Summary:
A half megasecond Chandra Spectral Imaging of the Hot Circumgalactic Nebula around Quasar Markarian 231

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Neutral Outflow Region and the Starburst Arc:
The spatially resolved Na I Douthout region detected by Rupke et al. (2005) and marked by Rupke & Veilleux (2011, 2013) extends at least ~2.5 kpc, depending on astrometric
There is a region ~1.0 - 2.5 kpc due north of the nucleus of Mrk 231 where the Na I Douthout detection are noticeably higher than other directions. The radial slit position in the eastern quadrant is significantly weaker than in the western arc region. In contrast, the best H X-ray flux deficit is in the western arc region which may be physically related to the outflow. Significant emission lines are detected near ~1.3 keV in the southern arc region. These features are identified as XI 1.3 kV and H X-21.1 keV (or Fe XXV 1.258 keV), respectively. This excess line emission may reflect alpha-element enhancement due to the starburst in the arc region (Fig. 3).

The soft X-ray flux deficit in the western outflow and arc regions is the strongest evidence in our data that the hot X-ray emitting gas "knows" about the massive neutral/molecular gas extending ~3 kpc north-west of the nucleus. This soft X-ray flux deficit is analogous to the behavior at smaller radii (the western region). The Na ID velocity map of Rupke & Veilleux (2011, 2013) also show blue-shifted emission in the northern region. We do detect a soft X-ray flux deficit in the western quadrant (Fig. 3).

Note the deficit of soft X-ray emission in the western spectrum, similar to that found in the western wind and Mg XI 1.352 keV and Si XIII 1.864 keV emission lines are seen in the arc spectrum, but nowhere else. These detections of the soft X-ray emission are consistent with the northeastern structure at the nuclear region. The fits indicate a prominent high-velocity wind (S) from the star-forming region to the south of the nucleus. All other quadrants are used as comparison regions. (Right, Top) Spectra extracted from the outflow regions shown with the best-fit model that is used to derive the ionization, the cross-like pattern in the center of the optical image in both the middle and right panels. (Middle) The same cross-like pattern in the center of the optical image in both the middle and right panels. (Bottom) The same cross-like pattern in the center of the optical image in both the middle and right panels. (Right) The outflow and tidal arc extraction regions. The northern wind region is coincident with the northern quadrant, the outflowing material appears to receive an additional kick from the jet. (Above, Right) The outflow and tidal arc extraction regions. The northern wind region is coincident with the northern quadrant, the outflowing material appears to receive an additional kick from the jet. (Above, Right) The outflow and tidal arc extraction regions. The northern wind region is coincident with the northern quadrant, the outflowing material appears to receive an additional kick from the jet. (Above, Right) The outflow and tidal arc extraction regions. The northern wind region is coincident with the northern quadrant, the outflowing material appears to receive an additional kick from the jet.