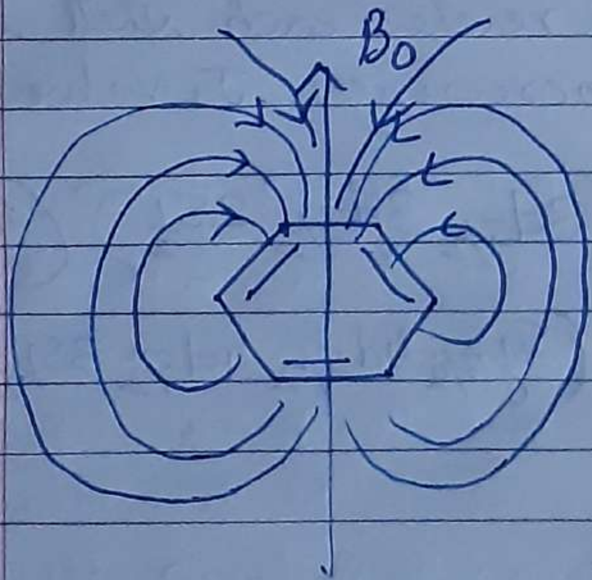
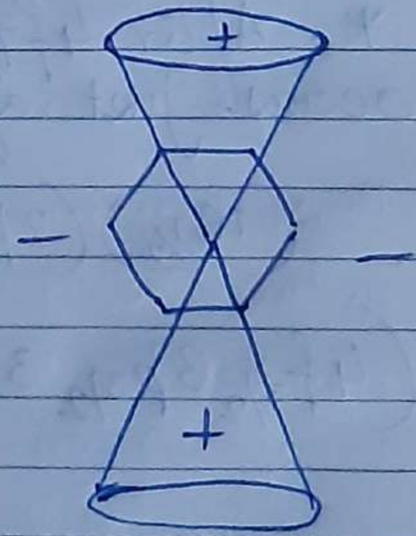
Ring Current :-

A special case of neighbouring group anisotropy occurs in aromatic compounds. In molecules such as benzene, the dominant contribution to the magnetic anisotropy comes from the extensive circulation of the π electrons in their delocalized molecular orbitals.

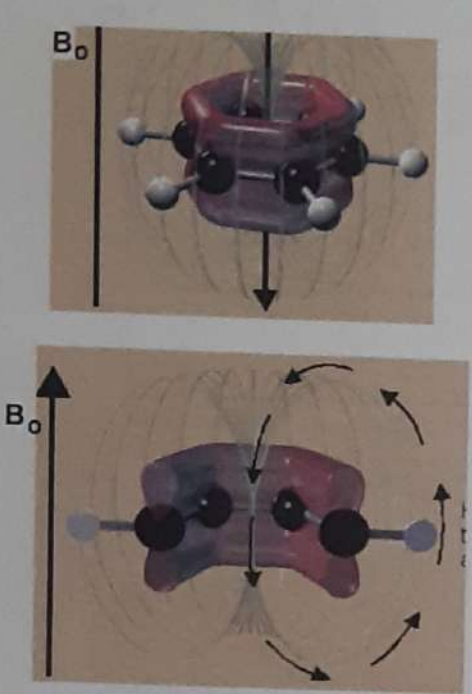




When the aromatic ring is oriented perpendicular to the applied magnetic field, the π electron circulates freely around the ring and move in a direction such that the magnetic moment resulting from their motion opposes the magnetic field. It may be visualised as a point magnetic dipole situated at the center of the ring. An aromatic proton in the plane of the ring experiences a field that enhances the applied field and hence its resonance occurs at a lower field than might otherwise be expected. Thus the effect of induced field is to deshield substantially the hydrogens attached to the aromatic ring which generally comes into resonance at δ 7.27 ppm in benzene. Accordingly the chemical shift of the benzene protons is about 1.7 ppm lower than that of ethylene.

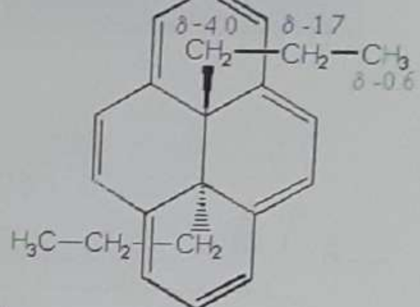
Ring Current in π-System

Magnetic field generated by a benzene ring π-system current

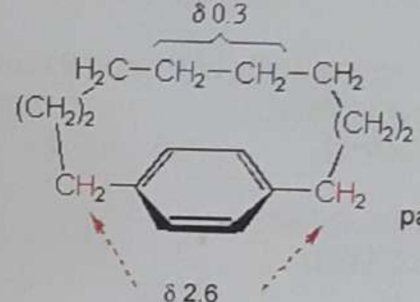


$B_{eff} > B_o$ at the aryl Hs

- ✓ Bonding electrons always produce shielding effect.
- ✓ π-system can produces magnetic field that reinforces B_o.

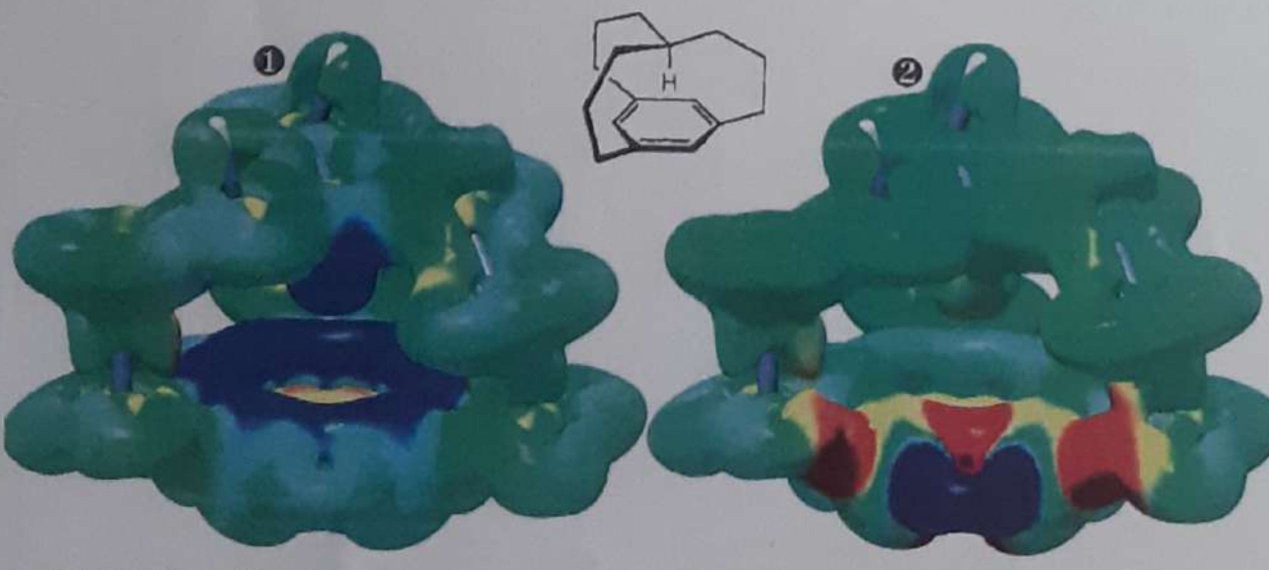


[14]annulene



paracyclophane

Ring Current in π-System



The NMR shielding densities for the methine proton (1) and the phenyl proton (2) in *in*-[$3^{4,10}$][7]metacyclophane, plotted on an isosurface of current density magnitude.

Shielding density increases from red (deshielding) to blue (shielding).

(Pascal, Winans & Van Engen, *J. Am. Chem. Soc.* **1989**, 111, 3007)