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Galactic Abundance Patterns via Peimbert Types I & II PNe

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Abstract. We present total element abundances based upon newly acquired spectrophotometry of a sample of >120 Galactic PNe. We continue to explore the use of the near-IR [S III] features to determine S^{+2} abundances and to improve total extrapolated sulfur - a useful metallicity tracer. With this compilation we explore abundance patterns in PNe that reveal signatures of stellar evolution and nucleosynthesis as well as larger-scale galactic chemical evolution.

Keywords. ISM: planetary nebulae: general, Galaxy: abundances

1. Introduction

We present total element abundances based upon newly acquired spectrophotometry of a sample of >120 Galactic PNe (Table 1). This new data set is extracted from spectra that extend from λ3600–9600Å allowing the use of [S III] features at λλ9069 & 9532Å. Since a significant portion of S in PNe resides in S^{+2} and higher ionization stages, including these strong features improves the extrapolation from observed ion abundances to total element abundance. S is believed to be precluded from enhancement and depletion across the range of PNe progenitor masses making it an alternate metallicity tracer to the canonical oxygen. If S can be reliably determined in PNe, its stability in intermediate mass stars makes it a valuable tool to probe the natal conditions as well as the evolution of PNe progenitors. This is a continuation of our Type II PNe work, the impetus being to compile a relatively large set of line strengths and abundances with internally consistent observation, reduction, measurement, and abundance determination, minimizing systematic effects that come from compiling various data sets.

With previous observations of 85 Galactic PNe in hand we have recently added an additional 40. These PNe cover a substantial range in galactocentric distance, and include Peimbert types I and II. Peimbert type classifies PNe according to chemical composition, a proxy for characteristics of the progenitor star (Peimbert 1978). This compilation allows us to look for abundance patterns (total element ratios such as X/H and X/O) across PNe progenitor masses, metallicities, and morphologies. In addition to looking for signatures of stellar evolution and nucleosynthesis via abundance patterns, we continue to explore the use of the near-IR [S III] emission features as reliable indicators of S^{+2} abundances, improved extrapolated total sulfur, and its use as a metallicity tracer.

2. Ongoing Work

We now have abundances for >120 Galactic PNe. This data is unique in that it is based upon newly acquired spectrophotometry covering an extended range in wavelength.

Table 1. Mean values of O/H and X/O for our Galactic PNe and other samples.

$O/H(x10^4)$	$S/O(x10)$	$Cl/O(x10^3)$	$Ar/O(x10^2)$	Ne/O	*Sample*
4.41 ± 1.81	0.18 ± 0.09	0.43 ± 0.19	0.83 ± 0.46	0.28 ± 0.13	Galactic Type I PNe[a]
5.30 ± 1.97	0.12 ± 0.09	0.30 ± 0.14	0.52 ± 0.25	0.23 ± 0.08	Galactic Type II PNe[a]
5.05 ± 1.96	0.13 ± 0.09	0.34 ± 0.17	0.60 ± 0.35	0.25 ± 0.10	all PNe in our sample[a]
3.05 ± 2.63	0.26 ± 0.21	···	0.64 ± 0.29	0.21 ± 0.14	Galactic PNe[b]
4.8 ± 2.0	0.17 ± 0.14	···	0.48 ± 0.48	···	Galactic PNe[c]
4.4 ± 0.19	0.25 ± 0.02	0.47 ± 0.04	0.69 ± 0.05	···	Galactic PNe[d]
4.57	0.32	0.69	0.33	0.15	Solar values[e]
5.25	0.28	0.41	0.59	···	Orion (gas + dust)[f]
2.11 ± 1.11	0.29 ± 0.04	···	0.62 ± 0.11	0.21 ± 0.03	M101 HII regions[g]
···	0.36	0.50	0.89	···	MW H II regions[h]

[a]Kwitter *et al.* (2001), Milingo *et al.* (2002), Henry *et al.* (2004), [b]Maciel & Köppen (1994), [c]Kingsburgh & Barlow (1994), [d]Aller & Keyes (1987), [e]Asplund *et al.* (2005), [f]Esteban *et al.* (1998), [g]Kennicutt *et al.* (2003), [h]Rodriguez (1999)

Utilizing a 5-level atom abundance routine we've carefully determined T_e, N_e, and ICFs, providing a consistent and homogeneous set of data. We are looking to minimize systematic effects that may creep in when combining various samples that utilize different reduction and abundance determination schemes, thus disguising subtle abundance patterns such as enhancements or depletions due to nucleosynthesis. Further analysis needs to be done to discern scatter due to uncertainty from true abundance distinctions and breadth. For example the anomalously low S/O ratio for PNe begs further examination (see R.B.C. Henry *et al.* in these proceedings), trends in N/O could signal the ON cycle at work, and the breadth in Ne/O for Type I PNe, due to a few extreme outliers, could be illustrating neon enrichment. In looking for distinguishing characteristics within our abundance data, more Type I PNe need to be added, and the entire ensemble of data requires a rigorous statistical analysis.

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