

Table 3.1. Crystallographic glide planes.

Plane symbol	Order	Graphical symbol ^a	Translation vector
a	2		$\frac{1}{2}\mathbf{a}$
b	2		$\frac{1}{2}\mathbf{b}$
c	2		$\frac{1}{2}\mathbf{c}$
n	2		$\frac{1}{2}\mathbf{d}^b$
d	4		$\frac{1}{4}\mathbf{d}^b$

^a Shown in the following coordinate system:

^b **d** is the diagonal vector, e.g. $\mathbf{d} = \mathbf{a} + \mathbf{b}$, $\mathbf{d} = \mathbf{a} - \mathbf{b}$, $\mathbf{d} = \mathbf{a} + \mathbf{b} + \mathbf{c}$, etc.

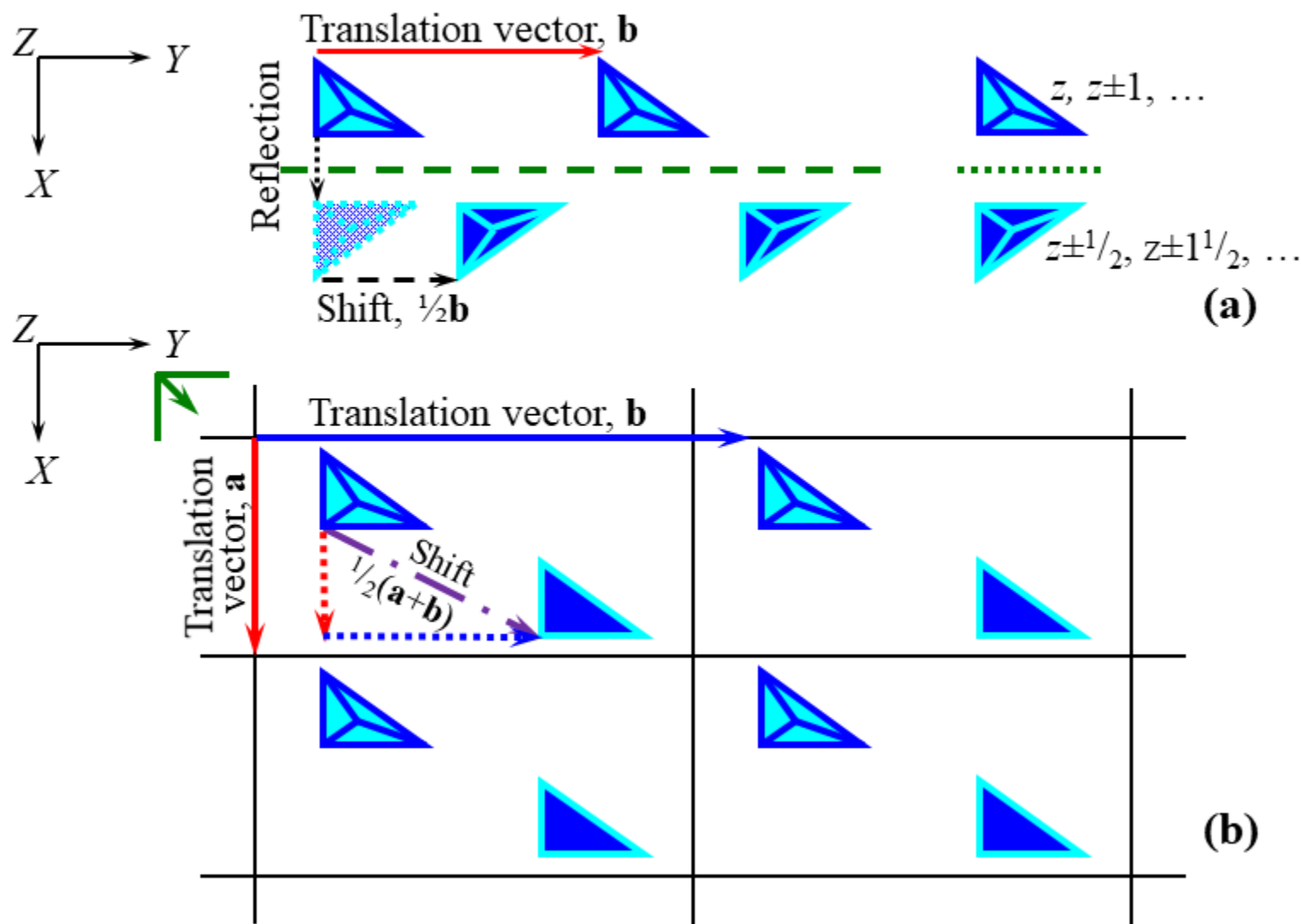
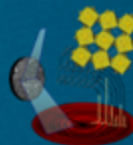


Figure 3.1. (a) - Vertical glide plane b , perpendicular to a with a horizontal translation by $\frac{1}{2}$ along b (*left*); vertical glide plane c , perpendicular to a with a vertical translation by $\frac{1}{2}$ along c (*right*). (b) Horizontal glide plane n , perpendicular to c with a diagonal translation by $\frac{1}{2}(a + b)$ parallel to the ab plane. The dotted pyramid in (a) indicates the intermediate position to which the first pyramid is reflected before it is translated along b and along the plane.

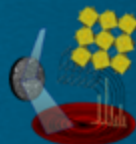
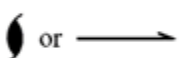
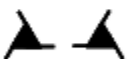


Table 3.2. Crystallographic screw axes.

Axis order	Text symbol ^a	Graphical symbol ^a	Shift along the axis ^b
2	2_1		$\frac{1}{2}$
3	$3_1, 3_2$		$\frac{1}{3}, \frac{2}{3}$
4	$4_1, 4_2, 4_3$		$\frac{1}{4}, \frac{2}{4}, \frac{3}{4}$
6	$6_1, 6_2, 6_3, 6_4, 6_5$		$\frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}$

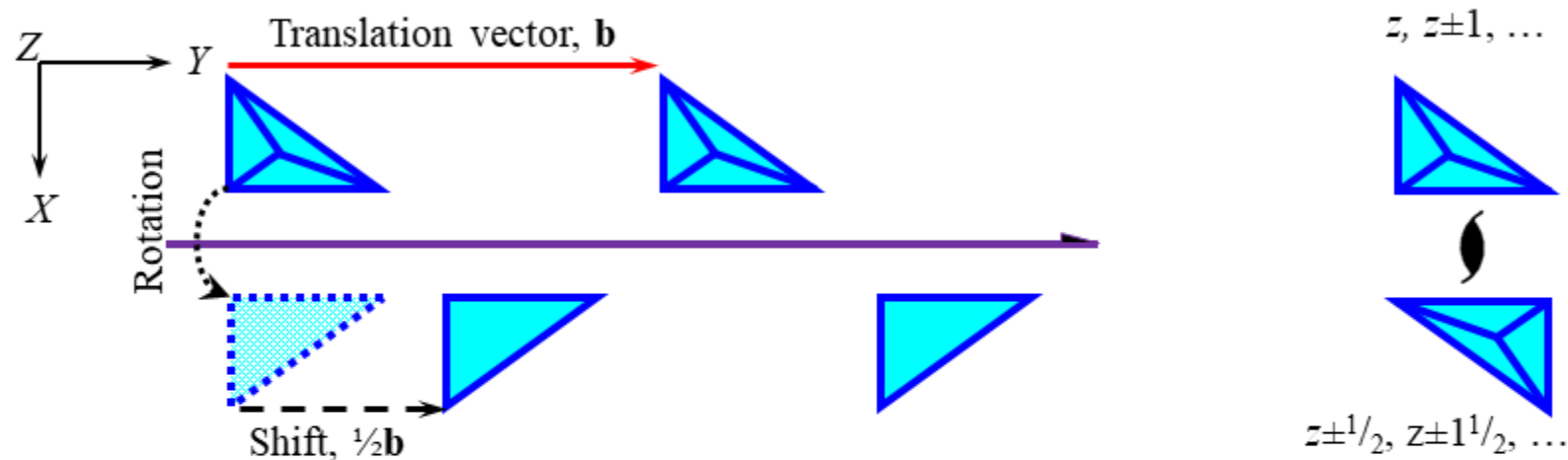
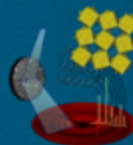


Figure 3.2. Horizontal (*left*) and vertical (*right*) twofold screw axis, 2_1 . The dotted pyramid indicates the intermediate position to which the first pyramid is rotated before it is translated along the axis.

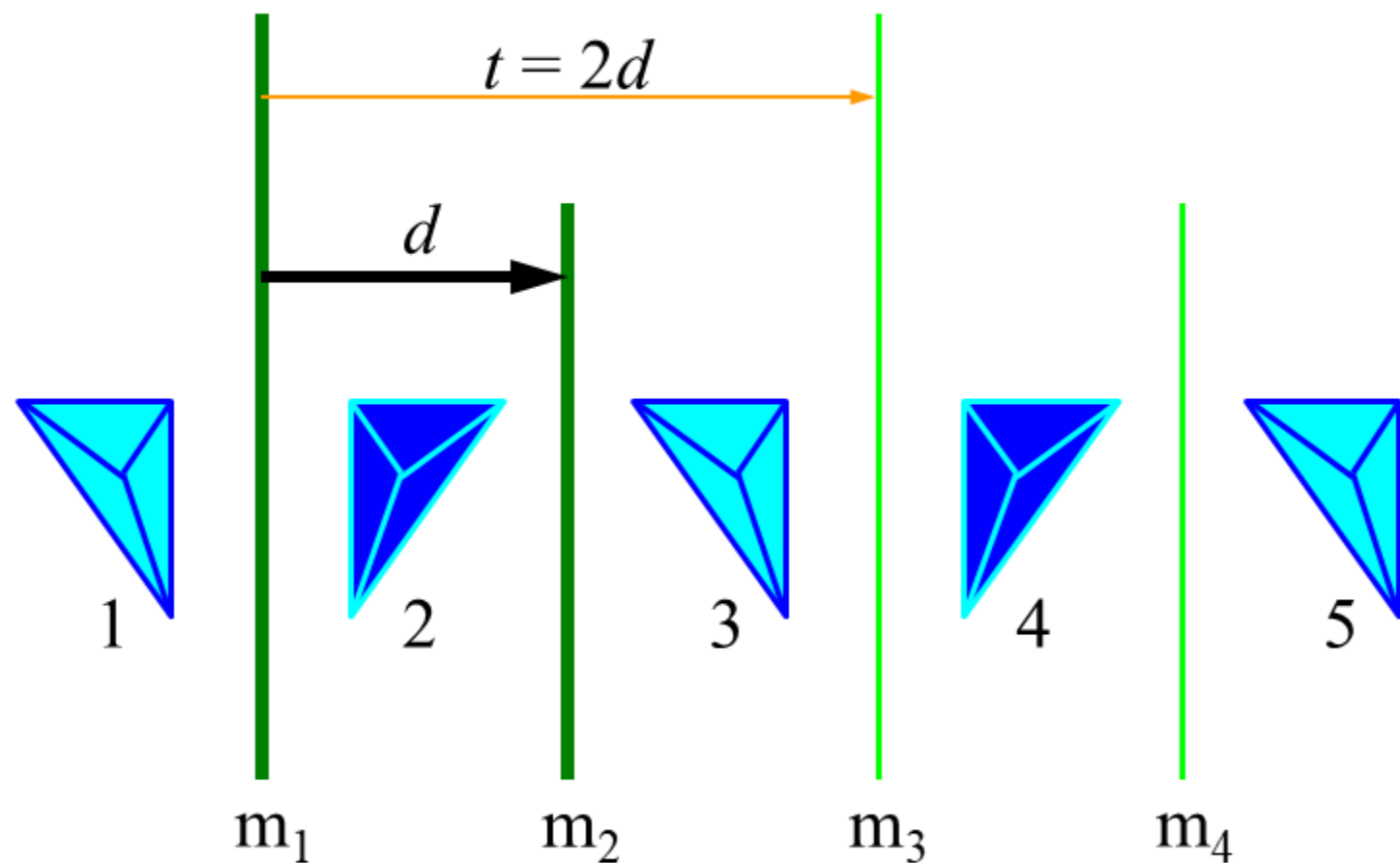
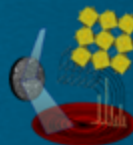


Figure 3.3. Example illustrating how two parallel mirror planes with the interplanar distance d result in the translation $t = 2d$ perpendicular to both planes. Starting from planes m_1 and m_2 (*thick lines*) and pyramid 1 we obtain pyramid 2 by reflecting 1 in m_1 . Pyramids 3 and 4 are obtained by reflecting Pyramids 2 and 1, respectively, in m_2 . Thus, plane m_3 (*thin line*) appears between pyramids 3 and 4. Pyramid 5 is obtained from pyramid 3 by reflecting it in m_1 and then resulting pyramid (not shown) in m_2 , which leads to plane m_4 (*thin line*), and so on. It is easy to see that pyramids 1, 3, 5, and so on, as well as Pyramids 2, 4, and so on are symmetrically equivalent to one another *via* the action of the translation $t = 2d$ (*thin orange arrow*).

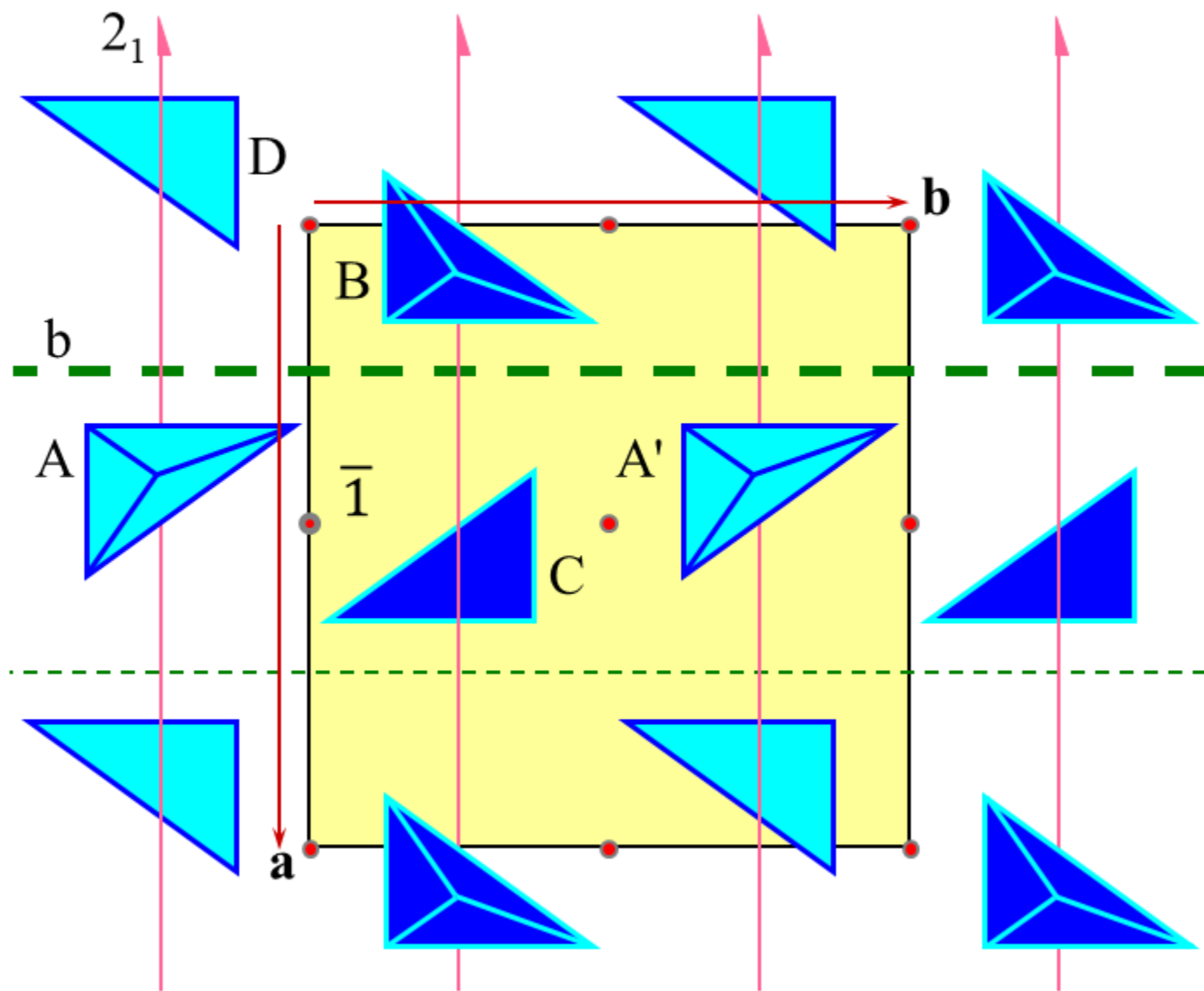
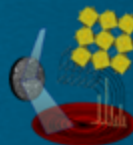


Figure 3.4. Example illustrating the result of interaction between the glide plane, b , and the center of inversion, $\bar{1}$. The original symmetry elements are shown using *thick lines* and the derivatives using *thin lines*. The resulting unit cell is *highlighted*.

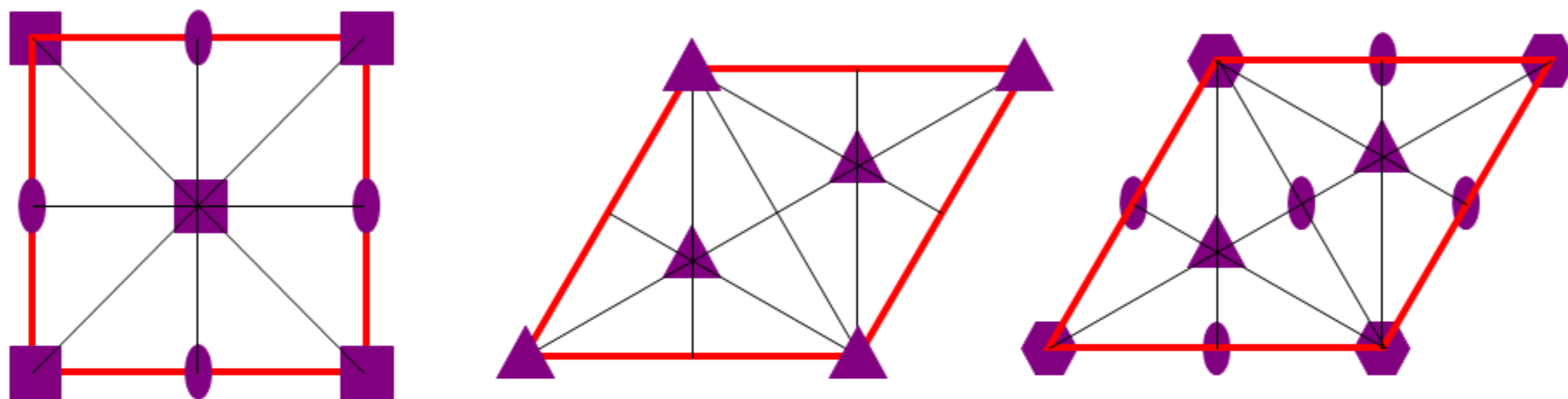
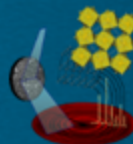
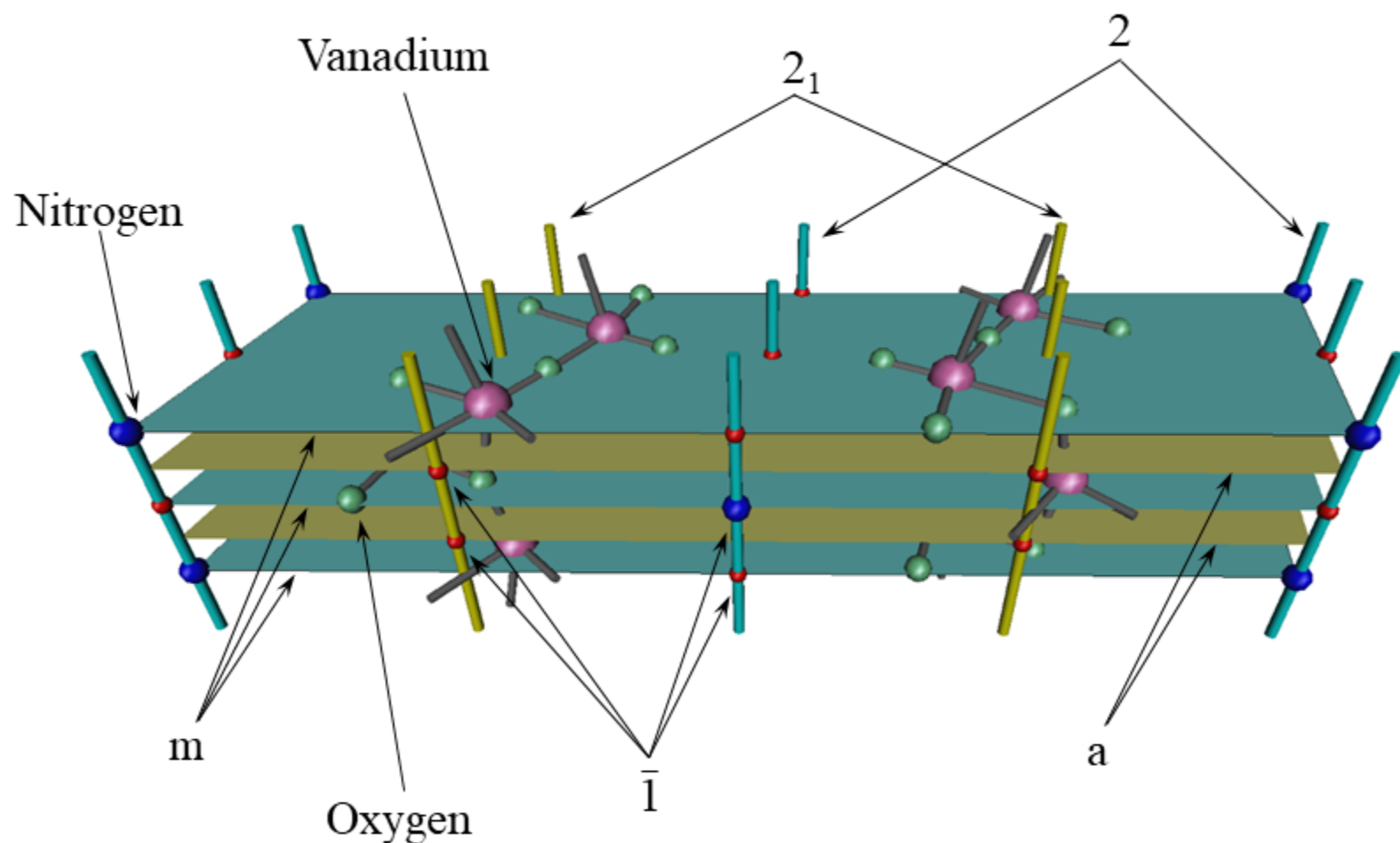
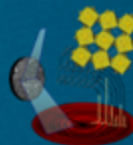


Figure 3.5. Characteristic distribution of the two-, three-, four-, and sixfold rotation axes parallel to the unique axis in the unit cell in tetragonal (*left*), trigonal (*center*), and hexagonal (*right*) crystal systems as the result of their interaction with lattice translations.



The drawing was created using the General Structure Analysis System (GSAS)

Figure 3.6. The 3-dimensional view of the crystal structure of $tmaV_8O_{20}$ (vanadium oxide layers and nitrogen atoms from *tma* molecules; the whole *tma* molecules are not shown for clarity) with added symmetry elements. The space group symmetry of the material is $C2/m$.

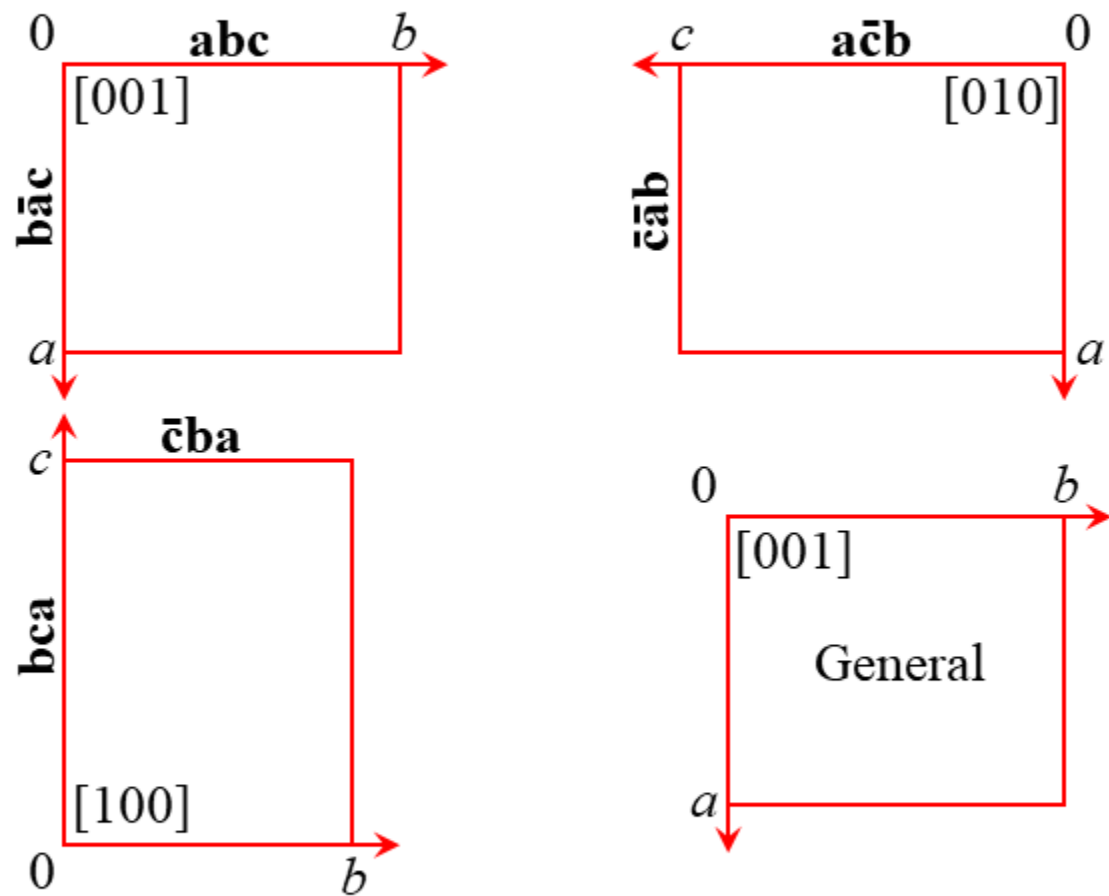


Figure 3.7. Schematic representation of orthorhombic space-group symmetry diagrams showing the origin of coordinates (0), the labels of the axes (a , b and c) and the projection directions ($[001]$, $[010]$ and $[100]$). The box marked “General” is a general position diagram (see the description of fields “Symmetry operations” and “Positions” in the numbered list in this section). The triplets (**abc** and so on) indicate settings symbols that result in the corresponding space group symbols. Each settings symbol is obtained by a permutation of the unit cell axes, e.g. **cab** is the cyclic permutation of **abc**: $\mathbf{a}' = \mathbf{c}$, $\mathbf{b}' = \mathbf{a}$, $\mathbf{c}' = \mathbf{b}$. It should be noted that a space-group symbol is invariant to the changes of the sign (direction) of the axes.

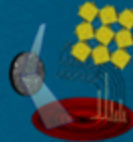


Table 3.4. The space group symmetry Cmm2 as it is listed in the International Tables for Crystallography, vol. A.

Field	Content		
(1)	Cmm2	C_{2v}^{11} mm2	Orthorhombic
(2)	No 35	Cmm2	Patterson symmetry Cmmm

(3)

