

HISTORICAL PHOTOGRAPHIC DATA ARCHIVES – TREASURE OF ASTROPHYSICS

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Long-term data are of extraordinary importance in astrophysics research. Astronomical archives of historical photographic plate collections worldwide are the storage of huge amount of such valuable information. More than two million photographic plates, mostly made of glass with photographic emulsions, are stored in the world's historical plate archives or plate stacks and represent a unique scientific heritage and irreversible resource for studying temporal variations in the universe. Many branches of astronomical research have directly profited from their findings, such as theory of stellar structure and evolution, pulsation theory, distance determination, understanding of the structure of the Galaxy etc. [1, 2].



Asiago Observatory of Padova (Italy) founded 1921 hosts over 70 000 archive plates taken 1942 – 1994 accurately preserved in a controlled environment. Their time spans overlap the so-called Menzel Gap when for about ten years the acquisition of plates with Harvard telescopes distributed around the globe was greatly reduced.



Sonneberg Observatory (Germany) houses almost 300 000 photographic plates and flat films of astronomical content. The exposures were taken between 1919 and 2010 with different instruments. Most of the plates have been exposed at Sonneberg in the course of the Sky Patrol covering the whole Northern sky down to -33° declination. The Field Patrol plates reach 17 mag in blue for about 80 fields situated next to or along the Milky Way. The plates have been scanned by 85%, a new scanner for the remaining plates is currently going to get working.



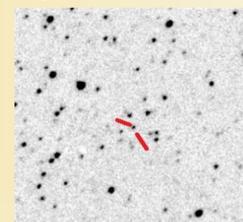
Photographic glass plates (left) and logbook (right) of Sonneberg Observatory



Harvard College Observatory's astronomical photographic plate collection is the largest archive of celestial glass plates in the world with over half a million images, covering northern and southern hemispheres, spanning the years 1885 - 1995. Henrietta Swan Leavitt 1912. made historical discovery of period-luminosity relationship for Cepheids on Harvard plates. Leavitt's law enabled accurate measurements of distances on an intergalactic scale and paved the way for



modern astronomy's understanding of the structure and scale of the universe. Digitization of the photographic plates started in 2003 and makes calibrated data available through the archive DASCH (Digital Access to a Sky Century at Harvard) [3]. In 2022, it reached more than 410 000 digitized plates of this largest collection.

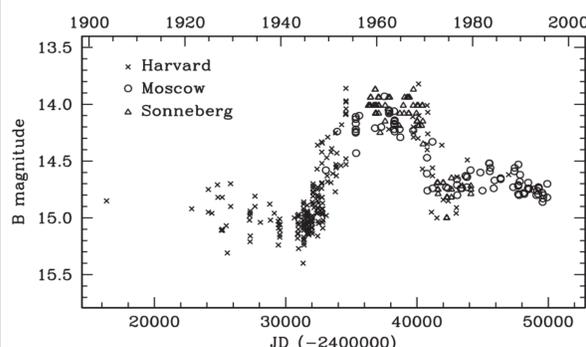


Example of digitized photographic plate showing variable star Hen 3-1591 on the archival plate b44713 taken on 2 July 1914. 10 arcmin \times 10 arcmin area around the target is shown

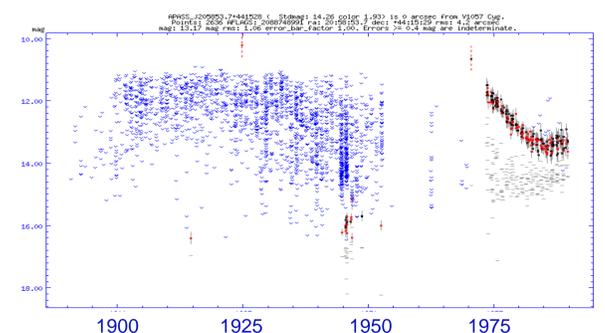
Digitization of the archive content started almost four decades ago with various scanning techniques, digitization challenges, expenses and with different outcomes to public access. Only some archives provide detecting and measuring all stars in all digitized plates and populate an incremental and indexed database with these measurements. The majority of astronomical photographic data is still waiting digitization [2].



Visual estimation of star magnitudes using Pickering method. The plates are placed under a high quality monocular lens and the area encompassing variable star and the surrounding comparison stars centered on the eyepiece [4, 5, 6].



Historical blue-band light curve of variable star VES 263 constructed on the century scale from photographic plates from Harvard, Moscow and Sonneberg archives [6].



DASCH pipeline results for variable star V1057 Cyg on the century scale. Blue arrows indicate plates upper limits (the magnitude of the faintest star on the plate still visible). The aim of this effort is reconstruction of photometric history of variable stars.

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DASCH Digital Access to a Sky Century @ Harvard

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