STATISTICAL STUDIES OF AGN AND QSOs

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ABSTRACT : We present some preliminary results on the determination of the masses of the central bodies of AGN and QSOs. They are given as an example of the statistical studies we are performing, based on a catalogue which we are still improving, and which is to be a compilation of many observational parameters concerning these objects.

The catalogue, baptized YEU, is being prepared by S. Collin, M. Joly, J.L. Masnou, L. Nottale and G. Stasińska. Presently, it contains 1062 objects. The basic data (coordinates, redshifts, magnitudes, radio fluxes) are taken from the catalogue of Véron-Cetty and Véron (1985). Line widths (≈650 objects), equivalent widths (≈500 objects), absolute line fluxes (≈340 objects), X-ray data (≈370 objects) have been selected from the literature. Unfortunately, even among these objects, all useful information is not available, either for technical reasons (e.g. redshift), or because the observers have published only the specific data which they have used, leaving aside those which were not necessary for their own project.

It would be of great benefit for the astronomical community, if the observers published more information derived from their spectra, even if they do not use them immediately, or if they believe that the accuracy is too poor for their needs. Still, the accuracy may be enough for statistical studies.

Let us now present, as an example, some results concerning the masses M of the central objects of AGN and QSOs, under the gravitational assumption, i.e. :

$$M \propto v^2 R,$$

where v is the velocity of the emitting clouds, and R their mean distance to the central object.

The velocity is determined by linewidths. R is estimated by two different means :

E. Ye. Khachikian et al. (eds.), Observational Evidence of Activity in Galaxies, 143–146.
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https://doi.org/10.1017/S0074180900155056 Published online by Cambridge University Press

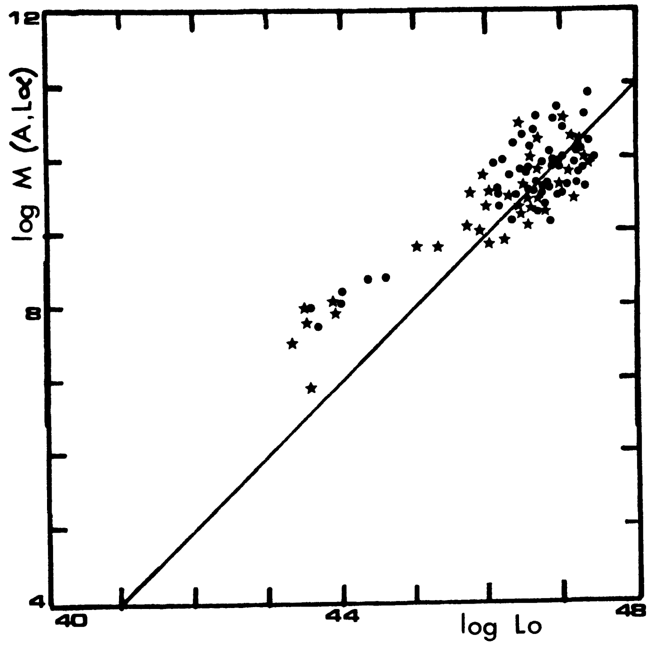

Figure 1

Fig.1 : Logarithm of M, the mass of the central object in units of solar masses, versus logarithm of Lo, the optical luminosity at rest between 3000 and 6000A. The mass is derived in the gravitational hypothesis and assuming that conditions (A) are fulfilled (see text). Velocities are given by the FWHM of the Lα lines.

The straight line corresponds to the Eddington limit (for spherical accretion), if Lo is one tenth of the bolometric luminosity.

Radio quiet (RQ) objects are represented by dots and radio loud (RL) ones by stars.

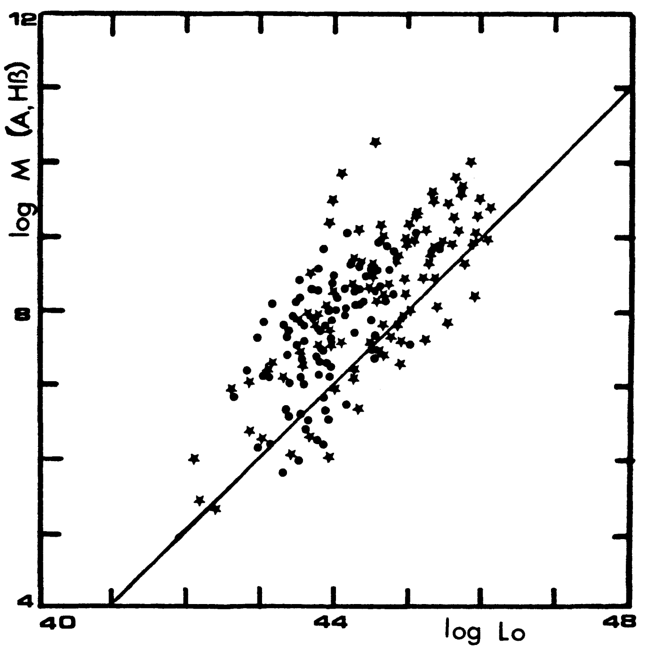

Figure 2

Fig.2 : Same as Fig.1, but velocities come from Hβ lines (note that Figs. 1 and 2 do not concern the same sample).

The spread is large but a correlation exists. The regression line (not shown) for the points in Fig.2 fits well the points of Fig.1 (most of which represent luminous and remote quasars).

Some objects radiate above the Eddington limit (EL). But RQ objects tend to radiate below the EL as Lo increases, which is not the case for RL ones. Besides, masses derived for RL objects extend further than for RQ ones. However, both these properties may be artefacts.

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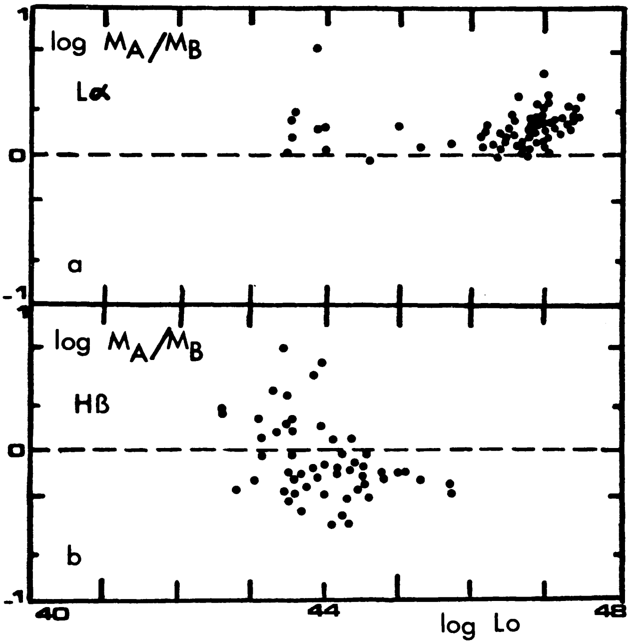

Figure 3

Fig.3 : Comparison of the masses derived by methods A and B (see text).
a) log M(A)/M(B) versus Lo, the masses being computed using the Lα lines; b) same as a), but using the Hβ lines.

In a), the scatter is quite small and there is no systematic variation with Lo. The fact that M(A)/M(B) tends to be slightly greater than one may merely reflect a calibration effect.

In b), the scatter is much larger. This is probably because part of the Hβ emission comes from collisional excitation in a hot neutral zone, whose importance varies among the objects.

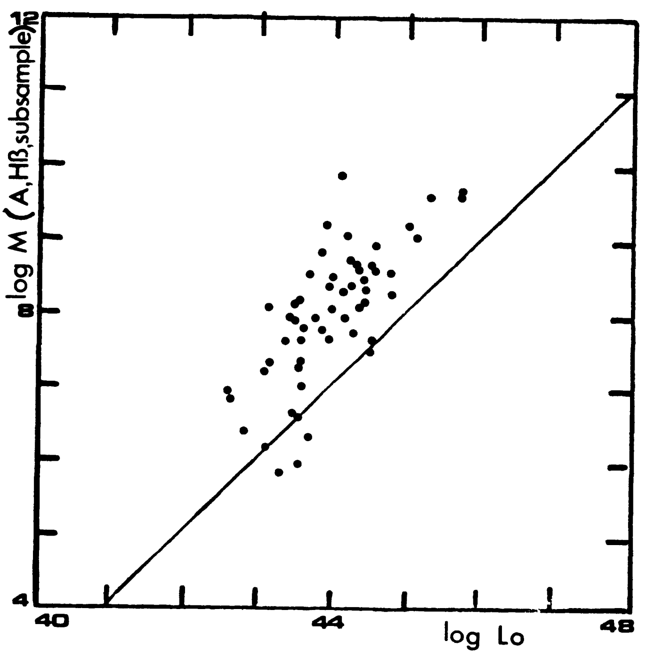

Figure 4

Fig.4 : Same as Fig.2, but for a subsample of objects. Only are plotted those for which the Hβ luminosity was available (as in Fig. 3b). RQ and RL objects are not distinguished here.

The difference in aspect between Fig.4 and Fig. 2 clearly demonstrates the importance of working with large samples and of being aware of selection effects even in that case.

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(A) : Assuming that Un is constant (we have taken $Un = 10^8$), where U is the ionization parameter, and n the cloud density, and that the number of ionizing photons is proportional to Lo (see Joly et al., 1985). Then,

$$M \propto v^2 (Lo/(U n))^{0.5}$$

(B) : Again assuming Un constant, but, using the luminosity in a given line (Lα or Hβ) and taking a constant covering factor f (see Wandel and Yahil, 1985). We have taken f = 0.2. Then, if the observational data are taken from the Hβ line for example,

$$M \propto v^2 (L(H\ )/(f\ U\ n))^{0.5}$$

Figures 1 to 4 present some of the results. A few comments are also given. A thorough discussion, including comparison with previous studies of the same kind (e.g. Dibai, 1981), is in preparation for Astronomy and Astrophysics.

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