We report on two Chandra observations of B1929+10, which reveal a PWN with a torus bent in the direction opposite to the pulsar’s proper motion and possibly a small jet in the immediate vicinity of this 3-Myr-old pulsar. There is also a long tail behind the pulsar, extending up to 2’ in Chandra images and ~15’ in the XMM-Newton data, with a luminosity of ~10^30 ergs/s in the 0.3-8 keV band. However, the PWN morphology does not seem to be entirely consistent with the existing MHD simulations for bow-shock PWNe, suggesting that the intrinsic anisotropy of the pulsar wind must be taken into account when modeling such objects. Contrary to previous results, our spectral analysis suggests that, in addition to the magnetospheric emission, there is a strong thermal component (~40-50% of the total emission in the 0.3-10 keV band) in the pulsar’s spectrum. The combined Chandra and XMM-Newton data suggest that the thermal emission emerges from a polar cap region with an apparent radius of ~30-40 m and a temperature of about 0.3 keV.

Possible Variability:
Top: 0.3-8 keV images of the first (left) and second (right) ACIS-S3 observations, smoothed using a Gaussian of FWHM 2”.
Bottom: The same images adaptively smoothed to show the structures with the signal-to-noise ratio in the range 2.2 to 4.

To interpret the B1929+10 PWN in the framework of the current MDH models, we attempted to match the observed morphological structures with those predicted by the simulations. However, the comparison leads to some discrepancies. For example, the predicted length of the pulsar tail would be ~150 pc, which is two orders of magnitude larger than observed by XMM-Newton and ROSAT. The main reason is the assumption of the model that the flow speed remains very high along the entire tail. Bucciantini et al. (2005) suggest that the flow can be slowed down by the interaction with the ISM. We estimated that the flow velocity of ~0.09c would be required to match the observed tail length of ~1.5 pc. This velocity is still much larger than the velocity of the pulsar.