1 Hexagonal lattice and primitive cell.

1. For a simple hexagonal lattice we can choose the following primitive vectors: \( \mathbf{a}_1 = \sqrt{3}/2 \mathbf{a}_x + 1/2 \mathbf{a}_y, \mathbf{a}_2 = -\sqrt{3}/2 \mathbf{a}_x + 1/2 \mathbf{a}_y, \mathbf{a}_3 = \mathbf{c} \mathbf{e}_z \). What volume does the primitive unit cell have?

2. Deduce the primitive vectors for the reciprocal lattice. Describe it from a point of view of the W-Z. construction.

3. Sketch the 1st Brillouin zone.

2 Crystal structure of BaTiO\(_3\)

Barium titanate BaTiO\(_3\) crystalizes in such a structure that Ba atoms sit at the corners of a cube with Ti atoms at the cube center and O atoms in the centers of its faces.

1. Describe this structure with a suitable lattice and basis.

2. Determine the intensity relationship between the first four Bragg reflections with the help of this structure factor. The following form factors apply to the atoms: \( f_{Ba} = 7f_O \) and \( f_{Ti} = 3f_O \).