

Disklike Structure in the Semiregular Pulsating Star X Her

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This poster presents the results of Berkeley-Illinois-Maryland (BIMA) array interferometric observations in the CO J=1-0 line toward X Her and EP Aqr, the semiregular pulsating stars with a composite CO line profile, and also reports finding of a disklike structure in X Her. In the CO spectrum both of X Her and EP Aqr, a composite profile including narrow and broad components is seen as reported by the previous single-dish observations. The spatial structure of the broad component region of X Her shows a bipolar shape, and that of the narrow component shows an elliptical/spherical shape. The blue- and red-shifted parts of the X Her narrow component show a systematic difference in the velocity integrated intensity map. The spatio-kinetic properties of the X Her narrow component are reminiscent of a Keplerian rotating disk with a central mass of $0.9 M_{\odot}$; however, an interpretation as an expansion disk seems to be more natural. The spatial distributions of both the narrow and the broad components of EP Aqr appear to be roughly round with the same peak positions; no significant velocity gradient is seen. The spatio-kinetic properties of EP Aqr are reminiscent of a multiple-shell structure model rather than of a bipolar flow and disk model.

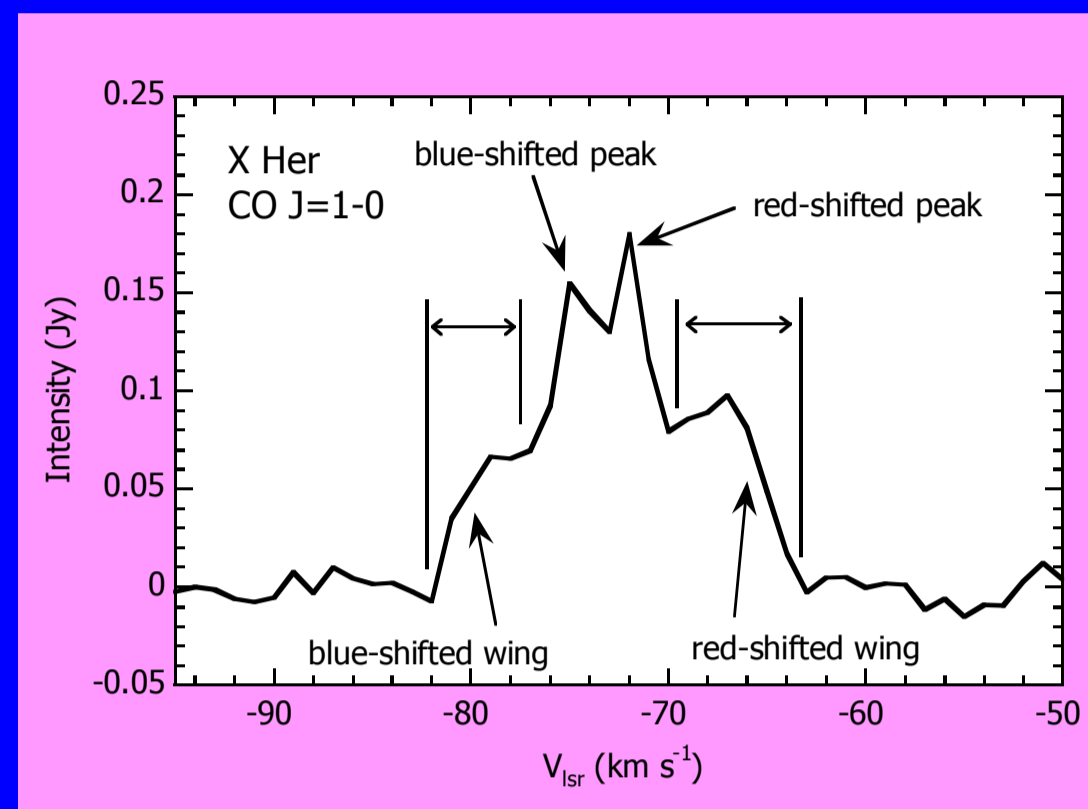


Fig. 1. — Spatially integrated spectrum of X Her in the CO J=1-0 line. The integrated area is a circle with a diameter of 15". The vertical solid lines represent the velocity ranges of the blue- and red-shifted wings. Each kinematical component is indicated by the arrows.

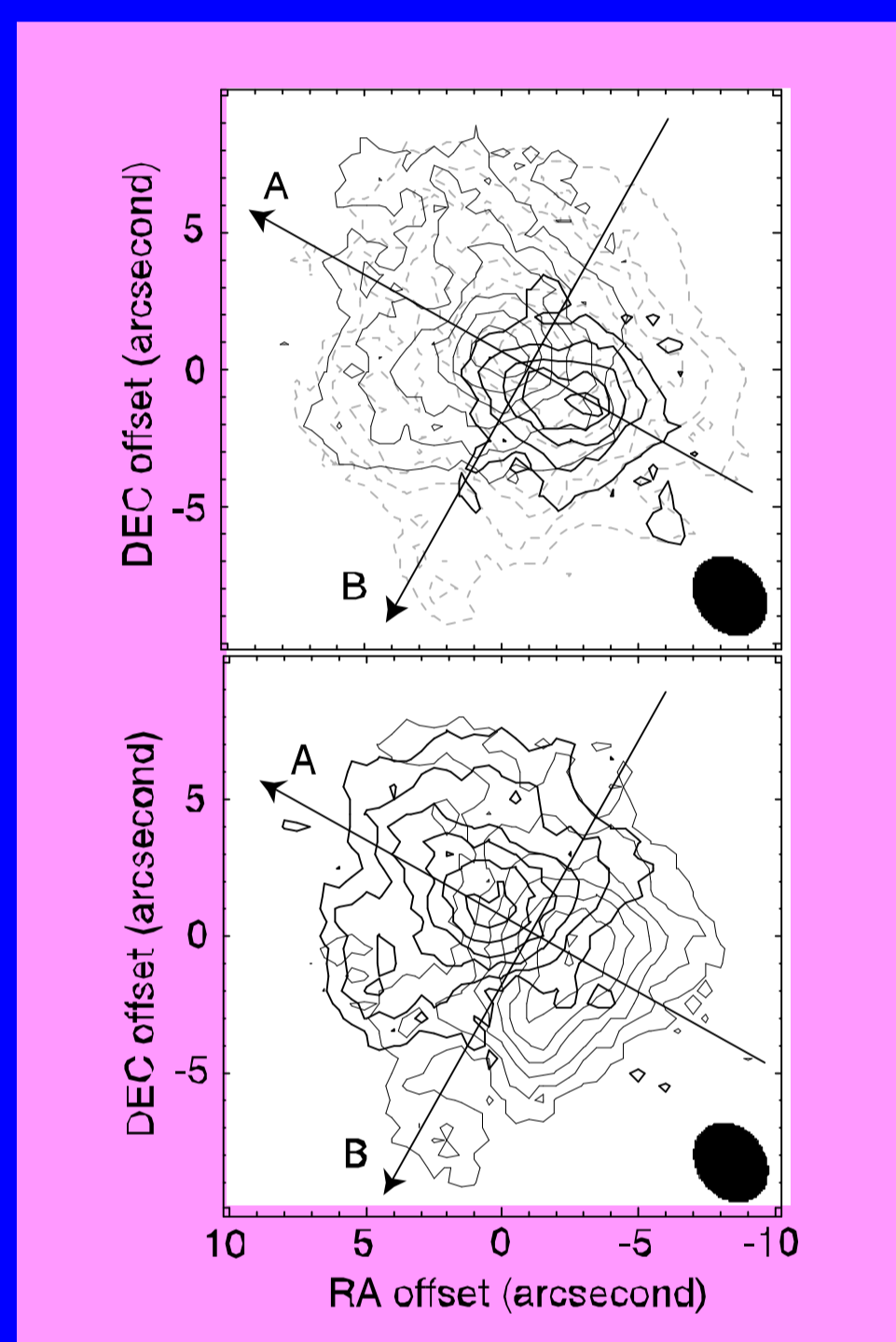


Fig. 2. — Velocity integrated intensity maps of the kinematical components indicated in Figure 1. In the upper panel, the thick and thin contours represent the maps of the blue- and red-shifted wings, respectively; the gray broken contours represent the map of combined intensity of the blue- and red-shifted peaks. In the lower panel, the thick and thin contours represent the maps of the blue- and red-shifted peaks, respectively. The dotted arrows represent the cuts used for Figure 3. The synthesized beam size is indicated in the lower-right corners. The contours start from a 5σ level, and the increment of the contours are every 2σ . In the upper panel the 1σ levels for the thick, thin and broken contours are 1.516×10^{-2} , 1.238×10^{-2} and 1.403×10^{-2} Jy beam $^{-1}$, respectively. Similarly, in the lower panel, the 1σ level is 2.144×10^{-2} Jy beam $^{-1}$ for both the thick and thin contours. The velocity integration ranges for the wings are -82 — -77 (blue-shifted wing) -71 — -63 (red-shifted wing), and those of the red- and blue-shifted peaks are 3 km s $^{-1}$ each (the peak velocities are taken at the center of the range).

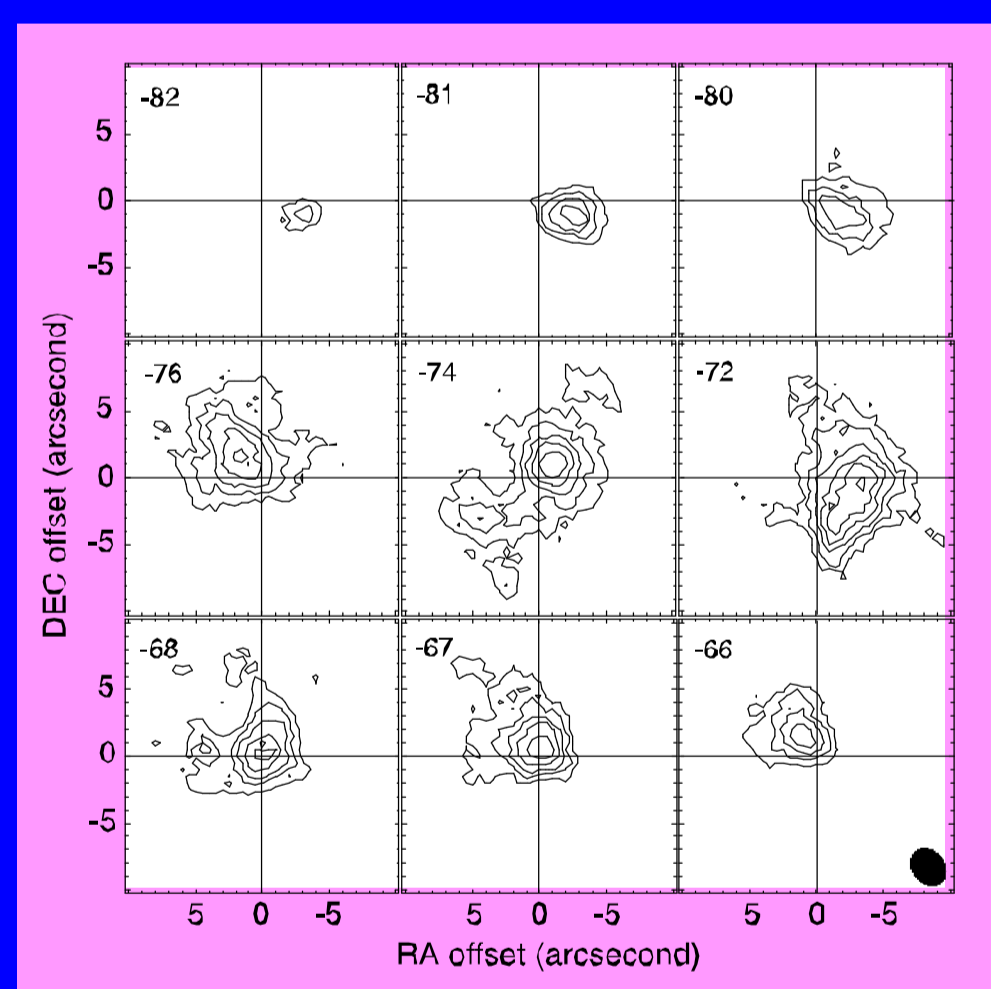


Fig. 3. — Selected channel maps of the CO J=1-0 line. The channel velocities are indicated in the upper left corner of each panel. The velocity channels were averaged over 2 km s $^{-1}$ intervals. The contours start from 5σ level, and the increment of the contours is every 2σ . The 1σ level corresponds to 2.63×10^{-2} Jy beam $^{-1}$. The synthesized beam size is indicated in the lower-right corner.

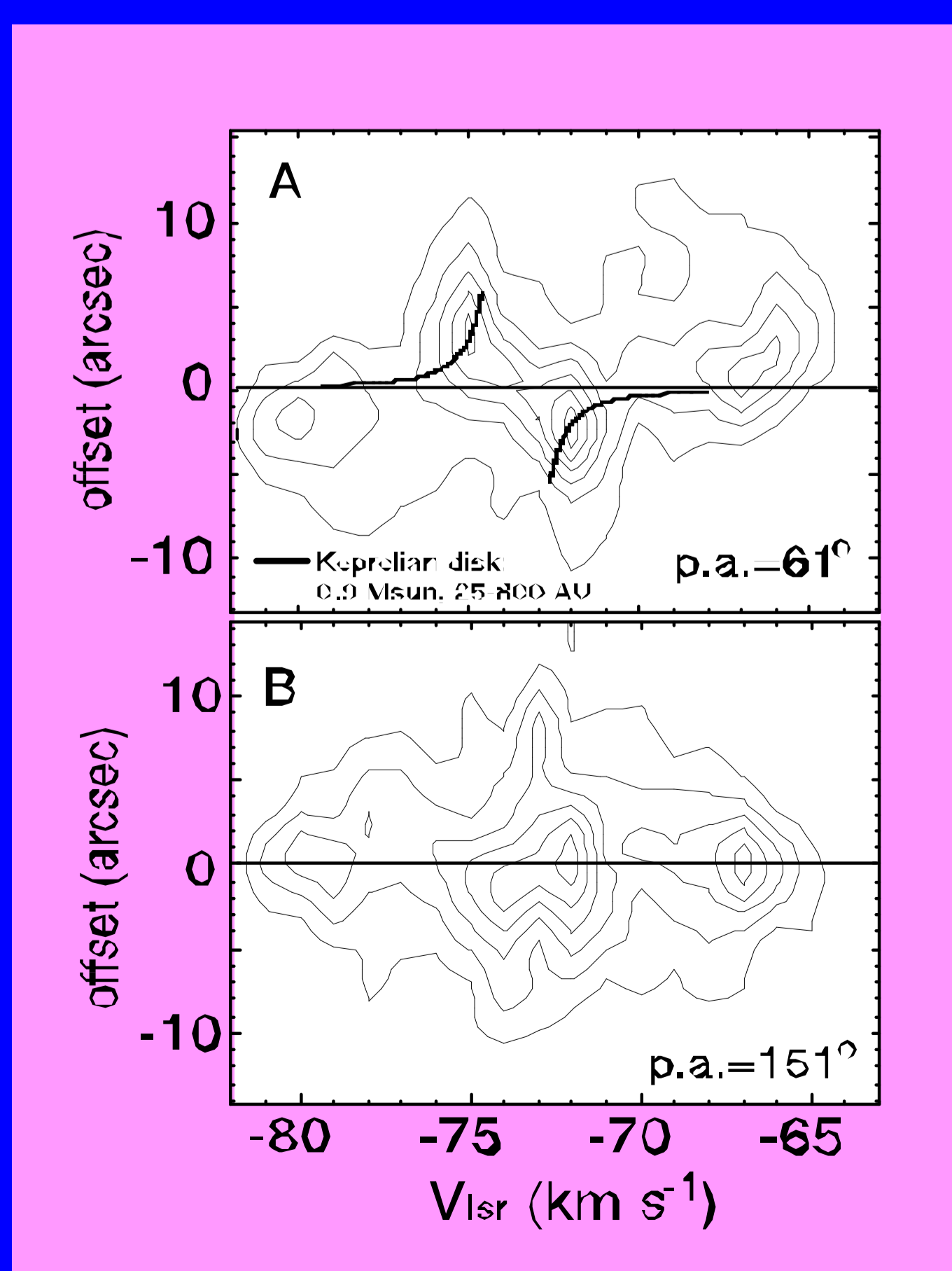


Fig. 4. — Position-velocity diagrams for the cuts indicated in Figure 2. The contour levels correspond to 90, 75, 60, 45, 30 and 15% of the intensity peak. The names of the cuts and the position angles are respectively indicated in the upper-left and lower-right corners of each panel. The solid curve indicated in the upper panel represents the best fit result of the Keplerian disk to the data. The broken horizontal lines represent the origin of the offset axes.

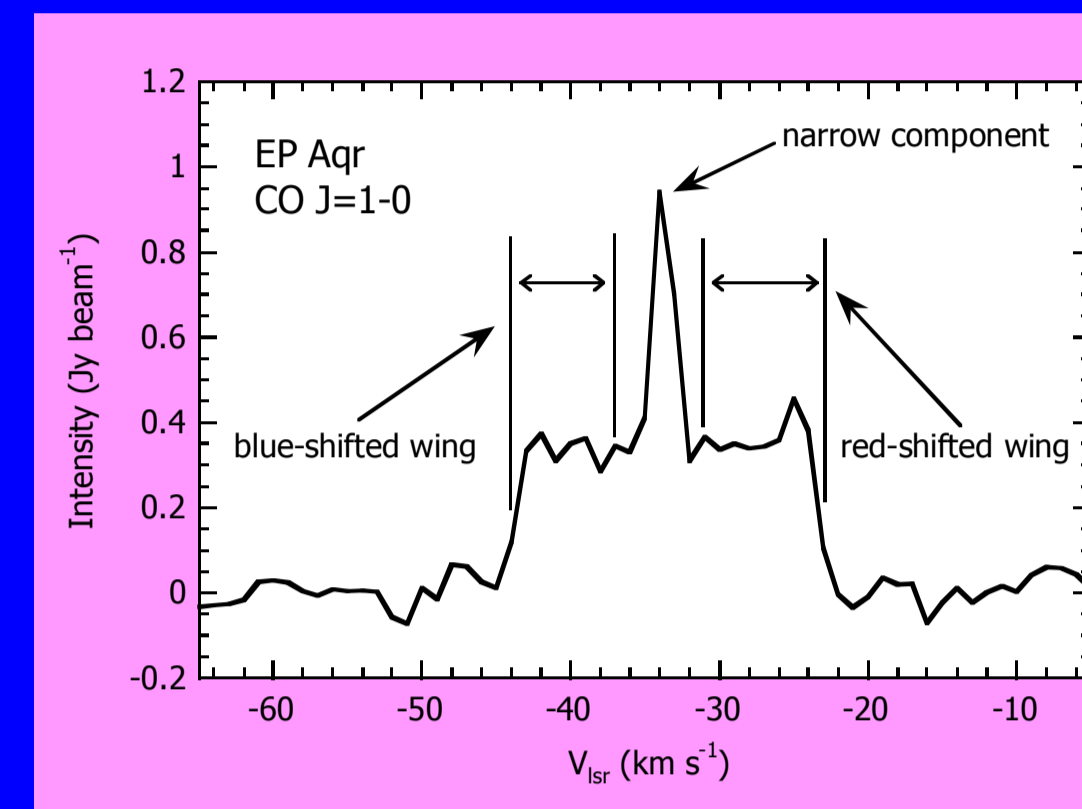


Fig. 5. — Spatially averaged spectrum of EP Aqr in the CO J=1-0 line. The averaged area is a circle with a diameter of 15"; the averaging circle is centered on the mapping center. The vertical solid lines represent the velocity ranges selected for the blue- and red-shifted halves of the broad component. Each component is indicated.

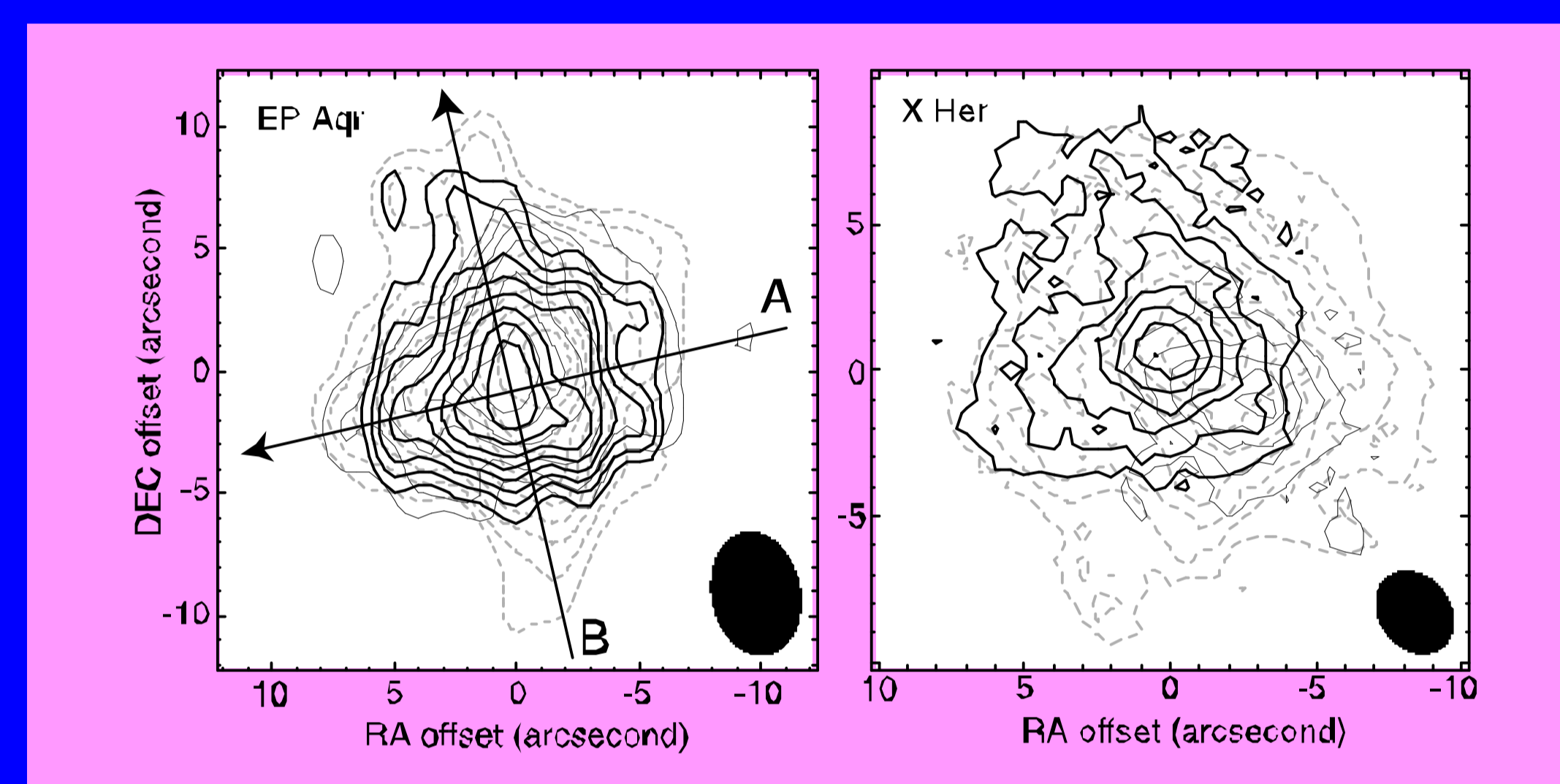


Fig. 6. — *Left panel:* Velocity-integrated intensity maps of EP Aqr. The thick and thin contours map the blue- and redshifted wings of the broad component, respectively; the gray dashed contours map the narrow component. The synthesized beam size is indicated in the lower right corner. The contours start at the 5σ level, with increment every 2σ . The 1σ levels for the thick, thin, and dashed contours are 5.1×10^{-2} , 5.1×10^{-2} , and 8.9×10^{-2} Jy beam $^{-1}$. The velocity integration ranges for the blue- and redshifted wings are -44 to -37 and -31 to -23 , respectively; the width of the integration range of the narrow component is 3 km s $^{-1}$ (the peak velocity is taken at the center of the range). The dotted arrows represent the cuts used for Fig. 7. *Right panel:* Similar map of X Her taken from Fig. 3 for comparison. The contours are the same as in the left panel.

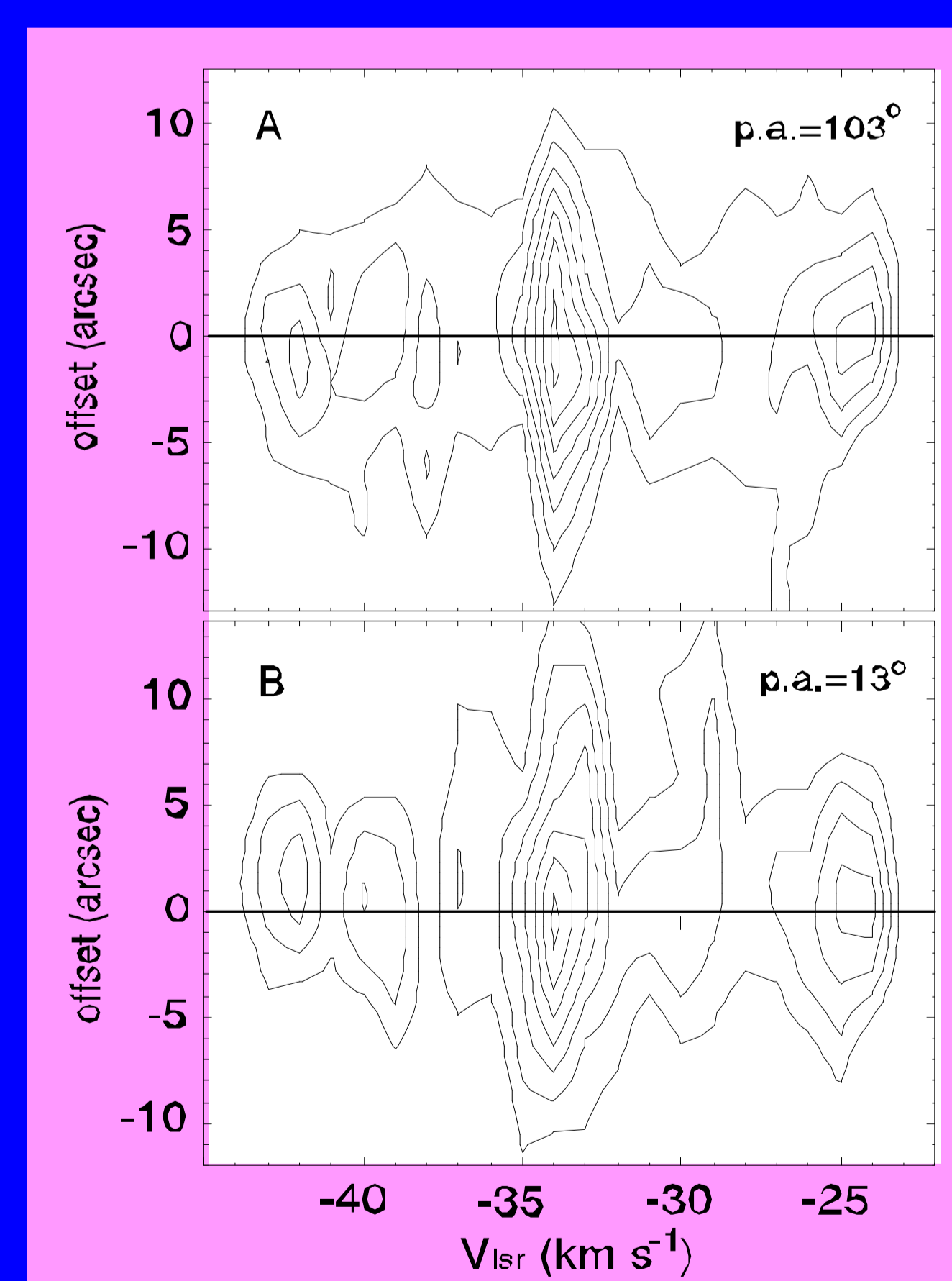


Fig. 7. — Position-velocity diagrams for the cuts indicated in Fig. 6. The contours start at the 2σ level, with increment every 1σ . The 1σ level is 1.5×10^{-1} Jy beam $^{-1}$. The names of the cuts and the position angles indicated in the upper left and upper right corners of each panel, respectively. The dashed horizontal lines represent the origin of the offset axes.

References

- Nakashima, J. 2005, *ApJ*, 620, 943
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