

# Preface

The symposium “The Science of Time” was held on June 5–9, 2016, at Harvard University in Cambridge, Massachusetts, USA. The symposium was to consider all scientific aspects of time.

The uses of time in astronomy—from steering and pointing telescopes, coordinating and processing observations, predicting ephemerides, determining Earth orientation, and analyzing time series data to many other ways—represent a broad sample of how time is used throughout human society and in space. Time and its reciprocal, frequency, are the most accurately measurable quantities and often important paths to the frontiers of science. But the future of timekeeping is changing with the development of optical frequency standards and the resulting challenges of distributing time at ever-higher precision, with the possibility of timescales based on pulsars, and with the inclusion of higher-order relativistic effects. The definition of the second will likely be changed before the end of this decade, and its realization will increase in accuracy; the definition of the day is no longer obvious. The variability of the Earth’s rotation presents challenges of understanding and prediction. It is time to take a closer look at time in astronomy and other sciences as a defining element of modern civilization.

The symposium aimed to set the stage for future timekeeping standards, infrastructure, and engineering best practices for astronomers and the broader society. At the same time, the program was cognizant of the rich history from Harrison’s chronometer to today’s atomic clocks and pulsar observations. The theoreticians and engineers of time came together with the educators and historians of science, enriching the understanding of time among both experts and the public.

“The Science of Time” was hosted by the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Massachusetts, USA; the CfA is a collaboration of the Smithsonian Astrophysical Observatory (SAO) and the Harvard College Observatory (HCO). Some CfA staff members are in the Harvard Department of Astronomy (HDA).

The following symposium topics are included in these proceedings:

- The scientific and technical uses of time and time series data
- The civil and scientific understanding of time—education and outreach
- The history of time and timepieces, clocks, and calendars
- Social, cultural, and religious uses of timing information
- Time from sundials and the pendulum to atomic clocks and pulsars
- Impact of precise time and frequency measurement in astronomy and science
- Earth rotation and time
- Time and solar-system ephemerides
- The physics of time

The proceedings contain many papers from the symposium. Where papers were already published or not available, abstracts and references to published papers, where available, are included.

Sevres, France  
Krugersdorp, South Africa  
Tucson, AZ, USA  
Taunton, Somerset, UK  
Charlottesville, VA, USA

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The Science of Time 2016

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