

## ANGULAR ROTATIONS OF SPIRAL NEBULAE\*

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The outstanding discrepancy in the current conception of nebulae as extra-galactic systems lies in the large angular rotations announced more than a decade ago by Dr. van Maanen.<sup>1</sup> The extraordinary significance of the phenomena, if they are real, has led the writer to remeasure four of the principal nebulae, M 81, M 51, M 33, and M 101.

TABLE I

COMPARISON OF OBSERVED AND EXTRAPOLATED ROTATIONAL COMPONENTS  
(Unit=0.001 mm for total interval)

	MEANS FOR 2 PAIRS OF PLATES			SINGLE PAIR WITH LONGEST INTERVAL		
	Interval	Obs.	Extrapolated	Interval	Obs.	Extrapolated
M 81*.....	15 yrs.	-2.0	+16	22 yrs.	-2.5	+23
51*.....	23	+1.5	16	23	+1.5	16
33.....	22	0.0	17	23	-0.1	18
101.....	16.5	+0.6	+13	23	0.0	+19
Mean...	19.1	0.0	+15.5	22.8	-0.3	+19.0

\* The results for M 81 and M 51 include measures by Nicholson and by Baade. Two recent plates of M 33 were measured against a single early plate.

In general, two early<sup>2</sup> and two late plates of each nebula, all made with the 60-inch reflector (Newtonian focus), were measured independently on a double-slide measuring machine, using about 20 reference stars and 50 nebular points. The results are given in Table I, in the form of total rotational displacements of the nebular points with respect to the reference frames, expressed in units of 0.001 mm

\* *Contributions from the Mount Wilson Observatory, Carnegie Institution of Washington*, No. 514.

<sup>1</sup> *Mt. W. Contr.*, No. 260; *Ap. J.*, 57, 264, 1923, where van Maanen gives a critical review of his results and includes references to his earlier papers. See also the *Mt. W. Annual Report*, 1930-1931.

<sup>2</sup> Only one early plate suitable for measuring was available for M 33. Most of the early plates were the same as those used by van Maanen.

$=0''.027$ . The results in all cases are comparable with the uncertainties of the measures, estimated as of the order of  $0.002$  mm, and various known proper-motion stars, included as checks, afford some direct evidence against the existence of serious systematic errors.

At the writer's request, Dr. Nicholson measured one of the pairs for M 81 and Dr. Baade the two pairs for M 51. The displacements in each case agree with the writer's results within the uncertainties of measurement and do not indicate rotations of the order expected.

Two sets of measures are thus presented, each internally consistent, differing by the large systematic terms which van Maanen has interpreted as rotations. Since several of the same plates were used, systematic errors of measuring are obviously present in one of the two sets. A careful study of the longest intervals with the blink comparator gives no indication of systematic displacements although the values of the extrapolated rotations should be above the threshold of perception. These results establish the existence of some systematic errors in the rotations although they indicate only lower limits to the actual amounts of the errors.

CARNEGIE INSTITUTION OF WASHINGTON  
MOUNT WILSON OBSERVATORY  
February 1935