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COMMISSION B6 **ASTRONOMICAL PHOTOMETRY & POLARIMETRY**

PHOTOMÉTRIE ET POLARIMÉTRIE ASTRONOMIQUE

TRIENNIAL REPORT 2021–2024

1. PHOTOMETRY

by J. Allyn Smith

1.1. *All-sky photometric survey with Gaia*

As reported in the 2018-2021 report, the ESA satellite *Gaia* has been in routine operation since July 2014 performing a continuous all-sky scan and observing all point-like sources down to $G \sim 20.7$ mag; G being the broad passband associated to the white light. Besides G, *Gaia* is performing low-resolution spectrophotometry (with corresponding integrated G_{BP} and G_{RP} bands, two broad passbands in the blue and red part of the optical spectrum). The mean rate of observations is of about 70 million a day, meaning 630 million photometric G measurements, 70 million BP and 70 million RP spectra a day. Photometric alerts are issued at a rate of about 6 a day.

During this past three-year period, *Gaia* continues to operate and had a focused product data release in October 2023 with data in five focused areas including: radial velocity time series for long period variables Trabucchi, et al. (2023) and the crowded field of the cluster ω Cen Weingrill, et al, (2023).

1.2. *The Dark Energy Survey and SDSS Photometric Standards*

The Dark Energy Survey (DES) has complete observations on the sky and the final calibrations are being completed. The DES Six-Year Calibration Star Catalog has been released to the community Rykoff, et al. (2023) and the final "absolute" zero-point effort is nearly complete. DES is still using DA white dwarfs to use as absolute flux calibrators (lead by Douglas Tucker, William Wester, and Sahar Allam at Fermilab).This effort will result in several (> 30) "faint" (r$\sim$16-17) spectrophotometric stars in the southern hemisphere useful as standards and survey calibrators. These results have been improved since the 2019 report and are in preparation for publication. These stars lie in the DES footprint so we anticipate they will be useful for LSST as well. Abhijit Saha and collaborators are continuing their semi-parallel effort to develop faint DA standards using HST, also for large survey calibration. The results of this effort are reported in Narayan, et al. (2019), Calamida et al. (2019). An inter-survey cross-calibration study was

completed comparing the SDSS Stripe-82 (equatorial) standards catalog to the *Gaia* EDR3, Pan-STARRS1, CFIS, and GALEX catalogs. These results were published in Thanjavur, et al. (2021).

1.3. *The Pan-STARRS1 Survey*

The Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) celebrated data release 2 (DR2) in January 2019. Since that time, enhancements to the catalogs to improve astrometry using *Gaia* EDR3 and value-added catalogs (moving objects, for example) have been added. This remains a valuable photometric database due to the sky coverage and the multiple epoch visits.

1.4. *Infrared Photometry*

There is nothing new to report in this period for infrared photometry.

2. POLARIMETRY

by Alberto Cellino

Polarimetry continues to be a very active field, be it in terms of research papers, meetings, instruments and research programs. This was particularly true from March 2021 through March 2024, period to which this report refers to.

Some important achievements in polarimetry of asteroids and comets during the last triennium can be briefly summarized in what follows: (1) First polarimetric observations of a comet coming from the interstellar space, not bound to the Solar System. This was the case of the interstellar comet 2I/Borisov. This object was observed by Bagnulo et al. (2021), who used the VLT 8-m telescope, and found evidence that this comet was mostly pristine. (2) The DART impact experiment on the binary system Didymos-Dimorphos was a milestone, and was followed by many teams, using a variety of observing technique. This included polarimetry. Bagnulo et al. (2023) measured the fraction of linear polarization in different bands at different epochs after the impact, and the post-impact evolution of the measured polarization. This analysis positively detected a clear change of linear polarization starting a very short time after the impact, and evolving in the subsequent months. Polarimetric measurements were then proven to be capable to detect the occurrence of the event, and the general change in polarimetric properties produced by the impact. New measurements are still being obtained to improve the post-impact over longer timescales. (3) The Calern Asteroid Polarimetric Survey has been producing a wealth of new polarimetric measurements of asteroids, and has become one of the major sources of information in the field of asteroid polarimetry. Bendjoya et al. (2022) described the state of the art including a catalogue published in the CDS web-site. (4) An analysis of the spectropolarimetric properties of large, low-albedo asteroids belonging to the C-taxonomic complex was performed by Kwon et al. (2023), who found evidence of heterogeneous surface properties for the sample of measured targets.

Please, note that several teams measured the multi-band photometric properties of 2I Borisov. As an example, the paper by Mazzotta Epifani et al. (2021).

2.1. *Polarimetry Notes*

Links to A Few Current Telescopes & Instruments with Polarimetric Capability

The previous report of Commission B6 (2018-2021) included a section, *Polarimetric Instrumentation*, to discuss a representative number of current telescope and instruments that possess polarimetric capability. **Commission B6 Forthcoming Newsletter** There has not been any substantial progress on the newsletter during this period.

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