EUROPEAN ASTRONOMICAL SOCIETY

NEWSLETTER

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Contents

Editorial

After four years in Athens, the EAS Newsletter production changes its publishing host place and returns to Geneva. The council has considered that Geneva offers the following advantages:

1) the production, although it is going to cost as much as in Athens, will be handled at the base, where the Secretariat of the Society is located, so it does not depend on the country where the editor is living and
2) the distribution is less expensive from a private company in Geneva.

I will continue to serve as editor and I believe that this new arrangement is for the benefit of the Newsletter. Therefore this issue is the first one under the new conditions.

I hope you will enjoy its contents and particularly our special features. Continuing the new column of **Skeptic's Corner**, Dainis Dravins writes a provocative article on the future of optical CCD photometry. In all his arguments to my opinion what lies behind, is the fact that **astronomy is driving technology ahead at a great speed.**

Cosmophysics is a new term that Maurice Jacob initiates to us, showing how the New Physics and its most hot topics are closely related to astrophysical problems and its space laboratories.

Light pollution is a hot issue for astronomy revealing its environmental importance as is lively described by Andre Heck, on the occasion of an international meeting in La Serena (Chile).

From EU DG-Research, Panayotis Moschopoulos gives us briefly the main goals of the 6th Framework Programme.

The highlights from the European networks and organizations, a regular feature in our Newsletter will give you useful hints on what is going on in astronomy.

Finally I hope to see many many EAS members in Porto next September for JENAM 2002.
see http://www.sp-astronomia.pt/jenam2002/

Mary Kontizas

Message of the President

In my message this issue I want to report briefly on the first results of our collection of national planning documents. Since our last Newsletter I have contacted colleagues in many of our countries to enquire about the existence of formal national priorities in astronomy. I thank those who have responded in a timely manner with information and documents. I hope those who have not yet done so will be able to well before the Porto JENAM, where I would like to have a summary available. While not yet complete, the inventory is already revealing a number of interesting trends.

First and most important, there seems to be extraordinary consensus on the important areas of science that astronomers wish to address during the coming decade. Here is clearly scope for a European wide document setting out our overall scientific priorities. Of course, priorities for investment and for technological development are another matter, because these elements also have historical and economic dimensions. The national documents also reveal this diversity in their detailed conclusions and plans.

There is also consensus that the largest research infrastructures will be European in scope. The essential roles of ESO and ESA are evident and are emphasized by all countries. Both organizations are seen as generally effective in carrying out their missions as regards astronomical research and are highly valued across the continent. Discussion of possible projects having global scope is not yet evident except in radio astronomy, where ALMA and SKA are developing as priority projects in essentially all countries around the world that have programs in radio astronomy.

But a conclusion may also be emerging that the ground-based program is hindered by the lack of a coordinated program of technology development. Especially in the larger countries there is an appreciation that the success of ESA's space science program relies on long lead times and substantial investment for R&D, while the parallel program for ground-based activities is fragmented and not very coherent. There is as yet no consensus as to how such a program might be organized, in particular because our international organization for ground-based astronomy, ESO, is generally viewed as a facilities organization, which generally should obtain its technologies for new instruments and facilities from elsewhere. Several large countries do indicate the necessity of ensuring synergy with technology development for space research, but how this might happen in a structurally healthy way is not made evident.

The smaller countries clearly are experiencing difficulty in maintaining a healthy national program while also investing in and obtaining maximum benefit from their participation in ESO and ESA. The question has been asked explicitly in at least one case whether a community can remain healthy by only participating in large international projects, with the conclusion that it likely cannot.

And it will surprise no one that in essentially all countries there is concern about the wave of retirements of astronomical staff in the coming decade. Governments cannot but be aware of this problem by now.

It is interesting that some possible questions are not generally being asked in these national planning documents. Are the organizational structures available for cooperation adequate for optimising the attack on our scientific goals? Are we making the best use of planned technological and scientific developments in other fields? Should we be working more closely with physicists, with industry? Should Europe begin to take the lead in some areas to organize global projects?

Again, it is our intention to continue to gather such information on national priorities as is available, summarize it as seems appropriate, and to report to the community in Porto.

Harvey Butcher

Sceptic's Corner

The Post-CCD Era in Optical Astronomy

You have heard it from colleagues. You have read it in press releases. You have repeated it to your students. Yes, it is claimed that the latest optical detectors are «extremely capable», «enormously efficient», and the «ultimate in sensitivity». They have so many pixels, and they will give so much data. Are they? Do they? Will they?

Having been invited to comment on such issues from a «devil's advocate» point of view, the response is clear: No, of course not! Today's detectors actually are tiny, inefficient, and provide only minuscule amounts of data.

The serious side is that the community (and our sponsors) should not be fooled into believing that today's detectors are good, and that there would perhaps not be much room for improvement.

Why do we need spectrometers?

Mainly because detectors are poor. The purpose of today's spectrometers is to disperse light, so that its different wavelengths fall upon different pixels of today's ordinary detectors.

Is this really required? Of course not! Already a number of detectors are being developed with intrinsic spectral segregation.

Energy-resolving detectors are common in X-ray and gamma astronomy, and related techniques are applied also for the optical and infrared. One option is *STJ's, superconducting tunnel junctions* (a photon generates a cloud of charge carriers in a superconductor, giving a measure of both the photon energy, and its arrival time), another is *transition edge sensors*.

Although those particular concepts offer only moderate spectral resolution, others are capable of a resolution approaching a million. This is possible with *spectral-hole-burning* devices, otherwise being developed for optical data storage. These exploit certain cooled organic molecules. The functioning is like that of a colour film with not three, but a very great number of dyes. While there are still issues about sensitivity, tests on the solar spectrum confirm a resolution inside the detector comparable to the highest resolution spectrometers ever used in astronomy.

Why do we need telescopes?

Mainly because detectors are poor. The purpose of a telescope is to collect light and to provide a spatial segregation, so that light arriving from different directions falls upon different pixels of today's ordinary detectors.

Is this really required? Of course not! Some concepts are already now planning to eliminate the telescope as such, at least at longer radio wavelengths. Take the planned Low-Frequency Array *LOFAR*. By directly recording the incoming electromagnetic wave in amplitude and phase, the selection of sources (corresponding to «telescope pointing») may be achieved in software either pre- or post-detection, enabling simultaneous observations in widely separated directions. True, already in radio the data rates become respectable: tens of TB (*terabyte* = 10^{12} bytes) per second, or a PB (*petabyte* = 10^{15} bytes) each minute. While the extension to the optical may not be simple, the limitation appears to be only practical, not fundamental.

Why do we need detector readouts?

Mainly because detectors are poor. The purpose of a readout is to accumulate a sensible signal, and to put a time-tag to it.

Is this really required? Of course not! Since light is quantized, photons are the units to be detected, together with their arrival times. Already classical photocathode devices can count photons at nanosecond resolution while, e.g., avalanche photodiodes do so with much higher efficiency. Again, the data rates may become significant: a modest (1024 x 1024) array with a 10 MHz count rate per diode may generate 10 TB per second, or 1 EB (*exabyte* = 10^{18} bytes) during a 3-night observing run.

What is a good detector?

Of course, the above spectral, spatial, temporal (and also polarization) capabilities should be combined in the detector. To measure all this might perhaps require a recycling of each photon during the detection process. This may be feasible with, e.g., entangled states of quantum optics, which allow for the repeated detection of a photon without its destruction.

As for data rates, a number being quoted in discussions on virtual observatories or GRID concepts of data handling is 100 TB, as required for one image of the whole sky with 0.1 arcsec resolution. Of course, this is only for one single wavelength (and polarization), and for each instant in time.

Aiming at a spectral resolution of 10^5, say, the celestial data rate becomes 10 EB per time resolution element. Setting that to 1 ms, say, we reach 10 ZB (*zettabyte* = 10^{21} bytes) per second or a few hundreds of yottabytes (YB = 10^{24} bytes) per observing night. Some of us are aiming for both higher spatial, spectral and temporal resolutions, but there are no greater prefixes among SI units...

Such numbers, then, may represent the data rates at which the Universe is trying to «talk» to us. But only once we get really efficient detectors will we be able to listen. And let's remember that, given the common hype in describing today's «efficient» detectors, there are still at least some twenty orders of magnitude of needed improvements left.

Dainis Dravins, Lund Observatory