The Plasma Structure of the Cygnus Loop from the Northeastern Rim to the Southwestern Rim

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The Astrophysical Journal, **671**, 1717-1725 (2007)

▶ No. 26 in "100 Papers Selection" (p. 60)

We observed the Cygnus Loop from the north-east to the south-west with XMM-Newton and studied the X-ray spectra along the path. Figure 1 shows the X-ray color image of our path superposed on the entire image obtained by ROSAT. The spectra can be well fitted either by a one-component non-equilibrium ionization (NEI) model or by a two-component NEI model. The rim regions can be well fitted by a one-component model with relatively low electron temperature (kT_e) whose metal abundances are sub-solar (0.1 ~ 0.2). The major part of the path requires two-component model. Due to the projection effect, we concluded that the low kT_e (~ 0.2keV) component surrounds the high kT_e (~ 0.6keV) component having relatively high metal abundances (~ 5). These components originate from the interstellar matter (ISM) and from the ejecta.

The flux of the ISM component shows a large variation along our path. We found it very thin in the south-west region suggesting a blowout along our line of sight. The metal distribution inside the ejecta shows non-uniformity, depending on elements. O, Ne and Mg are relatively in the outer region while Si, S and Fe are concentrated in the inner region with showing strong asymmetry. This shows an observational evidence of the asymmetric explosion of the progenitor star. The abundance of the ejecta also indicates the progenitor star to be 15 times solar mass.

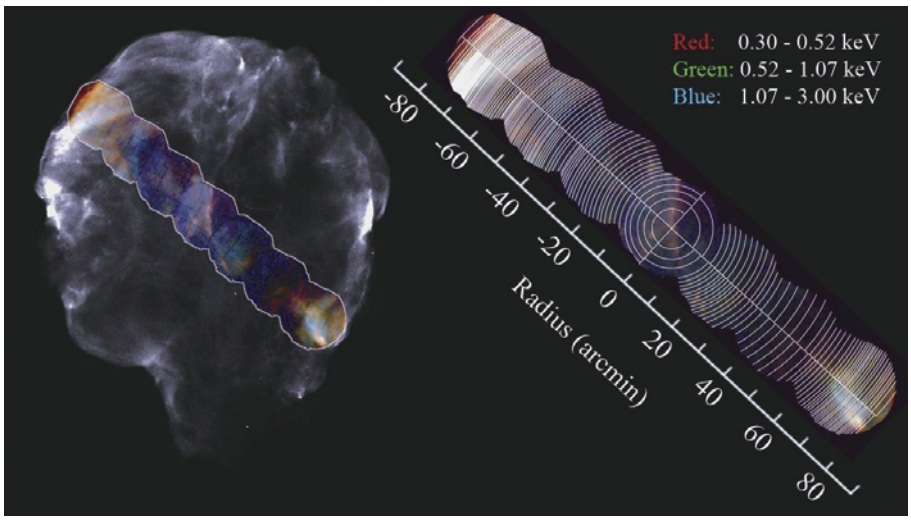

Fig. 1

A Concave-Bound CpFe Complex of Sumanene as a Metal in a π Bowl

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Angewandte Chemie International Edition, **46**, 8376-8379 (2007)

▶ No. 28 in "100 Papers Selection" (p. 61)

Sumanene ($C_{21}H_{12}$), which is one of the partial structures of C_{60}, was first synthesized in our laboratory in 2003. The facile derivatization of this π-bowl is permitted by nucleophilic bond formation of the corresponding benzylic carbanions, affording a variety of π-bowls. π-Bowls are expected to be the third key non-planar carbon materials, together with fullerenes and carbon nanotubes.

In the coordination chemistry of π-bowls, there is an intriguing issue how to prepare and characterize non-planar π-conjugated complexes. Furthermore, the preference for metal binding to a concave (bowl inside) surface versus a convex (bowl outside) one is to be investigated. To date, some coordination complexes of π-bowls like corannulene have been prepared and characterized by X-ray crystal analysis, indicating the preference for convex-selective coordination. However, concave-selective coordination complexes have never been isolated. Various coordination modes including η^1-η^9 fashions are conceivable with sumanene, but the coordination chemistry of sumanene with transition metals has been limited to the computational study.

We achieved the first synthesis of the concave-bound complex of sumanene with [cyclopentadienyl (Cp) iron]$^+$ by ligand exchange. The concave π surface serves as an η^6-ligand. It is also the first example for the ferrocene complexes with non-planar aromatic hydrocarbons. Such a structure was demonstrated in both solution and solid states by NMR spectroscopy and X-ray analysis, respectively.