Evidence for Jet Collimation in SS 433

Masaaki Namiki,1,2 Nobuyuki Kawai,1,3 Taro Kotani,3,4 and Kazuo Makishima1,5 1The Institute of Physical and Chemical Research (RIKEN), 2Department of Physics, Tokyo University of Science, namiki@crab.riken.go.jp 3Department of Physics, Tokyo Institute of Technology, nkawai@tithp1.hp.phys.titech.ac.jp 4Laboratory for High Energy Astrophysics, NASA Goddard Space Flight Center, kotani@milkyway.gsfc.nasa.gov 5Department of Physics, University of Tokyo, maxima@phys.s.u-tokyo.ac.jp

Jets — Stars: individual (SS 433) — Stars: binaries: general — X-rays: individual (SS 433) — X-rays: spectra

abstract

High-resolution X-ray spectra of SS 433 obtained after a binary egress with the Chandra High Energy Transmission Grating Spectrometer (HETGS) were studied. Many Doppler-shifted X-ray emission lines from highly ionized elements were detected. The initial temperature of the jets is estimated to be 20 keV. The lines are found to generally be broader than the instrumented resolution. The widths of the Fe xxv Kα and Si xiii Kα lines correspond to velocity dispersions of 2100 $^{+600}_{-340}$ km s$^{-1}$ and 840 $^{+180}_{-150}$ km s$^{-1}$ respectively, in terms of Gaussian sigma. Neither the measured line widths nor their dependence on the atomic number can be explained by thermal broadening alone. Alternative explanations of the observed line widths are discussed, including in particular a progressive jet collimation along its axis.