CODEX

2018 - ISSUE 10

4K PRODUCTION CASE STUDIES | DP INTERVIEWS | DIT STORIES

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ISSUE 10

BLACK PANTHER

WHO TO BLAME

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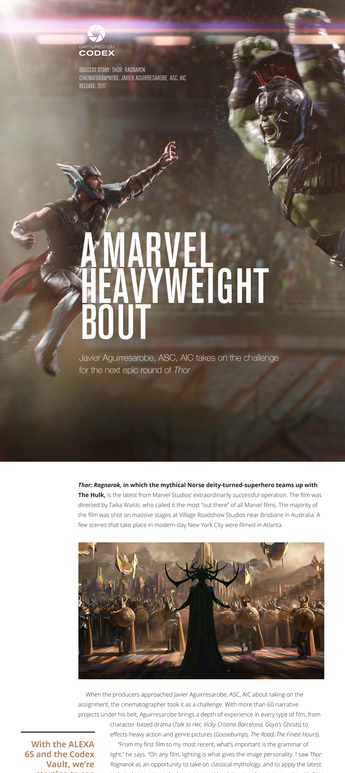
THE RITUAL

THOR: RAGNAROK

CODEX

SUCCESS STORY: THOR: RAGNAROK
CINEMATOGRAPHERS: JAVIER AGUIRRESAROBE, ASC, AIC
RELEASED: 2017



A MARVEL HEAVYWEIGHT BOUT

Javier Aguirresarobe, ASC, AIC takes on the challenge for the next epic round of *Thor*

***Thor: Ragnarok*, in which the mythical Norse deity-turned-superhero teams up with The Hulk,** is the latest from Marvel Studios' extraordinarily successful operation. The film was directed by Taika Waititi, who called it the most "out there" of all Marvel films. The majority of the film was shot on massive stages at Village Roadshow Studios near Brisbane in Australia. A few scenes that take place in modern-day New York City were filmed in Atlanta.

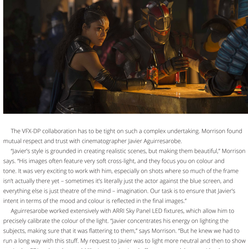
When the producers approached Javier Aguirresarobe, ASC, AIC about taking on the assignment, the cinematographer took it as a challenge. With more than 60 narrative projects under his belt, Aguirresarobe brings a depth of experience in every type of film, from character-based dramas (*Talk to Her*, *Vicky Cristina Barcelona*, *Goya's Ghosts*) to effects-heavy action and genre pictures (*Goosebumps*, *The Road*, *The Finest Hours*).

"From my first film to my most recent, what's important is the grammar of light," he says. "On any film, lighting is what gives the image personality. I saw *Thor: Ragnarok* as an opportunity to take on classical mythology, and to apply the latest technical innovations. And on a personal level, it was a chance to reunite with Cate Blanchett, with whom it was fantastic to work on *Blue Jasmine*."

In collaboration with Marvel, Aguirresarobe shot tests in London that led to the choice of ARRI ALEXA 65 and a blend of ARRI Prime 65 and Vintage 765 lenses. He also made extensive use of the latest in LED fixtures, which facilitated his precise and imaginative approach to color and on the project, and was inspired by the work of artist James Turrell, whose métier often immerses the viewer in light and space.

> **With the ALEXA 65 and the Codex Vault, we're starting to see more defined roles. Production is more streamlined**
> Javier Aguirresarobe, ASC, AIC

"We were able to control color to an extent previously unattainable," says the cinematographer. "LED lighting, the ALEXA 65 camera, and post-production meant that everything was possible. With its uncompressed-RAW capture, the camera is able to acquire a tremendous range of color with consistency and accuracy. With other digital cameras, I might call for some slight diffusion, but here I got fantastic faces and never missed the filtration. Sometimes when the image is technically perfect, it can be boring. Instead, this combination gave the picture a natural sweetness and smoothness."



Aguirresarobe says that the look was similar in spirit to the previous films, but not slavishly so. Key to his approach was the careful choice of colour. To communicate his intentions to the team, he sent a collection of carefully coloured images. Digital Imaging Technician Peter Harrow was crucial to successfully achieving the DP's intent for the project.

"Javier knows exactly what he wants," says Harrow. "It's very easy to work with someone who already has such a vision. Ultimately, it becomes a matter of making sure that vision happens."

Harrow's previous experience includes work in dailies and in final colour correction, valuable knowledge in his current role. "I've seen the way dailies used to work, where you see a couple of images from the DP and try to match them. Now I treat everything shot-by-shot before it passes to dailies colour. The DIT and the DP really work together in making new looks. We've certainly gone through a number of iterations. With the ALEXA 65 and the Codex Vault, we're starting to see more defined roles. Production is more streamlined. The DIT makes sure that the right tint is being realised right away, on the set, and the dailies colourist can look after colour and communicate with editorial and visual effects."

Images from the ALEXA 65 are recorded with the integral Codex Recorder and processed using the Codex Vault Lab 65 to maintain every bit of the richness in each frame. Harrow worked with Pomfort LiveGrade software and an ACES pipeline, subtly tweaking colours and contrast. Aguirresarobe values accuracy and intention in the initial image capture and on-set viewing, especially important given the more than 2500 visual effect shots the project eventually required.

> **I just can't wrap my head around how Marc Dando and his gang at SHED actually do it**
> Javier Aguirresarobe, ASC, AIC

With the consultation of dailies producer Stephen Ceci, SHED sent a Codex Vault to the near-set to handle the Capture Drives and backups. Especially during the first week or two of the shoot, Aguirresarobe would sit with dailies colourist Fergus Hally and make sure things were on track.

"The SHED people were very easy to work with," says Harrow. "They are moving from strength to strength, and we had a great working relationship in which we talked about how things might change going forward."

Visual Effects Supervisor Jake Morrison agrees: "SHED makes it a seamless process for us," he says. "They are a highly technical bunch, and they understand how we work. It's a very complicated process that requires everyone to get it right. The SHED process is extremely strong, and it's helped by the fact that they are fun, collaborative and smart people to work with."

Visual effects mostly fell into two categories – creature creation and backgrounds.

"If there's an opportunity to get scope and scale in any given shot, the production will always request it," says Morrison. "Even if the production has built a perfectly functional set that looks great, we'll punch holes in it, and put the rest of the world in."

The VFX-DP collaboration has to be tight on such a complex undertaking. Morrison found mutual respect and trust with cinematographer Javier Aguirresarobe.

"Javier's style is grounded in creating realistic scenes, but making them beautiful," Morrison says; "his images often feature very soft cross-light, and they focus you on colour and tone. It was very exciting to work with him, especially on shots where so much of the frame isn't actually there yet – sometimes it's literally just the actor against the blue screen, and everything else is just theatre of the mind – imagination. Our task is to ensure that Javier's intent in terms of the mood and colour is reflected in the final images."

Aguirresarobe worked extensively with ARRI Sky Panel LED fixtures, which allow him to precisely calibrate the colour of the light. "Javier concentrates his energy on lighting the subjects, making sure that it was flattering to them," says Morrison. "But he knew we had to run a long way with this stuff. My request to Javier was to light more neutral and then to show me in the CDLs where he would like it to go. In visual effects, we work better with a larger range and a more natural negative. Often the elements that we shoot are 100% neutral. Once we have everything holding together and looking like a finished photographic image, at that point we can apply an overall cooler colour cast, for example."

That approach puts extra importance on the on-set colour, which communicates the DP's intent without affecting the raw image file. Morrison adds stills to a colour bible that he uses to ensure that everyone stays on the same page. It's essential information for the dailies team at SHED.

From Morrison's perspective, the ALEXA 65 and the 6.5K image it captures is a game-changer. "Until they come up with something better, I'll be requesting this camera for the rest of my days," he says. "In the Marvel Universe, there's always an element of restlessness – a sense that if there's a better way, we should find it. They keep pushing it forward and making it better. We can't pass up any opportunity to make it better."

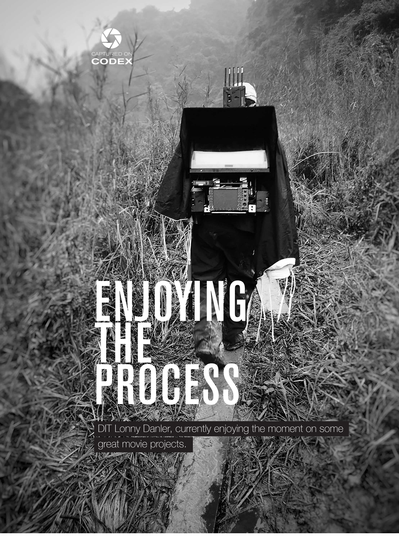
Marvel specifies clear preferences regarding the workflow of its projects. But the creatives generally don't mind, because the standards of practices and equipment that Marvel chooses are the best. The ALEXA 65-Codex Vault 65 is part of this solid, proven pipeline, which brings advantages in every aspect of production and post.

"So much of a movie like this comes together in post," says Morrison. "Because Javier shot at a 5.6 or an 8, the depth of field was deep. Because you have the 6K latitude, and everything is beautifully lit, you can create a beautiful close-up or medium shot if need be. That flexibility means that the ALEXA 65 has huge appeal for the director. It also gives you flexibility on the set, with the number of setups you need. It's a powerful creative tool."

Efforts in dailies colour are less about bringing things in line, and more about nuance and creativity, according to Morrison. Everyone who works on the film down the line sees images that at least approximate the final look, which also has far-reaching benefits. SHED ensures that the entire process is smooth, in spite of the technical challenges.

"It all comes back to trust, and to the desire to maintain quality every single step of the way," says Morrison. "There are good ways of doing things, and there are better ways of doing things. We've come to the point where we can do 48 frames per second in 6.5K mode. At that data rate, I just can't wrap my head around how Marc Dando and his gang at SHED actually do it. And the flashy numbers are nothing compared to dependability. SHED has is right – it's the preeminent solution."

Cameras: ARRI ALEXA 65
Lenses: ARRI Prime 65 and Vintage 765
DIT: Peter Harrow
Post Partner: SHED



ENJOYING THE PROCESS

DIT Lonny Danler, currently enjoying the moment on some great movie projects.

Codex had the pleasure of sitting down with Lonny Danler, a DIT who recently worked on *Downsizing*, *Jumanji*, *The Greatest Showman*, *Kong: Skull Island*, *Hotel Artemis*, *Beautiful Boy*, and more. We were able to get a glimpse of the man behind the equipment for an intimate interview over a sushi lunch and discuss his work on the newly released film, *Downsizing*.

On location for *Beautiful Boy*

> Most importantly, Codex has been fiercely reliable
>
> Lonny Danler

With an early fascination with cameras and still photography, Danler received his undergrad in photo-journalism in Utah. But with the coming internet age, he felt that he would at some point have to move away from still photography and explore something more tech-focused. After spending many hours in the developing room, Danler started to shift his attention. While working on his Masters, he fell victim to a theft of his camera equipment. Seeing the light through the darkness of such a violation, Danler said it was, "a bit of a blessing because I thought, 'Ok, maybe I should pursue what I'd rather be doing.'" From there he progressed with his studies to receive a Masters in Film, while still maintaining an immense respect for still photography. After he received his Masters, he started shooting promotional videos, then industrial videos that he would edit and produce. This garnered an awareness for production to post which became a catapult for his career as a DIT. He eventually began to make connections with prominent cinematographers such as Janusz Kamiński ASC, Phedon Papamichael ASC, Seamus McGarvey ASC, BSC, Gyula Pados, etc. Due to these connections, the past few years have been very busy and exciting for Danler.

As we dove into the Yellowtail Carpaccio with our chopsticks, we were able to get a closer look at Lonny Danler's workflow and how Codex plays an integral role.

Describe your set up and your cart on *Downsizing*. How often did you use Codex Production Suite?

I find that I'm always adapting my system to best meet the needs of a particular production. For *Downsizing*, I used my vertical cart that had both video signal for live grading and data management so I could keep the RAW close for review and grading in Resolve but also had a mobile option so I could go lean and mean when necessary. In those cases, my loader would manage the downloads back at the cart. But I always like to stay close to set and usually because of wireless video, HME communication systems, and remote iris control it's a must.

My vertical cart had two 25" OLEDs up top, two Leader 5330/5333, iris control, an Odyssey 7Q, Mac Pro w/ Codex Dual Dock hooked up for downloads to a fast SSD RAID and then to a bigger RAID 5 with spinning disks and some other bells and whistles. The mobile kit was an FSI DM250 on a rolling Steadicam style stand.

We used Production Suite daily at a wiping station where my digital loader would use a MacBook Pro and a Codex Thunderbolt Reader to format cards and prepare them to go back into circulation. I always like to keep the ingest and formatting in two entirely different places when possible. The Thunderbolt Reader is also a nice backup to the dual dock in case there was a problem with the dual dock. Notably, however, I've never had to use it as a backup because the dual docks have been super solid. Nevertheless, I like to have at least two ways to do any mission-critical tasks.

On location for *Kong: Skull Island*

How has Codex helped you with your job and workflow?

Most importantly, Codex has been fiercely reliable. There are so many other concerns on set - managing the elements, relationships, moving gear quickly from place to place, being able to focus on colour, iris, etc... - it's reassuring to know that the media is in good hands. It's always there, and when you have A-list talent and multi-million dollar productions depending on it, it's very reassuring.

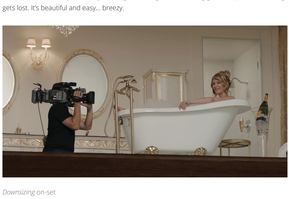
Describe working on *Downsizing* – what were the setbacks, challenges, or successes?

> It's reassuring to know that the media is in good hands
>
> Lonny Danler

Downsizing was a truly unique film, unlike anything I'd worked on before, more so, unlike anything I'd ever even seen tonally. Working on an Alexander Payne and Phedon Papamichael movie, it feels important, like something I really want to take extra, extra care to make sure everything is working smoothly, is there to help support their vision and how they like to work. *Nebraska* was like that and *Downsizing* definitely was as well. What made *Downsizing* especially unique was that in addition to being a character-driven film like Alexander is known for, it was also a big VFX movie with massive scale shifts from little to big. I knew it was going to be really important to be able to reference scene-to-scene changes so we could match photography and lighting so all those scale changes would be seamless. That is a big part of the reason I put both live grade and data onto one cart so all image control and reference was in one place, and close at hand. I also had a lot of people in my tent often so had to have enough monitoring for everyone to see and analyse the frame critically. A majority of the time I had both my mobile 25" OLED next to my other two 25" OLEDs on my cart so I could pull up any references I had as well as footage that was just downloaded from my dual dock for reference. In addition, Phedon was operating, as Alexander prefers to have him close to set, so I always wanted to make sure he had a calibrated feed of not just the live cameras but could send those same references to his 17" monitor next to the camera. Those were the setbacks, challenges, and successes all in one; just managing all those colour critical pipelines and references, exposure, and keeping everyone happy with what they needed when the needed it. There are daily ups and downs, but you gotta just keep on working to make it better at every turn.

The value of RAW for image capture is high, however, people perceive it as a challenge to manage RAW data. How do you feel about managing RAW workflows with Codex, compared to other formats such as ProRes, RED, IntraAVC, etc.?

Arri RAW with the Codex workflow is a breeze. Terabytes are only getting cheaper, hard drives bigger, pipelines and throughput more robust, and playback more powerful with GPU acceleration where even a laptop can easily handle the footage if need be. Arri RAW data rates aren't variable so it's pretty simple to figure out where you're going to need to be by the end of a production once you know your rough shooting ratios. Nothing gets compressed, nothing gets lost. It's beautiful and easy... breezy.



Downsizing on-set

If Codex could improve something about its service or products, what would it be?

Mobility is key. Having a bus-powered, low power draw and/or 4-pin XLR compatible power option would be great for those remote hard to reach locations where you have to be battery powered.

What's coming up in the pipeline for you? Anything you can talk about?

I'm slated to do 2nd unit for a Netflix show, which in and of itself is a "funny" story as I was slated to do main unit until the DP, sadly, got fired. But the main unit guys were kind enough to take pity on me and put my name in the hat for 2nd unit, which was very kind of them. Phedon has a movie or two coming up which is always exciting as he attracts great projects. Then there are rumours of other stuff. Haha. We'll see what pans out and what's meant to be. Roll with the punches, try not to take anything personally, keep my head up, smile and enjoy the process. Those are my goals.

CAPTURED ON CODEX

SUCCESS STORY: OKJA
CINEMATOGRAPHER: DARIUS KHONDJI AFC, ASC
RELEASE: 2017

CAPTURING OKJA

Codex explores behind the camera with DIT Dan Skinner on making Netflix's *Okja*

In 2013, South Korean director Bong Joon-ho wowed international audiences with Snowpiercer, his English-language debut. His follow-up, *Okja*, blends English and Korean dialogue and concerns a young girl who has raised a gentle giant and must now defend the creature from corporate greed, among other nemeses.

Bong enlisted Darius Khondji AFC, ASC to handle lighting and camera. The master cinematographer has worked with a roster of international auteurs but reportedly was leery of Netflix's insistence on 4K digital. But with the collaboration of Panavision, Codex, and DIT Dan Skinner – not to mention the support provided by ARRI Rental for the ALEXA 65 cameras – Khondji made peace with the new medium without compromising.

Codex is presented as an all-in-one system, but i think where it shines is its ability to work with the traditional systems...
Dan Skinner

Skinner says that the ALEXA 65's 6.5K oversample really shows, "Everyone really saw it. We used a 4K 50-inch monitor on the set, or in a vehicle near the set, and that's where we were able to see the full quality. There's really no comparison. So clean, and so sharp."

Panavision made fine adjustments to the coatings and other attributes of their Primo 70 lenses to subtly mitigate the sharpness, and for certain shots, this was augmented with slight diffusion. Skinner also adapted his workflow in subtle ways to give Khondji and Bong the creative flexibility and control they needed, even at remote locales.

"The Panavision Primo 70 lenses don't cover the full ALEXA 65 sensor, so I came up with a 7% reduction," Skinner says. "We used just a bit more of the sensor and a bit more of the available shallow depth of field. To compensate for slight vignetting, we brightened the corners a tiny bit in post where needed. We still shot the full Open Gate 6.5K RAW."

The 79-day shoot was mounted in South Korea, New York, and Vancouver. In spite of the significant visual effects component, the schedule generally stayed on practical locations. Skinner says that the days were planned meticulously and consisted mostly of faithfully shooting the storyboards. Coverage was minimal. The crew never shot more than 4TB in a day, and the total was roughly 276TB. "When you shoot with three cameras and just keep them running all day, you're talking 10TB plus a day," says Skinner.

In Korea, Skinner acquired a van and spent a week outfitting it with more than 3500lbs of gear shipped from the States. The result was a version of the Sprinter vans he owns and uses in the US. "It worked pretty well because I never once had to worry about resources or space," he says. "We were set for every scenario. We had a smaller cart with a monitor and wireless, and I could be ready to go moments after arriving at a location. We never really had a problem with the Codex Vault 65 or the cameras."

We never really had a problem with the Codex Vault 65 or the cameras
Dan Skinner

Skinner tends to avoid the larger 2TB Codex Capture Drives, sticking with the 512 XR Capture Drives. "I like to keep it to a traditional, film-like length, which forces a quick reload every ten minutes or so," he says. "I also feel that it's important to have a DIT on the set, not just blindly downloading, but also checking and viewing files throughout the day, and keeping caught up. It quarantines all possible issues – a row of dead pixels, for example – to ten minutes."

Using smaller capture drives also saves the production money. The crew went with roughly 20 Codex 512 XR and 8 2TB Capture Drives. The files would be ingested in the Vault 65 and generated into .ari files.

Once generated, ARRIRAW files are offloaded to a separate 40TB solid state drive that Skinner keeps in his vehicle, which functions as an auxiliary backup. The data is then copied to another medium via a 16GB fibre channel Skinner added to the Vault 65, then the footage could then be played back in real-time. The tweak allowed speeds of 1600 megabits per second, about three times normal, accelerating the move into DaVinci Resolve. There, Skinner could apply LUTs and perform some functions that are not normally considered part of dailies – compensating for the vignetting, for instance.

As a compromise with SHED, the Santa Monica-based boutique post house, I gave them my DaVinci project each day," says Skinner. "Once the files were on that transfer drive inside the Vault, I would immediately hand that data off to a runner. But I would still have another hour of my own time to finalise the look of that day. Separating the colour correction information from the data worked out really well, and it meant I didn't have a gun to my head at wrap. The colour data is a small file which was uploaded a bit later to a secure FTP. I respect the colour correction side of the process. I know the psychology of it. Being all frazzled on-set yields a different look compared to when I have a calm, assertive moment, just me in my vehicle with no pressure and no one asking me, "how long?" Obviously, that's where the best work comes out. It's probably a little bit more difficult for the people downstream, but I feel it gives me the ability to be less cornered into one look."

Skinner adds, "Codex is presented as an all-in-one system, but I think where it shines is its ability to work with the traditional systems that we are comfortable with and accustomed to. DITs are becoming more open to the system, and I think it's becoming a more open platform, which allows the DIT to bring something more to the table, and not just get by with the simplest workflow."

Final colour, crucial to the organic blend of effects and practical photography, was handled by Yvan Lucas, SHED colourist and founder member, under Khondji's supervision. *Okja* debuted to a standing ovation at Cannes and is now available on Netflix.

Cameras: ARRI ALEXA 65
Lenses: Primo 70 lenses
Amount of data: Approx 276TB
Rental House: ARRI Rental
Post Partner: SHED

CAPTURED ON CODEX

SUCCESS STORY: WONDER WOMAN
CINEMATOGRAPHERS: MATTHEW JENSEN ASC
RELEASE: 2017

THE WONDER OF TECH

DP Matthew Jensen ASC talks to Codex about capturing Wonder Woman on film and combining digital formats with the ALEXA range, all of which incorporate Codex technology.

In late July 2017, Variety announced that *Wonder Woman* became the highest-grossing film of the summer, with box office totals rocketing past $800 million. Captured by DP Matthew Jensen ASC, his technical skill is evident in every frame – the vast majority of which he shot on film emulsion using the 4-perf Super 35 format and Panavision lenses. A wide range of other digital formats was used for specific purposes, including the ALEXA Mini, ALEXA SXT and ALEXA 65 models, all of which incorporate Codex recording and technology.

Asked how he prevents the dizzying array of high technology used on today's big-budget films from inundating the creative aspects of his job, Jensen says, "That's on my mind from the minute I take a project. The great thing about *Wonder Woman* was that I knew that Patty [director Patty Jenkins] wanted a reality-based feel. So much of our work was grounded – there were actual objects and people in front of the lens. We knew we had effects work and green screen, but that never overwhelmed the project.

ARRI and Codex and the companies making these advancements haven't lost the lessons learned through the history of film cameras
Matthew Jensen ASC

Jensen goes on, "The technology today has reached a point where you start with a question: What is it that I'm trying to achieve with this shot? What information am I trying to get across? How is the story trying to be told? And then you have endless resources at your disposal to go about breaking that down and figuring out exactly how you are going to achieve it. I no longer fear that we don't have the technology to do something."

Jensen refers to a George Lucas interview with which the Star Wars director said the technology at that time was so cumbersome that he couldn't bring to fruition everything he imagined.

"I've heard that throughout the age of effects movies, but I certainly don't feel that way now," says Jensen. "I'm glad that film is still around so that if you want to use it to tell your story, you can. If film cannot provide you with the shot that you need to accomplish, you can go with a digital camera. You have tremendous capabilities in the effects world and they can extend your shot and give it more scope with relative ease."

As an example, Jensen cites the opening moments of *Wonder Woman*, a Technocrane shot of Diana walking toward her office in the Louvre.

"Patty and I went to the location and plotted that out," he says. "We figured out the angle that we wanted with our viewfinders, and we went back with still frames. We gave those to the effects department and they plotted out for us the exact camera move – where the tracks should be laid and where the crane would start and end, including lens height, etc. That eliminated so much guesswork, and it allowed us to swoop in and shoot that in a half a day, executing it very precisely. I think 15 years ago that would have been easily a day's work because we would have had to do a lot more guesswork and adjustment to get the shot."

Still, he says, the ability to react in the moment of photography is crucial. "At the end of the day, you're still looking through the eyepiece, and you still want to feel the performance of the actors and make the move in conjunction with what they're doing and how they are emoting," he says. "You're translating that to an audience."

Orson Welles famously said that "The enemy of art is the absence of limitations." Jensen agrees that it can be a major problem.

"The films that I enjoy, and are the best-directed, in my opinion, and the most pleasing from a purely filmmaking standpoint, are the ones that have limits," he says. "Films where the directors have given themselves a set of rules that the camera abides by, and in so doing creating a very definite personality – not only in the way the shots are designed, but in the way information is revealed to the audience. When you set limits for yourself, it causes you to think about how your story is being told. There's a strict discipline imposed, which creates more of a relationship with the audience.

The films that I enjoy, and are the best-directed, in my opinion, and the most pleasing from a purely filmmaking standpoint, are the ones that have limits
Matthew Jensen ASC

"Even with all the tools at our disposal, the purest form of cinema is still looking through that eyepiece," he says. "It still comes down to that. We haven't lost that. ARRI and Codex and the companies making these advancements haven't lost the lessons learned through the history of film cameras. They've engineered the newer cameras in ways that replicate how film has been shot for more than hundred years. So, I think we're at a good nexus point, if you will, and I just hope that we will continue to make movies that are about people – even if they have super-human abilities."

The danger, he cautions, is that VR and animation will get so good, and the display technology will continue to shrink. "Then it won't really matter what we do," Jensen says. "Then the craft won't matter. But we're not there yet. Honestly, I feel like if we could freeze where we are right now and just concentrate on telling better stories, we'd be in great shape."

A *Wonder Woman* sequel will be directed by Jenkins with a target release date of June 2019.

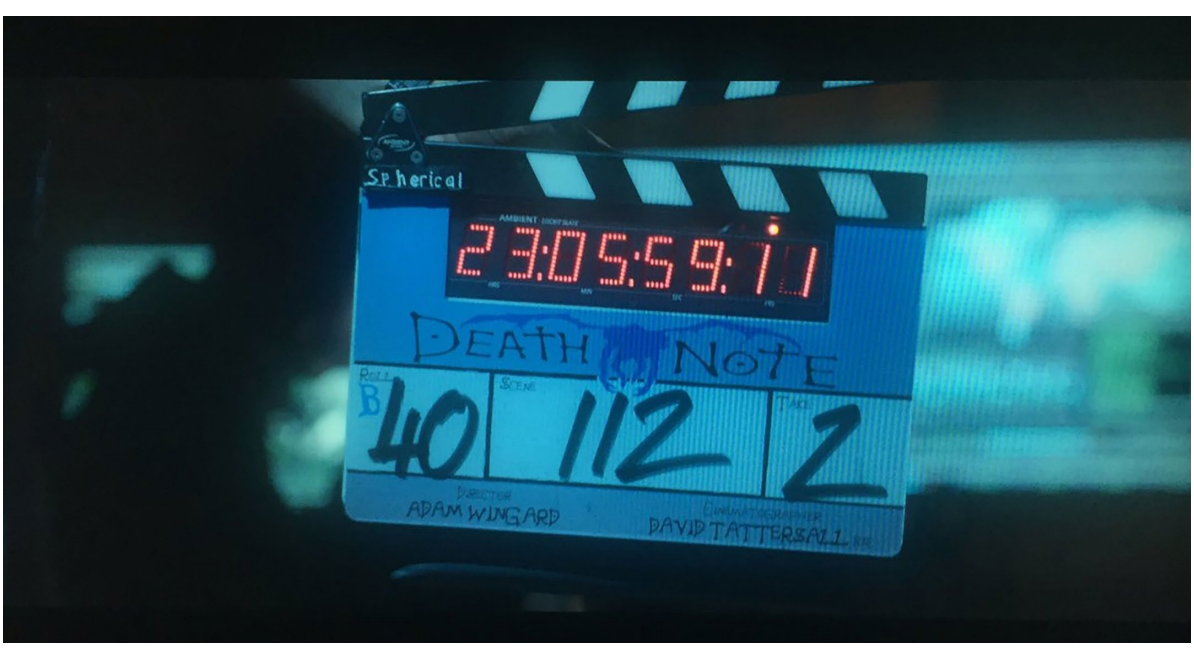
Cameras: ARRI ALEXA 65, ARRI ALEXA Mini, ARRI ALEXA SXT, Arriflex 235, Arriflex 435, Panavision Panaflex, Millennium XL2, Phantom Flex4K
Lenses: ARRI Prime 65, Panavision Primo
Post Partner: Company 3

CAPTURED ON CODEX

VANCOUVER COVERED

Vancouver-based DIT Mitch Bax has enjoyed a thriving schedule since 2009. *Death Note* being one of his latest Codex workflows.

The on-set digital workflow for Netflix's $50m feature, *Death Note,* was supervised by Vancouver-based Mitch Bax – one of the first DITs to have experienced the 4K Codex workflow for the then brand-new Panasonic VariCam 35 (now marketed as VariCam Pure).



Prior to production, Bax worked closely with DP David Tattersall BSC to create a trios of 3D LUTs, with varying colours and contrast levels, for the Panasonic VariCam 35 used on the shoot. During production he then ensured the safe capture and delivery of the original 4K Panasonic V-RAW camera files, using Codex workflow systems, over to Fotokem, which provided an overall dailies and deliverables service from a satellite facility it operates in the city. Bax's role also encompassed performing daily, non-destructive grading tasks in collaboration with the cinematographer.

Codex makes life easier for people like me, which is just as it should be.

Mitch Bax

Bax began his DIT career in Vancouver in 2009, and has enjoyed a thriving schedule ever since, thanks to the city's on-going attraction as a production centre. His growing credit list encompasses major motion pictures and episodic TV series, including *V* (2011), *Chronicle* (2012), *RoboCop* (2014), *Deadpool* (2016), *Star Trek Beyond* (2016), *Sidekick* (2017), plus *Altered Carbon, Tully* and *Power Rangers,* which are set to release in 2018. All of these productions used Codex recording and workflow systems.

"Starting out with the Codex Onboard Recorder on an ARRI D21 on *Chronicle,* I've had a lot of exposure to the Codex equipment on many different projects. In just a few short years I have seen the company grow, and its workflow products evolve considerably – from on-board devices to in-built capture drives and the powerhouse Codex Vaults. *Death Note* was my first experience of using Codex with the then brand new Panasonic VariCam 35. Whilst you always have a little trepidation of working with new equipment, I needn't have worried, as it proved another good workflow experience."

Death Note was shot in the VariCam 35's open gate mode (4096 x 2160 active pixels) for an Anamorphic 2.39:1 extraction in post. During production, the Codex 2TB Capture Drives, which slot inside VariCam's recorder module, were initially delivered to a near-set workflow hub, where the V-RAW material was copied to a secure RAID.

Death Note on location

When the duplicate footage was secured and verified, the Codex Capture Drives were then forwarded to Fotokem in Vancouver. As soon as clones, LTO-back ups and QC of the material were made via a Codex Vault, the Codex Capture Drives were then cleared and returned to the set, ready to be recycled into the production workflow. A single Codex 2TB Capture Drive provides around 55 minutes of Panasonic VariCam 35 capture at 4K. The production used around 35 Codex Capture Drives, with the recycling procedure taking two to three days.

Working closely with Tattersall, during each day's shoot, Bax would typically apply one of the selected 3D LUTs non-destructively to the Panasonic VariCam feed on-set, and perform on-set grading tasks as required using Pomfort Live Grade. On-set monitoring was done at 1080p in V-Log Rec.709, on a Sony PVM 250A. The resulting CDL grading metadata and 3D LUT were passed on a USB drive along with the Capture Drives and relinked to the RAW material at Fotokem.

"Both David and I thought the VariCam 35 footage looked gorgeous from the get go, and when we viewed the 4K footage at Fotokem, the quality was unquestionable – with lots of latitude and colour information in the picture," says Bax. "From a technical standpoint, the VariCam 35 files are as large as the ARRI ALEXA 65s, and the data rate is close to the ALEXA 65 too, which is pretty mindboggling, and a great testament to Codex's collaborative engineering with Panasonic.

"The beauty of the Codex workflow on *Death Note,* was that David and Adam Wingard, the director, had the joint reassurance of seeing an accurate representation of their desired aesthetic on-set, while knowing the images would look the same in post. Codex makes life easier for people like me, which is just as it should be. It is quite an achievement that they have created yet another robust workflow, this time for the Panasonic VariCam 35."

Cameras: Panasonic Varicam 35
DIT: Mitch Bax
Post Partner: Fotokem

SUCCESS STORY: CRAZY RICH ASIANS
CINEMATOGRAPHERS: VANJA CERNJUL
RELEASE: 2018

FRAMING CRAZY RICH ASIANS

Vanja Cernjul ASC captures a romantic comedy with the VariCam Pure

Last year, Vanja Černjul, ASC was commended by his peers in the American Society of Cinematographers for his outstanding work on Netflix's *Marco Polo.* The ASC Award is all the more impressive given the competition – today's television cinematography sets a high standard.

Černjul's education began in his native Croatia and continued at New York University, where he earned an MFA. His career began in earnest in the late 1990s, and he has since crafted a varied body of work that includes television landmarks like *30 Rock, Orange is the New Black,* and *Nurse Jackie* as well as features like *The English Teacher, Violet and Daisy* and, most recently, *Crazy Rich Asians,* a Warner Bros. romantic comedy shot in Malaysia and Singapore.

The project is based on a best-selling novel in which an American-born economics professor travels to her wealthy boyfriend's hometown for a wedding and discovers that he is desired by a flock of unscrupulous, rich and ruthless women. *Crazy Rich Asians* is believed to be the first major studio production with an all-Asian cast, directed by Jon Chu.

"It was a great experience, but it was a challenging show because we had 43 shooting days and something like 38 different locations," says Černjul. "We considered the ALEXA 65 because we wanted a big, classic Hollywood look. But I knew we were going to be moving a lot. I thought that in order to consistently get the look I wanted on all these locations, the Panasonic VariCam was the right choice."

I thought 4K uncompressed raw was the right choice, and that's why I chose to use the Varicam pure with Codex recording

Martin ahlgren

Černjul has become familiar with the VariCam 35 on HBO's *The Deuce,* which is set in the 1970s and was shot last year on location in the streets of New York City, with available light.

For the production of *Crazy Rich Asians,* Černjul turned to TCS in NY for the VariCam 35 package. TCS recently upgraded their Varicam 35 camera systems to the VariCam Pure with RAW recording capability using Codex media. TCS is known for offering a vast inventory of motion picture cameras, and modern and vintage cinema lenses, to support independent filmmakers, TV show productions, and feature films. Černjul was comfortable with TCS's endorsement of the VariCam Pure with RAW recording and Codex.

"I was blown away by the results," he says. "I thought the dual native sensitivity was something that could help me on that project. In testing, I found that I could switch between 800 and 3200 ISO with virtually no difference in the texture. I convinced HBO to let me use it, and I was elated. Once you have that flexibility, you can start working in a completely new way, and it's difficult to go back. You get used to it quickly."

The additional latitude changes every aspect of photography, he says. "You can make decisions in the middle of the scene. For example, you have complete control in depth of field. You can decide to go up on the ISO if you want more depth of field or want to close down, which was not possible before without relighting. It's easy to do unplanned slow motion or use camera and lighting filters that used to require boosting light levels."

On *Crazy Rich Asians,* that versatility would come in handy. The filmmakers wanted to showcase the beautiful locations and make extensive use of existing practical light. "This project is a very stylish romantic comedy," Černjul says. "I needed the ability to work quickly using low light levels without compromising on the quality of light. I wanted to work with smaller, cooler light sources, and to diffuse and bounce the light, while still getting the stop I needed. I knew I could do it with this camera."

The Panasonic VariCam Pure offers a 4K Super 35 sensor and features integrated Codex recording media and the proven simplicity of the Codex One Workflow. During the *Crazy Rich Asians* shoot, the ISO was set at 2000 or below, with one or two exceptions.

"I wanted to preserve as much information as possible to work with in colour grading," says Černjul. "I thought 4K uncompressed RAW was the right choice, and that's why I chose to use the VariCam Pure with uncompressed RAW recording. I shot tests and looked at them on the largest screen I could find in Kuala Lumpur, and the images shot at 2000 ISO looked surprisingly clean. We may add some grain in post, so it was very important for me to have as clean an image as possible so that there is no interaction between the noise of the camera and any texture we end up adding."

The lenses were Hawk 1.3x anamorphics from Vantage Film. The final aspect ratio will be 2.40:1. "The 1.3x lenses give you a bit of anamorphic feel, but the lenses are small and open up to T-2.2," he says. "The VariCam viewfinder allows you to switch to 1.3 very easily. We tended to stay on the wider focal lengths because we wanted the environment to be present in every shot. Even the close-ups were done between 35mm and 40mm. Also, the VariCam Pure is more compact than the original VariCam 35, which is nice for location work. We were working in the tropics, and the camera didn't let me down once. It was the ideal choice for this job, and it paid off. It was a beautiful combination."

Camera: Panasonic VariCam Pure
Camera Rental Provided by: TCS
Lenses: Hawk 1.3x anamorphic

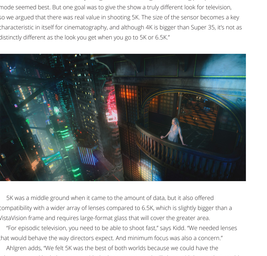
CODEX

SUCCESS STORY: NETFLIX'S ALTERED CARBON
CINEMATOGRAPHERS: MARTIN ANSEREN AND NEVILLE KIDD
RELEASE: 2018

ALTERED IMAGES

5K sci-fi tale tests the limits of television image quality

***Altered Carbon*, a dystopian, cyberpunk action/sci-fi tale, set centuries in a bleak future,** taking place partly in other solar systems, is a ten-episode television series based on the Richard Morgan novel, debuting in February 2018.



In a crowded television field, one question that Netflix and showrunner Laeta Kalogridis faced, was how do you set the tale apart from other sci-fi fares. In keeping with the Netflix 4K mandate, the makers of *Altered Carbon* decided to emphasise visual quality, shooting large-format with the ARRI ALEXA 65 camera in 5K mode, one of the first television series to follow this path.

With three months of prep, directors of photography Martin Ahlgren and Neville Kidd established a strong working relationship. Ahlgren says that he's never had that kind of close collaboration with another director of photography.

> **The Codex Vault has a workhorse quality that is reassuring**
> Martin Ahlgren

"It was a unique opportunity to use our combined creativity, with both of us attacking it in different ways," he says. "It's been a real treat to work together and bounce ideas. You don't usually have the luxury to design sets and lighting, and work out as a team how to approach a project."

Ahlgren and Kidd both like shooting with the ARRI ALEXA, but Netflix's 4K minimum requirement took that off the table. Once the ALEXA 65 was proposed, they shot tests to determine whether 4K, 5K or 6.5K mode was right.

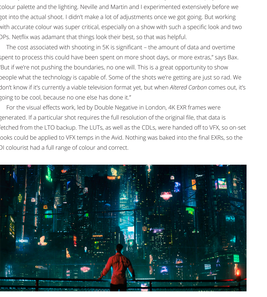
"Because the camera only records in ARRIRAW, you're creating massive amounts of data," says Ahlgren. "From a storage and handling perspective, 4K mode seemed best. But one goal was to give the show a truly different look for television, so we argued that there was real value in shooting 5K. The size of the sensor becomes a key characteristic in itself for cinematography, and although 4K is bigger than Super 35, it's not as distinctly different as the look you get when you go to 5K or 6.5K."

5K was a middle ground when it came to the amount of data, but it also offered compatibility with a wider array of lenses compared to 6.5K, which is slightly bigger than a VistaVision frame and requires large-format glass that will cover the greater area.

"For episodic television, you need to be able to shoot fast," says Kidd. "We needed lenses that would behave the way directors expect. And minimum focus was also a concern."

Ahlgren adds, "We felt 5K was the best of both worlds because we could have the advantages and look that comes with the large sensor, and still shoot with lenses that would open up to 1.3 or 1.4. We could focus literally ten inches from a face, and have the shot develop into something wider. That flexibility was important. And in 5K at a stop of 1.4, your depth of field is actually even shallower than you can achieve in 6.5K. Our focus pullers had their work cut out for them, but they did an outstanding job."

With those priorities in mind, the cinematographers went with Canon CinePrimes for focal lengths less than 65mm, Cooke S5i in 65mm and 100mm focal lengths, and Cooke S4s when longer lenses were called for - 135, 150 and 180mm. A spherical Hawk 100-400mm zoom was also on hand.



The bulk of the first season was shot in the Vancouver area, where the production took over a former printing facility and filled it with built sets, offices and dedicated space for carpentry, makeup, stunt rehearsal, and art department – even editorial was just across the street. About 85% was done on stages. Budget estimates of $7 million per episode were rumoured to be on the low end.

With complete control, the cinematographers relished shooting as much as possible practically, as opposed to creating elements for visual effects to finish. Involved early on, they were able to collaborate on the aesthetics of the sets and lighting.

"A lot of our prep time was spent figuring out basics," says Ahlgren. "What do house lights look like in the future? How do people get around? Of course, there are visual effects, but to a large degree, they were minimised. We had very few green screen days. Often the sets worked in 360 degrees. Keeping things in camera was an economic decision, but from a shooting perspective it's been really fun."

As many as six ALEXA 65 cameras were in use on the project at once. A LUT was developed with the help of Jill Bogdanowicz of Company 3. Encore in Vancouver handled the initial lab work, converting to 4K ProRes submasters for post.

It's estimated that the decision to shoot 5K resulted in 13 times the amount of data.

> **I personally have been thrilled with everything Codex has done. I've worked with them since the beginning, and when I first saw it, I was like, 'This is cool.'**
> Nick Bax

"It was crazy," says digital imaging technician Mitch Bax. "It was an unprecedented amount of footage. Going in, we didn't expect that – everybody thought it was a normal TV show. But then we got going, and it was six or seven terabytes a day. To download and handle it all, we had Codex Vaults – I'm not sure what else could have handled all that, with the size of the files and the fact that we were transcoding while turning them into ARI sequences. About 60% of the schedule was three-camera. I realised from the beginning that we needed more manpower and gear, so I implemented the Codex Vault system from the beginning and insisted on extra loaders. As soon as the mags were exposed they'd come off the camera, and we'd take them to the Codex Vault for downloading. Once there, we backed up onto a Codex Transfer Drive or sled and held the mags until the LTOs were cleared by Encore, which could take up to about two days. For three cameras, we had about 45 2TB SXR Capture Drives, which is insane. The biggest thing was having enough. We did a calculation at the beginning and it held true throughout the rest of the shoot.

"Using multiple Codex Vaults was a clever idea," says Bax. "Otherwise, we saw a bottleneck of footage. And it allowed us to avoid separating the download and the creation of the ARI sequence. Then post could create the 4K ProRes XQ submaster and clone everything more efficiently.

On-set viewing was via the 1920x1080 signal off the camera, into 23-inch Sony LLD monitors calibrated to Rec 709 colour space by Encore. Changes were saved and sent to the dailies colourist via CDL.

Because of the sci-fi nature of the show, we could do almost anything," says Bax. "There are so many directions, and no rules, which was fun for us. For every set, we could play with the colour palette and the lighting. Neville and Martin and I experimented extensively before we got into the actual shoot. I didn't make a lot of adjustments once we got going. But working with accurate colour was super critical, especially on a show with such a specific look and two DPs. Netflix was adamant that things look their best, so that was helpful.

The cost associated with shooting in 5K is significant – the amount of data and overtime spent to process this could have been spent on more shoot days, or more extras," says Bax. "But if we're not pushing the boundaries, no one will. This is a great opportunity to show people what the technology is capable of. Some of the shots we're getting are just so rad. We don't know if it's currently a viable television format yet, but when *Altered Carbon* comes out, it's going to be cool, because no one else has done it."

For the visual effects work, led by Double Negative in London, 4K EXR frames were generated. If a particular shot requires the full resolution of the original file, that data is fetched from the LTO backup. The LUTs, as well as the CDLs, were handed off to VFX, so on-set looks could be applied to VFX temps in the Avid. Nothing was baked into the final EXRs, so the DI colourist had a full range of colour and correct.

Although image quality was high on the list, and a 4K HDR deliverable has been made, archival considerations were cited as another important reason for going with the rich format. The theory is that the quality of the imagery will hold up as delivery and display technologies continue to improve, increasing the potential upside for the studio and investors. "The archival argument is the best way to keep these large format cameras on television shows," says Bax.

> **To download and handle it all, we had Codex Vaults – I'm not sure what else could have handled all that**
> Mitch Bax

"If they can use it down the line, the integrity still holds up. There are so many subtle artistic benefits, but the archival rationale is the one that is protecting the directors of photography and their work."

Codex played an important role in making the ambitious project run smoothly. "Having that massive data flow handled safely and reliably made it possible," says Ahlgren. "The Codex Vault has a workhorse quality that is reassuring."

Bax adds, "I personally have been thrilled with everything Codex has done. I've worked with them since the beginning, and when I first saw it, I was like, 'This is cool.' It just seems like they're coming along with the next innovative thing. The Vault revolutionised that aspect of what we do. For camera technicians, whose jobs entail so many other critical things, Codex alleviates all of the unnecessary thinking. We can walk up to the camera and hit record. We can focus on the task at hand – what's happening on the set. I've had nothing but good experiences with them."

"Directors of photography just want everything to work," says Kidd. "You go into it hoping to concentrate on your creative process, and hopefully knowing that the backup you're getting from your cameras and data is faultless. Everyone embraced the ALEXA 65 and the larger amount of data and ran with it throughout for the benefit of the project. And I think it will show in the final product."

Cameras: ARRI ALEXA 65
Camera Rental Provided by: ARRI Rental NJ
Lenses: Canon CinePrimes, Cooke S4 and S5
DIT: Mitch Bax, Simon Jori
Post Partners: Encore, MobiLabs, Company 3

CAPTURED ON
CODEX

SUCCESS STORY: THE RITUAL
CINEMATOGRAPHER: ANDREW SHULKIND
RELEASE: 2018

EXPOSING THE DARK

Cinematographer Andrew Shulkind lights up the night with *The Ritual*

For *The Ritual*, a horror film that takes place mostly in dark and deeply forested exteriors above the Arctic Circle in northern Sweden, cinematographer Andrew Shulkind and director David Bruckner knew they needed a camera that could see well in the darkness. On a previous project, they had tested a variety of cameras and settled on Canon, since testing revealed another full stop of light and a superior noise threshold.

"We were really going for the nuance of shadow in *The Ritual*," says Shulkind. "The idea was to expose the whole range of the sensor with the intention of crushing it down in post so we'd have as dark a movie as possible. Very early on, we grappled with what night really looks like, and how authentic we could make it, given the incredibly sensitive cameras and super-fast lenses we now have. The idea wasn't to use all natural light or to avoid lighting, it was to light the night very naturally at very low, subtle levels."

Codex and SHED were really a dream team that helped assure our success
Andrew Shulkind

The story, an adaptation of Adam Nevill's award-winning novel, concerns a group of college friends who reunite in almost completely natural surroundings. Eventually, a malevolent presence reveals itself, and the drama becomes an examination of how different characters respond under extreme circumstances. The tagline: "They should have gone to Vegas."

The film was shot almost entirely in central Romania, using Canon C300 Mark II and Canon EOS C700 cameras and Hawk T1 lenses. The image format was 4K RAW, captured with Codex Recorders. Colourist Matt Watson and the team at SHED in London and Santa Monica helped Shulkind achieve the look he envisioned.

"We were extremely fortunate to receive a prototype C700 about halfway through the shoot," says Shulkind. "It gave us all the flexibility of the C300 Mark II, but in a more robust package - with internal Codex recording, which were very stable throughout the shoot despite the conditions. The C700 also allowed us to shoot 120 frames per second at 4K. Shooting the Canon at 3200 ISO, and times up to 6400 ISO, with a T1 lens – it's more than your eye can see!"

For the night exteriors, there was usually an approximately two-hour window in which to shoot, depending on the clouds. Shulkind kept a close eye on the waveform when possible and aimed to keep everything under 80 IRE. That gave him some insurance since he was seeing a linear image on-set. He built some custom battery-powered lighting to subtly underscore the deep forest while using silhouetted trees and the lack of visible horizon to emphasise the characters' growing disorientation and unease.

The 4K RAW images helped when it came to visual effects, which were done by Nvizible. The motion capture performances were recorded at The Imaginarium, a unique independent motion capture studio founded by Andy Serkis, who also served as one of the producers on the film. The decision to shoot 4K would prove prescient when it came time to sell the film.

"The creature is hinted at throughout the course of the movie, and about halfway through we start to reveal it more," says Shulkind. "We had some practical elements including a foam model, and we were always looking for ways to marry real on-set elements into the photography. There was a lot of wire work, and a big practical fire scene. Legendary visual effects producer Ron Ames was instrumental in bringing all the elements and vendors together to create this mesh of believability."

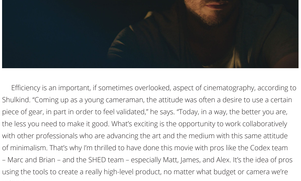
We were really going for the nuance of shadow in The Ritual
Andrew Shulkind

The final colour was done at SHED London, but some earlier colour passes were required to make sure that the visual effects elements would work. Shulkind, who is based in Los Angeles, was able to make some of the earlier passes remotely from SHED's facility in Santa Monica. For the final two weeks, he was able to sit with Watson in London to put on the finishing touches.

"SHED supported us throughout the project," says Shulkind. "Matt Watson was outstanding, and they sent us Alex Golding, our wonderfully fastidious DIT. Codex and SHED were really a dream team that helped assure our success. We were running around in the woods at 8,000 feet on these mountainsides, building safety lines on very steep inclines, and working quickly. In most cases, under those less-than-ideal conditions, you're just happy to make your day and move on. To be assured that not only did we have the footage-with no issues, but with all the range and consistency we needed to achieve the movie we were trying to make – that's a big deal."

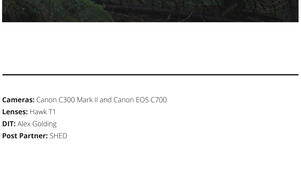
Shulkind says that while recent developments in filmmaking technology have lowered the barrier to entry, artful work is still the goal.

"I get to experiment with a lot of new technology before it gets released, like LEDs, plasma lights, new cameras, and lenses," he says. "Ours is a business of compromise and I like to look for shortcuts anywhere I can to save time or money or both. Inevitably, some tools will be worthwhile and some won't. On *The Ritual*, we had a prime opportunity to marry highly sensitive sensors and superfast lenses with very subtle artificial light at very low levels, to create the same artful artifice of cinematography and production design that we've been using for 100 years of storytelling. We were able to activate the newest tools, on a modest budget, under difficult conditions, to tell our story in an efficient and unique way."



Efficiency is an important, if sometimes overlooked, aspect of cinematography, according to Shulkind. "Coming up as a young cameraman, the attitude was often a desire to use a certain piece of gear, in part in order to feel validated," he says. "Today, in a way, the better you are, the less you need to make it good. What's exciting is the opportunity to work collaboratively with other professionals who are advancing the art and the medium with this same attitude of minimalism. That's why I'm thrilled to have done this movie with pros like the Codex team – Marc and Brian – and the SHED team – especially Matt, James, and Alex. It's the idea of pros using the tools to create a really high-level product, no matter what budget or camera we're using. "

After positive reviews at the film's Toronto International Film Festival premiere, *The Ritual* was quickly picked up by Netflix, reportedly for about $5 million – vindicating the decision to capture in 4K many times over, since Netflix insists on 4K RAW capture for its original content. It's now available for streaming on Netflix.



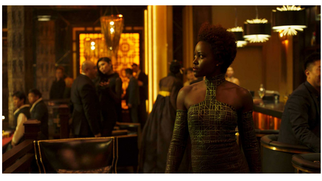
Cameras: Canon C300 Mark II and Canon EOS C700
Lenses: Hawk T1
DIT: Alex Golding
Post Partner: SHED

SUCCESS STORY: BLACK PANTHER
CINEMATOGRAPHERS: RACHEL MORRISON
RELEASE: 2018

MAINTAINING HUMANITY ON A LARGE SCALE

The huge hit, Marvel's *Black Panther*, is shot by Academy Award-nominated cinematographer Rachel Morrison

Rachel Morrison's Oscar nomination for *Mudbound* is one more welcome crack in the glass ceiling, and it builds on the work of pathfinding cinematographers like Ellen Kuras, ASC; Brianne Murphy, ASC; Amelia Vincent, ASC; and Nancy Schreiber, ASC. On a more personal level, Morrison has been working towards that breakthrough her entire life. The daughter of an enthusiastic amateur still photographer, she turned the camera around early and became obsessed with the ability to freeze time. At NYU, she split time between cinematography and photo-journalism but eventually realised that she relished the collaborative nature of motion picture production, and went on to study at AFI. The recognition for *Mudbound* was especially affirming since her devotion to photography was informed by still masters of the single image like Robert Capa, Gordon Parks, Dorothea Lange, Arthur Rothstein and Walker Evans, whose work was also a source of inspiration for that film, which is set in the post-WWII south.



"They were the reason that I got behind the camera in the first place," says Morrison. "It was the power of what was achieved through documentary photography, and the direct result of these incredibly moving and potent and emotional photographs that are a real testament to the power of imagery."

Now Morrison has executed a flawless following act, *Black Panther,* a major hit, is the first film of its size and scale that's redefining the idea of cinematography's male-dominated industry. The reviews have been ecstatic, and the box office take is approaching three-quarters of a billion dollars after roughly two weeks in release. *Black Panther* reteamed Morrison with director Ryan Coogler and presented a technically more complex challenge. The superhero saga was shot mainly with ARRI ALEXA XT cameras in Open Gate RAW format cropped to a 2.39:1 aspect ratio and the lenses were spherical Panavision Primos.

> **I've been recommending Codex since 2008, & I still do**
> Rachel Morrison

"We wanted it to feel grounded in something real, rather than in fantasyland," says Morrison of the film's look. "In a way, it's a love story, a love poem to Africa. Our references were really big, humanist portrayals of earth, like *Baraka* and *Samsara*. We wanted to find a way to blend something you'd see on the Nature Channel with something you'd see in a Marvel film."

Baraka and *Samsara* are both wordless visual feasts directed and photographed by Ron Fricke using large format film and state-of-the-art 8K scanning to produce breathtakingly rich and deep imagery. Strictly speaking, they're documentaries, but the combination of stunning imagery, time-lapse and slow-motion photography and incantatory music is uniquely cinematic.

Morrison also cites *The Dark Knight,* shot in 65mm and IMAX film gauges by Wally Pfister, ASC, as a model for maintaining humanism on a large-scale canvas. Another crucial ingredient was the personal, subjective camera that buoyed her previous collaborations with Coogler, like Fruitvale Station.

"We thoroughly tested everything, including IMAX," says Morrison. "But honestly, the main reason we went with digital was the expedited post schedule. Ryan wanted to stay away from the largest sensors because he didn't want shallow depth of field. He wanted to see and feel the texture of everything, including the backgrounds. With the raw format, we were able to capture all the colour information and resolution that we needed."

Marvel strongly recommends a standard workflow developed over the course of many projects centered on the Codex Vault. The result is a rock-solid, dependable procedure that allows the filmmakers to focus on the creative aspects of the project, in spite of some very high technology under the hood.

"I found that the VFX component is actually quite intuitive," says Morrison. "The software and technology have gotten so good that you can roto almost as easily as compositing against green or blue screen. I remember when you had to light a chroma screen to within a tenth of a stop across the entire screen. Now, if it's green or blue, they can composite. And that is liberating for us as well as for the actors.

Still, I'm used to doing everything in camera," she says. "Here, you're combining the real with the imagined. This is the first time I had to light a scene driven by firelight without any fire. It couldn't be any more different from *Mudbound*."

> **Marvel strongly recommends a standard workflow developed over the course of many projects centered on the Codex Vault.**
> Rachel Morrison

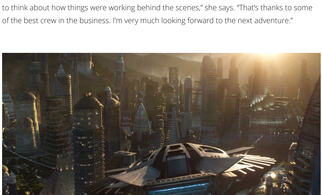
Digital imaging technician Nicholas Kay was focused on keeping the cameras balanced and ready to go, as well as on keeping track of continuity.

"We shot ten-hour days, so we were going as fast as possible at all times," says Kay. "Rachel would tell me what stop to maintain for certain scenes and lenses, and I would work to maintain that over the course of scenes. It was a privilege to have her trust in me to help maintain exposure throughout the course of the job."

LogC came off the camera, but the camera crew worked in ACEScct 1.0.3. The Log C initially went through an input transform (IDT) to ACEScct colour space, where CDL grading was done in scene linear space. A corrective LMT, essentially an ACES-scaled LUT, was applied before the ACEScct image was transformed via RRT and ODT to Rec 709 viewing space. The footage was downloaded on Codex Vaults, and storage sleds were shared with near-set SHED personnel, who worked on the dailies pipeline, which continued in ACEScct. Élodie Ichter and Fergus Hally of SHED Atlanta handled dailies using a custom ACES workflow LUT. Final colour was done at Technicolor in Los Angeles with Maxine Gervais in 4K resolution on a FilmLight Baselight system.

"The Codex workflow has always been very helpful and reliable to use," says Kay. "I've been recommending Codex since 2008, and I still do. Working with Rachel was awesome – she kept me on my toes. At the time ACEScct was brand new, and we were one of the first jobs to use it. I think it was a great choice for the African-American palette and grading on *Black Panther*."

Morrison is quick to credit her team with helping to make the shoot smooth. "I didn't have to think about how things were working behind the scenes," she says. "That's thanks to some of the best crew in the business. I'm very much looking forward to the next adventure."



Cameras: ARRI ALEXA XT
Lenses: Panavision Primo

CAPTURED ON CODEX

SUCCESS STORY: MARY MAGDALENE
CINEMATOGRAPHER: GREIG FRASER, ASC, ACS
RELEASE: 2018

6.5K BRINGS TO LIFE A BIBLICAL DEPICTION

Greig Fraser, ASC, ACS opts for the large format ALEXA 65 and power of the Codex Vault for *Mary Magdalene*

In 2015, director Garth Davis and cinematographer Greig Fraser, ASC, ACS combined their talents on *Lion*, resulting in one of the highest-grossing Australian films of all time. *Lion*'s success, which included six Oscar nominations including Best Picture and Best Cinematography, was all the more astonishing given that it was Davis' feature debut.

Now the duo has completed a new project, *Mary Magdalene*. A story about the biblical follower of Jesus Christ who witnessed his crucifixion and, according to some accounts, was a repentant prostitute. Rooney Mara plays the lead role, with supporting cast Joaquin Phoenix, Chiwetel Ejiofor, and Tahar Rahim.

For the visual style, Davis and Fraser emphasised a purely natural look, a decision that had ramifications throughout the project. Davis reportedly reviles the artificiality of sets and stages, preferring to shoot entirely on actual locations. In this case, it was Italy.

An early decision to shoot with the ARRI ALEXA 65 was augmented by Fraser's lens package, which included more than 35 lenses in a wide array of brands and models.

"I've been very much enjoying exploring the new, larger format," says Fraser. "Every movie is different, and if I had my way, I'd shoot every film in a different format to try to enhance the director's vision. That's the ideal scenario. Short of that, one of the great things about the ALEXA 65 is that the gauge makes everyone rethink their understanding of how to shoot. With 35mm film, the gauge is the size of the film, and the lenses cover that. That's what you shoot, and you don't deviate.

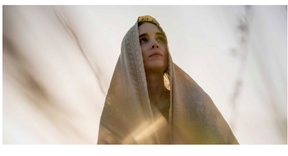
"Whereas on the ALEXA 65, you have so much resolution, you can elect to shoot different sizes and resolutions on the chip," he says. "You can use one camera and be open to so many more lenses, even if the lenses don't cover 6.5K. That effectively gives me, as a DP, more control. Whilst digital has been an amazing revolution, it's also reduced some of our choices. With film, we had three manufacturers, each with ten or twelve stocks. With digital, that range of options was reduced. Now, having the ability to choose sensor size within a given camera feels like liberation."

Fraser points out that images from the ALEXA 65 usually appear on cinema screens with the same physical size whether they were captured in 4K, 5K or 6.5K mode. "But changing the mode does change the size of the sensor, which therefore changes the feel of the shot. Imagine if you could shoot fine grain 16mm and fine grain 35mm and have the grain matched so no one knew the differences. Because of the field of view, they would still feel different – and that's what happens with 65. You feel a bit more restricted in 4K, a bit more claustrophobic. We were using 6.5K to open the world up. We used medium lenses, but you see wider. There's an intensity that is all-encompassing and enthralling. Resolution is a factor, but the larger sensor is the key."

> **There was not a single, comprehensive solution like we have nowadays with the Vault**
> Christopher Rudkin

DIT/Colourist Christopher Rudkin was also a veteran of the Lion shoot. On *Mary Magdalene*, he served a hybrid role along with on-set DIT Dan Carling, who also had some B camera duties. Rudkin acted as dailies colourist, working with a more robust toolset to bring the images very close to their final state before they went to editorial.

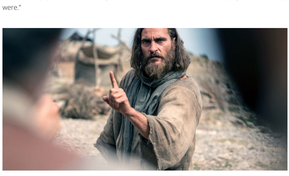
> **In the old days, the gear was so cumbersome and held together with duct tape...**
> Christopher Rudkin



"We had some headaches on *Lion* with the disparity between the DI and the dailies," says Rudkin. "Greig was very keen to put a system in place to avoid that, so that's what we built, and it worked very well. The existing structure of how a movie is graded is sort of a vestige from the days of film. You process the film, and then you colour time it. It's very linear. Everything nowadays is more networked, and that's the way it worked on this movie. The grade is happening as we start production. It makes a lot more sense."

On the set, Carling worked with a Codex Vault S to upload from the cards to sleds, which then went to the mobile lab, where a Codex Vault XL connected to a big network server was used to generate work files. The 'lab' was usually in a nearby hotel, or somewhere close so that Fraser and Davis could have a quasi-dailies screening at wrap.

"We did a lot of grading in that situation," says Rudkin. "Often there's a couple of months of work that gets thrown away when you move into the DI, and it's work that is often more informed by the whole process of making the film. You lose a huge body of knowledge about what's right for the show. If I come in to do a DI and I don't have that knowledge, I spend a hell of a long time just working on what things are supposed to look like. But if you've got that worked out, and can carry that along, you've got a very solid foundation. I did a comparison the other day between the dailies grade and the final, and it was quite amazing how close they were."

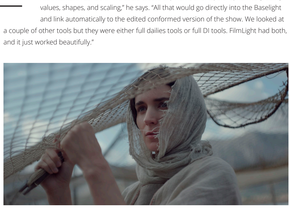


The other benefits of maintaining an accurate dailies grade are numerous: If the DP can't be present for the grade, or if the post house changes, his or her intent is more likely to survive. Test screenings, AVID and all subsequent versions of the cut are pre-graded to a high degree of quality, with more informed decisions the result.

A normal day's shoot generated between eight and twelve terabytes of data, with a high of 20 TB. The Codex Vault offers two methods for creating files. "You can generate media, or you can archive it," says Rudkin. "Archiving is more secure but is slower. We found that there's a lot more metadata available to us through archiving, so we adjusted some of the other parameters around verification to speed things up. Once it was offloaded into high-speed shared storage, we could sit with our dailies grading tools and access it at high speed."

> **The grade is happening as we start production. It makes a lot more sense**
> Christopher Rudkin

To make sure all of the information from the dailies grade was carried into the DI, Rudkin needed a system that could manage it. He used FilmLight Daylight with a P3-tuned monitor for dailies and Baselight for the grading, all provided by ARRI Rental in London. "We could create any number of layers, dynamite grading values, shapes, and scaling," he says. "All that would go directly into the Baselight and link automatically to the edited conformed version of the show. We looked at a couple of other tools but they were either full dailies tools or full DI tools. FilmLight had both, and it just worked beautifully."



Rudkin likes the principle of ACES, but in this case, he preferred to work from a log space, using LUTs creatively. "Greig and Garth were both adamant that all the images should be soft, natural and unprocessed," says Rudkin. "If there was anything that would take away detail from the shadows, it was just not an option. Sometimes if we were in a sunny environment and looking the other way, the LUT would do strange things to the skin tones. I could just remove the LUT or key it out. In the online, I actually blended LUTs together for one look. Having the freedom to experiment a little was wonderful."

The ability to dependably and easily track and carry on decisions in metadata is a game-changer for Rudkin. "Before, that was a closed door," he says. "To augment the metadata and have that follow through is a first step to making things easier. We had a huge range of lenses, and each of them had a different colour bias and lens coverage. When I started grading for the day, I'd do a pass to create metadata that would produce a camera negative that was consistent, without being limited to a single exposure.

"That ability to get right under the hood and fix things is fantastic," says Rudkin. "In the old days, the gear was so cumbersome and held together with duct tape. There was not a single, comprehensive solution like we have nowadays with the Vault. The portability, functionality, and speed mean that when you're getting 10 TB of data, you don't freak out. The Vault sets everything up downstream – it's the first part of the chain, and everything else hangs off of that."

Mary Magdalene was released in late March 2018 by Universal Pictures.

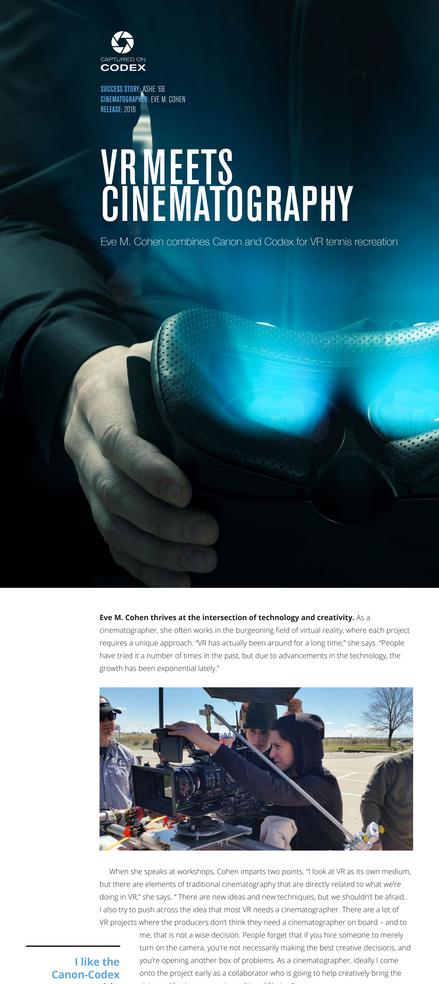
Cameras: ARRI ALEXA 65
Lenses: ARRI Rental PRIME DNA lenses plus a wide assortment
Amount of data: Approximately 600 TB
Rental House: ARRI Rental London
Post Partner: Soundfirm in Melbourne

SHOT/EDITED ON
CODEX

SUCCESS STORY: ASHE '68
CINEMATOGRAPHY: EVE M. COHEN
RELEASE: 2018

VR MEETS CINEMATOGRAPHY

Eve M. Cohen combines Canon and Codex for VR tennis recreation



Eve M. Cohen thrives at the intersection of technology and creativity. As a cinematographer, she often works in the burgeoning field of virtual reality, where each project requires a unique approach. "VR has actually been around for a long time," she says. "People have tried it a number of times in the past, but due to advancements in the technology, the growth has been exponential lately."

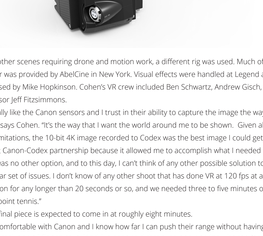
When she speaks at workshops, Cohen imparts two points. "I look at VR as its own medium, but there are elements of traditional cinematography that are directly related to what we're doing in VR," she says. " There are new ideas and new techniques, but we shouldn't be afraid. I also try to push across the idea that most VR needs a cinematographer. There are a lot of VR projects where the producers don't think they need a cinematographer on board – and to me, that is not a wise decision. People forget that if you hire someone to merely turn on the camera, you're not necessarily making the best creative decisions, and you're opening another box of problems. As a cinematographer, ideally I come onto the project early as a collaborator who is going to help creatively bring the vision to life, the same as in traditional filming."

> **I like the Canon-Codex partnership because it allowed me to accomplish what I needed to**
>
> Eve M. Cohen

In late 2017, Cohen served as cinematographer on a VR project that offered a worthy challenge to her problem-solving and creative skills. *Ashe '68: The VR Experience* is partnered with a feature documentary about the iconic athlete and activist Arthur Ashe. The VR project recreates Ashe's pivotal victory at the men's singles final of the 1968 U.S. Open Tennis Championship. The piece required four distinct VR shots that will allow viewers with a monoscopic headset to see in any direction. The most complex shot was a re-creation of the dramatic match point, re-enacted on the shoot by two tennis pros. Applying her experience and network of VR pros, Cohen designed the perfect camera/lens rig to achieve the visual goals of the project.

Re-creating a match point that actually happened in a virtual reality space is a tall order in and of itself, but as with any shoot, there were other complicating factors. Step one was carefully planned with a trio of directors – Brad Lichtenstein, Jeff Fitzsimmons, and Rex Miller – as well as producers Beth Hubbard and Maddy Power, and live action director Janicza Bravo.

"Once we nailed how to accomplish that scene, that would guide the rest of the shoot," says Cohen. "The placement of the live action on the tennis court dictated the field of view that I needed to capture in one lens. We were only using the live tennis play, but adding in full VFX background later, so the court was wrapped in chroma blue screen – and that dictated the amount of resolution I needed to deliver."



The directors also wanted the ability to speed ramp during the shot. In the final frame of the shot, the hero tennis player had to be as close to the camera as possible to bring the audience into the action. One more consideration: The actor playing the hero tennis player was 6'7", which would have a significant impact on final placement and composition. The actor's proximity to the camera and the stitch line in the middle of that shot precluded any stereo or side-by-side delivery. Given these parameters, it was determined that the best result would be achieved by shooting nodally, where the VR space and the camera are centered on a single point in space.

> **I look at VR as its own medium, but there are elements of traditional cinematography that are directly related to what we're doing in VR**
>
> Eve M. Cohen

All these factors and more were weighed in the equipment choices. "Finding something that could give me that huge field of view, at 120 frames per second, with adequate resolution, seemed impossible," says Cohen. "I started by finding the right lens. We watched the actual match and mapped out how the players moved, and where they ended up. We found that we needed an approximately 280-degree field of view, which we cheated slightly – we agreed to keep everything within about 200 degrees."

At Radiant Images, Cohen found a 4.3 mm Entaniya super-wide fisheye lens that sees a 250-degree field of view that would fulfill her needs. At that time, only four existed and they were all in Radiant's inventory. The next question was the camera. Shooting nodal also meant that Cohen could choose a solid pro camera with sufficient resolution.

Radiant recommended the RED 8K Helium, but that camera crops in on the sensor at the high frame rate, sacrificing too much field of view. After extensive research, Cohen asked Loren Simons at Canon if the C700 crops the sensor at 4K/120 fps. The answer was no. She immediately went to Canon in Burbank to see whether the Entaniya lens would be compatible with the C700.

"Loren was so excited to see if this was going to work," says Cohen. "It's really fun when you're using something for the first time and seeing if every piece is going to fit together the way you need it to. The lens has an adaptive EF mount, and they are proprietary for each camera. It actually fitted. I was so happy. I have the lens. I get my 120 frames. And I have my field of view, and with Codex recording and the C700, I can have my resolution.

"We didn't have the budget to shoot each scene with a different camera," she says. "Once we decided on the C700 for the tennis scene, I knew it would work perfectly for the other scenes. I could feel very confident about the sensor and the camera, knowing I could fully control it visually. Because we were shooting nodally, I could fully light the interior scenes. So that the camera and the Codex recorder were used on two of the four scenes."

The C700 recorded the scene twice, once for each half of the 360-degree environment. The images were married later in post. On the set, the package included six 1TB Codex Capture Drives, which hold just under ten minutes at 120 frames. Footage was constantly offloaded to a Codex Vault as Cohen and the directors made more than thirty takes. Overall, the Vault handled 3.13 terabytes of data.

For other scenes requiring drone and motion work, a different rig was used. Much of the gear was provided by AbelCine in New York. Visual effects were handled at Legend and supervised by Mike Hopkinson. Cohen's VR crew included Ben Schwartz, Andrew Gisch, and VR supervisor Jeff Fitzsimmons.

"I really like the Canon sensors and I trust in their ability to capture the image the way that I want," says Cohen. "It's the way that I want the world around me to be shown. Given all the other limitations, the 10-bit 4K image recorded to Codex was the best image I could get. I like that Canon-Codex partnership because it allowed me to accomplish what I needed to. There was no other option, and to this day, I can't think of any other possible solution to that particular set of issues. I don't know of any other shoot that has done VR at 120 fps at a higher resolution for any longer than 20 seconds or so, and we needed three to five minutes of match-point tennis."

The final piece is expected to come in at roughly eight minutes.

"I'm comfortable with Canon and I know how far I can push their range without having the image break down," Cohen says. "And I've been told that everyone working with the footage, including the producers and the visual effects people, are really blown away by the quality of it, especially for VR. So much VR is done on poor quality cameras. There's just no comparison between a professional cinema camera and a hobbyist, consumer GoPro."

Cohen adds that because VR is a relatively new medium, there isn't a precedent or dependable source of answers. "You have to come up with them on your own," she says. "We're experimenting with everything VR has to offer - and discovering the possibilities. We learn so much in every endeavour. Finding the right combination of technology for this project took a lot of dedication and research. Every single time, we're solving a new technical and creative challenge. And I love figuring that out."

Camera: Canon EOS C700
Lens: 4.3 mm Entaniya super-wide fisheye
Data processed: 3.13 terabytes
Rental House: Radiant Images, AbelCine