The Fascination of Crystals and Symmetry

Unit 3.4

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Rotoinversions vs. Rotary reflections...
Schoenflies vs. Hermann-Mauguin

World of molecules

Symmetry notation system according to Artur Moritz Schoenflies

“Schoenflies symbolism”

World of crystals

Symmetry notation system according to Carl Hermann und Charles-Victor Mauguin

“Hermann-Mauguin symbolism”
## Rotoinversions vs. Rotary reflections

### Symmetry elements of macroscopic objects

<table>
<thead>
<tr>
<th>Schoenflies</th>
<th>Hermann-Mauguin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identity</td>
<td>Identity</td>
</tr>
<tr>
<td>Mirror plane</td>
<td>Mirror plane</td>
</tr>
<tr>
<td>Axis of rotation</td>
<td>Axis of rotation</td>
</tr>
<tr>
<td>Center of inversion</td>
<td>Center of inversion</td>
</tr>
<tr>
<td>Rotation-reflection axis</td>
<td>Rotoinvversion axis</td>
</tr>
</tbody>
</table>

- Identity: $E$
- Mirror plane: $\sigma$
- Axis of rotation: $C_n$
- Center of inversion: $i$
- Rotation-reflection axis: $S_n$

- Identity: 1
- Mirror plane: m
- Axis of rotation: n
- Center of inversion: 1
- Rotoinvversion axis: $\bar{n}$
Rotoinversions vs. Rotary reflections

Rotoinversion

$\overline{4}$ rotoinversion axis

Rotary reflection

$S_4$ rotation-reflection axis improper axis of rotation
Rotoinversions vs. Rotary reflections

$\bar{3}$ $S_6$
Rotoinversions vs. Rotary reflections

Excercise

Try to determine the order of
(a) the rotoinversion and
(b) the rotary reflection of
these two arrangements of locomotives!
Rotoinversions vs. Rotary reflections

- In the case of a rotary reflection a rotation is combined with a reflection at a plane perpendicular to this axis.
- A rotary reflection is equivalent to a rotoinversion, however, the order $n$ can be different.
- In the world of molecules (Schoenflies notation) only rotary reflections are used.
- In the world of crystallography (Hermann-Mauguin notation) the same symmetry property is expressed only by rotoinversions.
Rotoinversions vs. Rotary reflections

- Rotoinversion axis / rotary reflection axis
- Mirror plane perpendicular to the axis

$3 \quad S_6$