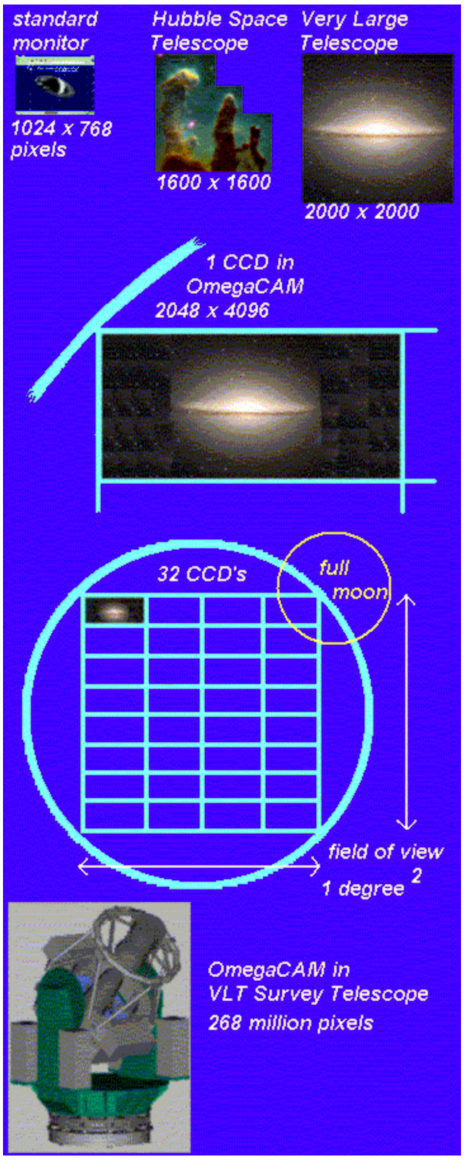
OMEGACAM: **Scanning the southern sky**



Telescopes can be 'biggest' in several ways, for instance with respect to the size of its primary mirror, or its spectral or spatial resolution. But the amount of data contained in one image is ultimately determined by the number of pixels in the digital camera at the focus of the telescope. In that respect, OmegaCAM, the camera for the VLT Survey Telescope (VST), will be the record holder on the southern hemisphere from 2003 on. This telescope will be located next to the four giant VLT-telescopes on mount Paranal, Chile. OmegaCAM will be the only instrument on the VST, which is highly unusual for a telescope in this class.

For technical reasons, the light-sensitive elements in digital camera's (CCD's) cannot be made arbitrarily large. The present limit is a CCD of a few thousand pixels squared. Consequently, OmegaCAM will consist of an array of 32 CCD's of 2048 x 4096 pixels each, creating a total of 16.384 x 16.384 pixels. The VST's 2.6 meter primary mirror and optics will project one square degree of the sky on the CCD-array, resulting in a mapping of .21 arc seconds per pixel. Theoretically, this enables the VST to discern a 1 Euro coin at more than 20 kilometers distance as a blip the size of a single pixel. In practice, resolution is limited by the 'seeing', the amount of turbulence in the atmosphere. The VST and VLT are located more than 2 kilometers above sea level, on the top of mount Paranal in the Chilean desert. Although the atmosphere there is extremely clear and quiet, even there seeing is rarely better than .5 arc seconds. So, OmegaCAM always has more than enough resolution to extract all available information from the images. The VST will 'scan' large parts of the sky that are visible from Chile, starting in 2003. The entire sky spans 40,000 square degrees, 30,000 of which can be observed by the VST. Expressed in standard computer monitor resolution, each VST-image would be a picture measuring more than 5 meters squared and the size of the total sky survey would be a map covering almost one square kilometer!

This survey will be instrumental in the hunt for rare and extreme objects, as well as in taking large samples of more common objects for statistical purposes. Rare objects might include planetary nebulae in old star clusters, gravitationally lensed galaxies or stars and Kuiper-belt objects. 'Data mining' the survey for these and other objects will produce candidates for further scrutiny by specialized instruments on other telescopes, including optical interferometry by the VLT.

Principal investigator for OmegaCAM is Prof. dr. K. Kuijken. NOVA provides funding for building the camera, together with European partners. After delivery of OmegaCAM, ESO will provide the personal and material infrastructure for operating the VST. In return for NOVA's contribution, Dutch astronomy gets a guaranteed share of total observation time on the VST.

OmegaCAM-partners:
Universitäts-Sternwarte Munich.
Osservatorio Astronomico di Padova.
European Southern Observatory.
web-site : www.astro.rug.nl/~omegacam/
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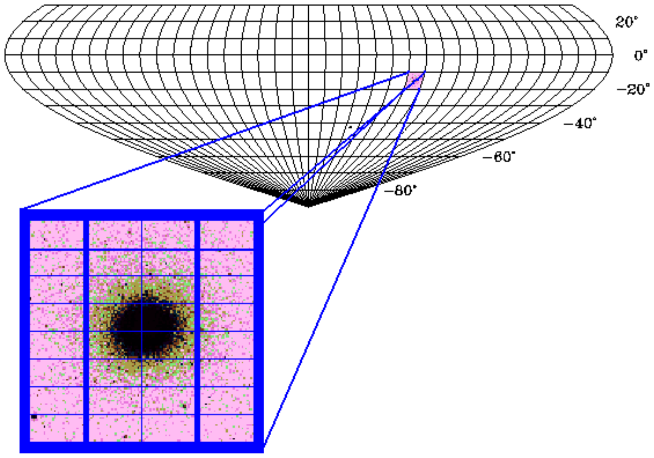
ASTRO-WISE: **Galaxies like electrons**

OmegaCAM/VST will produce 30 Terabytes of data per year, far more than all other telescopes on mount Paranal combined. The ever increasing torrent of data produced by modern wide-field imagers brings astronomy back to the cutting edge of information technology. ASTRO-WISE is a European collaboration to develop intelligent software that maximizes the scientific profits to be gained from Terabyte-size astronomical databases.



Traditional astronomical software is mostly designed for analysis of relatively small datasets, for example, separate images of a few galaxies. But hundreds of millions of galaxies - among many other celestial objects - will be imaged by the VST each year. Simply processing these many thousands of gigabytes into an atlas of the sky would fill up a huge library, but without much added value over existing surveys. Clearly, a more intelligent approach is called for, expressed by the motto: ‘ Stop copying the universe’. Wide-field imaging in astronomy is approaching a stage resembling high-energy physics, where millions of events in particle detectors have to be screened and selected in real time. With galaxies becoming as plentiful as electrons, archives will have to be dynamic: raw data will be reduced ‘on the fly’ on the basis of requests from the astronomer, using state-of-the-art software that can be tailored to specific research, even years after the data were collected. This might include software for automatically recognizing certain categories of objects, e.g. quasars or Kuiper-belt objects. The ultimate aim is a ‘dynamic’ and ‘personal’ observatory for every astronomer.

NOVA coordinates the ASTRO-WISE project, using the expertise developed in building the OmegaCAM wide-field imager. Software will be developed and standards set that can be used in a EU-wide shared environment. ASTRO-WISE will result in a federated database linking national data centers in the Netherlands, Italy, France and Germany

The project will also deliver software necessary to set up a satellite data center linked to this network, enabling the network to grow as needed. It will constitute a (limited) example of an Astrophysical Virtual Observatory (AVO), and links with the actual AVO RTD-project are planned.

Project coordinator for ASTRO-WISE is dr. E. Valentijn. The collaboration recently was accepted as a Research and Technology Development (RTD) - project by the European Union, receiving a 1.5 million euro grant for the period December 2001 till November 2005, which is about 1/3 of the total project budget.

ASTRO-WISE partners:
European Southern Observatory, Garching
Osservatorio Astronomico di Capodimonte, Naples
Institut d’Astrophysique de Paris/CNRS, Paris
Ludwig-Maximilans-Universität, Munich.
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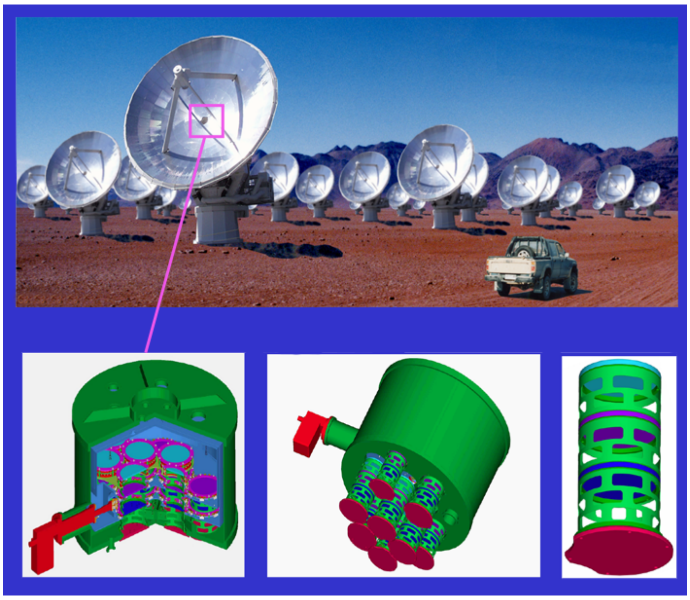
ALMA-DETECTORS: **Whispers from the dark ages**

On a barren plateau in Chile, 5000 meters above sea level, a powerful network of 64 radio telescopes will be operational in 2010, collecting (sub)millimeter radiation coming from the early universe and from cold dust in interstellar space. ALMA is one of the greatest future projects in astronomy, in which Europe and North America (Canada + U.S.) participate on an equal footing. Japan is considering joining as well. In Groningen, an ALMA-detector for the frequency range 602 - 720 GHz is being developed.



In the focal plane of each 12-meter dish, 10 cartridges with detectors for different frequency-bands will collect (sub)millimeter radiation and convert this to a signal with lower frequency, permitting electronic processing. In this way, the 64 telescopes can be made into one giant virtual telescope with .01 arc second resolution, much better than any stand alone optical or radio telescope.
The detectors use super conducting elements to achieve ultimate sensitivity. All cartridges are therefore embedded in a large cryostat that is kept at 4 Kelvin (4 degrees above absolute zero), the temperature of liquid helium. The ALMA-detector being developed in the Netherlands is smaller than a penlight-battery, and contains metal parts that have to be micro-machined in three dimensions at tolerances of down to 0,001 millimeter. Although not without precedent, production of such precision parts used to be done one at a time 'by the hand of the master'. But for ALMA at least 128 detectors have to be produced (2 for each dish), posing the challenge of serial production for such parts. If successful, such methods may be useful for many other applications as well.

ALMA construction will start this year and continue until 2010 when all 64 dishes are operational. ALMA will be able to look back to the 'dark ages', less than a billion years after the Big Bang, when the first galaxies and stars began to form out of the dilute primordial hydrogen gas that filled the early universe.
Closer to home, in our own galaxy, ALMA can peer deep into the center of the Milky Way and into dense molecular clouds where new stars and planets are being born. These regions, that are readily detectable at millimeter wavelengths, are forever obscured from view for optical telescopes, either because the light is red-shifted to longer wavelengths by the expansion of the universe, or because of interstellar dust that strongly absorbs visible light.

Manager for the NOVA-ALMA project is dr. W.Wild.

ALMA-partners:
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Delft Institute for Microelectronic Structures (DIMES)
European Southern Observatory
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