

$Cmmm$

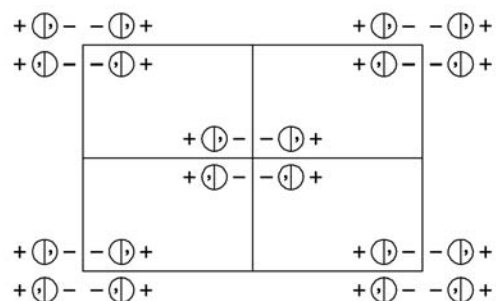
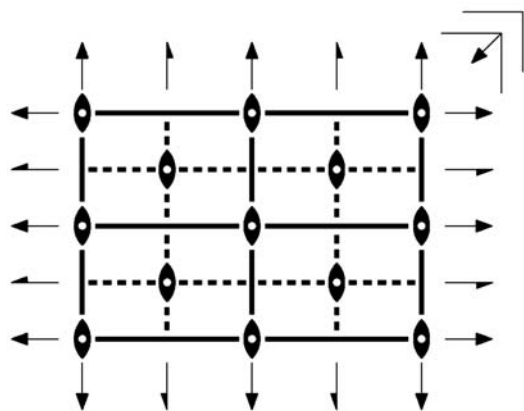
mmm

Orthorhombic/Rectangular

No. 47

$c2/m2/m2/m$

Patterson symmetry $cmmm$



Origin at centre (mmm)

Asymmetric unit $0 \leq x \leq \frac{1}{4}$; $0 \leq y \leq \frac{1}{2}$; $0 \leq z$

Symmetry operations

For $(0,0,0)+$ set

- | | | | |
|--|--|--|--|
| (1) 1 (1 0,0,0) | (2) 2 $0,0,z$ (2 _z 0,0,0) | (3) 2 $0,y,0$ (2 _y 0,0,0) | (4) 2 $x,0,0$ (2 _x 0,0,0) |
| (5) $\bar{1}$ $0,0,0$ ($\bar{1}$ 0,0,0) | (6) m $x,y,0$ (m_z 0,0,0) | (7) m $x,0,z$ (m_y 0,0,0) | (8) m $0,y,z$ (m_x 0,0,0) |

For $(\frac{1}{2}, \frac{1}{2}, 0)+$ set

- | | | | |
|--|---|--|--|
| (1) $t(\frac{1}{2}, \frac{1}{2}, 0)$ (1 $\frac{1}{2}, \frac{1}{2}, 0$) | (2) 2 $\frac{1}{4}, \frac{1}{4}, z$ (2 _z $\frac{1}{2}, \frac{1}{2}, 0$) | (3) 2 $(0, \frac{1}{2}, 0) \frac{1}{4}, y, 0$ (2 _y $\frac{1}{2}, \frac{1}{2}, 0$) | (4) 2 $(\frac{1}{2}, 0, 0) x, \frac{1}{4}, 0$ (2 _x $\frac{1}{2}, \frac{1}{2}, 0$) |
| (5) $\bar{1}$ $\frac{1}{4}, \frac{1}{4}, 0$ ($\bar{1}$ $\frac{1}{2}, \frac{1}{2}, 0$) | (6) $n(\frac{1}{2}, \frac{1}{2}, 0) x, y, 0$ (m_z $\frac{1}{2}, \frac{1}{2}, 0$) | (7) a $x, \frac{1}{4}, z$ (m_y $\frac{1}{2}, \frac{1}{2}, 0$) | (8) b $\frac{1}{4}, y, z$ (m_x $\frac{1}{2}, \frac{1}{2}, 0$) |

Generators selected (1); $t(1,0,0)$; $t(0,1,0)$; $t(\frac{1}{2}, \frac{1}{2}, 0)$; (2); (3); (5)

Positions

| Multiplicity, Wyckoff letter, Site symmetry | Coordinates | Reflection conditions |
|---|--|--|
| | $(0,0,0)+$ $(\frac{1}{2}, \frac{1}{2}, 0)+$ | General: |
| 16 <i>l</i> 1 | (1) x, y, z (2) \bar{x}, \bar{y}, z (3) \bar{x}, y, \bar{z} (4) x, \bar{y}, \bar{z} (5) $\bar{x}, \bar{y}, \bar{z}$ (6) x, y, \bar{z} (7) x, \bar{y}, z (8) \bar{x}, y, z | $hk: h+k=2n$ $h0: h=2n$ $0k: k=2n$ |
| 8 <i>k</i> $\dots m$ | $x, y, 0$ $\bar{x}, \bar{y}, 0$ $\bar{x}, y, 0$ $x, \bar{y}, 0$ | Special: as above, plus no extra conditions |
| 8 <i>j</i> $\dots m$ | $x, 0, z$ $\bar{x}, 0, z$ $\bar{x}, 0, \bar{z}$ $x, 0, \bar{z}$ | no extra conditions |
| 8 <i>i</i> $m \dots$ | $0, y, z$ $0, \bar{y}, z$ $0, y, \bar{z}$ $0, \bar{y}, \bar{z}$ | no extra conditions |
| 8 <i>h</i> $\dots 2$ | $\frac{1}{4}, \frac{1}{4}, z$ $\frac{3}{4}, \frac{1}{4}, \bar{z}$ $\frac{3}{4}, \frac{3}{4}, \bar{z}$ $\frac{1}{4}, \frac{3}{4}, z$ | $hk: h=2n$ |
| 4 <i>g</i> $mm2$ | $0, \frac{1}{2}, z$ $0, \frac{1}{2}, \bar{z}$ | no extra conditions |
| 4 <i>f</i> $mm2$ | $0, 0, z$ $0, 0, \bar{z}$ | no extra conditions |
| 4 <i>e</i> $m2m$ | $0, y, 0$ $0, \bar{y}, 0$ | no extra conditions |
| 4 <i>d</i> $2mm$ | $x, 0, 0$ $\bar{x}, 0, 0$ | no extra conditions |
| 4 <i>c</i> $\dots 2/m$ | $\frac{1}{4}, \frac{1}{4}, 0$ $\frac{3}{4}, \frac{1}{4}, 0$ | $hk: h=2n$ |
| 2 <i>b</i> mmm | $\frac{1}{2}, 0, 0$ | no extra conditions |
| 2 <i>a</i> mmm | $0, 0, 0$ | no extra conditions |

Symmetry of special projections

Along [001] $c2mm$
 $\mathbf{a}' = \mathbf{a}$ $\mathbf{b}' = \mathbf{b}$
Origin at $0, 0, z$

Along [100] $\not\!2mm$
 $\mathbf{a}' = \frac{1}{2}\mathbf{b}$
Origin at $x, 0, 0$

Along [010] $\not\!2mm$
 $\mathbf{a}' = \frac{1}{2}\mathbf{a}$
Origin at $0, y, 0$

Maximal non-isotypic subgroups

| | | |
|------------|-------------------------------|--|
| I | [2] $cm2m$ (35) | (1; 3; 6; 8)+ |
| | [2] $c2mm$ ($cm2m$, 35) | (1; 4; 6; 7)+ |
| | [2] $cmm2$ (26) | (1; 2; 7; 8)+ |
| | [2] $c222$ (22) | (1; 2; 3; 4)+ |
| | [2] $c12/m1$ ($c2/m11$, 18) | (1; 3; 5; 7)+ |
| | [2] $c2/m11$ (18) | (1; 4; 5; 8)+ |
| | [2] $c112/m$ ($p112/m$, 6) | (1; 2; 5; 6)+ |
| IIa | [2] $pmmn$ (46) | 1; 2; 7; 8; (3; 4; 5; 6) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pbam$ (44) | 1; 2; 5; 6; (3; 4; 7; 8) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pbmn$ ($pman$, 42) | 1; 3; 5; 7; (2; 4; 6; 8) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pman$ (42) | 1; 4; 5; 8; (2; 3; 6; 7) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pmam$ (40) | 1; 3; 6; 8; (2; 4; 5; 7) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pbmm$ ($pmam$, 40) | 1; 4; 6; 7; (2; 3; 5; 8) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pban$ (39) | 1; 2; 3; 4; (5; 6; 7; 8) + $(\frac{1}{2}, \frac{1}{2}, 0)$ |
| | [2] $pmmm$ (37) | 1; 2; 3; 4; 5; 6; 7; 8 |
| IIb | none | |

Maximal isotypic subgroups of lowest index

IIc [3] $cmmm$ ($\mathbf{a}' = 3\mathbf{a}$ or $\mathbf{b}' = 3\mathbf{b}$) (47)

Minimal non-isotypic supergroups

I [2] $p4/mmm$ (61); [2] $p4/mbm$ (63); [3] $p6/mmm$ (80)
II [2] $pmmm$ ($\mathbf{a}' = \frac{1}{2}\mathbf{a}, \mathbf{b}' = \frac{1}{2}\mathbf{b}$) (37)