

Observational study of the ISM oxygen abundance of star formation regions in three dlrr galaxies



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Mapping Oxygen in the Universe,
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About this work...

- **Collaborators:**

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- Wiebe, D.S.³

¹ Sternberg Astronomical Institute, Moscow State University

² Special Astrophysical Observatory of Russian Academy of Science

³ Institute of Astronomy of Russian Academy of Science

- **Publications:**

- IC 10:
 - *Lozinskaya et al.*, Astronomy Letters **35**, p.730 (2009)
 - *Arkhipova et al.*, Astronomy Letters **37**, p.65 (2011)
 - *Wiebe et al.*, Astronomy Reports **55**, p.585 (2011)
- VII Zw 403:
 - *Arkhipova et al.*, Astronomy Reports **51**, p.871 (2007)
 - *Egorov, Lozinskaya*, Astrophysical Bulletin **66**, p.293 (2011)
- Holmberg II:
 - *Egorov et al.*, in preparation.



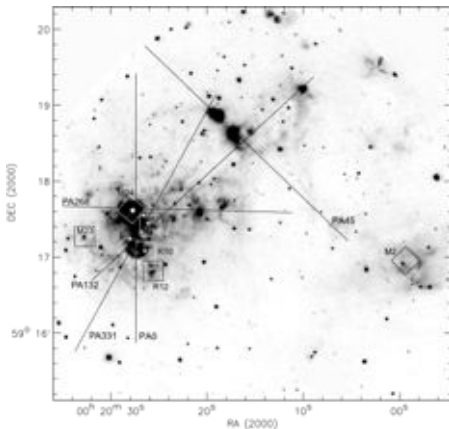
Observations



- Observations made at 6-m telescope of Special Astrophysics Observatory of Russian Academy of Science with focal-reducer SCORPIO from 2006 to 2011 years
- Longslit observations: 11 slit positions (5 for IC 10, 4 for Holmberg II, 2 for VII Zw 403), spectral range from 3600 to 7500 Å
- Field spectroscopy with MPFS: 12 fields 16x16'' (5 for IC 10 and 7 for VII Zw 403), spectral range from 4000 to 7000 Å



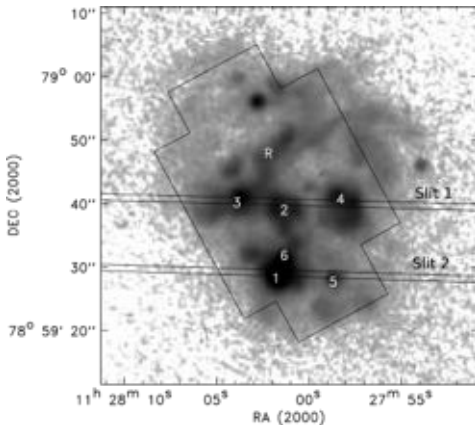
IC 10



- Member of our Local Group (Distance – 800 kpc)
- Extremely high amount of WR stars;
- Most bona fide identified hypernova remnant is here.

H α -image. Localization of slits and MPFS fields are shown.

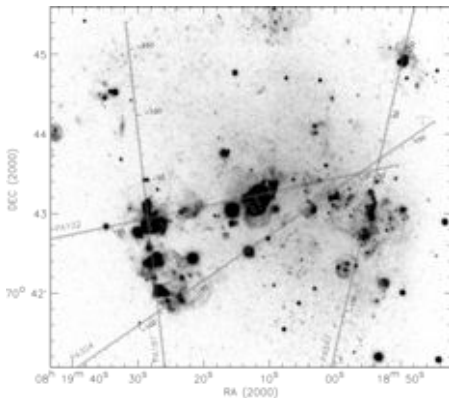
VII Zw 403



- Member of M81 Group (Distance 4.5 Mpc)
- Isolated, slowly rotating BCD-galaxy

H_α -image. Localization of slits and mosaic of MPFS fields are shown.

Holmberg II



- Member of M81 Group (Distance 3.4 Mpc);
- ULX source Holmberg X-1 is here;

H_{α} -image. Localization of slits are shown.

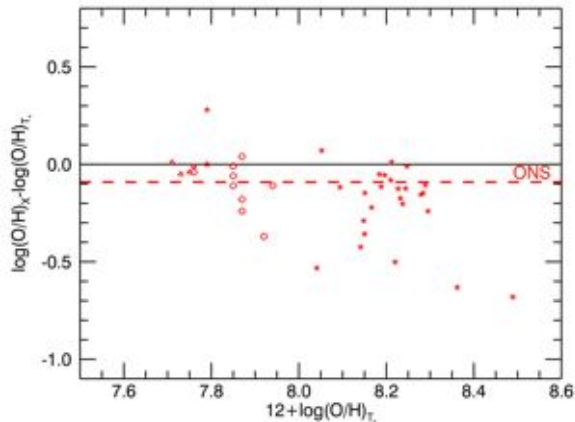


Oxygen Abundance determination

- We Used “direct” T_e -method and several most popular strong emission lines methods:
 - Empirical ON, ONS methods by Pilyugin et al. (2010);
 - Empirical NS method by Pilyugin et al. (2011);
 - Empirical PP04 method (O3N2) by Pettini and Pagel (2004);
 - Model-calibrated KK04 method by Kobulnicky and Kewley (2004).
- Comparison of methods are published in several work. One of the latest is López-Sánchez et al. (2012). They applied T_e -method, several SEL and RL methods to the modeled spectra of HII regions and compared results.
- For T_e -method we estimated electron temperatures:
 - $T_e([OIII])$ from $[OIII]\lambda 4959 + 5007\text{\AA}/[OIII]\lambda 4363\text{\AA}$
 - $T_e([OII])$ from $[OII]\lambda 3727\text{\AA}/[OII]\lambda 7320 + 7330\text{\AA}$ only for 4 regions. For other regions we used several empirical dependences from $T_e([OIII])$ (Pilyugin et al., 2009; Izotov et al., 2006; Stasińska et al., 2005; López-Sánchez et al., 2012). The best agreement with our direct estimations we obtained by the calibration of López-Sánchez et al., 2012.



Comparison of results

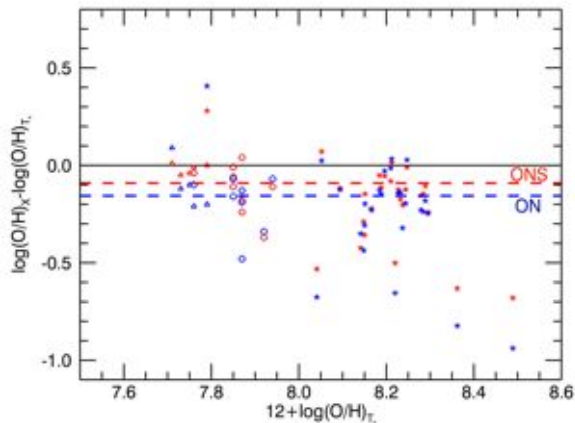


- PP04 - Pettini, Pagel (2004)
- KK04 - Kobulnicky, Kewley (2004)
- ONS, ON - Pilyugin et al. (2010)
- NS - Pilyugin et al. (2011)

- Holmberg II — circles
- IC 10 — asterisks
- VII Zw 403 — triangles



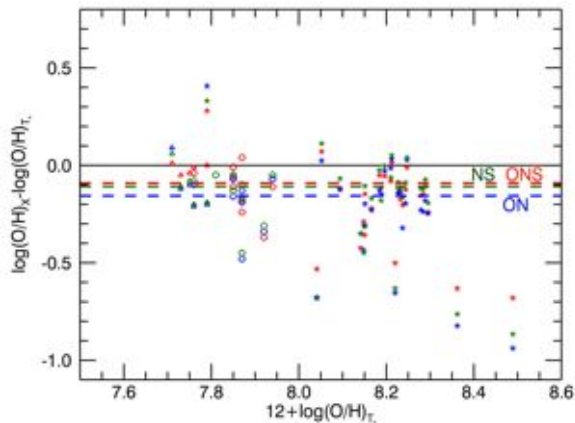
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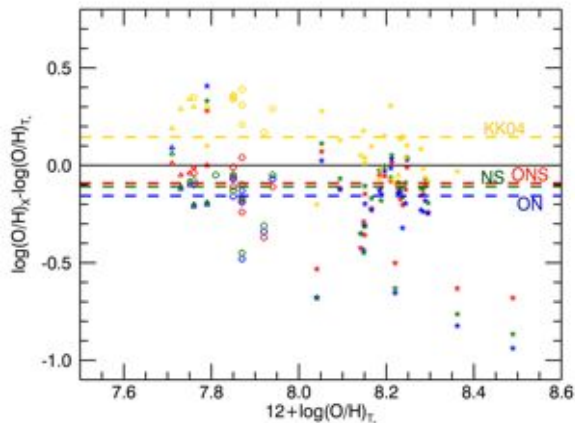
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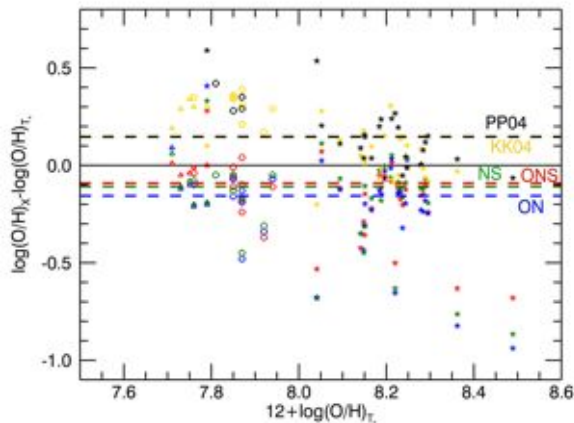
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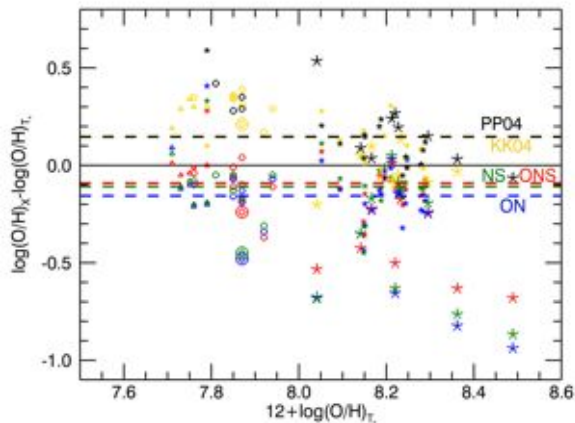


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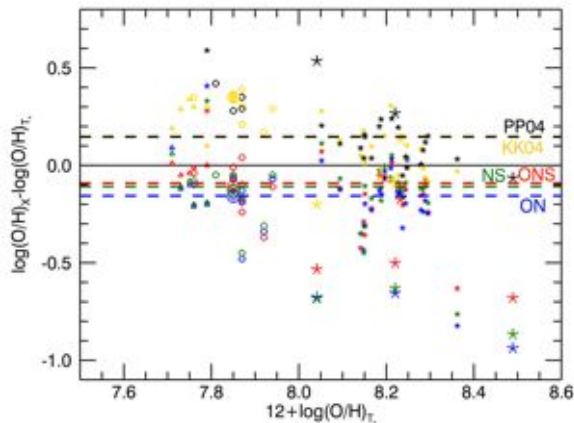


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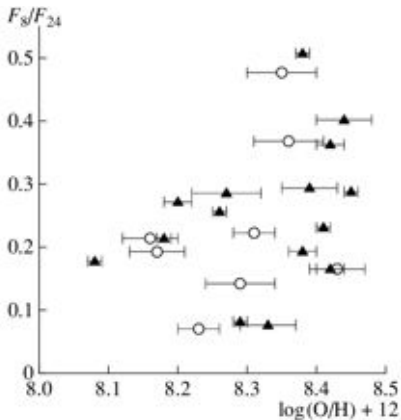


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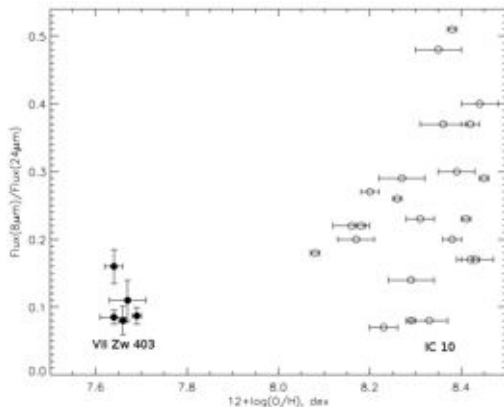
Metallicity vs PAH abundance (IC 10)



- $F(8\mu)/F(24\mu)$ correlates with the Polycyclic aromatic hydrocarbons (PAH) abundances (Draine et al., 2007)
- Dependence of PAH abundances from metallicity of whole galaxies is known (Galliano et al., 2008). But we found possible similar correlation for individual HII regions.
- Not clearly known a processes of PAH formation and destruction.
- If presented correlation is real - than it's may denote a properties of PAH linked not with their evolution, but with their formation.



Metallicity vs PAH abundance (IC 10 + VII Zw 403)



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Conclusions

- We obtained the oxygen abundances for 46 individual HII regions in three nearby galaxies using several methods.
- Comparison of the results obtained by these method shows the same discrepancies as in López-Sánchez et al (2012) obtained by model spectra.
- We found a weak correlation between oxygen and PAH abundances in IC 10 galaxy. These result must be checked with better data and in other similar galaxies with intensive star formation.
- Comparison of oxygen and PAH abundances may shed the light to the origin of PAH molecules.



Thanks for your attention!

