RevMexAA (Serie de Conferencias), **16**, 279–280 (2003)

QUASARS IN THE OTELO SURVEY

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RESUMEN

OTELO es un cartografiado de objetos con líneas de emisión que se llevará a cabo usando filtros sintonizables con OSIRIS en el GTC. Este survey sin duda producirá un gran impacto en astronomía extragaláctica por su gran área y su alta sensibilidad. En este artículo se discute la detección de cuásares y se estima el número de cuásares que se encontrarán en OTELO.

ABSTRACT

OTELO is a survey of emission line objects that will be carried out using tunable filters with OSIRIS at the GTC. The survey will have a deep impact on extragalactic astronomy owing to its large area and its high sensitivity. In this paper we discuss quasar detection within this survey and estimate the number of quasars that can be found in OTELO.

Key Words: **QUASARS**

Since the discovery of quasars, their distribution as a function of redshift and luminosity has been acknowledged as a problem of particular importance. First, the ability to observe objects at very high redshifts has provided a cosmological probe of great power, although it is limited by the lack of a complete understanding of the intrinsic properties of the quasars themselves. Second, changes in statistics of the quasar population provide important clues to the evolution of the Universe and to the epoch of galaxy formation.

Many quasar surveys exist that have been obtained using different techniques at different wavelengths, although not all surveys are useful for studying the spatial distribution and space density of quasars (Hartwick & Schace 1990).

QSOs have been found up to redshifts of 6, which leaves a short time for the formation of their host galaxies. Some studies (e.g., Warren et al. 1994; Schmidt et el. 1995; Kennefick et al. 1995) indicate that the space density of QSOs declines for $z > 3$, as expected if this is the epoch of galaxy formation. It is important to test this decline by exploring the $z > 5$ region by defining new deep surveys.

OTELO (OSIRIS Tunable Emission Line Object Survey) is a survey that will cover around 15 square degrees of the sky. Using tunable filters, it will scan three spectral regions at resolutions of around 15 Å at a limiting flux of $\sim 10^{-17}$ erg s^{-1} cm^{-2}. More than 8000 emission line sources are expected (see Cepa et al., this volume, p. 66), mostly galaxies with Hα emission at redshift below 0.4. The observational technique will also allow us to detect objects at higher redshifts with emission lines falling into these windows.

An important population that will be studied is AGN. OTELO will be very efficient in detecting AGN at different redshifts (see Sánchez-Portal et al., this volume, p. 316). Quasars will also be detected both in emission lines and in the continuum and the survey offers us a unique opportunity to measure the space density of quasars at different redshifts. We must remark that OTELO will provide flux-limited samples in well defined volumes of the Universe, making the survey a very powerful tool for determining accurate luminosity functions for all these populations.

We discuss here the expected number of QSOs that will be detected by OTELO assuming the luminosity function by Pei (1995). This quasar luminosity function (QLF) is based on more than 1200 QSOs in the redshift range 0–4.5 and refers to B magnitudes. Pei's QLF explicitly assumes a decline in the space density of quasars at $z \sim 2$–3, therefore OTELO will test this assumption.

1. ESTIMATED NUMBER OF QSOS

The OTELO survey will scan three windows at different line flux limits: 1) 7075–7205 Å at 2×10^{-16}

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Science with the GTC 10-m Telescope (Granada, España, 5-8 febrero 2002)
Editors: José Miguel Rodríguez Espinosa, Francisco Garzón López & Verónica Melo Martín

TABLE 1

EXPECTED NUMBER OF QSOS IN OTELO

Line	7075–7205	8072–8247	9060–9300
Ly limit	0	0	0
Lyβ	0	0	0
Lyα	0.0183	0.0053	0
Si IV	0.0124	0.0152	0.0016
C IV	0.2238	0.4339	0.4095
[C III]	0.1437	0.5415	0.7732
Mg II	0.2981	1.4676	2.3652
Subtotal	0.6963	2.4635	3.5495

erg s^{-1} cm^{-2}; 2) 8072–8247 Å at 3×10^{-17} erg s^{-1}] cm^{-2}; 3) 9060–9300 Å at 1×10^{-17} erg s^{-1} cm^{-2}. QSOs will be detected in these windows through different emission lines at different redshifts. For our computations we have considered only emission lines from QSOs at redshifts greater than 1.5.

To estimate the number of quasars from Pei's QLF we must first convert from line intensities to B magnitudes. We used mean values of line ratios from Zheng et al. (1997) and the relationship between Lyα flux and B magnitude:

$$M_B = 2.5 \log W_0 - 2.5 \log f_{\rm Ly} - 5 \log A(z) + 1.395\alpha - 61.60,$$

where W_0 is the rest-frame equivalent width of the Lyα line (taken as 100 Å), $f_{\rm Ly}$ is the line intensity, and $A(z)$ is the luminosity distance in units of (c/H_0). For H_0 and q_0 we have taken the values 50 km s^{-1} Mpc^{-1} and 0.5, respectively. A mean spectral index, α, of -0.5 has been assumed.

Table 1 shows the results of this computation for each emission line and redshift window for a single OSIRIS field of view ($\sim 8' \times 8'$).

The number of quasars predicted in the OTELO survey is then 6–7 per field observed in the three spectral windows. The area surveyed will be different for the three windows, being 1000, 57, and 10 fields for the first, second, and third window, respectively. Thus, the expected numbers of QSOs is 700, 140, and 35 in each window in the whole survey, making a grand total of 875 QSOs. Note that this estimate refers to QSOs detected by their line emission only. As a comparison, the expected number of quasars brighter than $B = 27$ in a single broad band image is around 100 considering redshifts from 0 to 7.

Lyα luminosity of these quasars will be in the range $\sim 1.5 \times 10^{42}$–10^{44} erg s^{-1}, depending on the redshift window and on the emission line detected.

In summary, OTELO is a very powerful tool for detecting quasars at redshifts from 1.5 to around 7, providing well defined samples both in volume and in line flux. This will allow us to obtain quasar luminosity functions at different redshifts and to measure the space density of quasars up to redshift 7, which will have a deep impact on cosmological evolution models of quasars and galaxies.

JIGS acknowledges support from the Spanish Ministerio de Educación y Cultura through project PB98-0409-C02-02.

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