E. JOINT DISCUSSION OF COMMISSIONS 28, 40, AND 45 EXTRAGALACTIC RADIO SOURCES

Wednesday, August 30, 1967

Organizing Committee: V. A. Ambarcumjan, W. P. Bidelman, R. Minkowski, M. Ryle, M. Schmidt, I. S. Šklovskij
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Contents:

https://doi.org/10.1017/S1539299600001404 Published online by Cambridge University Press

OPTICAL STUDIES OF EXTRAGALACTIC RADIO SOURCES

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Editorial Note: Dr. Sandage discussed three topics:

(i) the number of quasi-stellar objects,

(ii) the optical properties of QSO, Seyfert nuclei, and N-type galaxies,

(iii) the cosmological vs. local hypotheses of QSO distances.

Much of his material was included also in his Invited Discourse. Since this appears elsewhere in this volume he did not wish to repeat it here.

DISCUSSION

Sandage (in answer to question): I have looked for evidence of an underlying stellar population in the QSS near to the N galaxies in the UBV diagram but have not found any.

Rubin: Does the fuzz around 3C 48 affect the colours?

Sandage: No. It is probably a jet as in 3C 273.

Arp: 3C 120 and another compact galaxy which have UBV colours similar to those of QSS are probably intermediate between the QSS and Seyfert objects.

Gratton: Do the different K-corrections for N-type and elliptical galaxies affect the Hubble diagram?

Sandage: Not significantly.

Menon: Has it been established whether QSS do, or do not, exist in clusters of galaxies? If they do not then the 'continuity' argument would be affected.

Sandage: It is not yet established. The two which have been studied carefully do not lie in clusters, but since only 30% of radio galaxies are in clusters this is not yet significant. There are now 13 QSS for which clusters should be detectable if they are there. Some N-type galaxies are in clusters.

Bidelman: Could it not be that QSS turn into clusters of galaxies? This would certainly provide more mass.

Rubin: What is the evidence for the existence of 10^5 quasi-stellar objects?

Sandage: This is based on a small sample which indicates that there are between 1 and 3 per square degree down to $19^m.5$. The isotropy of the Cambridge radio-source counts, of which about 30% are QSS, suggests that this sample may be typical.

Oke: Photoelectric scans of the N-type galaxy 3C 371 show that it has changed in brightness by over one magnitude during the last 2 years and by 0·10 to 0·15 magnitude in intervals of a few days. The variability is confined to the stellar-like nucleus. The underlying galaxy can be easily distinguished on the scans and shows the usual features; namely, the Mg I lines at λ 5180, G-band, H and K of Ca II, and the CN-band at λ 3883. The absolute visual magnitude of the underlying galaxy is $-19{\cdot}9$. The non-thermal stellar-like component has the same continuum energy distribution as 3C 48 and in July 1967 was 1/10 as luminous as 3C 48. This object appears to provide the link between Seyfert galaxies and quasi-stellar sources. The rapid variability demonstrates that this property of quasi-stellar sources cannot now be used as an argument against their cosmological nature.

Morgan: I should like to make a short statement on the classification of the optical forms of the radio galaxies. Our system was devised to decrease as far as possible the systematic errors depending

Perek (ed.), Highlights of Astronomy, 354–355.

on the distance of the source. This requires that a minimum number of information elements be used (so that faint sources can be classified), but that there be a sufficient number so that a significant classification can be carried out. We have called attention to a class of supergiant galaxies (our cD class) which have the following interesting properties:

(1) They are the largest single optical complexes of stars and gas known up to now;

(2) They form the 'central bodies' of a considerable number of rich clusters of galaxies;

(3) They have the characteristic appearance of an elliptical-like core (containing peculiarities) surrounded by an extended amorphous envelope;

(4) Many of them are strong radio sources; and

(5) They may include within their boundaries other galaxies of ordinary 'giant' proportions.

It is, of course, of great importance to observe such remarkable objects with the largest possible optical and radio resolution. Their inner regions are complex, and I feel that no two members of this class will be found to be identical in form.