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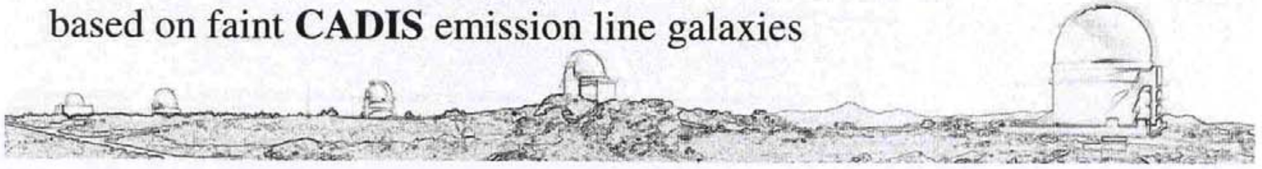
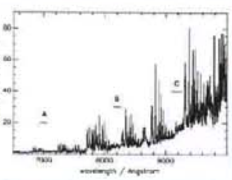


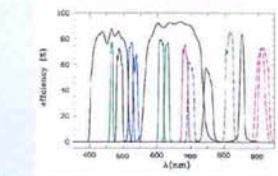
C. Maier, K.Meisenheimer, H.Hippelein, H.-J. Röser and the CADIS Team



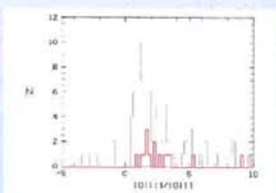
Night-sky emission spectrum. The windows A, B, and C which are searched by CADIS are essentially free from atmospheric OH lines.

CADIS (Calar Alto Deep Imaging Survey) has been a key-project of the Max-Planck Institut for Astronomie (MPIA) in Heidelberg since 1996. CADIS combines a moderately deep multi-band survey using 16 filters (see figure on the right) with an emission line survey employing an imaging Fabry-Perot interferometer, which selects emission lines in three waveband windows free of night-sky emission lines (see figure at the left): FPIA: $696<\lambda<708$nm; FPIB: $814<\lambda<825$nm; FPIC: $912<\lambda<928$nm. The typical flux detection limit for an emission line redshifted into these windows is $F_{lim}>3 \times 10^{-20}$ W/m² (which can be reached with the Calar Alto 2.2- and 3.5-m telescopes in a few hours).

After six years of observations on Calar Alto 90% of the planed Fabry-Perot data have been observed. 7 of 10 wavelength intervals A and B have been almost completely analysed. The analyis of 69% of window B and 47% of window A have been finished, in terms of the final $\Delta\Omega \times \Delta z$, and the following results are based on this data. The analysis of interval C has been postponed for the moment because of technical problems (strong "fringing" in the CCD images), and low expectations of success on the basis of the present results.

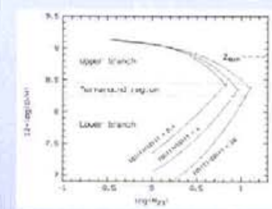


The CADIS filter set; optical broad and medium band filters are shown: pre-filter FP-A and veto-filter, pre-filter FP-B and veto-filter, pre-filter FP-C and veto-filter.



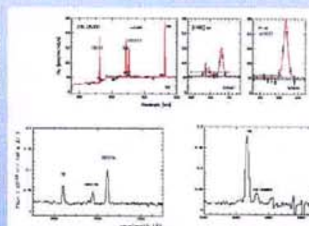
In order to extend the sample of already published metallicities of galaxies at medium redshift to fainter absolute magnitudes, we selected for the spectroscopic follow-up objects with absolute magnitudes fainter than $M_B \sim -19$ which were able to be placed on the slitmasks together with Ly-α candidates (Maier et al. 2003) in order to maximize the number of galaxies observed. 16 galaxies with with $M_B \geq -19$ and the [OIII]λ5007 line detected in FP window A ($z\sim0.4$) or FP B ($z\sim0.64$) have been selected for follow-up spectroscopy. The line identification (see also examples below) is done by means of the line profile, by fitting template galaxy spectra to the observed multi-filter SED, and by considering the flux in veto-filters at the expected wavelengths of other lines (*Hippelein, Maier et al. 2003*). In the histogram [OIII]/[OII] (figure on the left) of all galaxies selected by their [OIII]λ5007 line seen in the FP, the bold red line shows the 16 galaxies which have been spectroscopied in order to determine their abundances using the R_{23} method. There is no bias towards a special (metallicity dependent) [OIII]/[OII] ratio.

Oxygen abundances have been determined using the empirical abundance indicator **R_{23} =([OIII]λλ5007,4959 + [OII]λλ3726,3729)/Hβ** first suggested by Pagel et al. (1979), later refined by McGaugh (1991) (see figure on the right).



The galaxy 23h-5300 (M_B=-19) at z~0.41

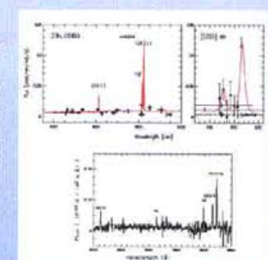
Upper panel: Photometry in all 14 optical CADIS filters fitted by a continuum-model with overlayed prominent emission lines (left panel), the Fabry-Perot measurements in window A with a [OIII] doublet profile fitted to the observed flux data (center), and the Fabry-Perot measurements in window C with a Halpha and NII three-line profile fitted to the observed flux data (right panel). Note that the [OII]λ3727 line is seen in the veto-filter at 522nm.
Lower panel: VLT spectrum using the 300I grism with FORS2. The galaxy 23h-5300 shows a [NII]λ6584/Hα line ratio of ~ 0.1, and lies in the turnaround region of the R_{23} relation.

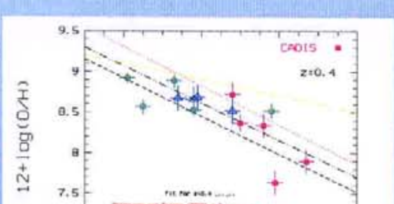


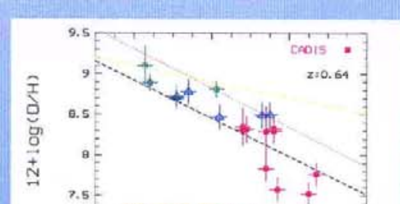
The galaxy 23h-5159 (M_B=-17.5) at z~0.64

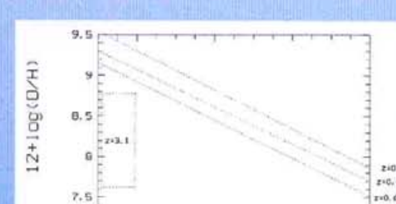
Upper panel: Photometry in all 14 optical CADIS filters fitted by a continuum-model with overlayed prominent emission lines (left panel), and the Fabry-Perot measurements in window B with a [OIII] doublet profile fitted to the observed flux data (right panel). Note that the [OII]λ3727 line is seen in the veto-filter at 611nm.

Lower panel: VLT spectrum using the 300I grism with FORS2.









The oxygen abundance as a function of absolute magnitude, for z~0.4 (left panel) and z~0.64 (center panel). Filled squares are CADIS data, open squares the data points from literature, from Carollo & Lilly (2001) at z~0.4, and from Kobulnicky & Zaritsky (1999) at z~0.64. Open triangles denote measurements from Kobulnicky et al. (2003). For comparison, the dotted line shows the luminosity-metallicity relation found by Melbourne & Salzer (2002) for a large sample of local emission-line galaxies, and the relation found by Kobulnicky et al. (2003) for local galaxies is shown as dashed-dotted line. The metallicity-luminosity relation found by Kobulnicky et al. (2003) for galaxies at z~0.64 is shown as dashed line, and, in the left panel, the dashed-dot-dotted line (shifted Kobulnicky et al. line) provides a better fit to the data at z~0.4.

The metallicity-luminosity relation including the metallicity-luminosity relation fits for galaxies in the two redshift bins, and the metallicity-luminosity relation found by Melbourne & Salzer (2002) for a large sample of local emission-line galaxies. Additional, the oxygen abundances for galaxies with bright M_B at z~3 from Kobulnicky & Koo (2000), and Pettini et al. (2001) are shown.

The CADIS data for galaxies with faint absolute magnitude at z~0.4 and z~0.64 show a clear **metallicity-luminosity evolution** compared to z=0. Either galaxies at z~0.4 have faded by ~1mag, and galaxies at z~0.64 have faded by ~2mag due to decreasing levels ofstar formation, or their metallicity increased by a factor of ~0.2dex from z~0.4, and ~0.4dex from z~0.64, or there is a combination of both effects. The metallicity evolution is consistent with models of Somerville & Primack (1999) and Pei et al. (1999), who predict a change in the star-forming metallicity with redshift of 0.2dex, and 0.3dex, respectively, over the last half of the age of the universe (see also Fig.18 in Lilly et al. 2003). When taking into account the data for galaxies with brighter absolute magnitudes from Kobulnicky & Zaritsky (1999) at z~0.64, Carollo &Lilly (2001) at z~0.4, and Kobulnicky et al. (2003) the metallicity-luminosity relation over a wide range of absolute magnitudes is displaced at lower abundances, i.e., the slope remains about the same, and the zero-point seems to evolve.

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