A New Method for Constructing Spherical Galaxy Models with Anisotropic Velocity Dispersion

D. Merritt (UC Berkeley)

Until now, self-consistent models of spherical galaxies with given density profiles and anisotropic velocity dispersions could only be constructed by the complicated method of linear programming (e.g., Richstone and Tremaine, Ap. J., 286, 000, 1986). It is now shown that, for any specified density profile, one may derive a particular family of anisotropic models for which the ratio of radial to tangential velocity dispersions obeys the law

\[ \left( \frac{\sigma_r}{\sigma_t} \right)^2 = 1 + \left( \frac{\sigma_r}{\sigma_0} \right)^2. \]

The "anisotropy radius" \( \sigma_0 \) is a free parameter. The models are isotropic in the center and become either more radial or more tangential at larger radii. The primary advantage of this method is that it enables one to write down the self-consistent distribution function that yields the desired model; thus one can determine whether the assumed run of velocity anisotropy with radius is physically reasonable (e.g., whether the corresponding distribution function is always positive).

The method is applied to a model galaxy characterized by the de Vaucouleurs density law. The range in observable properties of the derived set of models is very nearly as great as those generated by the more general linear programming method. The models appear to fit observed galaxy velocity dispersion profiles very well. Furthermore, the radially anisotropic models correspond fairly well to the N-body collapse models described by van Albada (M.N.R.A.S., 201, 939, 1982).

By taking linear combinations of two or more of the basic models with different \( \sigma_0 \), one may construct models in which the variation of velocity anisotropy with radius is more complicated than in the expression given above.

High Resolution Observations of Magnetic Features on the Sun

K.P. Topka and T.D. Tarbell (Lockheed)

The study of small, isolated, magnetic features on the sun reveals that they can apparently decay in place, without the simultaneous removal of an equal amount of opposite polarity flux. These results were obtained from a time sequence of 16 high resolution magnetograms (best have 1 arc sec resolution) covering 1 hour. The observations, made at Sac Peak Observatory, were made use of the Lockheed Tunable Filter (engineering model for the Spacelab 2 SOHO experiment and an active optical system (sunspot tracker), during moments of good to excellent seeing. Differential geometric image distortion, due to atmospheric seeing, was removed using a cross-correlation technique. This allows for a more accurate point-by-point comparison of the magnetograms.

Twenty-eight small (2 to 8 arc sec diameters) magnetic features were selected for study on the basis that they were usually monopolar and well isolated from surrounding features. The total magnetic flux present was carefully measured for each feature on each magnetogram. About 1/3 of all of these features showed evidence for a decrease in the total amount of magnetic flux present during the 1 hour observing period, without any measurable simultaneous loss of an equal amount of nearby opposite polarity flux. In one case the decaying magnetic feature was very well isolated from any other feature, surrounded by a region with no detectable magnetic flux. During its decay, no detectable magnetic flux was observed to spread out into this surrounding region.

Session 49: Solar Studies

9:40-11:30 (Mohave Room, Convention Center)

Observations Concerning the Energy Budget of a Solar Activity Complex


A complex of activity in 1962 first appeared in June and was last detectable in December. We have obtained two-dimensional photometry of this complex over much of its life. We present preliminary results of photometry with the STO Bartlon diode array system combined, where necessary, with proxy photometry derived from sunspot and calcium plage areas. For the entire lifetime of this activity complex, we find that about 53% of the sunspot radiative energy deficit is emitted by faculae. For this period, the sunspot energy deficit was 7 x 10^{36} ergs. The storage time is not known but would help determine how much energy is stored within the active region. Efforts are underway to determine the effect of the UV radiation from faculae. Corrections for the UV radiation, not measured by us, will increase the facular irradiation to perhaps over 60% of the sunspot energy deficit. This work was supported in part by the NSF.

Differential Photometry of Very Low Contrast Solar Structures in White Light

E. J. Seykora (East Carolina U.)

A high resolution differential photometer system, utilizing fiber optics and a solid state detector, is described which allows low contrast solar structures to be recorded. This photometer records the first derivative of the image intensity at a spot in the image plane, whose aperture is defined by an optical fiber. The derivative of the intensity at this spot results from the forced oscillation of the fiber with an amplitude of 1 \( \mu \)m at 5 kHz. Preliminary observations using the coelostat at the Big Dome facility of NSO/Sacramento Peak Observatory, indicate that the photometer is capable of recording spatial intensity variations on the solar disc of \( \approx 0.05\% \) per arcsecond. Drift scans