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## Biography

**Hans van 't Woud** (1983) was born in Leiden, the Netherlands, and studied Human Centred Multimedia at the University of Amsterdam where he was awarded his MSc degree for this research. Before this he graduated with a Bachelor's degree from Rotterdam University, and in part also, the Willem de Kooning Academy of Arts, in Communication and Multimedia Design. After this he worked a period as product manager for a company involving health-care software. During his Master's study at the University of Amsterdam he participated in a project regarding learning with mobile devices, where he was responsible for the general interface design. Nowadays he is a fulltime entrepreneur for his company, BlackShore — creative, where he is taking Cerberus to the next level. For this he is collaborating closely with and participating in the ESA business incubation centre in the Netherlands.

# Carbon Based Lifeforms @ Cosmonova: A Concert in Sight and Sound for IYA2009

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## Keywords

*International Year of Astronomy 2009, Arts, Music, Lightshow*

## Summary

Replacing its conventional analogue planetarium with a digital fulldome system, the Cosmonova theatre at the Swedish Museum of Natural History sought to come up with a variety of public offerings for the International Year of Astronomy 2009. Besides several fulldome shows it was decided that a concert of live music would both celebrate the year as well as attempt to attract a new audience.

Originally planned as a conventional planetarium, Cosmonova opened in mid-October 1992 as a combined ImaxDome 15/70 large-format film theatre and an Evans & Sutherland Digistar I video planetarium, both operating within the same 23-metre dome. With a 30-degree tilt the dome covers a large part of the audience's peripheral vision, making for a very immersive experience. Besides showing "off-the-peg"

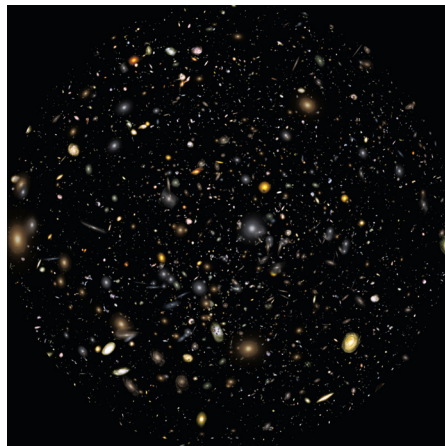
large-format IMAX films, a number of original planetarium shows were created that involved both Digistar and analogue media, such as 35 mm slides, videos, custom-built all-sky projectors that cover the dome and offered spectacular special effects, and even astronomy-themed IMAX film clips. While Cosmonova was one of the most technically advanced facilities in the world when it opened, by 2006 it was ob-

vious that an upgrade was needed to bring the theatre into the 21st century.

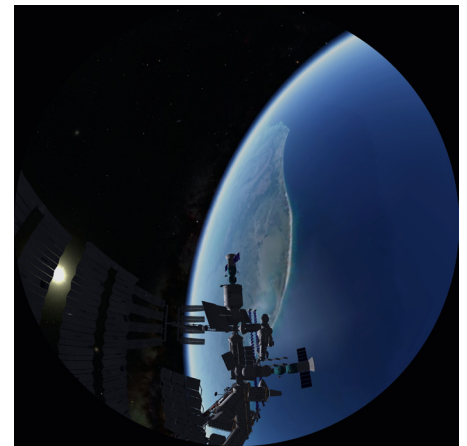
After the renovation, Cosmonova planned to show a selection of astronomy-related fulldome video shows during the International Year of Astronomy 2009, as well as featuring a small mini-exhibit with some historical telescopes outside the theatre's entrance. It was also thought that a



*Figure 1. Kokopelli, the humpbacked rain god and muse of music for a number of Native American tribes from southwestern US states, descends from the summer skies over the ruins of Wukoki, a structure built by an ancient pueblo people in Arizona, south of Flagstaff. Credit: T. Callen and Cosmonova.*



*Figure 2. Hundreds of galaxies fill Cosmonova's dome in this image from the Hubble Space Telescope. Transformed into a three-dimensional video, it was possible to travel through them just as if one were travelling through the real Universe. Credit: NASA/ESA, T. Callen and Cosmonova.*



*Figure 3. SCISS AB's Uniview™ rendition of the International Space Station (ISS) hangs in orbit some 350 kilometres above Earth's surface. Since the members of Carbon Based Lifeforms were so taken with a demonstration of the ISS in Cosmonova one whole song in the concert, MOS 6581, featured it. Credit: T. Callen and Cosmonova.*

live concert in the theatre with an astronomical and/or space theme would go over well. Cosmonova had hosted several live concerts in the past and produced appropriate visuals to show on the dome overhead. A general call for suggestions to the whole Museum staff bore fruit in the form of an idea from Hanna Taylor, who worked in one of the research departments. She knew of a Swedish ambient electronic music group, Carbon Based Lifeforms (CBL), whose music might be suitable. CBL was also a group that had performed live in a variety of different types of venues so playing under a planetarium dome would not be a problem for them.

CBL formed in 1996 and at the time of the concert consisted of members Johannes Hedberg and Daniel Segerstad. Based in the western coastal city of Göteborg they had three albums to their credit and a wider global following, although much of this was based in Europe. After a meeting in May 2009, it was decided to hold a live concert in Cosmonova late in the year, with CBL to provide the music and Cosmonova to provide the visuals. To make the concert even more special to their fan base CBL wanted to include three tracks from an as-yet unreleased album to mix in with others that were considered to be "classics". A total of seven tracks were decided on, making the whole show 45 minutes long.

Using copies of all seven live concert tracks for inspiration and reference I set about producing the visuals. Having worked with

creating musical light shows as far back as the late 1970s when I was a graduate student at Michigan State University's Abrams Planetarium in the US, this was going to be both a challenge and a lot of fun. CBL hadn't set any restrictions, so the concert's visuals could go in any direction that seemed appropriate. Since I was now working in a completely digital domain, production techniques had changed significantly in the years since I had made the visuals for Cosmonova's previous live music concerts. Instead of having to use Digistar, 35 mm slides, videos and all-skies synchronised via an automation system I had a whole new palette of digital tools at my disposal on the fulldome video system's production workstation.

SCISS AB's Uniview is the software used for Cosmonova's new digital planetarium and it was to provide any original astronomically-based video clips. Three-dimensional camera paths manually "flown" with the workstation's mouse could be recorded and rendered out of Uniview at 3200 × 3200 pixel resolution for later processing. Some examples of clips created in Uniview were flybys of planets, tours between galaxies, a view of the slowly turning band of the Milky Way changing through various parts of the electromagnetic spectrum, a scintillating night sky seen from the Arizona desert and the cosmic background radiation that pervades the Universe.

Adobe Photoshop CS3 was used to create and/or process digital photographs that I

had taken, as well as to prepare scanned all-sky images that had originally been shot on 120 roll or 4 inch × 5 inch sheet film with special ProDome all-sky cameras. Wondertouch's particleIllusion 3.0 software was used to generate a video clip of a dome full of microscopic paramecium-like life scurrying around. One original video clip had its origins in a film I made of sunlight obliquely reflecting off of the tops of waves on the bay in front of my house on the island of Rindö in the Stockholm archipelago.

Adobe AfterEffects CS3 was then used to compose all the various visual elements against each of the seven individual music tracks. In order to check the synch between audio and visuals, low resolution test renders were made as needed. Once the visuals were completed for all the music tracks the whole concert was rendered out in high resolution. From there the 132-gigabyte file was copied onto a portable hard drive and turned over to Cosmonova's technicians for a process colloquially known as "carving" (or "slicing and dicing" in some fulldome circles).

The standard for image files in a fulldome video show is circular and known as the dome master format. The centre of each dome master image represents the zenith of the planetarium's dome while its circular edge marks the 360-degree horizon with the bottom of the image south and directly in front of the audience. In our system 30 images are shown per second,



**Figure 4.** Carbon Based Lifeforms, Göteborg, a Swedish ambient electronic music group, and then (November 2009) band members Johannes Hedberg (left) and Daniel Segerstad. Credit: M. Fredriksson and Carbon Based Lifeforms.

which means that there are 1800 images displayed per minute. Since there are six projectors that present a fully blended image on the dome of a full-dome video show, each individual dome master image (some 81 000 for the 45-minute concert!) must be split into six pieces (for a total of 486 000 pieces); one complete set for each video projector's associated file server. In order to do this, a special program "carves" the images into these six video streams while taking into account the target and blending areas on the dome for each of the six projectors.

A copy of the concert's audio was also transferred to Cosmonova's audio servers as a back-up in the event that CBL's equipment had a technical malfunction, although this was thought to be highly unlikely. Unfortunately, there could be no such back-up in the improbable event that the full-dome video system developed a problem.

In order to make sure that CBL's final performance would match the visuals, a 720 × 720 pixel low-resolution version of the whole concert was sent to the group and happily enough they found it to agree to within a fraction of a second with the music track they would play at the concert. This was a major relief as the audio work in *After Effects* was new to all of us.

We had first planned on only one concert on Friday, 28 November 2009, but the demand for tickets — even from European-based fans outside Sweden — was so great that it was decided to add a second

concert the following night. As it turned out the first night sold out completely, while the second night was just short of doing the same. CBL arrived in Stockholm from Göteborg on Thursday and after setting up their equipment and integrating it with Cosmonova's sound system we had a dress rehearsal to check out the audio and visual elements together on the dome for the first time. Considering the vastness of CBL's musical soundscape there was only an office tabletop full of their synthesizers, laptops and audio equipment, plus Johannes Hedberg's electric guitar, which was fed through outboard sound processors. After several run-throughs to ensure that the live version of the concert would work, everyone sat down together and watched the concert while the so-called "just in case" emergency back-up soundtrack provided the music.

Friday night's audience was definitely made up of hardcore fans as CBL got a lively response when they entered and took up their positions in the front stage area of the theatre. At the end of the concert they received a standing ovation, and, based on people's reactions as they left the theatre, the concert was a success. A special area just outside Cosmonova's exit, and within a Museum exhibit area, was set up so that the band could "meet and greet" their fans afterwards, which also saw a lot of CD signing and lively conversations with the band.

Saturday night's audience, while not made up mostly of fans, was just as eager with anticipation. I was standing up front in the stage area keeping an eye on the band's equipment as the audience took their seats when I recognised an elderly woman who I had seen accompanied by a friend of hers from the night before. As she passed by she recognised me and (with a different person in tow that evening) came over to tell me that: "There were tickets left for tonight and I just had to come again." And she was not the only person who I saw attending both concerts. Clearly this was music that appealed to a variety of ages, as there were people present from grade school and up. As on Friday night the "meet and greet" area outside Cosmonova was set up again.

With two successful nights of concerts, Cosmonova fulfilled at least two goals; having a live astronomy-related musi-



**Figure 5.** Astronomer/Programme Producer Tom Callen in Gamla Stan (Old Town), Stockholm. Credit: C. Russo.

cal performance during the International Year of Astronomy 2009 and introducing people who might not normally come to Cosmonova to the types of things that they do. Listening to the audience as they left the theatre it was evident that there were people in attendance who were in this latter category, and some made a point of coming up to Cosmonova staffers to tell them that they would be back to see some of their other show offerings.

Could it be done again? I think that both Carbon Based Lifeforms and Cosmonova were pleased with the final results and there is no doubt — based on the positive comments and the pirate video clips shot from out in the theatre that were later posted on YouTube ([www.youtube.com/watch?v=LokHAcHliVQ](http://www.youtube.com/watch?v=LokHAcHliVQ), [www.youtube.com/watch?v=9DEpyze0Zs8](http://www.youtube.com/watch?v=9DEpyze0Zs8) and [www.youtube.com/watch?v=rgMN9UEH4Zc](http://www.youtube.com/watch?v=rgMN9UEH4Zc)) — that the audience would do it again too!

## Biography

**Tom Callen** is the former Astronomer and Programme Producer at Cosmonova, the Imax-Dome, digital full-dome video planetarium and 3D theatre at the Swedish Museum of Natural History, Stockholm. Prior to coming to the Museum in 1991 he was at the Albert Einstein Planetarium at the Smithsonian Institution's National Air and Space Museum in Washington, DC., for 13 years. He has also worked at three other planetariums in the United States. Today Callen is Managing Director of *eyemmersive*, a newly formed company that specialises in scientific visualisations with an emphasis on space and astronomy applications. Long interested in all types of music he currently finds a more personal music outlet playing "Pratt," his hybrid digital/analogue drum set.