

Haverford College

Haverford Scholarship

Faculty Publications

Astronomy

1987

Cluster Diffuse Light Measurements

Stephen P. Boughn

Haverford College, sboughn@haverford.edu

J. R. Kuhn

Follow this and additional works at: https://scholarship.haverford.edu/astronomy_facpubs

Repository Citation

Kuhn, J. R., Boughn, S. P., & Uson, J. M.. "Cluster Diffuse Light Measurements." *Bulletin of the American Astronomical Society* 19 (n.d.): 1105. Print.

This Journal Article is brought to you for free and open access by the Astronomy at Haverford Scholarship. It has been accepted for inclusion in Faculty Publications by an authorized administrator of Haverford Scholarship. For more information, please contact nmedeiro@haverford.edu.

51.03

Cluster Diffuse Light Measurements

J.R. Kuhn (Michigan State Univ.), S.P. Boughn (Haverford), J.M. Uson (NRAO)

We report on a new technique, and measurements of the cluster diffuse light (CDL) in the galaxy cluster A2029. Our measurements are obtained from a large number of 4.5' x 7.3' CCD frames that are tessellated to yield a single image of accurate R-band surface photometry over approximately a 1/2 degree field centered on the cD cluster A2029. We've devised an unbiased algorithm which uses all image pixels to separate a radial variation in the diffuse cluster light from the light contribution of stars and galaxies to the CDL. The CDL and the galactic light have distinctly different radial profiles. We find that beyond the R-band cD envelope the diffuse cluster light is less than 5% of the total cluster light. If the missing dynamical cluster mass in A2029 is distributed like the radial galaxy density, and responsible for the CDL, then low luminosity stars are ruled out as the source of the missing mass.

51.04

Spectroscopy and Polarimetry of Two Giant Luminous Arcs

J. S. Miller, R. Goodrich (Lick Observatory)

Using the Shane 3-m telescope and CCD spectrograph/polarimeter, we have spectrophotometric data covering 3200 to 7000 Å and imaging polarimetry of the giant arc associated with the cluster 2244-02. The data are consistent with zero polarization, and we set an upper limit of 5% for the polarization of the arc. The spectrum is featureless over this range, showing no obvious absorption or emission lines or continuum energy distribution breaks. The continuum is bluer than that of the nearby cluster galaxies. Our spectra of the giant arc in Abell 370 covering 3200 to 6000 Å are also featureless and bluer than those of early-type galaxies.

We conclude that these data allow the following possible explanations for the arcs to be ruled out: (1) light echoes from some central object, perhaps now extinguished, (2) tidal tails of stars stripped from the cluster galaxies, (3) star formation precipitated by a passing shock wave in the cluster, and (4) emission from a radiating shock in the cluster. We consider the most likely remaining explanation is that they are the result of a gravitational lens associated with the cluster that images a more distant object, presumably a rather blue galaxy.

This research was supported in part by NSF grant AST 84-06843.

51.05

Star Formation in the Cooling Flows of M87/Virgo and NGC1275/Perseus

R. E. White III (IoA, Cambridge and U. Alabama), C. L. Sarazin (U. Virginia)

X-ray observations indicate that M87/Virgo and NGC1275/Perseus have cooling flows which are associated with accretion rates of $\sim 20 - 30$ and $\sim 300 - 500 M_{\odot} \text{ yr}^{-1}$, respectively. By deconvolving X-ray surface brightness profiles of these cooling flow clusters, a number of authors have found the respective accretion rates to decrease inwards, suggesting that the bulk of the mass flux is dropping out (presumably to form stars). However, models in which there is *no* star formation (*i.e.* models with constant mass flux) have never been calculated (self-consistently). We therefore assess whether star formation is necessarily occurring in these

cooling flows by calculating models *without* star formation for all reasonable parameter space (assuming steady-state and that collisional heating and thermal conduction are insignificant). We find no constant-mass-flux models which are consistent with all of the relevant observations.

We then consider for these two objects a variety of star-forming models in which the X-ray emission due to cooling condensates is taken into account. For M87/Virgo we can find models in which all of the mass drops out of the flow by the time it reaches the center. In NGC1275/Perseus, we find that the mass flux diminishes by $\lesssim 40\%$ by the time the flow reaches ~ 20 kpc (the effective inner limit of the X-ray surface brightness data). The remaining mass flux within 20 kpc is $\sim 300 M_{\odot} \text{ yr}^{-1}$.

51.06

Spatial Clustering in the Lyman Alpha Forest

A. P. S. Crofts (McDonald Obs., U. Texas-Austin)

New spectroscopic data is presented here from groups of quasars close to each other in the sky indicating that Lyman alpha forest redshift systems do cluster in space on small scales. The clustering signal is only seen on scales just under 1 Mpc (comoving, with $H_0 = 100 \text{ km s}^{-1}$). This is compared to clustering in line-of-sight velocity to single quasars reported by Webb (1987, *Proc. I.A.U. Symp.* 124, p. 803) to indicate the extent to which splittings in the line-of-sight might be due to internal velocities of clouds rather than true spatial clustering. The implications of this comparison to the distinction between Lyman alpha and metal-line systems is also discussed.

51.07

The Distance to the Virgo and Ursa Major Clusters and a Determination of H_0

Michael J. Pierce and R. Brent Tully (Institute for Astronomy, University of Hawaii)

Multicolor CCD photometry of spiral galaxies within the Ursa Major and Virgo clusters is presented and combined with accurate 21 cm HI line width measurements to investigate the luminosity-line width relations (Tully-Fisher relations [*Astr. Ap.*, 54, 661]) as a distance indicator. There is evidence for a slight morphological type dependence of the TF relations, although the effect is present only at the 1-2 σ level. No difference in the slope of the TF relations is found between the two clusters, despite the considerable difference in densities and crossing times. A significant reduction in the dispersion of the TF relations is made possible from both accurate total magnitudes and accurate inclinations derived from ellipse fitting to galaxy isophotes. As a result, galaxies with inclinations as low as 30° can now be included in the sample. The intrinsic dispersion in the TF relations is found to be only about 0.25 mag, making it an excellent distance indicator. We show that the use of aperture magnitudes (*e.g.*, H-band data [Aaronson et al., *Ap. J. Suppl.*, 50, 241]) results in an artificially large slope to the TF relations. The use of total magnitudes yields a slope of 8 at near-infrared wavelengths, as a result $L \sim V_{\text{max}}^{3.2}$. An absolute calibration of the TF relations was obtained by fitting to three nearby galaxies with reasonably accurate distances: M31, M33, and NGC 2403. These systems establish the distance to the Ursa Major Cluster to be 15.5 ± 1.2 Mpc and the mean distance to the Virgo Cluster to be 15.6 ± 1.5 Mpc, with a slightly greater uncertainty due to the possible presence of superposed galaxies. A determination of the value of the Hubble Constant was made by using a Virgocentric flow of 300 km/s at the Local Group, yielding a derived value of $H_0 = 85 \pm 10 \text{ km/s/Mpc}$.

WEDNESDAY