The Power of Prodigy's Wide Wavelength Range

A new cesium emission line with a detection limit 600 times lower than the wavelength formerly thought to be the "primary line"

INTRODUCTION

Since the introduction of ICP-OES in the 1970s most instruments have offered a wavelength range which approximates 165 to 777 nm. Once the transition from photomultiplier tube to array detection occurred, wavelength coverage tended to be reduced by either limiting the user to discrete spectral segments where [in the designers opinion] the most useful emission lines existed or where the manufacturer chose to eliminate large regions of the spectrum that were deemed unnecessary. In most cases this was necessary for reasons of cost (i.e. the smaller the area covered by detector elements (pixels), the less expensive the instrument is to build) and/or physical size limitations of historically available array detectors.

Prodigy's large format programmable array detector and long focal length optical design make it the only commercially available ICP to offer continuous wavelength coverage between 165 to 1100nm. Prodigy does this while also providing very high spectral resolution in the critical 175 to 350 nm region. There are distinct advantages to such large wavelength coverage. One of many examples is demonstrated in this technical bulletin wherein access to a new cesium emission line at 894.347 nm is shown to yield a detection limit over 600 times lower than the previously thought of "primary emission line" at 455 nm. This work was inspired by an ICP user who needed to determine Cs at significantly lower levels than their existing instrumentation was able to achieve. Prodigy is shown in Figure 1.

Figure 1. Prodigy ICP Spectrometer

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Experimental Conditions

Operating parameters for this work are shown in Table 1. Please note that standard pneumatic nebulization was used for all aspects of this work.

RF Power	1.1 kW
Coolant Flow	20 L/min
Auxiliary Flow	0.1 L/min
Nebulizer Pressure	40 psi
Nebulizer	High Solids Concentric
Spray Chamber	Cyclonic with Baffle
Integration Time	10 sec

Table 1. Instrument Operating Parameters

Results and Discussion

The first step in exploring other options for the determination of cesium was to acquire two full ICP spectra from 165 to 1100nm; one while nebulizing a cesium standard and one while nebulizing a high purity blank. A spectral subtraction of the blank from the standard was then performed using Prodigy's Spectroscopy Toolbox. The two spectra and the resulting blank subtracted spectrum are shown in figures 2, 3 and 4. The blue rectangles shown in each spectral display represent the pixel sub-arrays that were used during fully quantitative analysis.

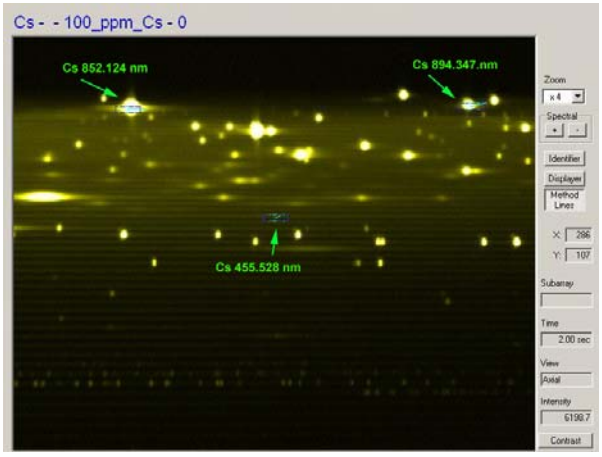

Figure 2. Spectrum of 100 ppm Cs in 5% HNO_3

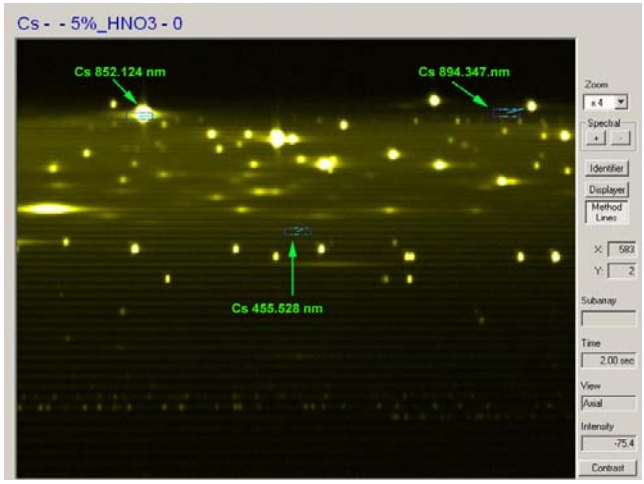

Figure 3. Spectrum of 5% HNO_3

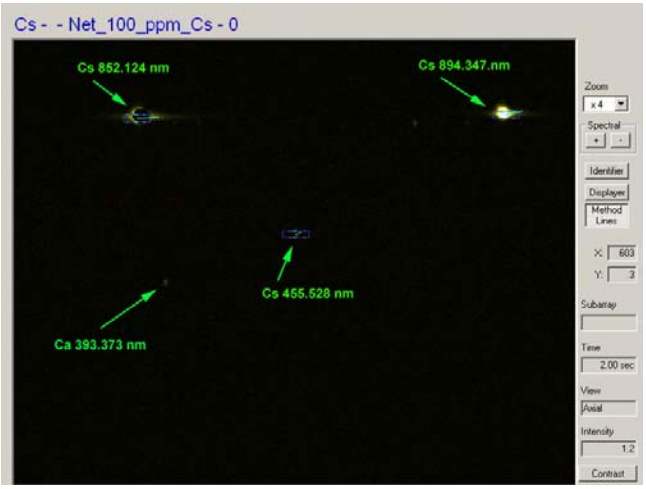

Figure 4. Spectral subtraction of 5% HNO_3 from 100 ppm Cs

Figure 2 and 4 show the very intense 894.34nm emission line. Although Figure 2 also shows a strong Cs emission line at 852.12 nm, that line has an argon interferent which will cause it to be inherently less analytically reliable than the 894.34nm line.

The comparative 3 sigma detection limits between the 455.5 line and the 894.3 line are shown in Table 2 below.

Wavelength (nm)		Axial	Radial
		ppm	ppm
455.528		1.2	25
894.347		0.002	0.204

Table 2 . Cesium Detection Limits, ppm

This technical bulletin demonstrates the versatility and analytical potential of the Prodigy High Dispersion ICP Spectrometer.