each frame, so at 30 fps every streak is twice as long as at 60. The trip itself is timed in seconds and doesn't change with the frame rate.



Hyperspace at Journey 0.30, SW Slipstream otherwise at its defaults, rendered by `sliptest` rather than captured from Resolume. Top left 0°, top right 45°, bottom left 180° (the default), bottom right 360°. Each panel is a whole 1280 × 720 frame at half size.

Cruise Speed, Top Speed and Shutter do nothing in the Black Hole, whose camera never moves.

The Light group

Stars (0 to 20,000, a whole number; default 4,000). How many stars are in the box, and in the Black Hole how densely the sky is filled. A few are blinding and most are faint, as in the real sky. At 0 Hyperspace is only the tunnel, and the Black Hole only the shadow, the disc and the corona.

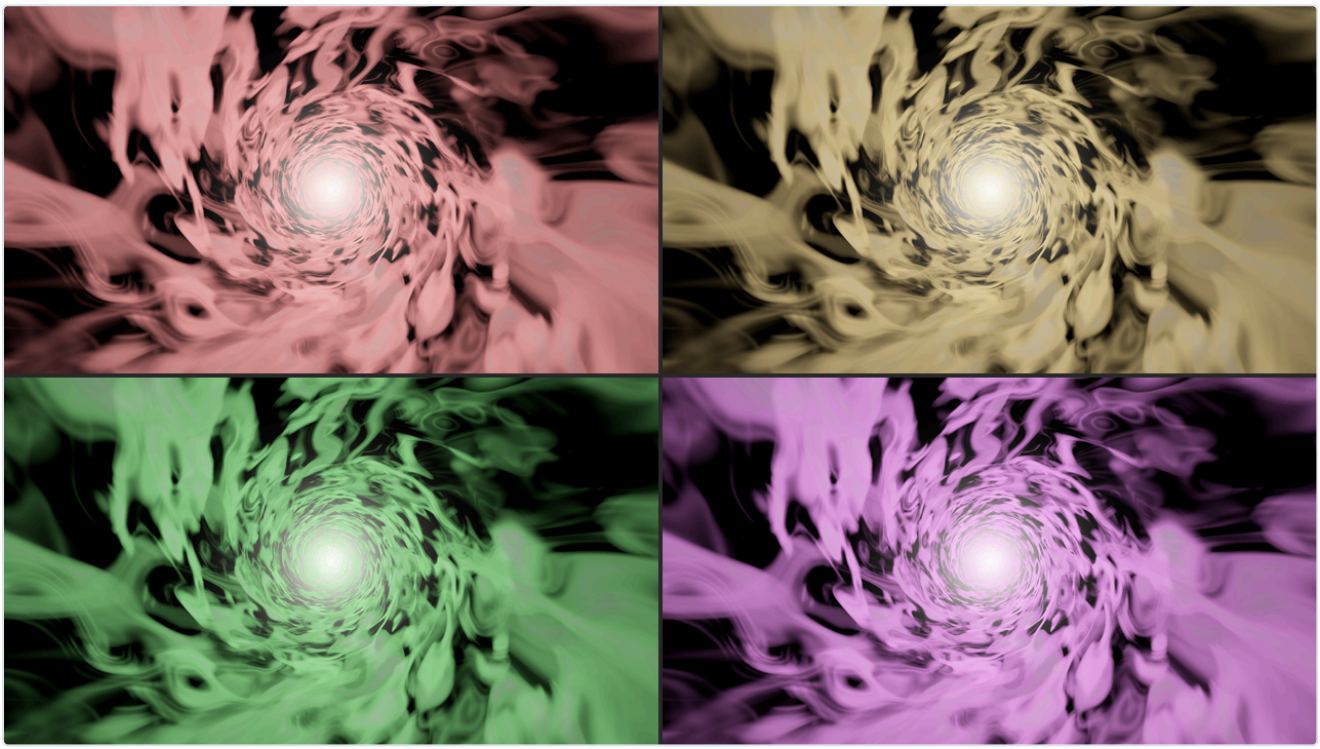
Star Colour (0 to 1, default 0.6). 0 is every star white; 1 is each star its own blackbody colour, from orange at 3,000 K to blue-white at 30,000 K. It's subtle, since the bright stars burn out white in the middle anyway, and shows mostly in the fringes and the faint streaks.

Exposure (−4 to +4 stops; default 0, at the middle). The light of the stars, the sky, the tunnel, the clouds, the disc, the corona and the Wormhole's white-out; each stop doubles it. More exposure doesn't lengthen the streaks, it brings up more of the faint ones and burns more of the bright ones out white. It doesn't touch your clip in the Over, or the flashes.

Flash (0 to 1, default 0.7). How bright the flashes are. Hyperspace has a blue-white wash over the frame, brightest at the vanishing point, going in and again dropping out; Warp a core, ring and horizontal streak at the snap and on arrival; the Wormhole a white flash of the whole frame at the end; the Black Hole the white hole. At 0 there are none, and the Black Hole's plunge ends in a cut

from black to the stars. The Wormhole's white-out isn't a flash, so it's still there at 0, fading away as it always does. See *Flashes*.

Tint (0 to 1, default 0.6). A pale colour round the hue wheel: red at 0, gold at 0.1, green at a third, cyan at a half, blue at the default, violet past three quarters and red again at 1. It colours the Hyperspace tunnel, the Wormhole's clouds and a third of the Warp flash.



The Wormhole in transit at Tint 0, 0.1, 0.33 and 0.83, SW Slipstream otherwise at its defaults, rendered by `sliptest` *rather than captured from Resolume. Each panel is a whole 1280 × 720 frame at half size.*

The look groups

Each look has a group of its own. They're all there whichever Look is chosen, and each only does anything in its own look.

Hyperspace

Tunnel (0 to 1, default 0.6). How bright the tunnel is. At 0 there's no tunnel, only the lines. It's only ever there around transit, from Journey 0.375 to 0.575.

Warp

Stretch (0 to 1, default 0.75). How hard the rubber band pulls. At 0 there's no rubber band, and the snap comes out of an undisturbed picture; at 1 the middle of the picture is pulled nearly all the way in before it snaps. It also sets how far the middle bulges out as the picture settles on arrival.

Dispersion (0 to 1, default 0.4). The warp streaks' colour split: each streak's blue runs further out than its red, so the outer end goes from white through cyan to blue. At 0 each streak is one colour.

Wormhole

Swirl (0 to 6 turns at the middle; default 3, at 0.5). How hard the picture twists into the whirlpool going in and unwinds coming out, strongest at the vanishing point and dying away outwards, and how fast the clouds spin in transit. At 0 the picture doesn't twist, the mouth opens straight out of it, and the clouds have no spin of their own, only rushing past.

Clouds (0 to 1, default 0.75). How thick the cloud is. Thinner cloud shows more of the dark between the layers; at 0 there's only the glow at the far end, on black.

Black Hole

Hole Size (0.05 to 0.9 of half the view, measured as an angle; default 0.3 on the slider). How big the shadow is when the hole is held: at the default 60° view, the default is a shadow about 200 pixels across at 720p. A bigger shadow is a hole seen from nearer, so the disc and the bending round it grow faster than the shadow does; at 0.7 the disc runs off the bottom of the frame.

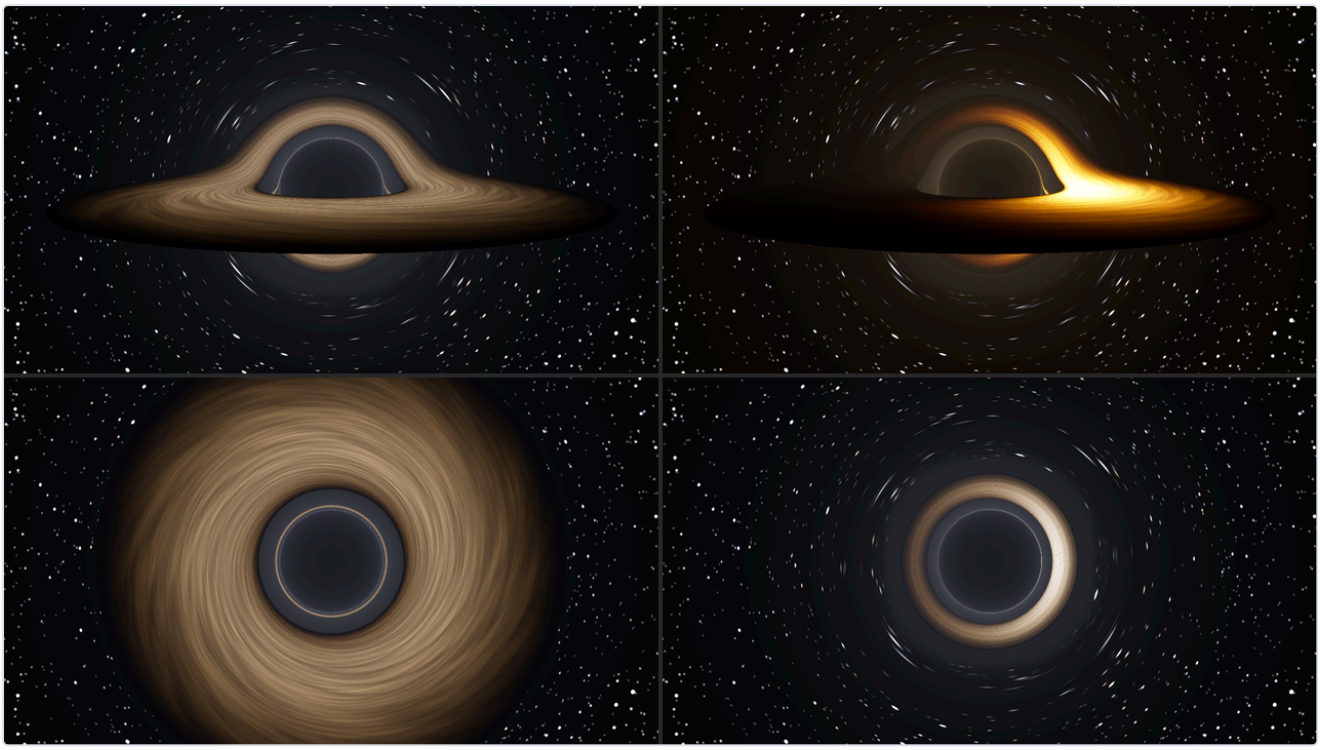
Disc (0 to 1, default 0.8). How bright the accretion disc is. At 0 there's no disc, which shows the shadow, the corona and the bent sky on their own.

Disc Tilt (0° face on to 90° edge on; default about 84°, at 0.93). At 0 you look down on the disc, a wide ring round the shadow. Towards 90° it closes to the brim across the middle, its far side bent up over the shadow and under it. At 90° the disc itself is a line too thin to see, and what's left is its far side's lensed image, a ring round the shadow.

Disc Size (0 to 1, default 0.4). How far out the disc reaches, from a narrow ring hugging the hole (its outer edge a third further out than its inner one) to a disc whose outer edge is nearly seven times as far out as its inner one. The inner edge never moves: nothing can orbit closer than that.

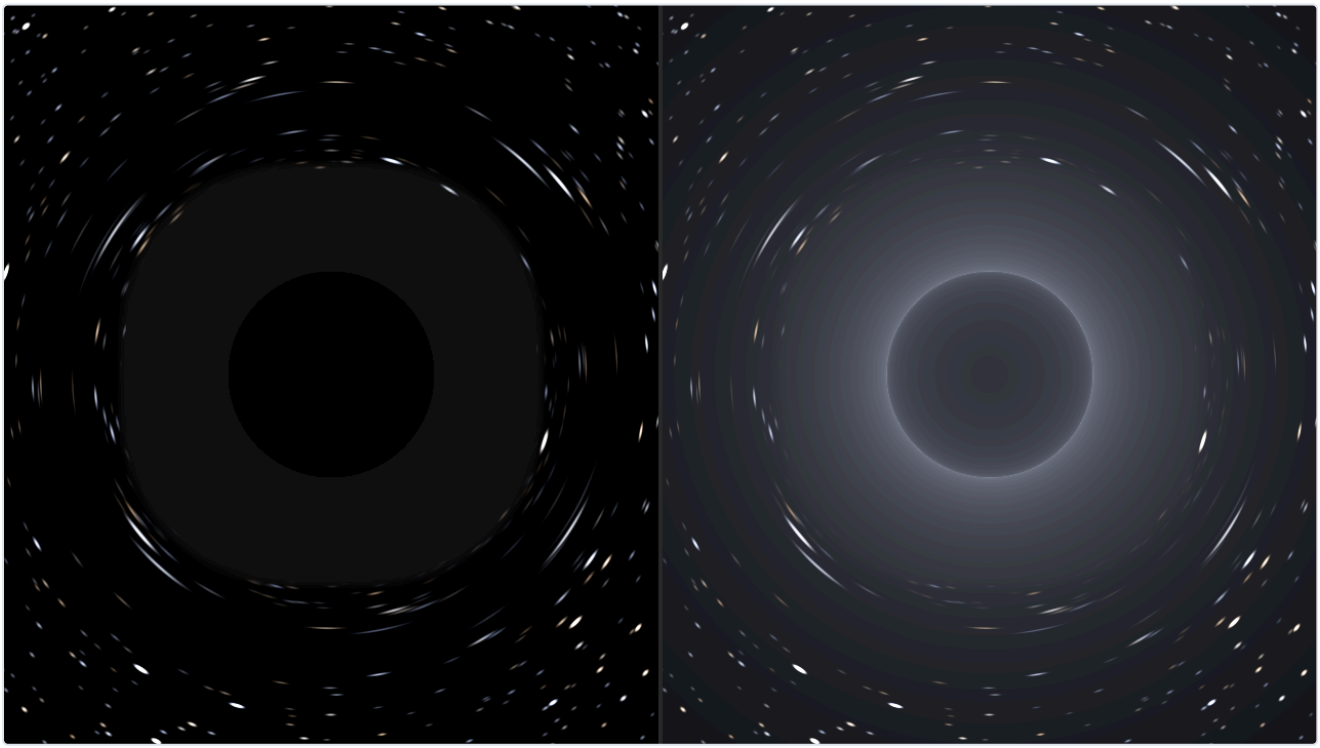
Disc Heat (2,000 K to 40,000 K at its hottest, geometrically; default 4,500 K, at 0.27). The disc's colour: orange at the bottom, pale gold at the default, white at the middle (about 9,000 K), blue-white at the top. The hotter it is, the less lopsided it looks, because a very hot thing's light changes less with the Doppler shift.

Doppler (0 to 1, default 1). How much of the Doppler shift the disc gets. At 1 the side coming towards you, the right-hand side at the defaults, is bluer and many times the brighter. At 0 the disc is mirror-symmetric, which the harness checks to the last bit.



The Black Hole held (Journey 0.5), SW Slipstream otherwise at its defaults, rendered by `sliptest` *rather than captured from Resolume. Top left, Doppler 0. Top right, Disc Heat 0 (2,000 K): orange, and far more lopsided. Bottom left, Disc Tilt 0, face on. Bottom right, Disc Tilt 1, edge on. Each panel is a whole 1280 × 720 frame at half size.*

Corona (0 to 1, default 0.35). How bright the glow round the hole is. The glow is in front of the horizon as well as round it, so it lights the inside of the shadow faintly too; at 0 the shadow is black. Turn it up with Disc at 0 to see the photon ring on its own.

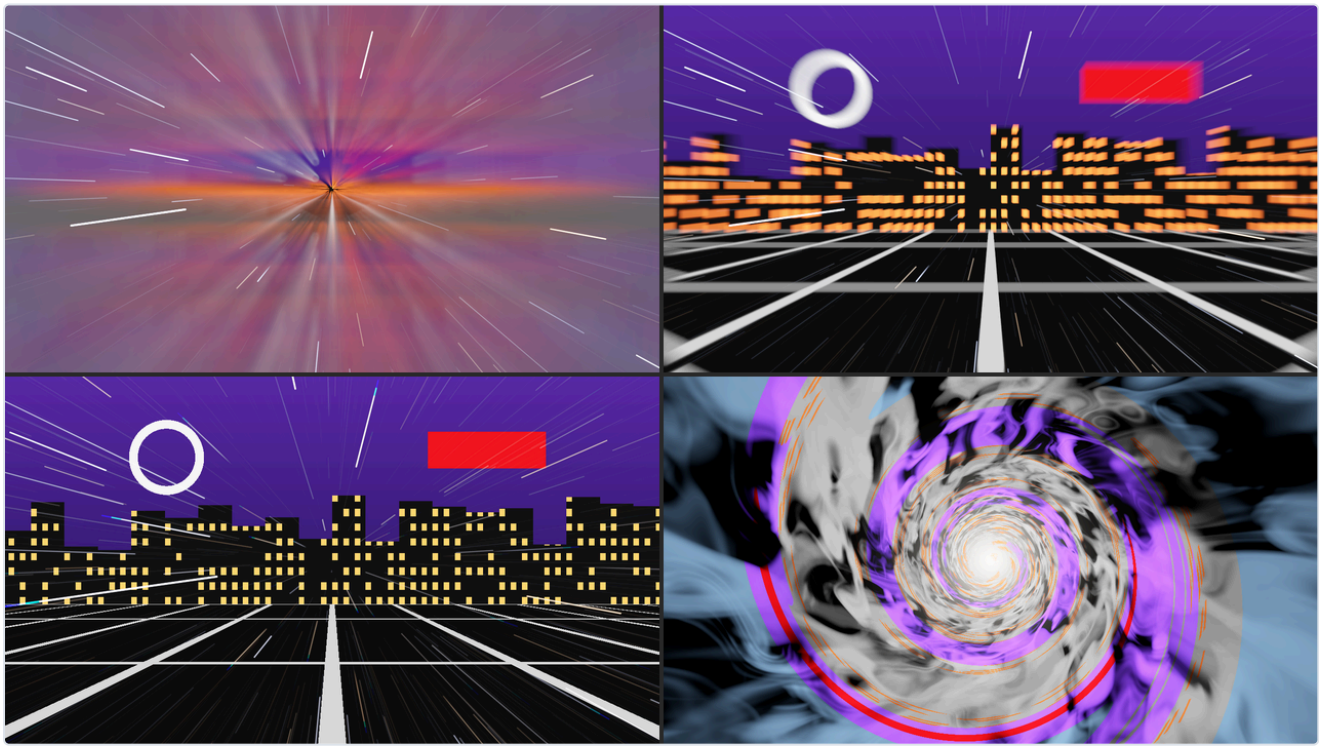


The Black Hole held with Disc 0: left Corona 0, right Corona 1. SW Slipstream otherwise at its defaults, rendered by `sliptest` rather than captured from Resolume; each panel is the middle 638 × 720 of a 1280 × 720 frame. On the left, the sky round the shadow is bent too hard for single stars to be drawn, so it's drawn as its average light: the flat grey ring. On the right, the corona, brightest in the photon ring on the shadow's edge.

The Clip group (SW Slip Over only)

Clip Depth (0.02 to 2 field depths ahead, geometrically; default 0.3, at 0.588). How far ahead of the camera your clip rides in Hyperspace, the only look it affects. Nearer smears more: at 0 the clip smears into radial bands of its own colours as soon as you move; at 1 it hardly smears until you're nearly at full speed.

Clip Through (0 to 1, default 0.25). How much of your clip you can still see in transit: in Hyperspace, how far its smear fades as the tunnel comes up; in Warp, how much of it stays behind the streaks while the picture has gone into the vanishing point; in the Wormhole, how much of its colour goes into the clouds. At 0 transit is all stars, tunnel or cloud; at 1 your clip carries on at full strength. It does nothing in the Black Hole, where your clip is the sky the whole way.



SW Slip Over on the night-city card, otherwise at its defaults, rendered by `sliptest` rather than captured from Resolume. Top, Hyperspace at Journey 0.30 with Clip Depth 0 (left) and 1 (right). Bottom, Warp and the Wormhole in transit with Clip Through 1. Each panel is a whole 1280 × 720 frame at half size.

Mix (0 to 1, default 1). The whole effect against your clip. At 1 the output is opaque whatever your clip's alpha; at 0 your clip comes back untouched, alpha and all.

Flashes

Every look has a moment where most of the frame changes brightness at once, and on a big LED wall that's a lot of light. Measured through the offline harness (320 × 180, 60 fps, one trip at the defaults under Loop) as the whole frame's average light, 0 for black and 1 for white:

look	brightest frame	biggest change between two frames	with Flash at 0
Hyperspace	0.40	0.30, at the drop-out flash	brightest 0.12, biggest change 0.02
Warp	0.15	0.10, at the snap	brightest 0.07, biggest change 0.02
Wormhole	1.00, over half-white for 0.9 s	0.13, as the white-out grows	brightest 1.00, biggest change 0.13, over half-white for 0.37 s
Black Hole	0.95	0.67, black to the white hole	brightest 0.27, biggest change 0.08

They come once or twice a trip, so they're flashes rather than a flicker, but the white hole goes from black to most of the way to white in one frame, and the Wormhole fills the whole frame with white for a moment whatever Flash says.

- **Flash** at 0 takes the flashes out of all four looks.
- **The Wormhole's white-out isn't a flash**, so Flash doesn't remove it. At Flash 0 it rises to white over about seven frames, holds for nine and fades over sixteen, with no cut. **Exposure** dims it: at −4 stops with Flash at 0, its brightest frame measured 0.41 rather than 1.00. Or turn the layer down in Resolume, or use another look.

None of this was measured inside Resolume or on any output but the harness's. Check before it goes to a broadcast feed or a big screen in front of an audience.

The source is transparent where space is empty

SW Slipstream's output is premultiplied: empty space is transparent, and a star, a streak or the tunnel is as opaque as it is bright, so the layer goes over whatever is below it. The black hole's shadow and disc are opaque, and so is the plunge's fade to black, which blacks out the layers under it too. Use it on Add or Screen for stars over a picture.

Recipes

A jump on cue. Drive *Trip*, and map **Jump** to a MIDI note or a button: each press is one round trip. For a jump that hangs in transit until you say so, use *Hold* and map **Engage**: on to go, off to come back.

Bars, not seconds. There's no beat sync, but you can set the times to bars. A bar of four is 240 ÷ BPM seconds, two at 120 BPM: Entry 0.5 (2 s, one bar), Transit 0.801 (8 s, four bars), Exit 0.5 (one bar) and Cruise 0.651 (4 s, two bars) make an eight-bar loop. Three decimal places only get within a few thousandths of a second of 4 and 8, so it runs about 8 ms a cycle long: in the harness, ten times round, it was less than a tenth of a second behind the bar. It isn't locked to Resolume's tempo, Loop counts from the plugin's first frame, and I haven't tried what a retriggered clip does to it in Resolume.

Scrubbing it by hand. Drive *Fader*, and put **Journey** on a fader. The tables under each look say where everything is. A ramp on Journey can loop: at the wrap from 1 back to 0 it carries straight on into the next trip, so a looping 0-to-1 ramp is a Loop that goes at the ramp's pace, with no time in normal space between trips.

A hyperspace jump out of your own picture. SW Slip Over on the clip, Look *Hyperspace*, Drive *Trip*, Clip Depth 0.4 for a smear that eats the picture properly, Clip Through 0 so transit is all stars and tunnel, and Tunnel 0.8. On the way out the clip comes back out of the lines.

Warp to the next clip. SW Slip Over on the layer rather than the clip, so it stays put when the clip changes. Look *Warp*, Drive *Trip*, Clip Through 0. Press Jump and switch clips while you're at warp: at the default times, anywhere from about a second and a half after the press, once the snap has taken the old clip away, to about five seconds after, when you arrive. The new clip bursts out of the vanishing point. (That's what the harness did with the picture under the effect changed halfway through transit. I haven't tried it in Resolume.)

A slow approach. The Black Hole with Drive *Hold*, Entry Time 0.849 (10 s), Hole Size 0.45 and Disc Tilt 0.9. Engage, and the hole comes in over ten seconds and stays. Doppler 0 and Disc Heat 0.4 (about 6,600 K) for the even, pale disc the film went for, and Field of View 0.6 (80°) to make it loom over the bottom of the frame. Switch Engage off for the plunge.

Stars for a backdrop. SW Slipstream with Drive *Hold* and Engage off stays in normal space: a slow star field. Cruise Speed 0.6 (about 0.18 field depths a second), Shutter 1 (360°) so the nearest stars draw short trails, and Stars 8,000. Heading Y 0.6 lifts the vanishing point above the horizon of whatever's on the layer below.

Time comes from the host

The trip, the camera, the whirlpool and the disc all run on Resolume's clock. Each frame they move on by the host's time since the last, so when the host's clock stops, everything stops, and a jump in the clock, backwards or more than a second forwards, passes no time. For the first few frames

after it loads, while it works out whether the host counts in seconds or milliseconds (Resolume has been seen to send both), the plugin runs on a steady clock of its own. Time is kept in double precision, because Resolume's clock grows to hundreds of millions of milliseconds, where a float can't tell one frame from the next; the harness checks every frame's step at 499,000 seconds in. Changing the composition's size mid-trip carries on where it was.

How it works

Every host frame:

1. **The trip**, on the CPU: where Journey is at the start and end of the frame, and the look's script at both, so anything that moves during the frame (the rubber band, the snap, the whirlpool) is blurred by the shutter along with the stars.
2. **The camera**, on the CPU: how far it flew while the shutter was open.
3. **The flash**, if the trip passed one of the look's flash points, averaged over the open shutter.
4. **The stars**, on the GPU: one quad per star, covering its streak, and the streak's light worked out in closed form, its blur and its two ends included, whether it's a point or half the frame long. Where a long shutter sees the same star more than once, each pass is counted.
5. **The scene**, on the GPU: the clip's smear, the rubber band, the whirlpool and the clouds, or the black hole, where each pixel's ray is followed round the hole using a table of light paths worked out once when the plugin loads.
6. **Development**, as film: everything so far is exposure, turned into a picture at the end, with the flash and the plunge's blackout on top, then Mix in the Over.

Performance

Measured by the offline harness (`sliptest --bench`) on an Apple M4 Max, the median frame timed with `glFinish` both sides:

plugin	moment	720p	1080p	4K
SW Slipstream	Hyperspace, normal space	0.34 ms	0.58 ms	1.93 ms
SW Slipstream	Hyperspace, in transit	0.56 ms	1.05 ms	3.53 ms
SW Slip Over	Hyperspace, jumping	0.71 ms	1.26 ms	4.51 ms
SW Slip Over	Warp, the rubber band	0.63 ms	1.02 ms	3.64 ms
SW Slipstream	Wormhole, in transit	1.46 ms	2.93 ms	10.85 ms
SW Slip Over	Black Hole, held	0.79 ms	1.50 ms	5.12 ms

Wormhole aside, that's under a tenth of a 60 fps frame at 720p and 1080p, and up to about a third at 4K. The Wormhole's clouds are three layers of noise bent through more noise at every pixel, which costs about two thirds of a 60 fps frame at 4K. These are the README's figures, measured on a quiet machine just before the last fixes went in; timed back to back with the build before them on a busy machine, the released build came out within a quarter either way in every row, with no pattern. Nothing was timed inside Resolume, and nothing was timed on Windows.

If it looks wrong

The Wormhole's clouds flicker at the edges of the frame in transit. Out there the clouds are close and rush past faster than any shutter can blur, so one frame's clouds look little like the next's. It's a known limit of this release. Top Speed at 0 (a tenth of the default) steadies them.

Fine rings and spokes at the vanishing point in Hyperspace. The tunnel's pattern aliases there with Tunnel up and a short Shutter or a low Top Speed. Open the Shutter, turn Top Speed up, or turn Tunnel down.

Stars vanish as they swirl in the Wormhole. That's the Wormhole's cheat with the stars: a streak the whirlpool would bend too far to draw straight fades out instead.

A flash and a frame of streaks out of nowhere, under Fader. Journey jumped by a big step in one frame, so that whole stretch of the trip, flashes and all, went by in one frame. A jump forwards is always taken literally, so 0.1 to 0.9 flies the entry, transit and the drop-out in a frame. A jump back of up to half a trip runs backwards; one further back than that goes on round instead, so 0.9 to 0.1 is a short step forwards through normal space and shows nothing. Move it more slowly, or let a ramp do it.

It never goes anywhere. Drive is *Hold* with Engage off, *Trip* waiting for Jump (which is ignored during a trip), or *Fader* with Journey at 0.

The streaks are dots. Shutter is at or near 0°.

Hyperspace's lines have gaps in them. Top Speed is below about 0.41. Turn it up, or open the Shutter.

The Over's clip is covered in stars. That's the star field in front of it. Stars 0 for your clip on its own in normal space.

The shadow isn't black. That's the corona in front of it. Corona 0 makes it black.

The disc runs off the frame. Hole Size or Field of View is up, which puts the camera nearer the hole. Turn one of them, or Disc Size, down.

Neither plugin is in the browser. Check the folder under *Installing*, and that Resolume was restarted.

It does nothing at all. That's what a shader that won't compile looks like. The error is in the log:

```
macOS    ~/Library/Logs/slipstream/slipstream.YYYY-MM-DD.log
Windows  %LOCALAPPDATA%\slipstream\logs\slipstream.YYYY-MM-DD.log
```

It records the GL vendor, renderer and version at load, which shader failed if one did, and whether the buffers couldn't be allocated.

Known limits

- **Never loaded into Resolume on macOS**, only into `oxbow`. For Windows, see the box at the top.
- **On a Mac, only ever run on an Apple M4 Max** and Apple's software renderer, although the macOS build has an Intel slice.
- **The Wormhole's clouds flicker at the frame's edges in transit** at the default Top Speed, where they run past faster than the shutter blurs. A tenth of the speed (Top Speed 0) steadies them.
- **The Hyperspace tunnel aliases** into fine rings and spokes at the vanishing point with Tunnel up and a short Shutter or a low Top Speed.
- **The Wormhole's stars fade** where the whirlpool would bend a streak too far to draw straight: the one cheat with its stars.
- **The black hole doesn't spin.** A spinning one has a lopsided shadow and drags space round with it, which needs a much bigger table of light paths. The disc spins; the hole doesn't.
- **The plunge and the white hole are cheats.** The camera stops just outside the photon sphere, where the shadow already covers half the sky, and everything after that is a fade to black and a flash.
- **Hyperspace never brings your clip any nearer**: the one cheat in the smear.
- **The black hole's sky** is built on a grid wrapped round a cube. Stars on the seams between its faces are drawn whole, but that was checked by eye on a render at 120°, and nothing measures it.
- **No beat sync and no audio input.** Map Jump or Engage to a cue, or set the times in bars.
- **The looks were judged by eye** on the harness's renders, and the only clip they've been measured on is the harness's test card.
- **No presets and no OpenFX version.**

About

The last group, **About**, has the plugins' name, version, licence and maker, and buttons that open this guide, the project page, the source on GitHub and the support page in your browser.

Links

- Project page: stoatworks-labs.com/software/slipstream
- Source: github.com/stoatworks-labs/slipstream
- User guide: stoatworks-labs.com/software/slipstream/guide

Reporting something

If something's wrong, shout at github.com/stoatworks-labs/slipstream/issues. A screenshot, the Look, the Drive, where Journey was, any other controls you moved, and the composition's resolution and frame rate are usually enough. If the plugin did nothing, attach the log.

The black hole follows Schwarzschild (1916) and Synge (1966), and the disc Shakura and Sunyaev (1973); the full list of the work it stands on is in ATTRIBUTIONS.md.