THE CALAR ALTO DEEP IMAGING SURVEY

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1. Introduction

The **C**alar **A**lto **D**eep **I**maging **S**urvey (CADIS) combines deep multicolor imaging in broad and narrow band filters with deep probing in several selected wavelength intervals through a Fabry-Pérot (FP) interferometer with a spectral resolution of ~450.

Though the survey is primarily designed to detect emission line galaxies such as primeval galaxies at high redshift and faint blue galaxies, its multi-filter technique also allows the classification and redshift determination of early type galaxies, of faint QSOs beyond $z = 3$, and of faint M stars. In the case of emission line galaxies, the accurate redshift is obtained from the FP observations, which allows to derive the faint end of the luminosity function of galaxies at $z \lesssim 1$, and their three dimensional correlation function.

2. Survey Strategy

The limiting flux is dictated by the search for primeval galaxies. In order to detect a representative number of primeval galaxies the sensitivity for the deep FP observation of the redshifted Lyα line needs to be $F_{lim} = 3\times10^{-20}\,\mathrm{W\,m^{-2}}$ (Thommes & Meisenheimer 1994). With this sensitivity we should be able to detect bright spiral galaxies out to $z > 1$, and the first burst of star formation in primeval galaxies at $z \lesssim 5$ down to star forming rates of $\sim 30\,\mathrm{M_\odot\,yr^{-1}}$. The filter observations should reach a limiting (5σ) magnitude of $R = 24.3$ mag.

Since we expect most primeval galaxies to be located at $z \gtrsim 5$ we have selected for the Lyα line search three atmospheric windows centered at 700, 820, and 918 nm. In each window we observe at 10 wavelength settings at intervals of 1.5 nm. In order to discriminate foreground galaxies that light

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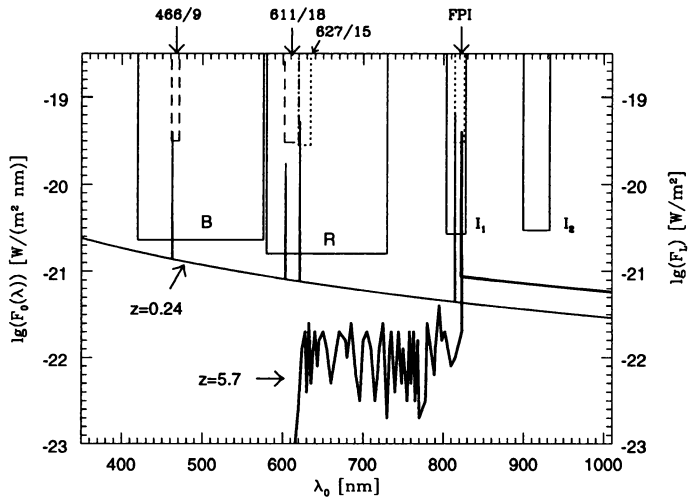

Figure 1. Demonstration of the veto-filter strategy used in CADIS. Solid boxes indicate the bandwidths and 5σ limits for the deepest broad and medium band filters and the dotted and dashed boxes the same for the Fabry-Pérot scans and for the veto-filters 466/9, 611/18, and 627/15 nm. Whilst a Lyα galaxy at $z = 5.7$ will be only detected in the FPI band and (perhaps) the I-bands, for example a foreground galaxy at $z = 0.24$, which has its Hα line at the FPI band at 820 nm exhibits detectable emission lines in both the 466/9 and 627/15 nm filters.

up with emission lines in the same FP bands we have introduced several so-called *veto*-filters, which are selected in such a way that for every prominent emission line appearing in the FP window a second or third line should show up in them. Figure 1 demonstrates this strategy for a galaxy detected in H α.

We added a complete set of broad band (B, R, K') and of medium band filters ranging from 400 to 930 nm, and with bandwidths between 10 and 30 nm. These are optimized both for the continuum determination and the identification of contaminants such as faint galactic M stars. We thus get a global view of the spectral energy distribution (SED) for every object in the field, without biasing towards a fixed color. With these SEDs we should be able to classify most of the objects and determine the redshift of early type galaxies with an accuracy of $\Delta z \lesssim 0.05$, in the redshift range $0.5 < z < 1.2$.

3. Survey Fields

CADIS surveys 10 empty $11' \times 11'$ fields. The selection criteria are: no stars brighter than $R \sim 16$ mag, and a low FIR(100μm) flux of $< 2.0\,\mathrm{MJy\,sr^{-1}}$. The total area covered is thus 0.33 deg^2. The observations are done at

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the 2.2 m and 3.5 m telescopes on Calar Alto, Spain. The total survey will consist of ~4500 CCD exposures and yield a list of approximately 50,000 objects. We expect 20 to 200 primeval galaxies at $z \gtrsim 5$, more than 10,000 emission line galaxies at redshift 0.24 to 0.9, several 100 early type galaxies, more than 300 QSOs, and about 1500 low mass stars (possibly brown dwarfs). The first two CADIS fields will be completed at the begining of 1997.

References

Thommes & Meisenheimer 1994, Galaxies in the Young Universe, p.242.