**Workshop VIII: Molecular Symmetry**

*Group theory is a systematic, mathematical treatment of symmetry within a molecule. Applications of group theory allow us to predict spectroscopic properties of molecules and transitions between molecular orbitals.*

**Symmetry operation:** an action that leaves the molecule essentially unchanged.

Identity (E)

Rotation Axis (C_n)

Mirror Plane (σ)

Center of Inversion (i)
Improper Rotation ($S_n$)

Exercise: Determine all the symmetry elements for each of the following molecules. Models will help!

$\text{Cl} \quad \text{Pt} \quad \text{NH}_3$

$\text{Cl} \quad \text{NH}_3$

$\text{H} \quad \text{C} \quad \text{H}$

$\text{H} \quad \text{C} \quad \text{H}$

$\text{Cl} \quad \text{Pt} \quad \text{NH}_3$

$\text{Cl} \quad \text{NH}_3$

$\text{Cl} \quad \text{Cl}$

$\text{O} \quad \text{S} \quad \text{O}$
Point Groups

Classifications of molecules with the same symmetry elements.

Exercise: Assign point groups to the following molecules.

![Molecule 1](image1)

![Molecule 2](image2)

![Molecule 3](image3)

![Molecule 4](image4)

H$_2$S - draw the Lewis structure first!

this one is pretty hard!

Applications of Group Theory
IR spectroscopy and dipole moments

Orbital symmetry and allowed/forbidden transitions
Flow chart here... Separate page so that they can tear it off!