

COMMENTARY ON: FITZGERALD M. P., 1970, A&A, 4, 234

Toward mapping the spiral arm tracers

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The paper by Maurice Pim FitzGerald is one of the very first “success-papers” published in A&A, one year after its foundation. It is also the first refereed paper of this author, the material for which came from his 1967 Ph.D. Thesis.

The aim was to obtain intrinsic Johnson UBV and Cape U_CBV colors for Galactic stars of all spectral classes and to discuss the properties of the interstellar extinction and reddening in these photometric systems, the first of which is still very much in use, especially for stars in other galaxies. The knowledge of these quantities is a prerequisite for any work on stellar populations and galactic structure. There had been many attempts to obtain them before FitzGerald's studies; however, he had at his disposal an excellent new photometric catalog containing observations of 17 000 stars with Morgan-Keenan spectral classification (Blanco et al. 1968), which he helped to build. With these data, he could do much better than his predecessors.

Intrinsic colors are obtained in a rather straightforward way for nearby stars, say closer than 50 parsecs, because extinction is negligible in this case. Obtaining intrinsic colors and reddening for cluster stars is more problematic, although easier than for isolated stars because the reddening can be considered as uniform for a given cluster. The difficulty grows for O and B stars in the field, which are generally reddened, so that a direct method cannot be applied. Bright giants and supergiants are very rare, thus quite distant and reddened on average both in clusters and in the field, so that special care must be exercised to obtain their intrinsic photometric properties. Even in the large sample available to FitzGerald, there were only a handful of such stars for each spectral class.

FitzGerald showed a deep knowledge of the difficulties in the problem and in the methods that must be used in each case to solve it, so that together with the large number of excellent observations he used, one can be confident of his results. He also studied reddening in different directions throughout the Milky Way, with the now classical result that the two-color reddening line parameters are the same everywhere within the uncertainties, except in the Cygnus region, which is different. The reason for this difference is not yet clear. It may have to do with the abundance of molecular clouds in the Cygnus arm, which is directed along the line of sight, or with some alignment of dust grains by the magnetic field along this arm. The constancy of the reddening-line parameters in the rest of the Galaxy is a very favorable circumstance for any study of stellar populations, and there is evidence that this property also holds for external galaxies, where it is generally assumed to be true. This

constancy is also valid in the infrared (Koornneef 1983, another of the A&A most cited papers; Rieke & Lebovsky 1985), except in dark clouds and perhaps in the direction of the Galactic center (Lutz et al. 1996). Conversely, extinction is quite variable in the far ultraviolet (Fitzpatrick & Massa 1988).

The results obtained by FitzGerald are given in the form of simple tables and relations that are very easy to use by anyone, an ingredient for the success of the paper. His results have been considered as definitive or almost definitive by many astronomers. Essentially, all the subsequent work has confirmed their work, even if similar studies now extend to other colors (e.g. Draine & Lee 1984 and Rieke & Lebovsky 1985) and to other photometric systems like the Strömgren one (see Nordström et al. 2004). They have been, and are still widely used for investigations of Galactic stellar populations and structure, and also in searches for the differences between stars in our Galaxy and stars in other galaxies with different heavy-element contents: most of the papers that cite FitzGerald's article are of this nature. This testifies to the longstanding value of this excellent paper.

Remarks by P. FitzGerald

After obtaining the B. Sc. and M. A. in the Dept. of Astronomy at the University of Toronto (Thesis: Spectroscopic Study of four Eclipsing Binaries), I was admitted to the Ph.D. program at the Dept. of Astronomy (Warner-Swasey Observatory) at what is now Case-Western-Reserve University in Cleveland, Ohio, USA. This department was particularly interested in Schmidt – based studies of Galactic structure. There, I developed a keen interest in the study of the Milky Way and in the problems of accurately mapping the distribution of spiral arm tracers. These, of course, include interstellar dust, which in its turn makes tracing the arms of the Milky Way more difficult. It was obvious that a comprehensive catalog of all available high – quality photometric data (necessarily UBV at that time) and absolute magnitudes was required.

To this end, and with the strong encouragement of my initial supervisor, Dr. Victor M. Blanco, I embarked on compiling a complete catalog of UBV and MK spectral data, both in open clusters and for stars in the field, and in the process I developed a strong love-hate relationship with IBM punch cards. At the same time, I was greatly impressed with the Case Univac 1 computer, which more or less faithfully read these cards and stored them on

large reels of magnetic tape. I was privileged to have numerous blocks of sole-user, post-midnight time on this machine. A single reduction run of all the data could take up to 8 h, compared with the very few minutes on today's machines. After Dr. Blanco's acceptance of the Directorship of the US Naval Observatory, Dr. Peter Pesch inherited me as his Ph.D. student. (Dr. Con Fernie also inherited me from Dr. Jack Heard for my M. A. Thesis). I owe a lot to both sets of professors, especially to Victor's continued interest, and to all the time spent in debate with Peter as we both learned a considerable amount from each other. Having hated the subject as a Toronto undergraduate, I developed a continuing appreciation for the power of correctly applied Statistics.

Of course, the internet was still the purview of the US military at the time, and the cost of publishing the (US Naval Observatory) Catalog of UBV photometry was too high for the Warner and Swasey Observatory. Dr. Blanco arranged for the US Navy to have all the input data checked by the fellow authors at the Naval Observatory and to publish it. Driving the dozen or more cases of punch cards from Cleveland to Washington was also a difficult experience in my overloaded station wagon. Today, of course, that data can be stored on a memory stick of a few megabytes and transferred world-wide in a few seconds!

As an aside, I kept my IBM printout and cases of cards in my office at the Dept. of Physics, University of Waterloo (UW) for a few years. A day after finally handing them over to the janitor to dispose of, a most efficient process at UW, I received an early morning phone call from a US colleague desperate to obtain both! I told him I'd thrown them out, but I would check to see if, unexpected, they still existed. They did! I called back, and was

asked if I could bring them to the local Waterloo-Wellington airport by 3:00 p.m. that very afternoon. He would fly his Cessna from Illinois to get them. Needless to say, it was my German Ph.D. student, Maike Luiken, who got the courtesy ride in the two-seater Cessna.

Now, why did I choose the new A&A Journal to publish in? My paper on the distribution of interstellar dust was accepted by the *Astronomical Journal*, and the one on the absolute magnitudes by P.A.S.P., both obvious choices for a Canadian studying in the US. I chose A&A for the paper on intrinsic colors, partly to widen my exposure to the international astronomical community, and, more importantly, because I felt strongly that a European-wide Journal would greatly benefit both myself and the strengthening European astronomical community. (And, admittedly, A&A cost less). I am delighted that my confidence in the European, as well as the generous U.S., astronomical communities, was fully justified. I am also delightfully surprised and privileged to be included in the A&A anniversary publication!

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