Small-Telescope Astronomy on Global Scales
ASP Conference Series, Vol. 246, 2001
W.P. Chen, C. Lemme, B. Paczyński

Concluding Remarks

Brian Warner

Department of Astronomy, University of Cape Town, Rondebosch 7700, South Africa

This is the first IAU conference devoted to research with small telescopes since the Symposium on Instrumentation & Research Programs for Small Telescopes, held in Christchurch, New Zealand, almost exactly fifteen years ago. Both the climate for, and the definition of, small telescopes has changed since then. Now, with the construction and operation of 8m class telescopes, anything less than about 3m is considered small. But whereas fifteen years ago there were concerns whether instrumentation could be improved in order to make small telescopes competitive, and whether there was any ultimate future for these outside of education, it is now clear that an extensive niche has been found, with remodelling, refurbishment and construction of new small telescopes well under way.

Many of the research programs proposed in 1985 have been carried through (e.g. using the multiplex advantage in radial velocity meters) and have in some ways been completed successfully (e.g. lunar occultations for positional measurements of the Moon and for stellar angular diameters). Some of the instrumentation has passed into oblivion, but CCD detectors have proved to be all that been hoped for. (A state-of-the-art CCD can turn a 20-inch telescope into the equivalent of the 200-inch telescope of 50 years ago - but there are many more 20-inch telescopes than there ever were 200-inch telescopes.) The development of the Internet and its advantages to collaborations were also not fully foreseen.

In this Colloquium we have seen that large parts of variable star research are conducted entirely on small telescopes; wide fields of view are helpful for surveys; searches for moving objects, almost undreamt of in 1985, are producing numbers of NEOs and EKBOs; gravitational microlensing has been specifically a small telescope industry; there has been an increased interest on the part of telescope manufacturers - as witnessed by the presence of some of them at the Colloquium; and the best indicator of all of the good health of the use of small telescopes is that there is a looming data handling and archiving crisis. It is perhaps ironic that whereas most theoreticians and modellers wait impatiently for computers that are orders of magnitude faster than those presently available, excellent science is being done with telescopes that are an order of magnitude smaller than the largest currently coming into operation.

Some of the obvious strengths of small telescopes are their wide field of view - useful for all-sky searches and searches within clusters; the fact that there are so many already in existence and often underused; the flexibility of scheduling and the concomitant rapid response to alerts; the absence of TACs to get in the way of the enthusiastic researcher; the expertise in technology that is rapidly growing among the manufacturers; the affordability for smaller and poorer countries and institutions - which as a result can participate in unique and often cutting-edge

https://doi.org/10.1017/S0252921100079288 Published online by Cambridge University Press

science; the ease of networking and organising, made possible by the Internet; the possibility of designing telescopes to be dedicated, specialised and hence efficient; the relative ease of using robotic and/or autonomous systems.

A few definitions are required here: there used to be no doubt about what a financially poor institution is, but with small telescopes within financial reach of most institutions, there has been a reversal of meaning - now a financially disadvantaged observatory is one with a Director and 8m class telescope to support. A robotic telescope is one which does what it is told to do (parallels were drawn with the perfect student); an autonomous telescope is able to make decisions and adjust the observing program according to prevailing conditions and history (here parallels were drawn with faculty members).

Currently, small telescopes, in addition to carrying out programs not possible on large telescopes (see below), act as a Discovery Service for larger telescopes - providing the All-Sky searches to find objects to be studied in more detail, providing triggers for immediate study by larger telescopes (e.g. supernovae) and providing general follow-up opportunities for long-term behaviour. One obvious area in which small is bigger is the possibility of coordinated round-the-world observations (e.g. WET, CBA) which generate the multi-day, almost continuous, coverage that is essential for asteroseismology and the study of fast non-periodic variable stars. Such distributed observing is rarely possible even with telescopes of intermediate size. The practical demonstrations possible with small telescope do more to promote interest in astronomy in particular and science in general than does the often mere existence and bulk of large telescopes.

In the Discovery area, small telescopes are generating catalogues and light curves of tens of thousands of new variables stars - as by-products of the MACHO and other gravitational lensing experiments. But, as Bohdan Paczynski pointed out, our knowledge even of variable stars brighter than 12th magnitude is still very incomplete. The All-Sky surveys (rather than selected areas, as in the lensing projects) needed to complete knowledge of variable stars down even to 20th are within reach of present technology. These variables include myriads of eclipsing and contact systems, as well as intrinsic variables. In particular, various arguments show that there should be a population of short period detached white dwarfs and M dwarfs, of which only a few have so far been found.

Almost all the Colloquium was devoted to variability - of brightness, position or radial velocity (an exception was John Gaustad's beautiful H alpha survey of the southern sky, made with one of the smallest of lenses). This is where the strengths of small telescopes lie - in repeated observations on a variety of time scales, which reveal changes. Although large telescopes may technically be able to do everything that small telescopes can, it is not practicably or politically feasible for them to do so. This leaves a large amount of science undone, unless small telescopes come to the rescue. In Figure 1 I show an Apparent Brightness/Time scale diagram which is partitioned according to what is feasible for very large telescopes (VLTs) to explore (both intentionally and serendipitously) and what is left for very little telescopes (vlts) to concentrate on. There is a fuzzy region of overlap, but no one will doubt that VLTs are not going to be employed to find or study large numbers of Mira variables, or follow dwarf novae through entire outburst cycles, or be used on bright stars, or for any All-Sky surveys to find NEOs. Also, it does not make sense for smaller telescopes to try

https://doi.org/10.1017/S0252921100079288 Published online by Cambridge University Press

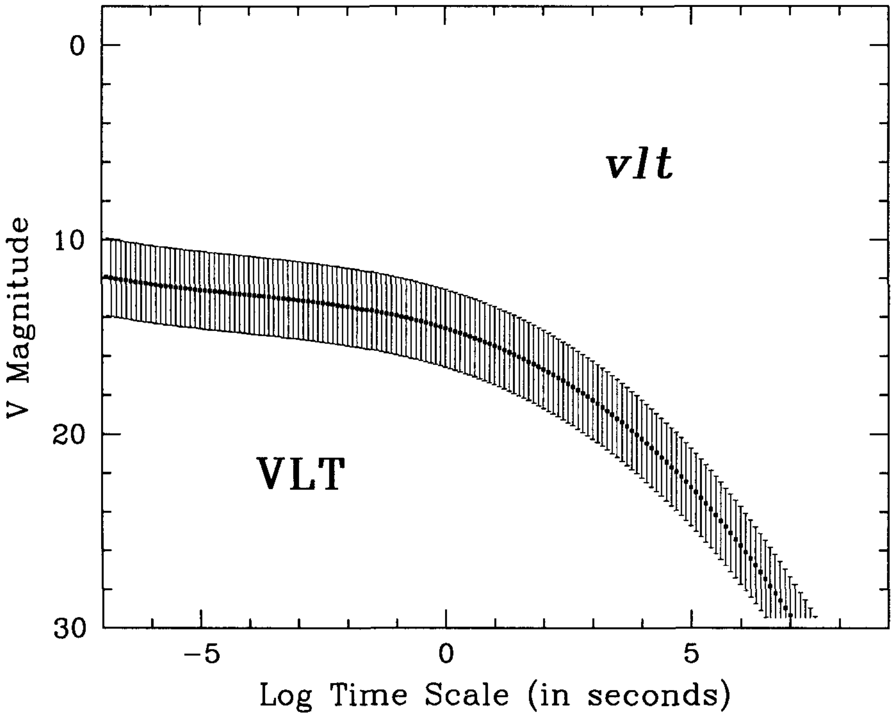

Figure 1. The Apparent Brightness – Variability Time Scale diagram.

to compete where large numbers of photons are indispensable (e.g., very high resolution light curves of optical pulsars, or in the study of excessively faint objects). Figure 1 becomes even more interesting if one uses a linear rather than logarithmic time scale axis - there is plenty of phase space for vlts to occupy.

The evident successes of vlts are shown in the rapidly growing data archives. But it should not be overlooked that the small telescope users can participate in High Energy Astrophysics through the discovery of optical Gamma Ray bursts and high-z supernovae; this is Big Science and New Science, and it does not require large accelerators nor VLTs to join in.

There are also some evident needs of the small telescopes community. Good Public Relations, showing the successes and uniqueness of the research output, are needed, to maintain the flow of funds for continuation of the present programs, and to generate funds for the next generations of specialised small telescopes and their software. Coordinated, standardised archiving is already an urgent need - this should be addressed through international cooperation and not left to a form of survival of the fittest (in fact, it could well result in survival of the largest, which is not necessarily the best - viz. the UBV system of photometry). The overwhelming number of light curves of variable stars that are being generated surpasses what can be digested by human inspection - there is a need here for development of software, perhaps using Artificial Intelligence

https://doi.org/10.1017/S0252921100079288 Published online by Cambridge University Press

techniques, where self-learning software can sieve through the light curves and draw attention only to the really interesting ones.

There is also another evident need - and that is for another conference on small telescopes before a further fifteen years passes by.

https://doi.org/10.1017/S0252921100079288 Published online by Cambridge University Press