

SOUTHERN HORIZONS IN TIME-DOMAIN ASTRONOMY
IAU SYMPOSIUM 339

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Introduction

In 2011, IAU Symposium 285 (*New Horizons in Time-Domain Astronomy*) tackled the subject of variability by focussing on its different manifestations, such as periodic, explosive, recurrent or transient, and sought explanations through commonalities that could be identified across the cosmos rather than through studying groups of like objects. The first meeting of its kind in this sense, it brought together as diverse a cross-section of participants as an IAU symposium must ever have seen. The scheme injected a novel and potentially fruitful introduction into the understanding of variability by comparing occurrences of similar phenomena regardless of site. Symposium 339 (*Southern Horizons in Time-Domain Astronomy*), held in November 2017 in Stellenbosch, near Cape Town, followed a similar pattern. It, too, was attended by participants who between them represented a very broad cross-section of astrophysics. But there were important differences; not only did S339 see considerably more input from the radio astronomy community compared to S285, but the entire programme of plenary talks on Day 1 was taken up with ‘New Developments’, and were necessarily only a representative selection at that.

Another novel feature introduced by S285, and repeated in S339, was the holding of Workshops on the afternoons of Monday, Tuesday and Thursday. In both concept and planning, the Workshops ran orthogonal to the main conference programme, offering opportunities to discuss in-depth matters or to gain instruction in some new or unfamiliar software package for handling time-domain data. With so many huge data sets, particularly of spectra, currently being provided or expected in the very near future, new methods of sorting, analysing and pinpointing the changes which the data must surely contain are now needed. Parallel to the science of the time-domain must therefore be energetic developments of semi-automatic, efficient tools, neural nets, etc., that we do not have at present, or do not know how to use to maximum advantage. Accordingly, one topic that was scarcely a recognized feature six years ago, the science of *Astroinformatics*, this time occupied a double Workshop slot, illustrating its undisputed importance, not to say its indispensability.

Yet another novelty introduced by S285 was the topic of data *sonification*, or *listening* to your data, as featured by a blind graduate, Wanda Merced Diaz. Now stationed at the IAU’s Office of Astronomy for Development in Cape Town, Wanda paid our Symposium a return visit in order to organize a Workshop (WS 9) featuring sonification. Even further: a *second* blind researcher also attend the meeting, and assisted with Wanda’s Workshop.

The programme for S339 specified five daily themes:

- (a) New Developments in the last five years
- (b) Explosive Transients
- (c) Long-term and stellar variability
- (d) High Energy
- (e) Can our techniques meet the challenges?

In many cases the scientific topics themselves were not new: searches for elusive objects such as supernovæ, classical novæ, cataclysmic variables, flare stars, extrasolar planets and the many ramifications thereof have been key research areas for several – sometimes a great many – years. What was new was the means, the aspect, the scope, the scale and (of course) the technology which is now being enlisted to revolutionise the research. What was also new to everyone were the recent echoes of Gravity Wave GW170817, whose detection and its offshoots gained prominence in several talks.

Of the other ‘new developments’ that were featured, a strong accent was placed on automated surveys, the majority with new instruments in space. Explosive events are

showing up in both targeted and triggered observations, the classical view now being enriched by programmes to detect radio transients too. Aspects of long-term variability are being stretched and enhanced through new and novel technologies, and even objects once believed to be rather quiescent are proving to harbour variabilities previously unimagined and certainly undetected; some are challenging core theories about aspects such as stellar pulsations. Many high-energy projects are particularly gaining expansion and promotion through new developments involving *inter alia* X-ray missions, and revealing new populations of high-energy transients. And in addition to the topics just sketched were many others, some deeply associated with them, others more peripheral, that were discussed in the Workshops. But – as the final day showed vividly – each of these new programmes rests heavily on adequate and appropriate software techniques, now being promoted efficiently through astroinformatics.

These *Proceedings* follow the daily programme closely, mingling invited with contributed talks as they occurred. However, unavoidable constraints prevented the Workshops from clustering around the daily themes, and in this book they are handled all together in a separate section. A rich set of posters was also on display. Because the Workshops inevitably limited the number of opportunities for contributed talks, every applicant wishing to contribute a talk at S339 was given the opportunity to present the work as a poster if it could not be accommodated as a talk. Poster presenters were also offered an opportunity to submit a summary of the poster for inclusion here.

These *Proceedings* are being published in two forms: not only in the traditional hard-back book, but also online. Since the latter does not suffer hard space restrictions, we could offer to reproduce posters *in extenso* in pdf format there, when the book could only reproduce a text summary. In some cases where a poster is reproduced in full in the online version, the book includes a link to it, without a text summary.

One final note: a conference represents only a snapshot of the current state of affairs in the field(s) in question, so its *Proceedings* quickly become dated, especially in a topic as fast developing as ‘time-domain astronomy’. As far as possible, references to papers that were ‘submitted’ or ‘in press’ at the time of S339 have been updated with their present literature citations, as those are of more value to the reader, and we have adjusted the history of a few items such as the launch of satellites to read ‘launched’ rather than describing events that were still anticipated when the respective presentations were made. But in most other cases we decided to leave the *Proceedings* as the temporal snapshot that they truly are.

Elizabeth Griffin (co-Chair)
December 2018

Preface

Change pervades the entire cosmos, in every manner and on every time-scale. Awareness of the extent, multiplicity and complexity of those changes is taking research beyond the first phase of cataloguing “what?” Delving into that extent and complexity is already hinting at some of the fundamental explanations that are to be had, and at some of the new science that is to be gleaned if more morphological approaches can be organized and more adventurous methods for handling the full supplies of information can be applied.

The science presented in 2011 at IAU Symposium 285, *New Horizons in Time-Domain Astronomy*, gave a comprehensive overview of the status quo in various aspects of time-domain astronomy, and offered glimpses of where the near future would be heading. Six years later sees astronomy at a new level of activity and planning: ambitious new instruments that add a new dimension to some of those current in 2011, and ingenious new methodology in the field of “astroinformatics” that adds a quite different look to the tasks of uncovering variability in the cosmos. Symposium 339 thus offered a rather different flavour of the time-domain in astronomy. Instead of a clean cross-section, it revealed a great many projects – some barely started or still on the drawing board – that were attempting to prise detections of, and information about, astronomical variability, at both Galactic and extragalactic distances. Major new instruments whose output dwarfs that seen six years ago, and analysis techniques that could not have been programmed until very recently, are being coupled with a broadening diversity in wavelengths. It felt breathtaking just to listen to the plethora of schemes and ideas being described, and challenging to grasp the significance of apparently unrelated data types.

Each of those individual projects commands its own clientele, as well as its own purpose and place within the grand scheme of time-domain astronomy. S285 forecast that “it would necessarily be the last meeting that could be so broad: future ones would need to concentrate on the individual”. However, that forecast did not seem to hamper the planning of S339, nor dampen the eagerness which participants (representing 33 different countries) displayed in order to present their work. In fact, the diversification that we are seeing in both hardware and software will make it *the more essential* to come together every few years in order to compare notes and recapture correct perspectives.

The way that the whole of one morning of plenary talks was absorbed by accounts of new instruments and new technologies brought home the need to update oneself about the new potentials and purposes that must accompany those developments. Introducing new techniques for both analysis and communication pointed to the richness of those new potentials, while including the basic fundamentals such as data quality, standardization and archive accesses helped retain a good balance of what was truly novel and what were new songs on old themes. All were indispensable ingredients of S339, and the following pages provide glimpses – if tantalizingly brief – of those ingredients. And one of the most exciting features of all was the high proportion of early-career scientists who already are central players in many of the projects classified as “future” ones. Time-domain astronomy is *their* future, and in their hands it will flourish and grow.

Elizabeth Griffin (co-Chair)
December 2018

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- The IAU, whose generous grant made it possible for us to assist 20 participants with travel costs, mostly (but not exclusively) graduates and post-docs; it was particularly pleasing to be able to help those for whom no other means of support was possible. As a result, no less than 33 countries were represented at the meeting.
- The South African Institute of Physics, for secretarial assistance that was fundamental to the smooth running of the meeting, and for additional sponsorship in providing grants to cover unassigned costs.
- The University of Cape Town, the South African Astronomical Observatory and the National Research Foundation for their financial support in running this Symposium.
- The staff of STIAS, who served scrumptious refreshments and lunches that were well beyond the ordinary, and seasoned amply with good humour and friendliness.
- The members of the Local and Scientific Organizing Committees, who assisted in establishing a well-balanced social and scientific programme, respectively. The meeting displayed an excellent mix of workshops and presentations at the venue. Scientific discussions were enjoyed not only at the venue but also amidst the beautiful Cape scenery of Table Mountain, Robben island, Kirstenbosch and the Stellenbosch winelands.
- and of course – the participants, whose supplies of energy, ideas, questions, discussion topics and enthusiasm added zest to each session and workshop.

Please accept our heartfelt gratitude!

*Elizabeth Griffin, Rob Seaman, Mark Sullivan and Patrick Woudt (Co-Chairs),
December 2018*

CONFERENCE PHOTOGRAPH



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