## **INTENSITY CONSERVING SPLINE INTERPOLATION (ICSI): A NEW TOOL FOR SPECTROSCOPIC ANALYSIS**

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this is only appropriate if the profile is linear within the bin, which is rarely the case. As indicated in Fig. 1, if the profile is concave downward, the intensity  $I_{mid}$  at midpoint  $\lambda_{mid}$  is greater than the bin average I<sub>avg</sub>. We can account for this using spline interpolations and an iterative procedure called ICSI. It determines the shape of the profile (and I<sub>mid</sub>) while conserving intensity; the integral of the spline fit over  $\Delta\lambda$  is equal to the observed intensity  $I_{obs}$  (=  $I_{avg}$ ). The corrected intensity  $I_{mid}$  can then be used for standard analyses.



Fig. 1. Schematic of a spectral bin where the line profile is concave downward.

Fig. 2. Active region observed in Fe XIV (274) by EIS/Hinode. Intensity on left, BR asymmetry on right. Asymmetry is the difference between the intensities in the blue and red wings ( $\pm 50$  to  $\pm 150$  km/s) divided by the core intensity (-30 to +30 km/s) after subtracting a linear background. Line center is taken to be the position of peak intensity in the spline fit.





Fig. 3. Line profiles from positions A and B in Fig. 2. Stars—observed intensities; dashed—spline fit without ICSI; solid—spline fit with ICSI. The asymmetries with and without ICSI correction are 0.039 and 0.026 for A and 0.074 and 0.073 for B. The greatest source of error is the identification of line center (peak intensity).

Fig. 4. Maximum difference between I<sub>obs</sub> and the spline fit average over the wavelength bin for profile A, normalized by peak intensity, as a function of iteration number.



## **Results**

ICSI is a highly efficient method (Fig. 4) for correcting spectral data to account for line profile curvature within spectral bins. Such corrections are important for precise measurements of blue-red asymmetries (Fig. 5) and for multi-Gaussian fits used to diagnose unresolved flow

	Main	Red
	Component	Component
Central Intensity	4.9%	-10.6%
Width	8.5%	3.4%
Doppler Shift	1.1 km/s	1.1 km/s

Fig. 5. Distribution of BR asymmetry errors when ICSI is not used for the measurements in Fig. 2.

components and to separate spectral blends (Table 1).

ICSI runs in IDL and is available in SolarSoft and upon request (James.A.Klimchuk@nasa.gov).

See Klimchuk, Patsourakos, and Tripathi (2015, arXiv: 1506.08102) for a complete description of ICSI and Patsourakos, Klimchuk, & Young (2014, ApJ, 781, 58) for a discussion of Fig. 2.

Table 1. Errors in fit parameters for double Gaussian plus linear background fit to profile B (difference of fit with and without ICSI correction).