Preface

Márcio Catelan[1,2,⋆] and *Wolfgang* Gieren[2,3,⋆⋆]

[1] *Pontificia Universidad Católica de Chile, Instituto de Astrofísica, Av. Vicuña Mackenna 4860, 782-0436 Macul, Santiago, Chile*
[2] *Millennium Institute of Astrophysics, Santiago, Chile*
[3] *Universidad de Concepción, Departamento de Astronomía, Casilla 160-C, Concepción, Chile*

Abstract. The 22nd edition of the Los Alamos Stellar Pulsation Conference Series was held in San Pedro de Atacama, northern Chile, between Nov. 28 and Dec. 2, 2016. Here is a short description of the event.

Between Nov. 28 and Dec. 2, 2016, about 140 astronomers from different parts of the world came to San Pedro de Atacama, northern Chile, to celebrate the 22nd edition of the Los Alamos Stellar Pulsation Conference Series. This was a very special occasion for the organizers, as it marked the very first time a meeting of the series took place in Latin America, and only the third time the event was held in the southern hemisphere.

On this occasion, we gathered together at Hotel Cumbres, in the outskirts of San Pedro, to discuss the subject of *Wide-field variability surveys: A 21st-century perspective*.

Astronomy is undergoing a major revolution in the way it approaches its core subject. With the increase in detector efficiency and size and the availability of ever more powerful computers, wide-field surveys, once few in number, have become increasingly common – and indeed, it is clear that the field will be largely dominated by massive wide-field surveys, photometric and spectroscopic alike, in the not-too-distant future. Many of these surveys are being, and will continue to be, conducted from Chile, not far from the chosen venue.

At this special transition moment between "classical" and survey-based astronomy, we are faced with important challenges on how to properly handle, process and analyze the increasingly large datasets that are continuously amassed by these surveys. Astronomers must increasingly work together with computer scientists and statisticians. Entirely new fields, such as the booming but fairly young field of Astrostatistics, are emerging in the process.

The challenge is particularly evident in the case of time-domain astronomy, where the databases needed can be larger by orders of magnitude, compared with the case of single-epoch surveys. Microlensing surveys such as MACHO, EROS, and OGLE have revealed to the community the enormous power of time-resolved surveys to study a vast number of different science topics, especially in the more general context of stellar variability. In this sense, pulsating variable stars, which were the main focus of this conference, come high at the top of the list.

Perhaps surprisingly, the last meeting that was aimed at discussing the impact of large-scale surveys on pulsating star research was held back in 1999, in Budapest, Hungary (IAU Colloq. 176,

⋆ mcatelan@astro.puc.cl
⋆⋆ wgieren@astro-udec.cl

which was also the 14th edition of the Los Alamos Stellar Pulsation Conference Series). That meeting did help set the stage for the current state of affairs, but back in those days there were still few such massive surveys that were in operation – and those look rather small, in comparison with current and future surveys.

As a case in point, consider the OGLE project. Back in 1999, OGLE-II was taking data using a single $2k \times 2k$ CCD. At present, OGLE-IV is scanning the southern skies from Las Campanas Observatory, again in northern Chile, using an array of thirty-two $2k \times 4k$ CCDs, covering a much wider area of the sky, and with data flows that are higher by orders of magnitude than in the early phases of the OGLE project. In the near infrared, no time-resolved surveys were in operation back in 1999. Massive, wide-field variability surveys in the near-IR covering vast swathes of the sky are now being conducted for the first time in history. This includes the Vista Variables in the Vía Láctea (VVV) survey and the Vista survey of the Magellanic Cloud system (VMC), both of which are ESO Public Surveys running on ESO's Visible and Infrared Visible Telescope for Astronomy (VISTA), located in Cerro Paranal, northern Chile. Particularly revealing, in terms of the rise of the survey era, is the fact that ESO has built not just one, but actually two, state-of-the-art telescopes in Chile that are entirely dedicated to conducting surveys – the other one being the VLT Survey Telescope (VST). Wide-field spectroscopic survey facilities are also rising in prominence. The Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), located in Xinglong Station, Hebei Province, China, with its unique design, is a remarkable example. Among its achievements, LAMOST's key role in the spectroscopic follow-up of variable sources monitored in the *Kepler* space satellite fields is particularly noteworthy.

While LAMOST is now proving key in the follow-up of *Kepler* sources, back in 1999 space-based astronomy did not count on any instruments devoted to time-resolved astronomical observations even remotely approaching the power of CoRoT and *Kepler*, which have provided a major recent boost to the field of asteroseismology in particular. In fact, back in 1999, the field of extrasolar planet research (CoRoT and *Kepler*'s main *raison-d'être*, to be sure) barely existed, and so the variable star community could not profit much from the constant flow of information that is now coming from wide-field surveys whose main goal is to detect extrasolar planets through the transit method. In the late-1990's, data collected with the Hipparcos satellite provided a fundamental contribution to the field of variable stars, and Gaia was just a distant concept. By providing accurate parallaxes and proper motions to hundreds of thousands of variable stars across the Milky Way, Gaia will decidedly revolutionize our knowledge of the intrinsic properties of pulsating variable stars. Now Gaia has become a reality, and it was a privilege for us, as organizers, that some of its very first scientific results were presented precisely at this conference.

In like vein, many survey projects (often counting on dedicated telescopes) are now in operation, including several in Chile, whose main aim is to detect transient events, such as novae and (especially) supernovae. Examples include CRTS, PTF, ASAS-SN, HiTS, CHASE, Pan-STARRS, and many others. The most important (and largest) of all these projects, the Large Synoptic Survey Telescope (LSST), which is currently being built in Cerro Pachón, northern Chile, is slated to start operations in the early 2020's. The nightly LSST data flow will dwarf that from even the largest existing surveys. A data tsunami is in the horizon, and its first ripples have just started to hit the shore. A change in paradigm in the way variable star astronomy is pursued is clearly imminent. This is why we realized, a few years ago, that the time was ripe for a meeting specifically devoted to studying the impact of wide-field variability surveys upon pulsating star research.

At the San Pedro meeting, we made a concerted effort to bring together astronomers who have been involved in the planning and execution of wide-field variability surveys – past, current, and future – in order to share experiences, ponder what we have been able to learn about pulsating variables in this way, and discuss strategies to face the approaching data tsunami. We envisaged a meeting

where leaders of some past variability surveys would highlight the lasting legacy of their work on the field of pulsating star research, and also where key players of ongoing and planned surveys – ground- and space-based alike – would present their projects and discuss the impact of their experiments on this type of science.

Importantly, we also saw our meeting as a perfect opportunity for players in the fields of transient and exoplanetary surveys to explore the synergies between their projects and pulsating star science. Last but not least, we also attempted to bring statisticians and computer scientists who make astronomy one of their main (if not the main) areas of research to San Pedro, so we could also hear their perspective on how to better "navigate the tsunami" and thus maximize the scientific return from the truly huge datasets that are now becoming a reality.

We hope that the many interesting contributions that are included in these proceedings will reflect our current view of this increasingly interdisciplinary field. We are especially grateful to our colleagues who have agreed to contribute review papers, several of which cover topics that, in our opinion, had heretofore been sorely missing from the the modern literature.

We would like to express our gratitude to the additional members of the Scientific Organizing Committee, who helped us put together an exciting program: L. Althaus, G. Clementini, L. Deng, A. J. Drake, F. Grundahl, N. Matsunaga, K. Pollard, A. Udalski, L. Walkowicz, and P. Whitelock. We are also tremendously grateful to the Local Organizing Committee, who helped ensure a nearly flawless meeting experience for all participants: J. Borissova, J. Alonso-García, M. Vučković, R. Contreras Ramos, A. Gallenne, and – most especially – A. Lagarini and S. Varela.

We gratefully thank the following organizations and projects, without whose generous support this meeting could not have taken place:

- European Organisation for Astronomical Research in the Southern Hemisphere (ESO);
- ALMA Observatory;
- Carnegie Observatories and Las Campanas Observatory;
- Association of Universities for Research in Astronomy (AURA);
- National Science Foundation (NSF);
- Giant Magellan Telescope (GMT);
- Tokyo Atacama Observatory (TAO) Project, University of Tokyo;
- Chile's Ministry for the Economy, Development, and Tourism's Millennium Science Initiative, through grant IC 120009, awarded to the Millennium Institute of Astrophysics (MAS);
- Centro de Astrofísica y Tecnologías Afines (CATA), Proyecto Basal/CONICYT PFB-06/2007;
- CONICYT/FONDECYT grant #1171273;
- CONICYT/PCI grant DPI20140066;
- Pontificia Universidad Católica de Chile;
- Universidad de Concepción.

Santiago, August 2, 2017