The Extragalactic Optical/Radio Reference Frame
A Progress Report, IAU Comm. 24 Working Group

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Abstract: A catalog of 233 strong compact extragalactic radio sources which display optical counterparts has been prepared by the working group as a basis for the establishment of an almost inertial extragalactic reference frame. Optical properties of the catalog sources are summarized and further requirements for a refinement and extension of the present data are discussed.

Radio astrometric techniques now provide a powerful means for the establishment of an almost inertial reference frame, based on compact extragalactic radio sources. At the IAU Coll. 48 "Modern Astrometry", held in Vienna 1978, a working group was established by IAU Comm. 24 "Photographic Astrometry" (see Prochazka and Tucker, 1979) to study the problem of connecting the radio reference frame to the present independent optical reference frame by a suitable subset of those radio sources which display optical counterparts. A progress report which covers the group activities up to 1982 has been prepared recently (Argue and de Vegt, 1982).

Some of the present main activities of the working group are:

1) Compilation of a list of candidate sources
2) Detailed investigation of spatial structure properties of optical and radio emission, "Point Source Problem"
3) Selection of suitable galactic sources for tying together both frames by use of optically bright objects, most encouraging now: Special types of radio stars
4) Investigation of systematic differences of the individual optical and radio catalogs which will be used for the formation of the new reference frame
5) Special assistance to Space Telescope and Hipparcos projects (Hipparcos INCA-subgroup 2130: "Extragalactic Reference Link")

H. K. Eichhorn and R. J. Leacock (eds.), Astrometric Techniques, 173–177.

Future important fields are:

a) Further densification of the present net, especially on the southern hemisphere and continuous exchange of particular objects, where optical source structure has become evident from more detailed observations.
b) Investigation of potentialities of new optical interferometric techniques, "Astrometric Interferometers", to contribute to the establishment of the extragalactic reference frame.

THE PRESENT CANDIDATE CATALOG

The first version of a candidate catalog has now been compiled from eight radio astrometric survey reference catalogs (for details see Argue et al., 1984). All sources which have been selected display practically no spatial structure on the arcsec level and have flat or complex radio spectra. On the other hand all sources should have optical counterparts with "pointlike" optical structure. As the source selection were mainly dependent on radio astrometric requirements, the optical counterparts display a mixture of different object classes and certainly needs some refinement at a later stage of this work. The actual distribution of objects is given by the following table:

Quasars: 166 / Galaxies: 25 / BL-Lac: 26 / Uncertain type: 8 / Empty fields at present: 8. Redshift data, mainly provided by the work of H. Kühr (1984), are available for 136 objects.

Concerning the astrometric suitability of these objects, the main problem arises from their faint optical magnitude. Figure 1 shows the distribution of m_V-magnitudes, split up according to galaxies and the other object types. Most candidates have magnitudes between 18 and 19 which requires large telescopes for high quality groundbased optical astrometry. However, about 50 sources are within the range of the ST-FGS system and all sources can be observed easily with the wide field camera, thus a satisfactory number of sources is available to connect groundbased and space borne astrometry at a later stage.

PROBLEMS OF OPTICAL SOURCE STRUCTURE

Most of the optical counterparts of this candidate list, especially the quasars, do not show optical structure on ESO or SRC survey plates.

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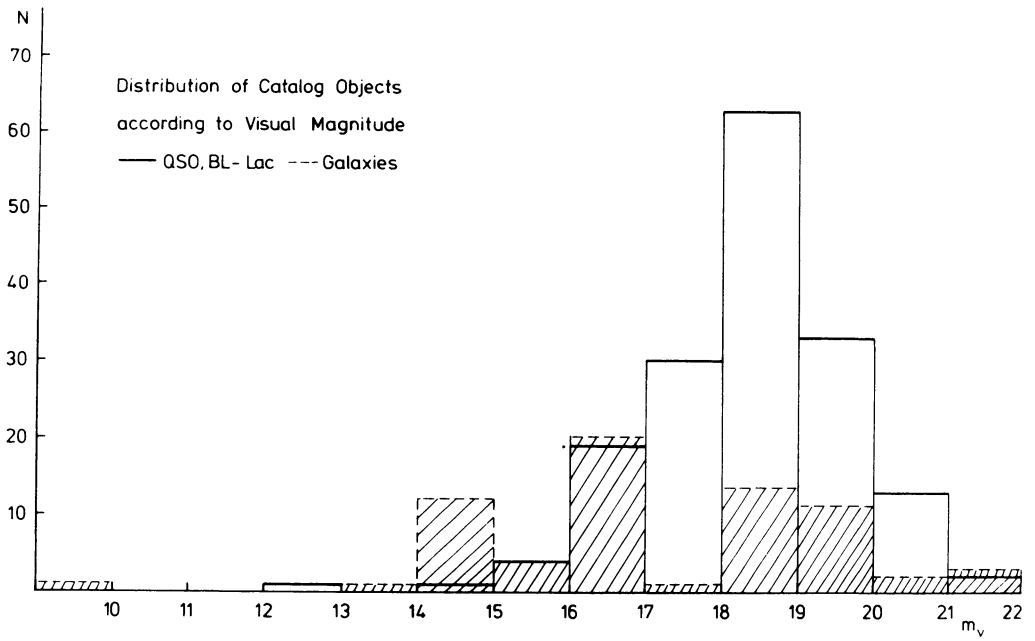
Figure 1



On the other hand definite optical structure as it is the case with brighter galaxies does not necessarily imply a significant offset of the optical and radio positions of those objects. There is no a priori knowledge on a definite coincidence of the "integrated" optical and radio emission centers. More detailed information can be obtained only from long range programs to determine precise optical positions of the counterparts in a well defined intermediate optical and radio catalog system (for further discussion see de Vegt and Gehlich, 1982a; de Vegt, 1984).

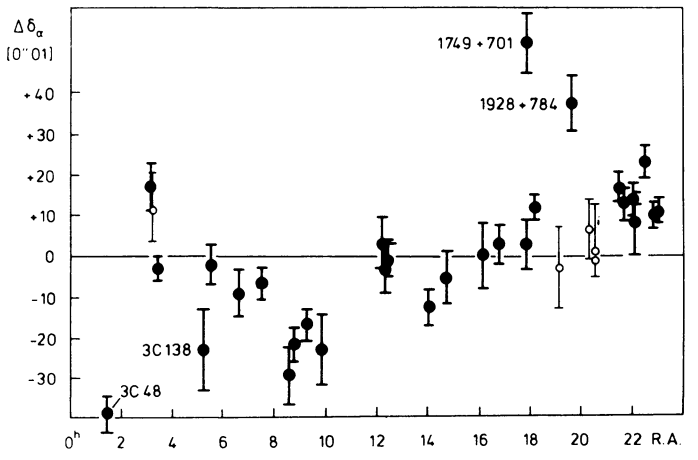


Figure 2 gives an example of what has to be expected from such a program. Whereas the general trend of the data points in the diagram displays the systematic differences of the radio and optical reference frames, some sources show a definite offset due to source structure.

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Further optical investigations by deep plates or CCD-observations may then clarify the reasons for this offset.

In the case of optically faint galaxies the astrometric properties depend strongly on exposure time, spectral range and telescope characteristics, this problem is well known from the Lick proper motion program. Furthermore, considering the application of the ST-FGS-system, resolution problems may arise from structures between 0".3 and 0".04 (Hemenway, 1982). It is planned therefore to modify the present catalog version by including suitable additional quasars near the position of the 25 galaxies, this, however, implies the inclusion of weaker radio sources < 1 Jy.

RADIO STARS

Recently encouraging astrometric results have been obtained for radio stars, although these objects share the galactic motion, positions and proper motions of high accuracy can be determined relative to the primary net of extragalactic sources (Johnston, 1984; Florkowski et al., 1986). In addition optical and radio spatial structures can be estimated from known pysical and geometric properties. Based on those data, a first candidate list has been prepared by de Vegt (1982b), for the majority of the stars in this list the a priori coincidence of optical and radio emission centers is better than 0".03 . As radio stars probably will provide the highest accuracy for tying together the Hipparcos stellar net and the radio reference frame (Froeschle and Kovalevsky, 1982) extensive VLBI and VLA observing programs are underway (Lestrade et al., 1986; Florkowski et al., 1986). Based on this forthcoming data material, the working group will prepare in addition to the extragalactic candidate list a separate list of radio stars which shall contain all relevant optical and radio information.

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