IV Workshop

Estallidos de Formación en Galaxias

A Spectroscopic Study of the Near-IR [SIII] Lines in a Sample of HII Galaxies

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OUTLINES

- Introduction
- Near-IR sample and observations
- Results

HII GALAXIES

General properties

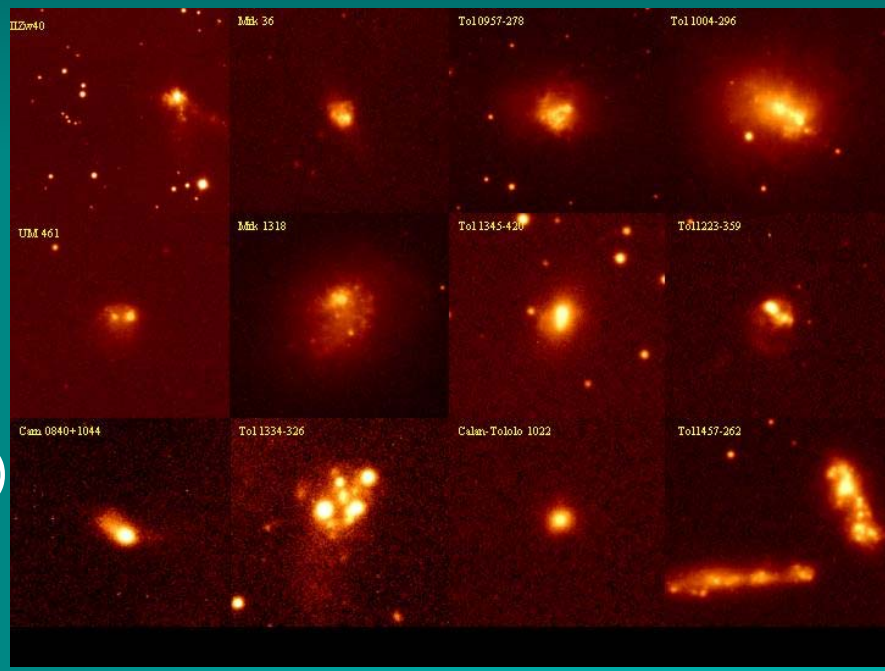
- Undergoing violent star formation and present high specific star-forming rate $\rightarrow$ 0.8 $M_\odot$ Kpc^{-2} yr^{-1} (Meurer et al. 1995)

- Higher spatial resolution images $\rightarrow$ many HII galaxies present knots (Telles et al. 2001)

- Strong emission lines and extragalactic HII regions-like spectra (Terlevich et al. 1991)

- Metal-poor objects ($Z_\odot/50 < Z < Z_\odot/3$)

- Least chemically evolved galaxies in the local Universe



Narrowband Hβ images of HII galaxies (NTT- Telles et al in prep.)

INTRODUCTION

Motivation

►The sources of O are well determined and the most important ionisation stages can be observed in the optical

► The relevance of studying the strong near-IR [SIII] lines :

Aim: *derive accurate sulfur abundances, still lacking for these objects and produce a large sample of the low metallicity, blue compact dwarf galaxies in this spectral range.*

* In HII galaxies, sulphur is mostly in the S^{++} form → S^{++} abundance (the dominant ion) in determining the S/H

* Most of works: S^{++} abundance is based on [SIII]λ6312Å that is a faint and temperature-sensitive line

* The best lines for S abundance derivation are the nebular lines, [SIII]9069,9532 Å , we have used, in the near – IR.

* Number of works for HII galaxies, having used these lines is still small (e.g. Pérez-Montero & Díaz 2003, Garnett 1989)

Sample and Observations

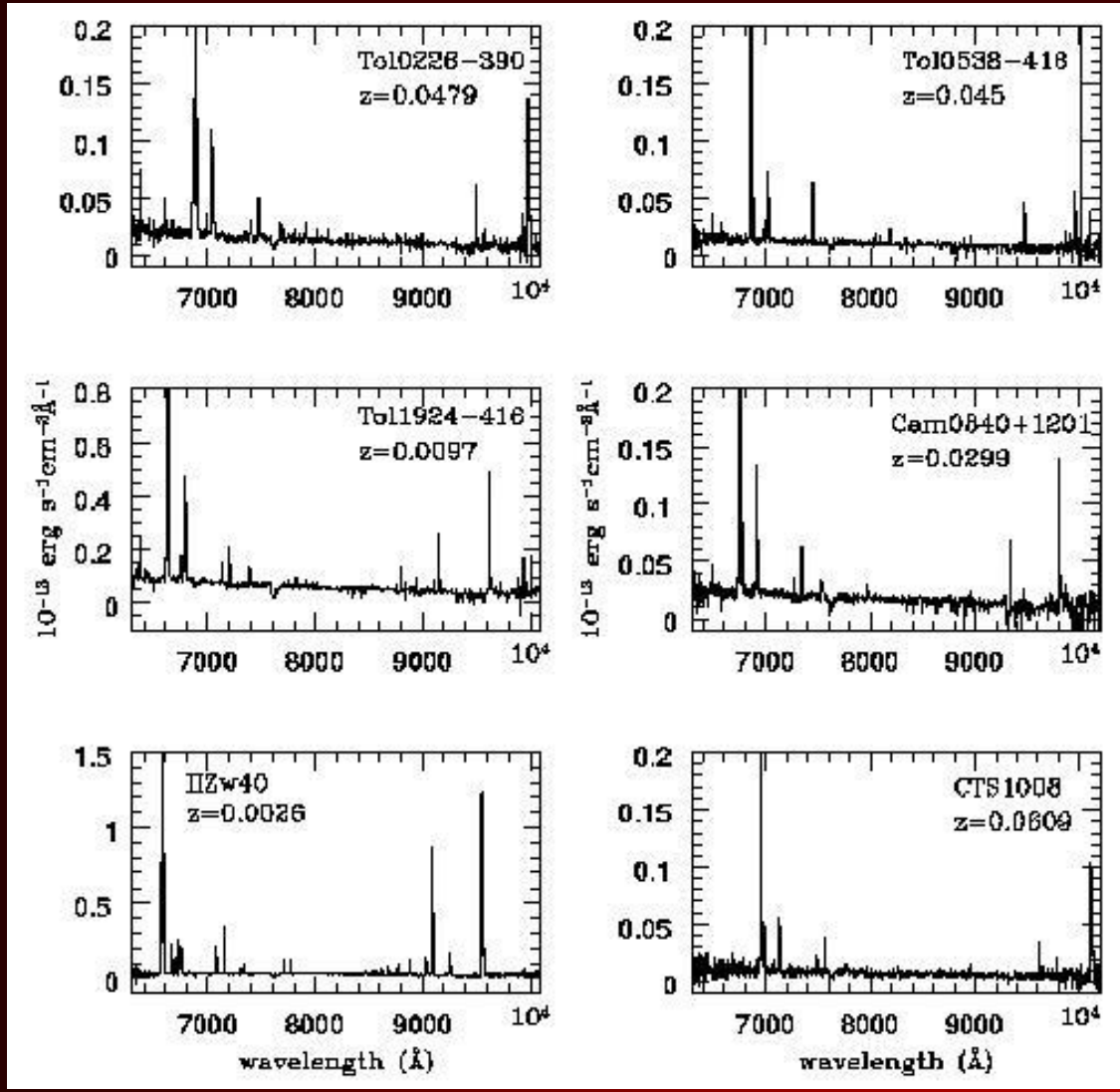
► Long – slit spectrophotometric observations of a sample of 34 HII galaxies ($z < 0.1$, Local Universe)

► 1.52m telescope/ESO, La Silla, Chile

► Spectral range : (6000 Å - 1μm) → nebular near-IR [SIII] lines λλ9069,9532Å.

► This sample has been previously observed in the blue (Kehrig et al. 2004), spanning a range of O/H from $1/20(O/H)_{\odot}$ to $(O/H)_{\odot}$

Sample and Observations



Examples of Near-IR Spectra of the HII Galaxies of our sample

Data Reduction and Atmospheric Absorption Correction

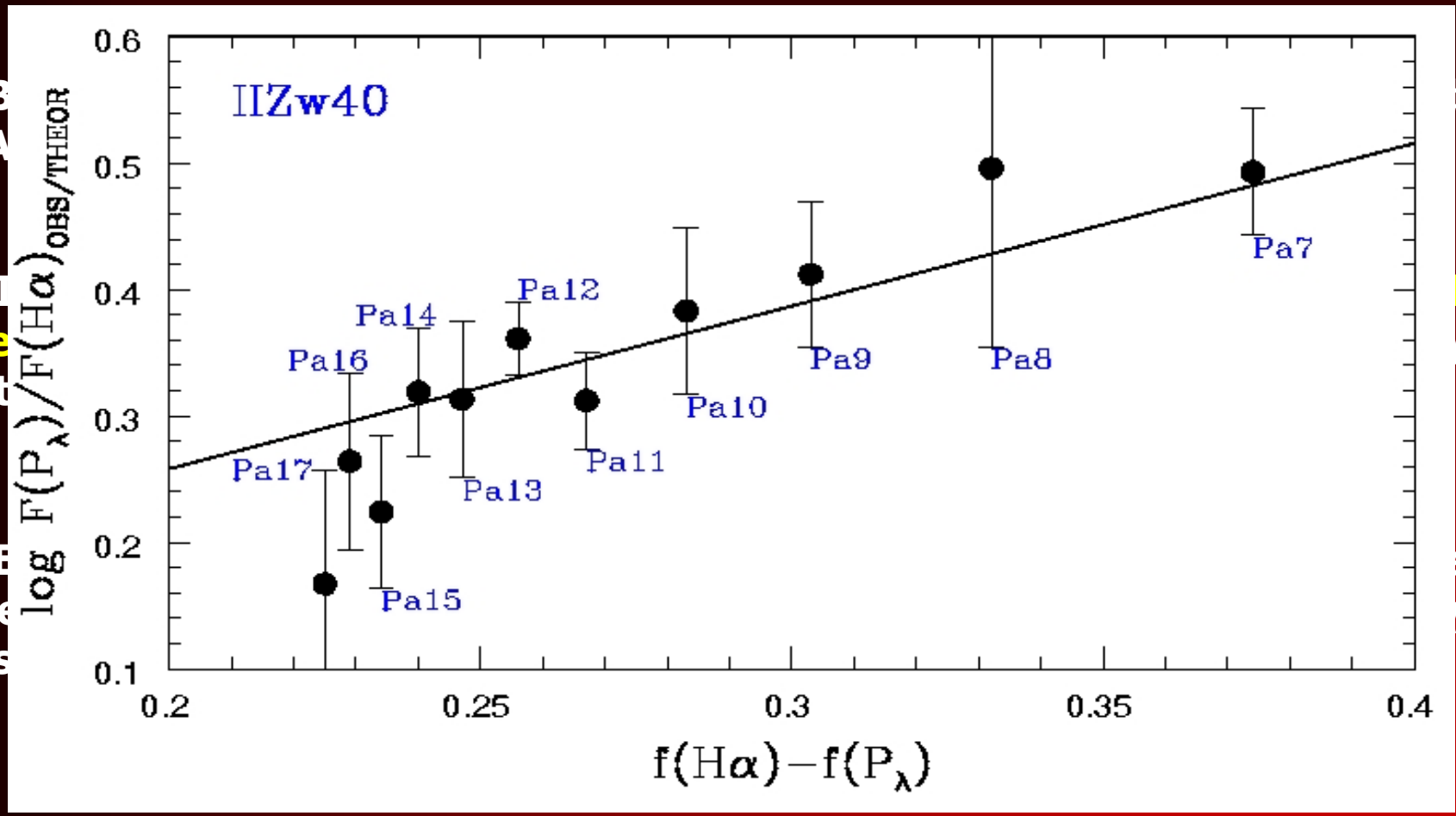
► Basic reduction (bias and flat-field correction, flux calibration) → standard IRAS package

► In the analysis of the near-IR spectra **a crucial step is the correction from the effects produced by the earth's atmosphere on the spectra**, especially between 8000 Å and 1 μm.

► Exhaustive work has been done to correct the whole sample for these effects: **a realistic spectrum of the atmosphere** (8000 Å to 1 μ) , for every observed night **using ~ 6 standard stars.**

► To check the realiability of the reduction process → compared the 4 brightest Paschen lines (Pa8, Pa9,Pa10,Pa11) with the theorical values → the corrected values P_λ /Hα tend to the theorical values **(IIZw40: Pa17 to Pa8)**

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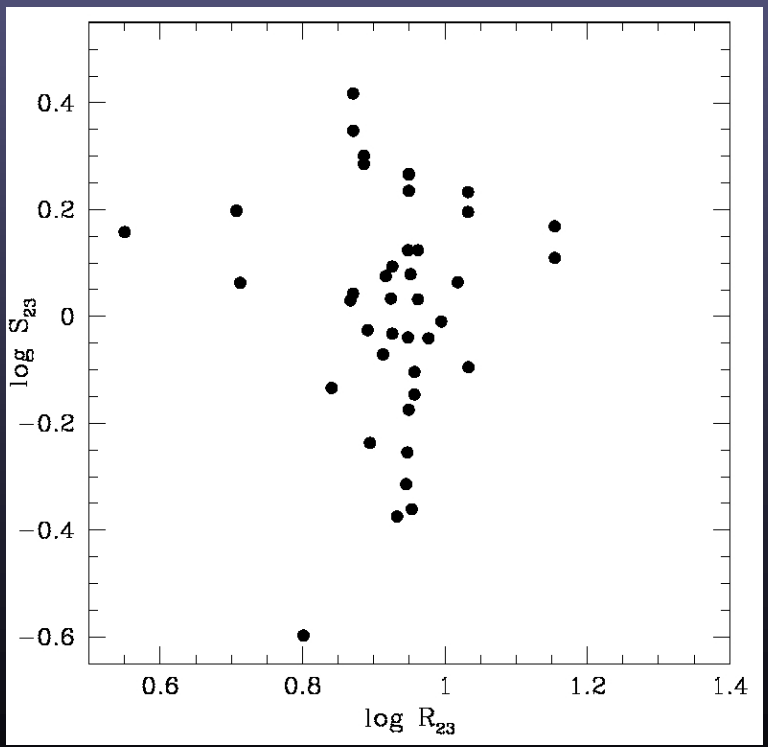


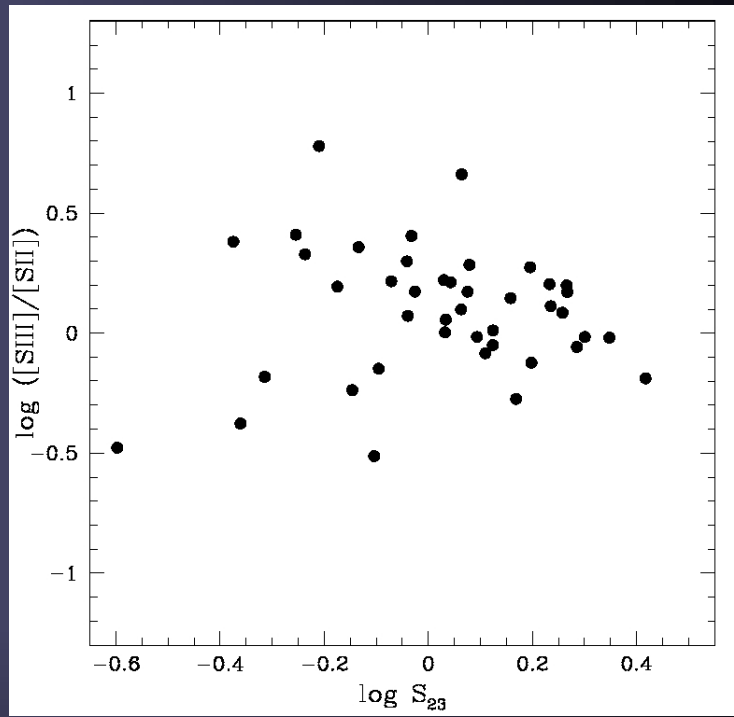
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Results ...

►**Empirical indicators S_{23} vs. R_{23} for our sample of HII galaxies: S_{23} varies of 0.8 dex, log R_{23} close to 0.9-1 → our sample in the turn-over region**

►**S_{23} is ideal to derive chemical abundances**





► **S_{23} does not show a strong dependence on the ionization conditions**

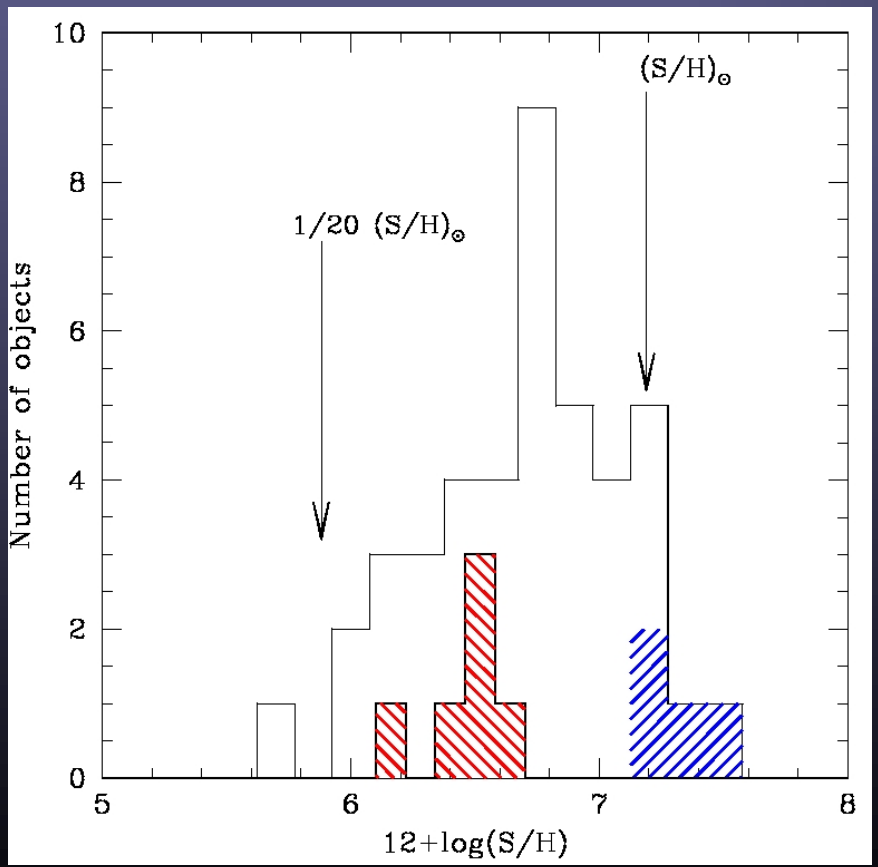
► **S_{23} : a robust empirical indicator**

[SIII]/[SII] = *[SIII]9069,9532 / [SII]6717,6731*

Results ...

★ 6 of the 34 objects a direct value of the S/H - electron temperature obtained from [SIII]6312 Å.

★ the rest of the objects the S/H - S_{23} calibration (Pérez-Montero et al. 2005)

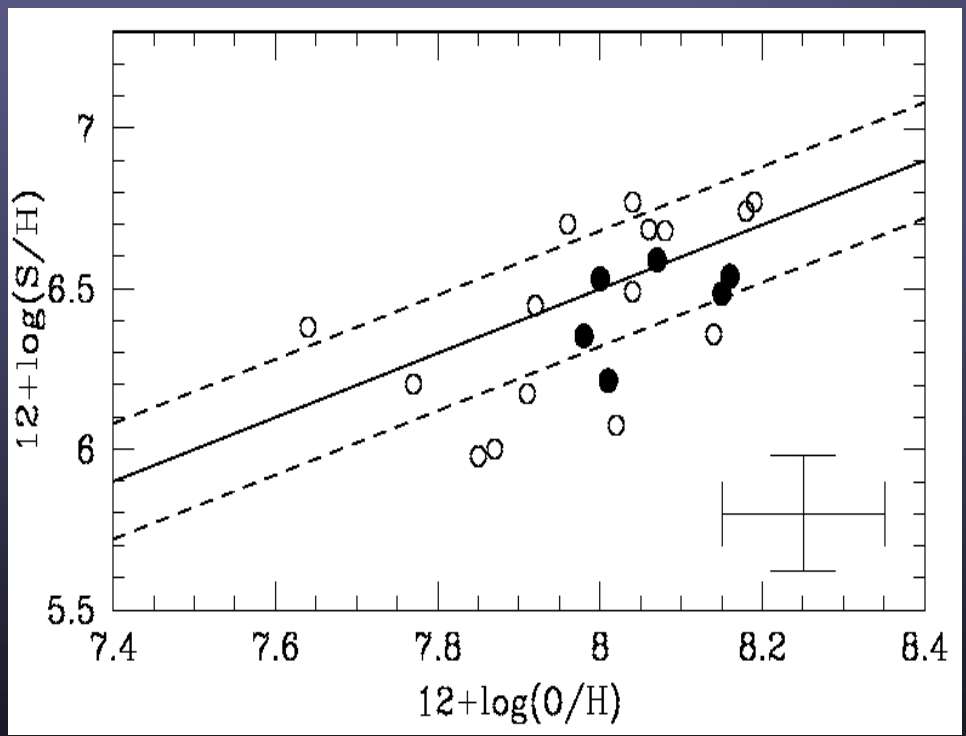


▶ Most of galaxies present $1/20\ (S/H)_\odot < S/H < S/H_\odot$ → our sample is composed mainly by low-luminosity galaxies

▶ **The S/H distribution extends towards somewhat higher S/H : star-forming knots within the nuclear starburst and the interacting pair of galaxies**

Results ...

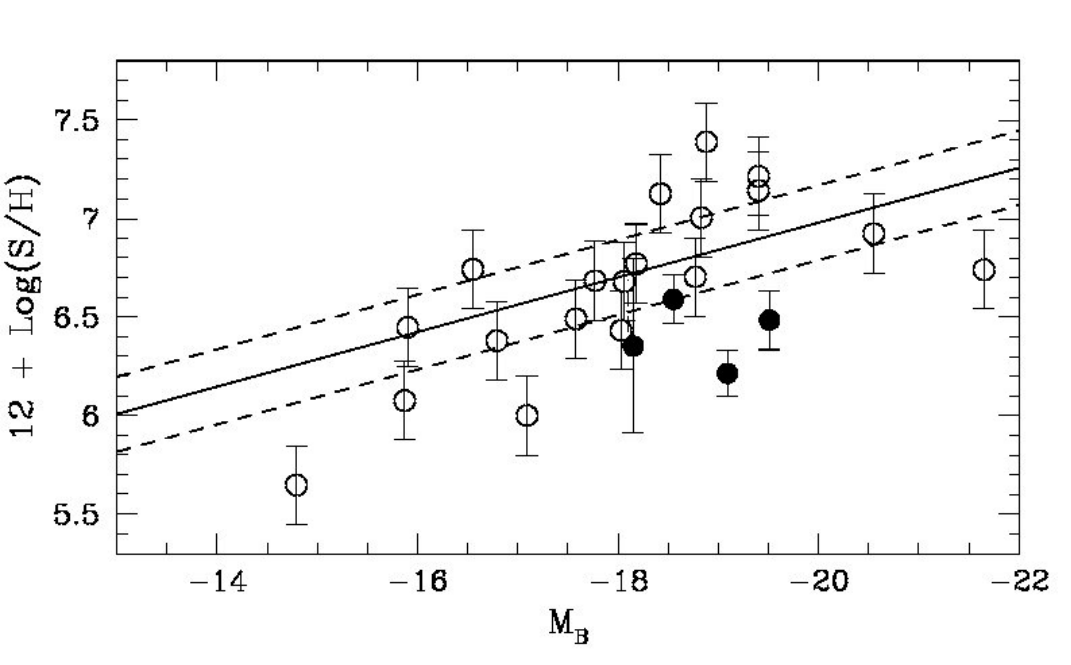
The comparison between S and O abundances → clues about S nucleosyntesis and the optimum stellar mass range for the production of S



- Solid line → $\log(S/O)_{\odot}$=-1.5 dex and dashed lines are +/- 2σ derived by Lodders (2003)
- Most of galaxies are located within +/- 2σ
- There is no statistical evidence for any systematic variation of S/O with O/H in this range of abundances

Results ...

Metallicity – luminosity relation using the S/H abundance



- For ~ 75% of our sample: M_B from LEDA Catalogue
- Solid line → Z-L relation for dwarf irregular galaxies (Pilyugin et al. 2004) scaled assuming $\log(S/O)_\odot$
- Most of galaxies follows the expected relation for S/H

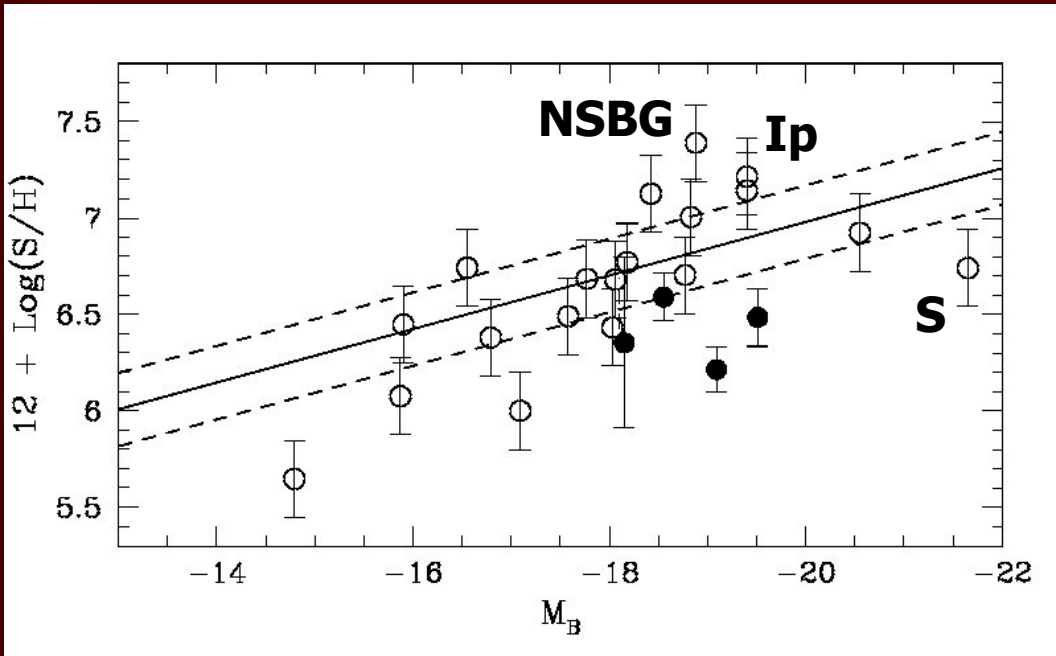
- It opens "doors" to investigate the Z – L relation for reddened galaxies

Summary of the results

- S/H shows a weak dependence on the excitation degree of the HII regions $\longrightarrow$ S_{23} is not sensitive to ionization effects $\longrightarrow$ robust empirical indicator
- For 6 galaxies: S/H with t_e[SIII] and the rest of the objects: S/H with S_{23} method
- We have compared the $(S/H)_{te}$ with $(S/H)_{S23}$ - both methods are consistent within the errors – validity of the S_{23} method as an abundance indicator
- S/H as a function of O/H in low metallicity environments – S/O remains constant as O/H varies from $1/20(O/H)_{\odot}$ to $(O/H)_{\odot}$ – the assumption that S/O ratio remains constant at all abundances is still an open question
- The relation of S/H with M_B ~ 75% of our sample – most of galaxies follows the expected metallicity-luminosity relation for S/H

$S_{23} = log[([SII]6717,6731 + [SIII]9069,9532)/H\beta]$

[SIII]/[SII] $= [SIII]9069,9532 / [SII]6717,6731$



Results ...

- Comparison between S/H derived directly from T_e [SIII] and empirically from S_{23} .

- Both methods appear consistent

