
Vicent Peris Astrophotography

With more than a 15 year career as astrophotographer, Vicent Peris (Valencia, 1980) has been working for the last 7 years at the Astronomical Observatory of the University of Valencia, Spain. He is now leading an astrophotography project, started 5 years ago, in collaboration with the Calar Alto Observatory. This is the first astrophotography project in the world with access to the observational time of professional telescopes (about 50 night per year). Along with this project, he is also co-founder of the Documentary School of Astrophotography, the first school of thought in the astrophotography discipline.

In addition, Peris has been a member of the development team of PixInsight during the last 10 years, an advanced, modular image processing software platform designed specifically for astrophotography and other technical imaging fields. You can see some of the published images within the Calar Alto project in the PixInsight website as well as some of his articles about his own image processing techniques.

Along with his photography production, he has a teaching career, giving astrophotography workshops and lectures around America and Europe.

Peris has also successful experience in forensic image processing and has worked during the last years as an image processing specialist for the Spanish National Police department. Right now he's teaching in a Master's Degree on Criminology at the University of Valencia.

In this document we are going to do a brief description of the past and present works being done by the author.

Cover image

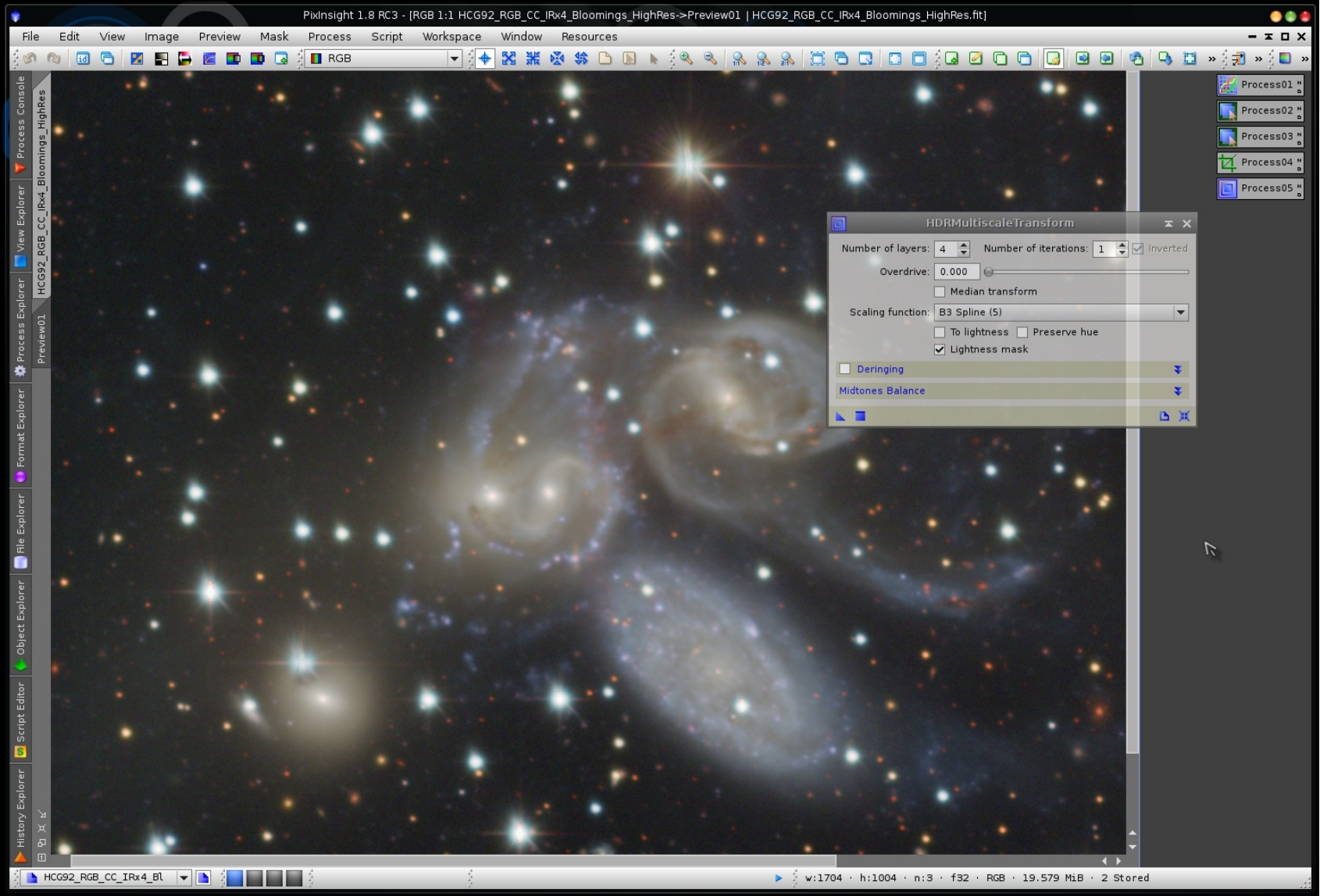
Star forming region NGC 6914 in constellation Cygnus. 23-hour exposure time with a 1.23-meter telescope and SITe back-thinned 2Kx2K CCD sensor.
CAHA / Descubre Foundation / DSA / OAUV / Vicent Peris (OAUV) / Jack Harvey (SSRO) / Juan Conejero (PixInsight).
More information at PixInsight Gallery.

Image Processing

Vicent Peris has a degree in Piano. He studied at the Conservatory of Castellón, Spain, with Antonio Soria. His research in music centered on the relation between basic musical concepts and multiscale image processing techniques, from which he devised new technical piano concepts.

This research also gave as a result new techniques for astrophotography image processing. His dynamic range processing algorithms are today the gold standard in the astrophotography community.

He have been part of the core development team of the PixInsight Platform during the last eleven years. Some of his image processing techniques have been implemented in this software, providing the users with avant-garde tools for their imaging needs. His most known technique is the *HDR multiscale transform* algorithm, designed to control the dynamic range of images. We are going to show some examples of these techniques in the next pages.



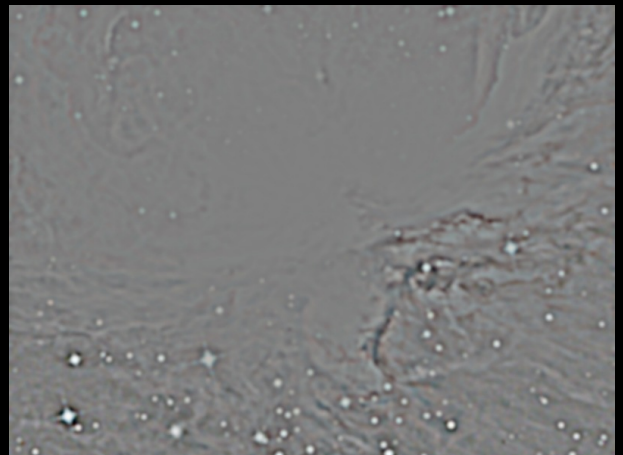
High Dynamic Range Multiscale Transform

The High Dynamic Range Multiscale Transform algorithm (HDRMT) is an algorithm designed to control the dynamic range of images. HDRMT is based on the à trous wavelet and multiscale median transform algorithms. While the wavelet transform is able to separate image structures as a function of their characteristic scales, HDRMT is a step forward that further separates and isolates individual wavelet layers and their contained structures. In this way, local contrast of structures defined in a given wavelet layer is not perturbed by larger structures defined in subsequent layers.

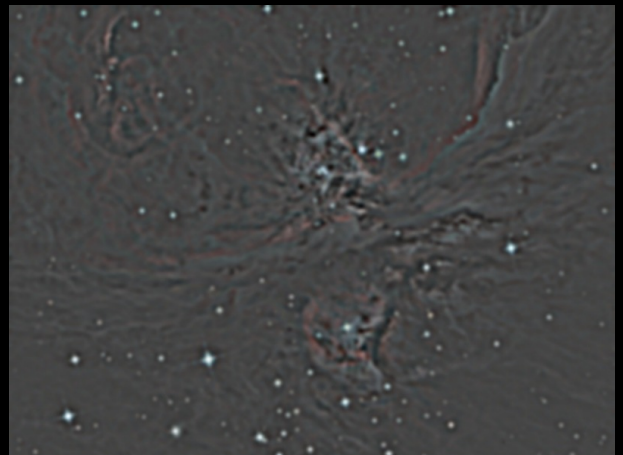
The HDRMT algorithm can act on *all* significant image structures throughout a wide range of dimensional scales, and it can do so in a very controllable way. This algorithm is extremely stable and resistant to many of the problems that are quite frequent with other techniques, such as oversaturation of bright features, and ringing artifacts around high-contrast structures. This makes the algorithm a very good solution for *automated image processing and machine vision*. With HDRMT and its implementation on the PixInsight platform (which supports up to 64-bit floating point real images), we can deal with dynamic ranges *of any practical size*. We are going to show some sample cases of application of HDRMT, all of them processed automatically with this technique.

Original image.

À trous wavelet transform, 4-pixel scale.



HDR multiscale transform, 4-pixel scale.



Extreme case of automatic HDR processing
14-stop HDR image. Exposures ranging from 1/4000 to 2 seconds.

Extreme case of automatic HDR processing
Processed with HDRMT.

Emission nebula Messier 42
Original image. HDR image with an exposure time set ranging from 2.5 seconds to 30 minutes.

Emission nebula Messier 42
Processed with HDRMT.

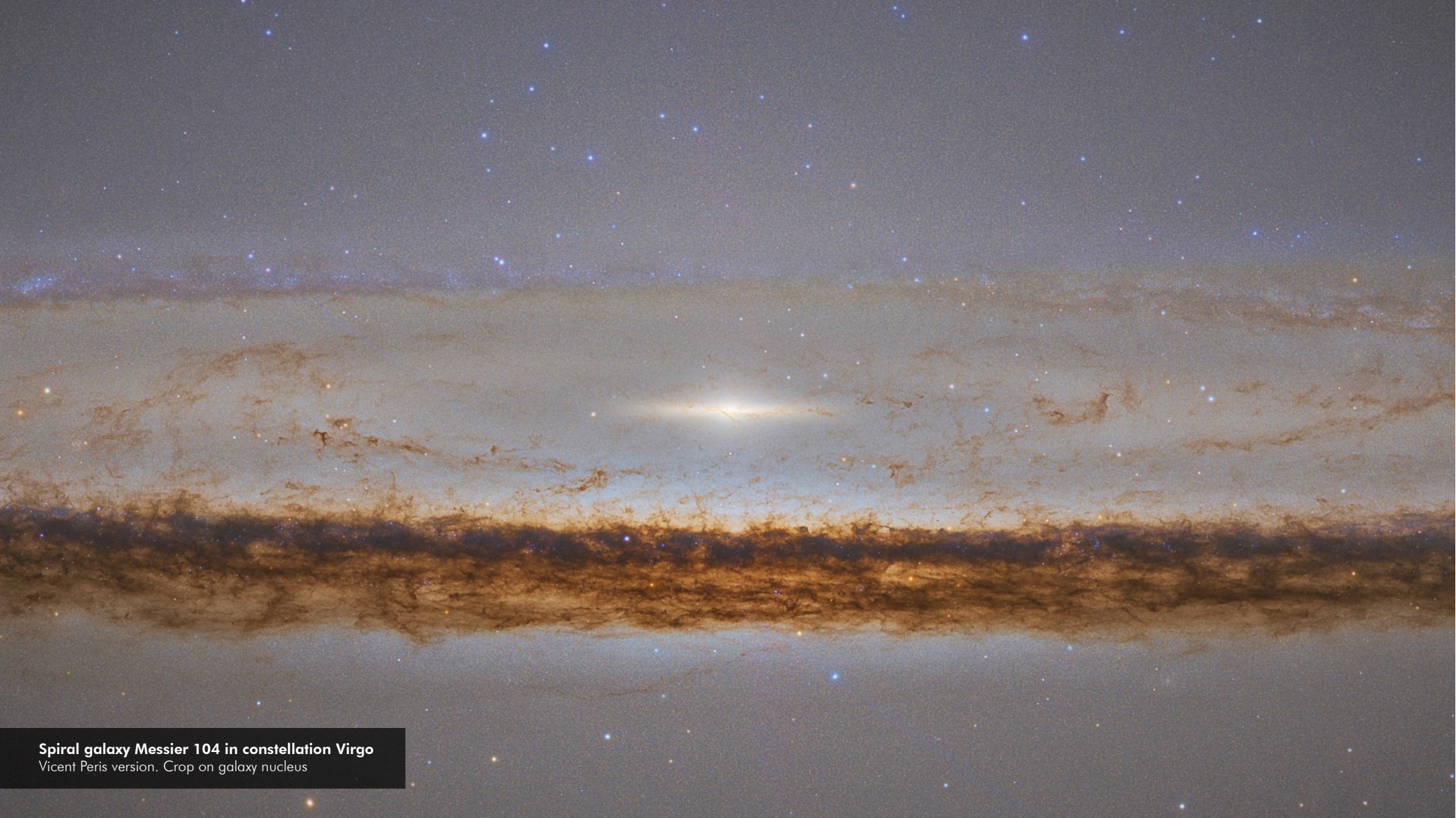
Spiral galaxy Messier 31
Original image. HDR image of 2 and 7-minute exposures.

Spiral galaxy Messier 31
Processed with HDRMT.

Spiral galaxy Messier 104 in constellation Virgo
Official Hubble Heritage image (processed without HDRMT).

Spiral galaxy Messier 104 in constellation Virgo
Vicent Peris version, processed automatically with HDMRT in PixInsight. APOD on 2008 March 8th.

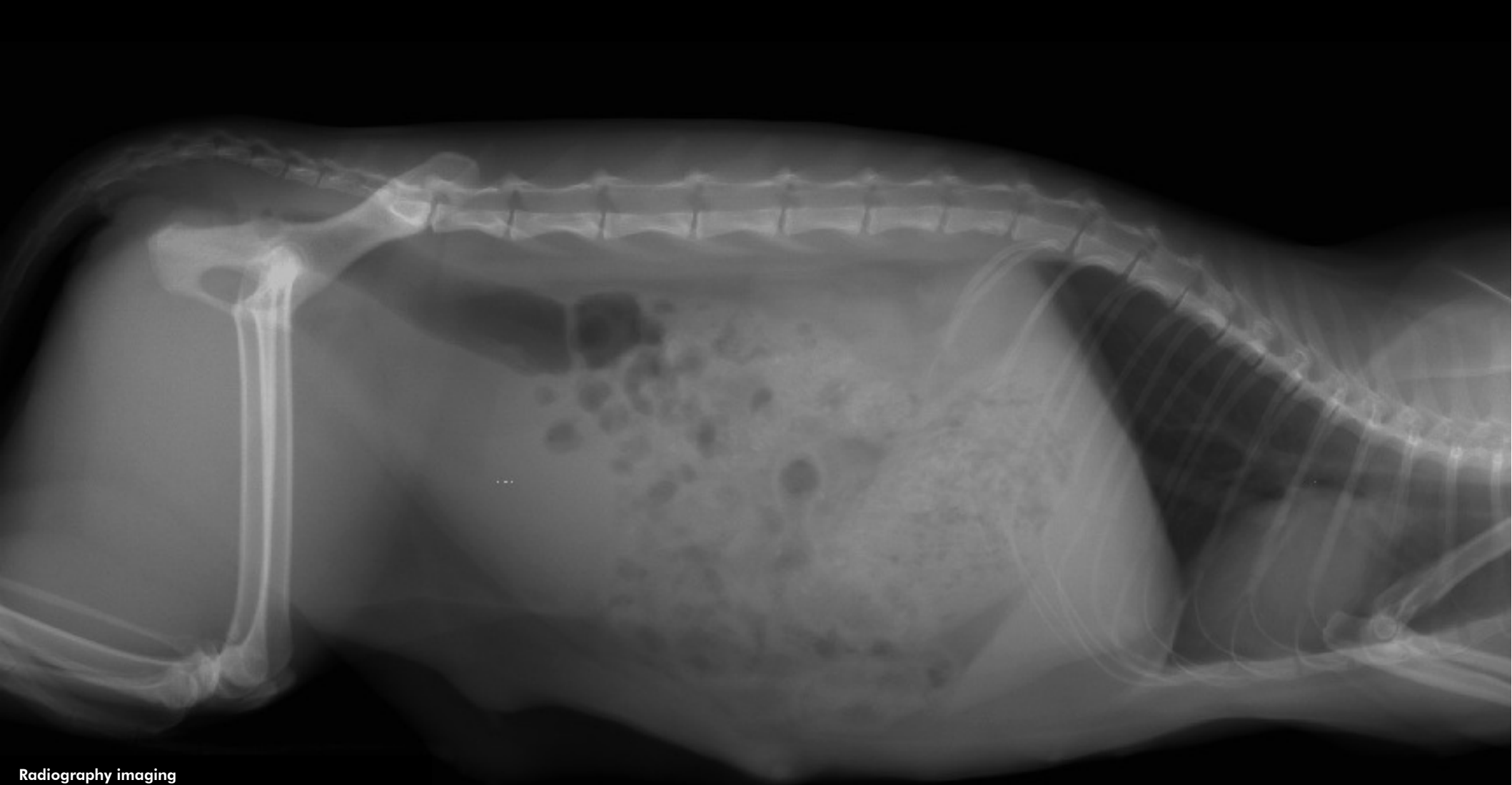
Spiral galaxy Messier 104 in constellation Virgo
Official Hubble Heritage image. Crop on galaxy nucleus



Spiral galaxy Messier 104 in constellation Virgo
Vicent Peris version. Crop on galaxy nucleus

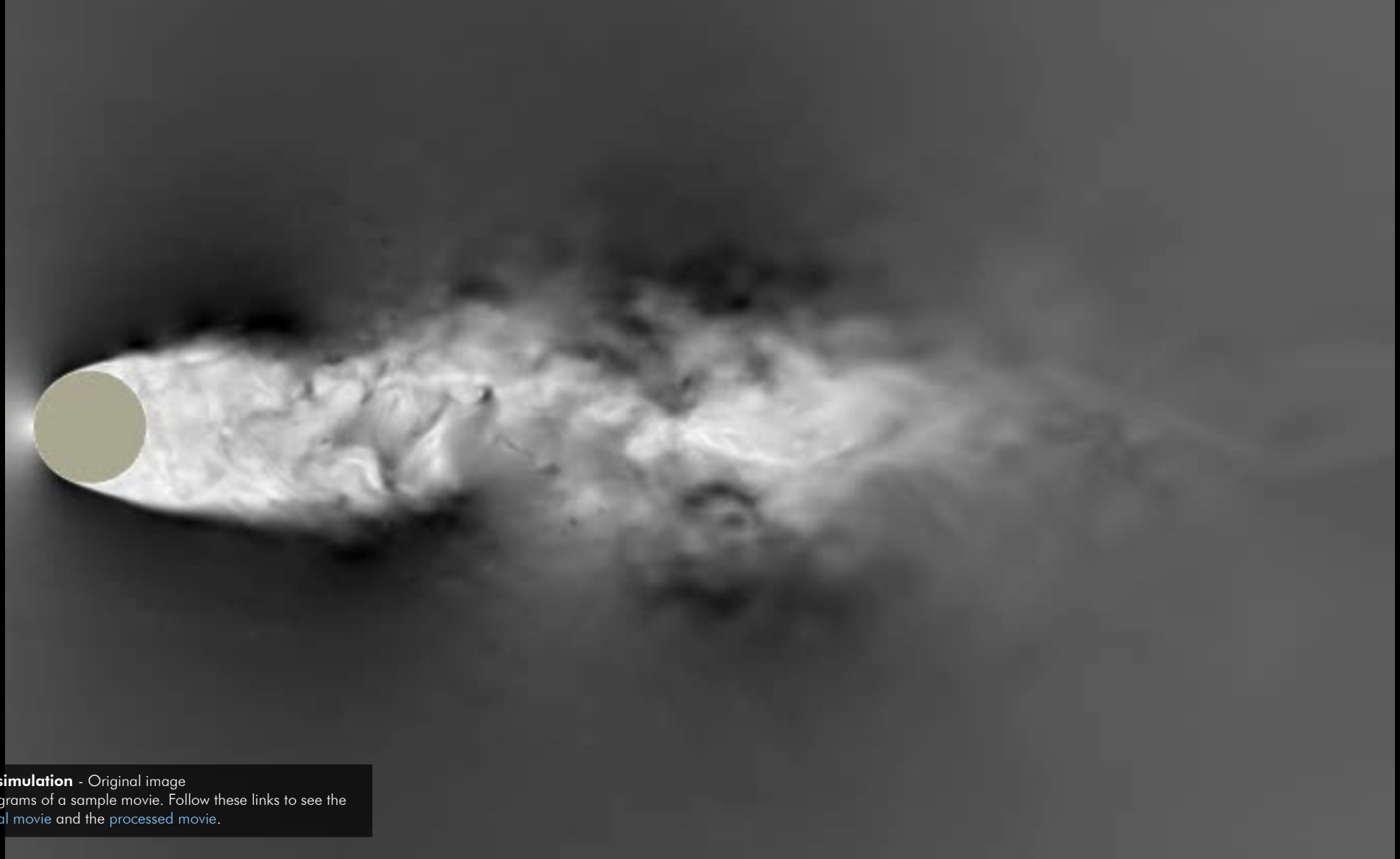
Aerial photography: Pyrenees mountain range (Spain)
Original image acquired with a 4-megapixel compact digital camera.

Aerial photography: Pyrenees mountain range (Spain)
Image processed with HDRMT.

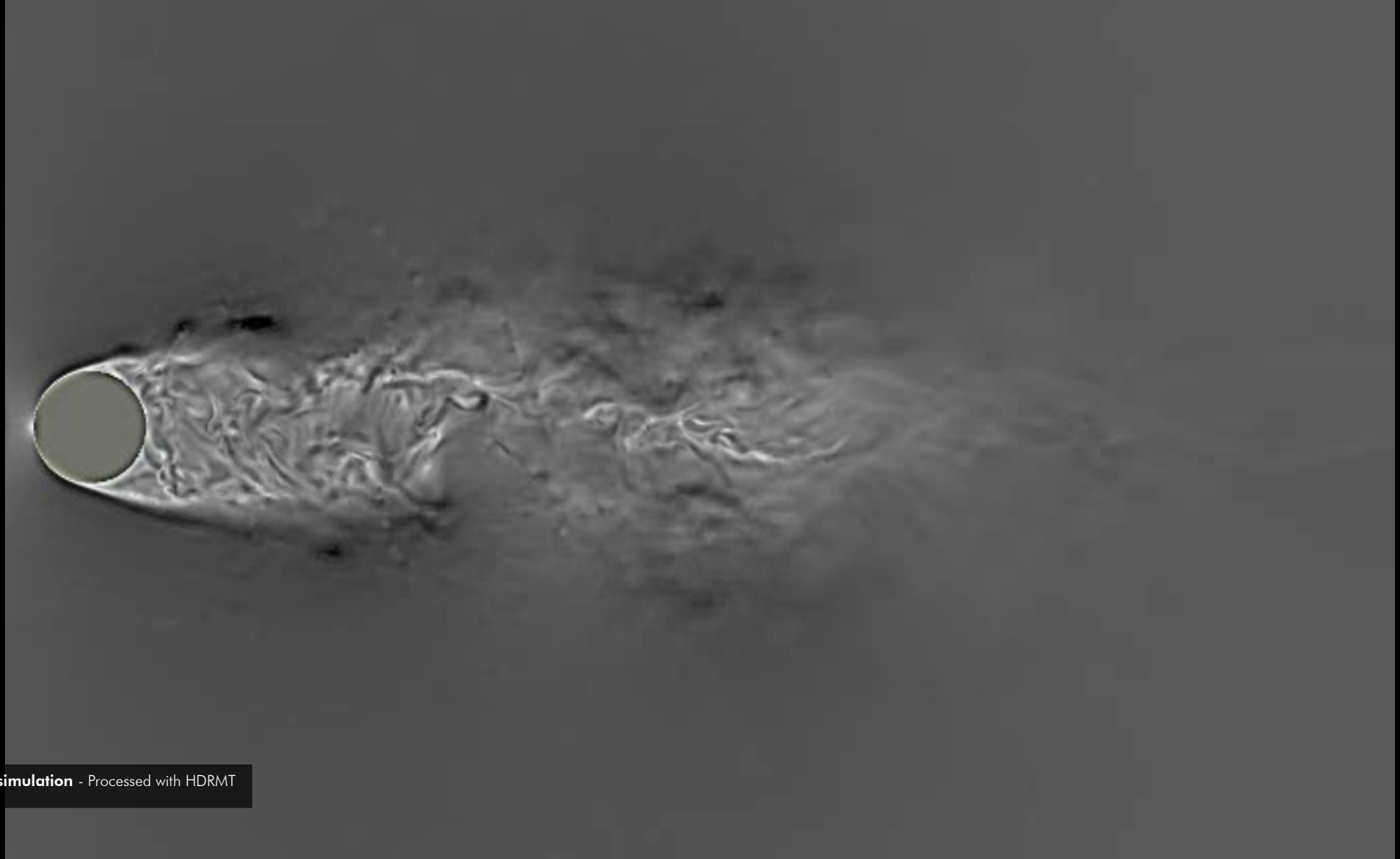


Radiography imaging
Original image.

Radiography imaging
Processed with HDRMT.



CFD simulation - Original image
Photograms of a sample movie. Follow these links to see the original movie and the processed movie.



CFD simulation - Processed with HDRMT

Forensic imaging

Works for the Spanish National Police Department

In 2012 – 2013, Vicent Peris worked for the Spanish National Police Department in a double murder case analyzing video images.
The goal of this work was to identify the suspicious car and to reconstruct its itinerary. Two of the contributed evidences are shown in these pages.

Identification of completely unreadable, 30-pixel wide vehicle plates using novel techniques that combine statistical and astronomical image processing concepts.

Video processing to detect moving objects.

Original video

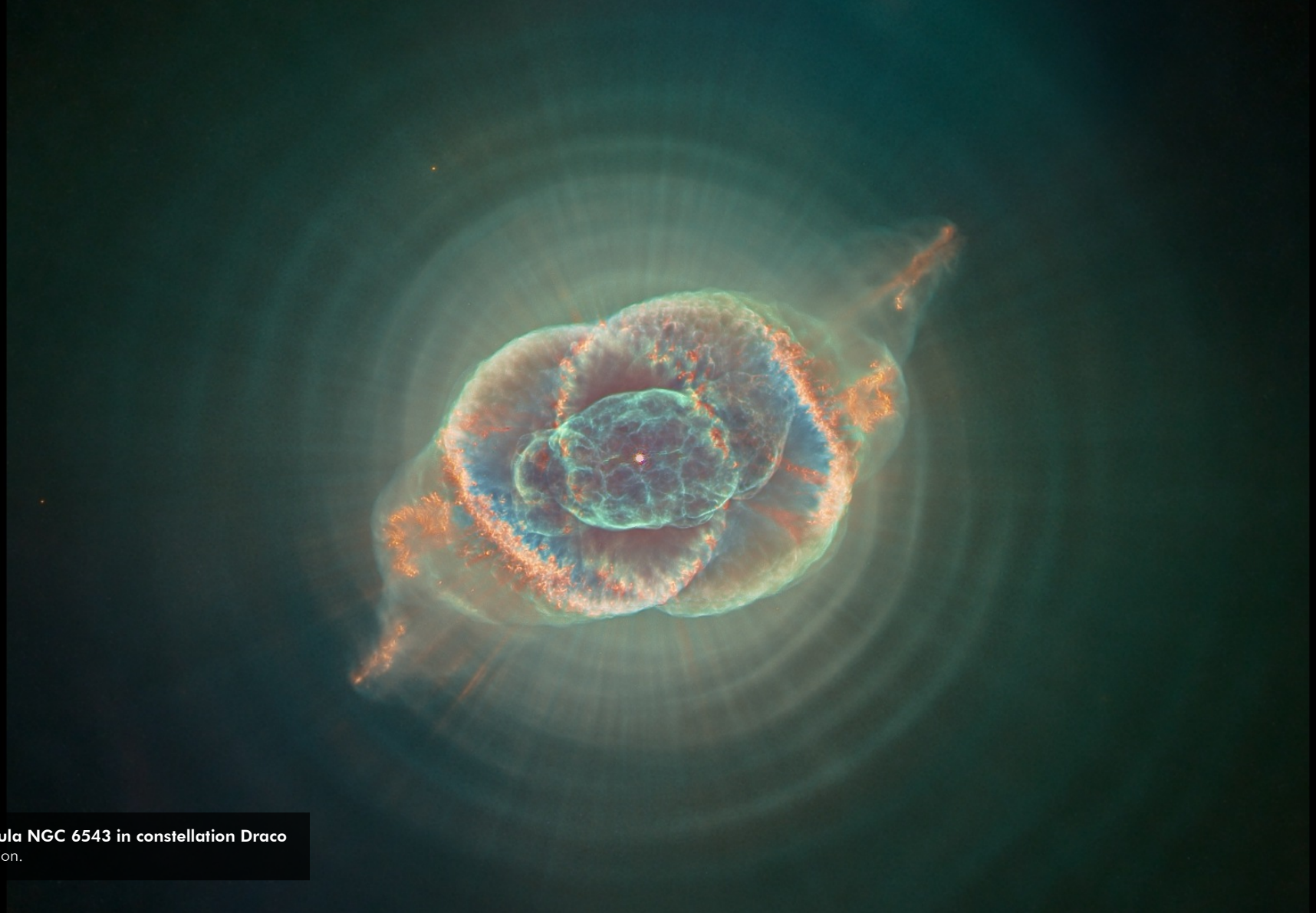
Processed video

The plate identification and the detection of the car going into and leaving the crime scene were critical to solve the case. These evidences allowed the Police to reduce the victim search radius from the whole Europe to 5,000 square meters.

In 2013, José Bretón was considered guilty (and sent to prison for 25 years) of a double murder of his 2 and 6 years old sons in a specially prepared bonfire which was burning up to 1,000ºC. These contributed evidences were fully approved in the lawsuit.

Hubble Space Telescope Images

Planetary nebula NGC 6543 in constellation Draco
Official Hubble Heritage image.



Planetary nebula NGC 6543 in constellation Draco
Vicent Peris version.

Colliding galaxies NGC 4038/39 in constellation Corvus
Official Hubble Heritage image.

Colliding galaxies NGC 4038/39 in constellation Corvus
Vicent Peris version. Pay attention to the recovered dark nebula between both galaxies, in the lower right part of the image.

Calar Alto Images

Spiral galaxy NGC 7331 in constellation Pegasus
159-minutes exposure time with a 3.5-meter telescope and Fairchild Imaging 4Kx4K back-thinned CCD sensor.
CAHA / DSA / OAUV / Vicent Peris (OAUV) / Gilles Bergond (CAHA).
APOD on 2008 October 22th.
This image was elected by NASA's scientist Phil Plait as one of the top ten astronomy pictures of the year 2008.
Image published also at Scientific American online gallery. More information at PixInsight Gallery.

Planetary nebula PK164+31.3 in constellation Lynx
28-hour exposure time with a 1.23-meter telescope
and SITe 2Kx2K back-thinned CCD sensor.
CAHA / Descubre Foundation / DSA / OAUV
Vicent Peris (OAUV) / Jack Harvey (SSRO).
More information at PixInsight Gallery.

Planetary nebula Messier 57 in constellation Lyra
22-hour exposure time with 1.23 and 3.5-meter telescopes.
Data acquisition with optical (SITe 2Kx2K and Fairchild 4Kx4K back-thinned CCD sensor)
and infrared (HAWAII-2, 2Kx2K HgCdTe sensor) cameras.
CAHA / Descubre Foundation / DSA / OAUV
Vicent Peris (OAUV) / José Luis Lamadrid (CEFCA) / Jack Harvey.
Image published at the online gallery of National Geographic.
APOD on 2009 November 6th.
More information at PixInsight Gallery.

Spiral Galaxy Messier 51 in constellation Canis Venatici.
35-hour exposure time with a 1.23-meter telescope and SITe 2Kx2K back-thinned CCD sensor.
CAHA / Descubre Foundation / DSA / OAUV / Vicent Peris (OAUV) / Jack Harvey (SSRO) / Steve Mazlin (SSRO).
APOD on 2010 June 11th. More information at PixInsight Gallery.

Reflection nebula NGC 7023 in constellation Cepheus.
23-hour exposure time with a 1.23-meter telescope and SITe 2Kx2K back-thinned CCD sensor.
CAHA / Descubre Foundation / DSA / OAUV / Vicent Peris (OAUV) / Jack Harvey (SSRO) / Steve Mazlin (SSRO).
Unpublished image.

ALHAMBRA Survey

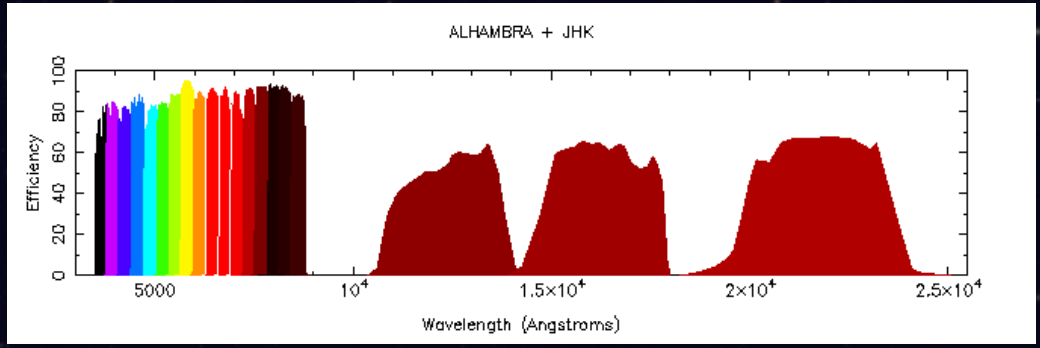
ALHAMBRA is a deep cosmological survey that covers a total area of 4 square degress in the sky. It uses 20 contiguous, equal width, medium band filters from 3500 A to 9700 A, plus the standard broad bands JHKs in the near infrared. The use of this filters system allows for the acquisition of low-resolution spectra of all the objects found in the images. By recognizing spectral features of the objects -like emission or absorption lines- some of their properties can be derived, one of them being redshift -doppler effect on the light due to the radial velocity of the object-, which gives the distance of the object to us. The survey has been performed with the 3.5 meter telescope at the Calar Alto Observatory (CAHA), making use of LAICA and Omega2000 intruments for the optical and the infrared respectively.

The ALHAMBRA-survey involves around 16 institutions of different countries, and around 70 scientist with different levels of implication. Vicent Peris is the astrophotographer of the project. In the work, Peris has developed a color calibration method for photography, today considered one of the gold-standards in astrophotography.

Vicent Peris and Juan Conejero developed a JavaScript script that automatically processes all the survey data sets and generates a RGB color image. Some of the ALHAMBRA fields are shown on the following pages. Almost all the objects in the images are far galaxies, which colors are reddened depending on their distance from us.

An article describing these techniques is available at PixInsight website.

Future plans include the automation of the generation of RGB images from the JPAS survey, being done in the next years at Javalambre Observatory. This survey is going to use the same methodology as ALHAMBRA with a set of 56 narrower filters and a 1.2-gigapixel camera. This tool will process and generate the RGB images in real time while the data is being acquired by the telescope.



The ALHAMBRA filter system

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