Using Vela X-1 to understand accretion and wind structure in High-Mass X-ray Binaries (HMXBs)

Contribution for a talk

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The spectral and timing behaviour of HMXBs offers a unique opportunity for the investigation of accretion onto compact objects and of wind structure in massive stars.
The bright and persistent neutron star HMXB Vela X-1 is one of the key systems for such studies. It has a complex clumpy stellar wind, prominent cyclotron resonant scattering features (CRSFs) and thus high magnetic field.

We analyse two new observations taken with NuSTAR and XMM-Newton at orbital phases ~0.68-0.78 and ~0.36-0.52. We follow the evolution of spectral parameters down to the pulse period time-scale to model the continuum and local absorption variability.

Modelling NuSTAR data, we observe parameter correlations that are flux dependent and imply a change in properties of the Comptonising plasma. The observed drop of the CRSF energy following a strong flare may indicate a change in the accretion geometry. The strong variability of the absorption observed along the orbit is due to the presence of a large-scale wind structure, such as accretion- and photoionisation wakes, combined with the variable line of sight as the neutron star moves along the orbit.

However, the main spectral features of the stellar wind are imprinted on the spectrum at lower energies than those covered by NuSTAR. We thus also present time- and absorption-resolved XMM spectral analysis based on our NuSTAR results and that we use to disentangle emission and absorption features imprinted onto the intrinsic spectrum by the wind.