X-ray Selection of AGN in Local SDSS Dwarf Galaxies

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Introduction

Black holes are ubiquitous higher up the galactic mass scale so AGN activity is inevitable at some point in the host's lifetime, but **how prevalent are AGN in the regime of dwarf galaxies**?

Dwarf galaxies can also be considered an analogue for the high redshift Universe[1]. Thus, determining the **occupation fraction of AGN within dwarf galaxies** gives us an insight into the **mechanisms by which black hole seeds form and develop**.

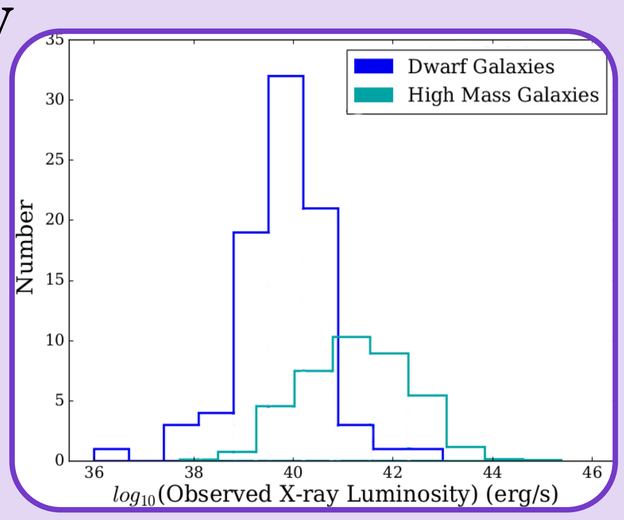
This is one of the **first large-scale and robust quantifications of AGN in nearby (z < 0.35) dwarf galaxies** using the **MPA-JHU**[2] catalogue, based on the **SDSS DR8,** and **3XMM DR7**[3] as our unbiased sample.

Sample Construction

We constructed a **sample of dwarf galaxies** ($M_* \leq 3 \times 10^9 M_\odot$) and **high mass galaxies** ($M_* \geq 1 \times 10^{10} M_\odot$) as a comparison, the **physical extent of the X-ray source was limited to < 10"**, and the **position-error-normalised separartion was limited to < 3.5** (corresponding to 7.5", on average for 3XMM).
This gave **87 dwarf galaxies** and **2,237 high mass galaxies**.

X-ray Luminosity

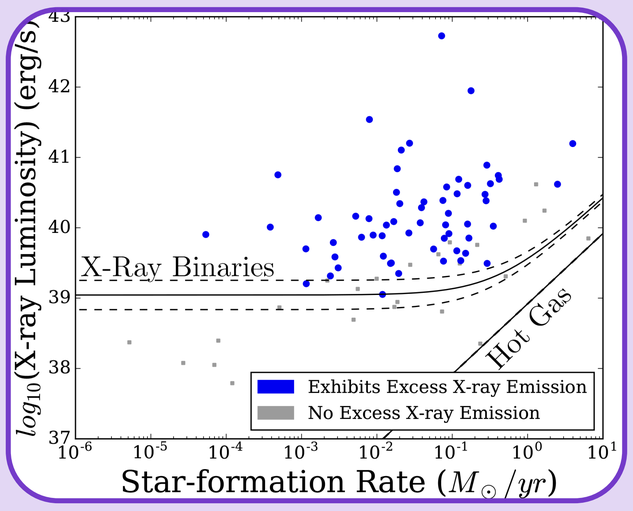
X-ray luminosities for dwarf galaxies are much lower than in the, normalised, high mass distribution.
A **typical AGN theshold luminosity** of **10^{42} erg/s**[4] gives only 3 dwarf galaxy AGN hosts, clearly not suited to finding the low luminosity AGN we expect.



X-ray Contaminants

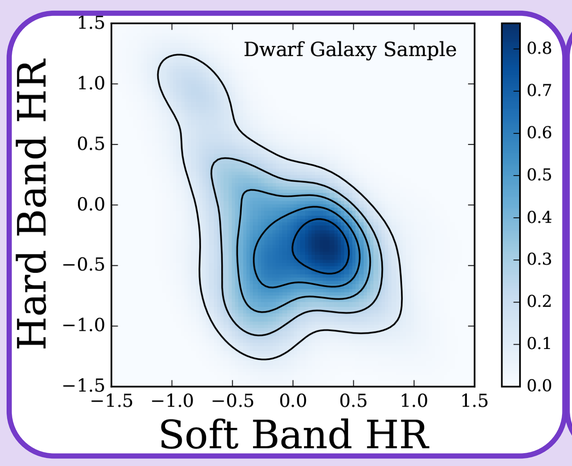
We **estimated the X-ray contributions** from the **X-ray Binary populations** , L_{XRB}, and **hot gas**, L_{Gas}, using the Lehmer et al (2016), and Mineo et al (2012) model relationships respectively.

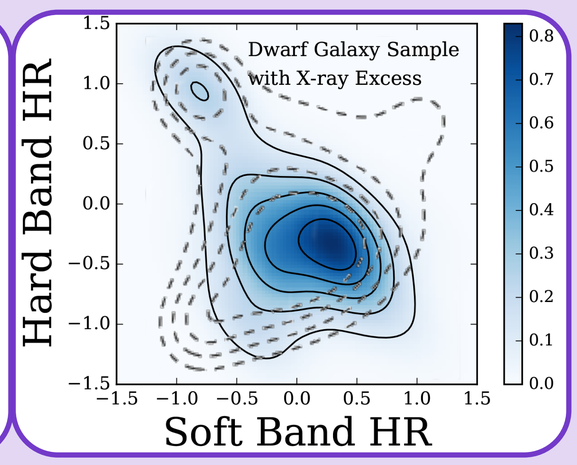
62 dwarf galaxies had **luminosities that met or exceeded our excess X-ray criterion**, thus **likely to host an AGN**



$$\frac{L_{Observed}}{L_{XRB} + L_{Gas}} \geq 3$$

Hardness Ratio

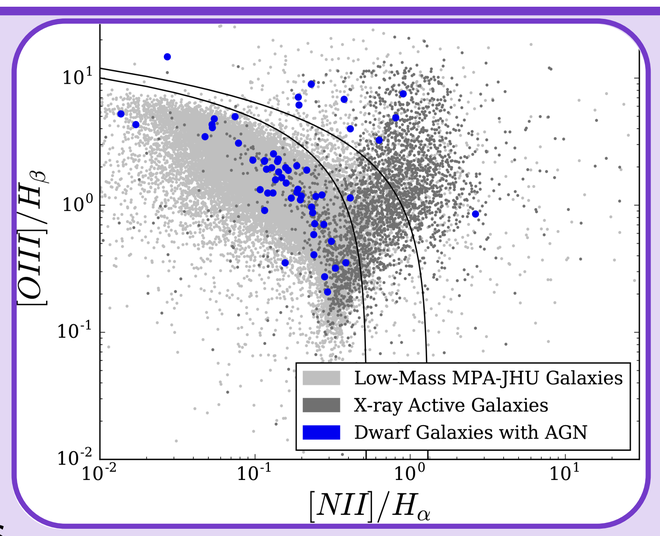




Hardness ratio helps indicate the source of X-ray emission; higher values are consistent with harder, AGN emission. **Our excess X-ray criterion isolates the harder emission in the dwarf galaxy sample** as intended. It also **strongly resembles the overlain (dashed) high mass distribution with the same criterion applied**. This shows, alongside the contamination analysis, our **62 dwarf galaxies are very like to host an AGN**.

BPT Analysis

Dwarf galaxy AGN hosts can be identified in other parts of the spectrum.
A commonly used optical diagnostic is the BPT diagram which can **identify the source of a galaxy's ionising radiation**[5]. We utilised this diagnostic to s**ee how our 62 X-ray selected AGN hosts would be classified. 49 were classified as star-forming** suggesting **BPT may not be suited find these types of AGN host** (primarily due to low X-ray luminosities).



References

1: Bellovary et al (2011); 2: mpa-garching.mpg.de/SDSS ;
3: Rosen et al (2016); 4: Brandt & Alexander (2015);
5: Baldwin, Phillips & Terlevich (1981)

Conclusions

Our analysis has identified **62 dwarf galaxies which are very likely to host an AGN**. In addition, we have shown that **BPT analysis does not identify all the AGN we find using our X-ray selection techniques, so may not be** suited to this type of study.
Our next step will be correcting for 3XMM's varying sensitivity to construct a complete parent sample of dwarf galaxies thus allowing us to calculate an accurate AGN fraction.

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