

# INTERNATIONAL TABLES FOR CRYSTALLOGRAPHY

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*Volume A*  
SPACE-GROUP SYMMETRY

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Theo Hahn

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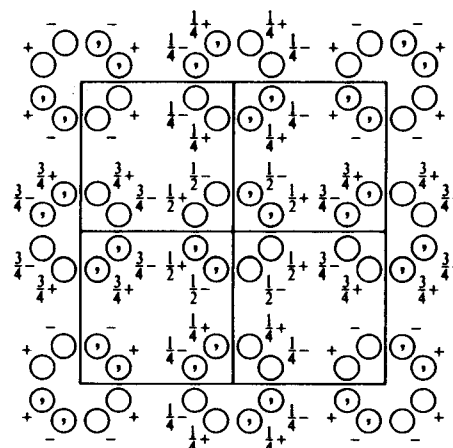
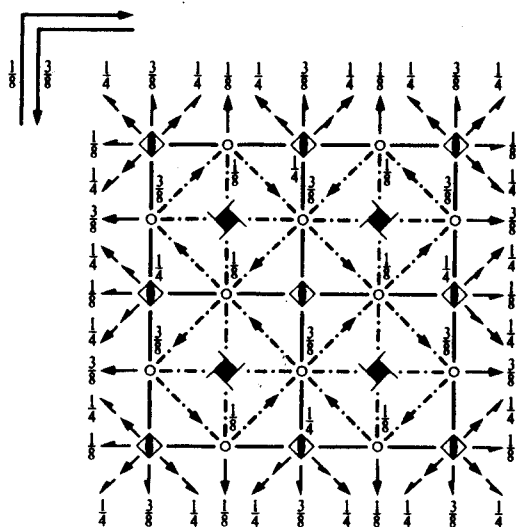
$I 4_1/a m d$  $D_{4h}^{19}$  $4/m m m$ 

Tetragonal

No. 141

 $I 4_1/a 2/m 2/d$ Patterson symmetry  $I 4/m m m$ 

ORIGIN CHOICE 1

Origin at  $\bar{4}m 2$ , at  $0, \frac{1}{4}, -\frac{1}{4}$  from centre ( $2/m$ )Asymmetric unit  $0 \leq x \leq \frac{1}{2}; 0 \leq y \leq \frac{1}{2}; 0 \leq z \leq \frac{1}{2}$ **Symmetry operations**For  $(0,0,0)+$  set

- |   |  |  |   |
|---|--|--|---|
| (1) 1   | (2) $2(0,0,\frac{1}{2})$ $\frac{1}{2}, \frac{1}{2}, z$ | (3) $4^+(0,0,\frac{1}{2})$ $-\frac{1}{2}, \frac{1}{2}, z$                      | (4) $4^-(0,0,\frac{1}{2})$ $\frac{1}{2}, -\frac{1}{2}, z$               |
| (5) $2$ $\frac{1}{2}, y, \frac{1}{2}$                     | (6) $2$ $x, \frac{1}{2}, \frac{1}{2}$                  | (7) $2(\frac{1}{2}, \frac{1}{2}, 0)$ $x, x, \frac{1}{2}$                       | (8) $2$ $x, \bar{x}, 0$   |
| (9) $\bar{1}$ $0, \frac{1}{2}, \frac{1}{2}$               | (10) $a$ $x, y, \frac{1}{2}$                           | (11) $\bar{4}^+$ $0, 0, z; 0, 0, 0$  | (12) $\bar{4}^-$ $0, \frac{1}{2}, z; 0, \frac{1}{2}, \frac{1}{2}$       |
| (13) $n(\frac{1}{2}, 0, \frac{1}{2})$ $x, \frac{1}{2}, z$ | (14) $m$ $0, y, z$                                     | (15) $d(\frac{1}{2}, -\frac{1}{2}, \frac{1}{2})$ $x + \frac{1}{2}, \bar{x}, z$ | (16) $d(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ $x - \frac{1}{2}, x, z$ |

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

- |  |   |  |   |
|--|---|--|---|
| (1) $i(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ | (2) $2$ $0, 0, z$   | (3) $4^+(0,0,\frac{1}{2})$ $\frac{1}{2}, \frac{1}{2}, z$                       | (4) $4^-(0,0,\frac{1}{2})$ $\frac{1}{2}, \frac{1}{2}, z$                |
| (5) $2(0, \frac{1}{2}, 0)$ $0, y, \frac{1}{2}$ | (6) $2(\frac{1}{2}, 0, 0)$ $x, 0, \frac{1}{2}$            | (7) $2$ $x, x, 0$  | (8) $2$ $x, \bar{x} + \frac{1}{2}, \frac{1}{2}$                         |
| (9) $\bar{1}$ $\frac{1}{2}, 0, \frac{1}{2}$    | (10) $b$ $x, y, \frac{1}{2}$                              | (11) $\bar{4}^+$ $\frac{1}{2}, 0, z; \frac{1}{2}, 0, \frac{1}{2}$              | (12) $\bar{4}^-$ $0, 0, z; 0, 0, 0$                                     |
| (13) $m$ $x, 0, z$                             | (14) $n(0, \frac{1}{2}, \frac{1}{2})$ $\frac{1}{2}, y, z$ | (15) $d(-\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ $x + \frac{1}{2}, \bar{x}, z$ | (16) $d(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ $x + \frac{1}{2}, x, z$ |

**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ;  $t(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$ ; (2); (3); (5); (9)

**Positions**

Multiplicity,  
Wyckoff letter,  
Site symmetry

**Coordinates**

Reflection conditions

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

General:

32	<i>i</i>	1	(1) $x, y, z$	(2) $\bar{x} + \frac{1}{2}, \bar{y} + \frac{1}{2}, z + \frac{1}{2}$	(3) $\bar{y}, x + \frac{1}{2}, z + \frac{1}{2}$	(4) $y + \frac{1}{2}, \bar{x}, z + \frac{1}{2}$	$hkl : h+k+l=2n$
			(5) $\bar{x} + \frac{1}{2}, y, \bar{z} + \frac{1}{2}$	(6) $x, \bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}$	(7) $y + \frac{1}{2}, x + \frac{1}{2}, \bar{z} + \frac{1}{2}$	(8) $\bar{y}, \bar{x}, \bar{z}$	$hk0 : h, k=2n$
			(9) $\bar{x}, \bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}$	(10) $x + \frac{1}{2}, y, \bar{z} + \frac{1}{2}$	(11) $y, \bar{x}, \bar{z}$	(12) $\bar{y} + \frac{1}{2}, x + \frac{1}{2}, \bar{z} + \frac{1}{2}$	$0kl : k+l=2n$
			(13) $x + \frac{1}{2}, \bar{y} + \frac{1}{2}, z + \frac{1}{2}$	(14) $\bar{x}, y, z$	(15) $\bar{y} + \frac{1}{2}, \bar{x}, z + \frac{1}{2}$	(16) $y, x + \frac{1}{2}, z + \frac{1}{2}$	$hhl : 2h+l=4n$

$00l : l=4n$   
 $h00 : h=2n$   
 $h\bar{h}0 : h=2n$

Special: as above, plus

16	<i>h</i>	$.m.$	$0, y, z$ $\frac{1}{2}, y, \bar{z} + \frac{1}{2}$	$\frac{1}{2}, \bar{y} + \frac{1}{2}, z + \frac{1}{2}$ $0, \bar{y} + \frac{1}{2}, \bar{z} + \frac{1}{2}$	$\bar{y}, \frac{1}{2}, z + \frac{1}{2}$ $y + \frac{1}{2}, \frac{1}{2}, \bar{z} + \frac{1}{2}$	$y + \frac{1}{2}, 0, z + \frac{1}{2}$ $\bar{y}, 0, \bar{z}$	no extra conditions
16	<i>g</i>	$.2$	$x, x, 0$ $\bar{x}, \bar{x} + \frac{1}{2}, \frac{1}{2}$	$\bar{x} + \frac{1}{2}, \bar{x} + \frac{1}{2}, \frac{1}{2}$ $x + \frac{1}{2}, x, \frac{1}{2}$	$\bar{x}, x + \frac{1}{2}, \frac{1}{2}$ $x, \bar{x}, 0$	$x + \frac{1}{2}, \bar{x}, \frac{1}{2}$ $\bar{x} + \frac{1}{2}, x + \frac{1}{2}, \frac{1}{2}$	$hkl : l=2n+1$ or $2h+l=4n$
16	<i>f</i>	$.2.$	$x, \frac{1}{2}, \frac{1}{2}$ $\bar{x}, \frac{1}{2}, \frac{1}{2}$	$\bar{x} + \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$ $x + \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, x + \frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, \bar{x}, \frac{1}{2}$	$\frac{1}{2}, \bar{x}, \frac{1}{2}$ $\frac{1}{2}, x + \frac{1}{2}, \frac{1}{2}$	$hkl : l=2n+1$ or $h=2n$
8	<i>e</i>	$2mm.$	$0, 0, z$	$0, \frac{1}{2}, z + \frac{1}{2}$	$\frac{1}{2}, 0, \bar{z} + \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \bar{z} + \frac{1}{2}$	$hkl : l=2n+1$ or $2h+l=4n$
8	<i>d</i>	$.2/m.$	$0, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, 0, \frac{1}{2}$	$hkl : l=2n+1$ or $h, k=2n, h+k+l=4n$
8	<i>c</i>	$.2/m.$	$0, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, 0, \frac{1}{2}$	
4	<i>b</i>	$\bar{4}m2$	$0, 0, \frac{1}{2}$	$0, \frac{1}{2}, \frac{1}{2}$			$hkl : l=2n+1$ or $2h+l=4n$
4	<i>a</i>	$\bar{4}m2$	$0, 0, 0$	$0, \frac{1}{2}, \frac{1}{2}$			

**Symmetry of special projections**

Along [001]  $p4mm$   
 $a' = \frac{1}{2}a$   $b' = \frac{1}{2}b$   
 Origin at  $0, 0, z$

Along [100]  $c2mm$   
 $a' = b$   $b' = c$   
 Origin at  $x, 0, \frac{1}{2}$

Along [110]  $c2mm$   
 $a' = \frac{1}{2}(-a+b)$   $b' = \frac{1}{2}c$   
 Origin at  $x, x, 0$

**Maximal non-isomorphic subgroups**

I	[2] $I4_122$	(1; 2; 3; 4; 5; 6; 7; 8)+
	[2] $I4_1/a11(I4_1/a)$	(1; 2; 3; 4; 9; 10; 11; 12)+
	[2] $I4_1md$	(1; 2; 3; 4; 13; 14; 15; 16)+
	[2] $I\bar{4}2d$	(1; 2; 5; 6; 11; 12; 15; 16)+
	[2] $I\bar{4}m2$	(1; 2; 7; 8; 11; 12; 13; 14)+
	[2] $I2/a2/m1(Imma)$	(1; 2; 5; 6; 9; 10; 13; 14)+
	[2] $I2/a12/d(Fddd)$	(1; 2; 7; 8; 9; 10; 15; 16)+

IIa none

IIb none

**Maximal isomorphic subgroups of lowest index**

IIc [3] $I4_1/amd(c'=3c)$ ; [9] $I4_1/amd(a'=3a, b'=3b)$

**Minimal non-isomorphic supergroups**

I [3] $Fd\bar{3}m$

II [2] $C4_2/amd(2c'=c)(P4_2/nnm)$

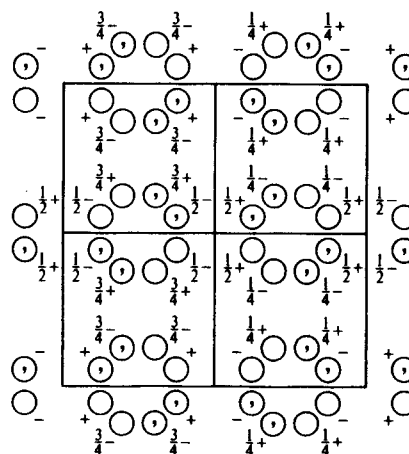
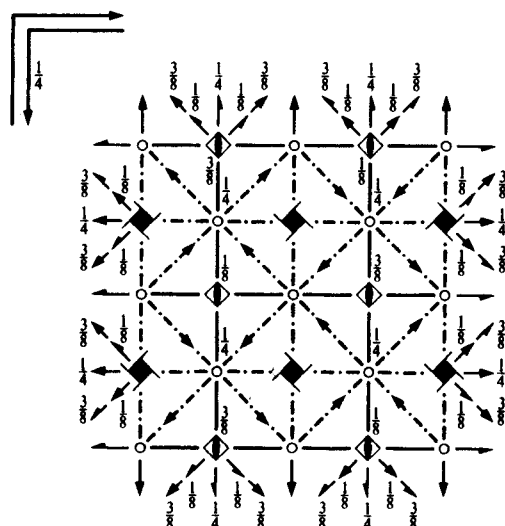
$I 4_1/a m d$  $D_{4h}^{19}$  $4/m m m$ 

Tetragonal

No. 141

 $I 4_1/a 2/m 2/d$ Patterson symmetry  $I 4/m m m$ 

ORIGIN CHOICE 2

Origin at centre ( $2/m$ ) at  $b(2/m, 2/n)d$ , at  $0, -\frac{1}{4}, \frac{1}{4}$  from  $\bar{4}m 2$ Asymmetric unit  $0 \leq x \leq \frac{1}{2}; -\frac{1}{4} \leq y \leq \frac{1}{4}; 0 \leq z \leq \frac{1}{2}$ 

## Symmetry operations

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

- |   |  |   |   |
|---|--|---|---|
| (1) 1   | (2) $2(0,0,\frac{1}{2}) \frac{1}{2}, 0, z$ | (3) $4^+(0,0,\frac{1}{2}) -\frac{1}{4}, \frac{1}{4}, z$                               | (4) $4^-(0,0,\frac{1}{2}) \frac{1}{4}, 0, z$                    |
| (5) $2 \frac{1}{2}, y, \frac{1}{2}$           | (6) $2 x, 0, 0$                            | (7) $2(\frac{1}{2}, \frac{1}{2}, 0) x, x+\frac{1}{2}, \frac{1}{2}$                    | (8) $2 x, \bar{x}+\frac{1}{2}, \frac{1}{2}$                     |
| (9) $\bar{1} 0, 0, 0$                         | (10) $a x, y, \frac{1}{2}$                 | (11) $\bar{4}^+ \frac{1}{2}, -\frac{1}{4}, z; \frac{1}{2}, -\frac{1}{4}, \frac{1}{2}$ | (12) $\bar{4}^- 0, \frac{1}{4}, z; 0, \frac{1}{4}, \frac{1}{2}$ |
| (13) $n(\frac{1}{2}, 0, \frac{1}{2}) x, 0, z$ | (14) $m 0, y, z$                           | (15) $d(\frac{1}{2}, -\frac{1}{4}, \frac{1}{2}) x+\frac{1}{2}, \bar{x}, z$            | (16) $d(\frac{1}{2}, \frac{1}{4}, \frac{1}{2}) x, x, z$         |

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

- |   |   |   |   |
|---|---|---|---|
| (1) $i(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$      | (2) $2 0, \frac{1}{2}, z$                               | (3) $4^+(0,0,\frac{1}{2}) \frac{1}{4}, \frac{1}{4}, z$                              | (4) $4^-(0,0,\frac{1}{2}) \frac{1}{4}, 0, z$                    |
| (5) $2(0, \frac{1}{2}, 0) 0, y, 0$                  | (6) $2(\frac{1}{2}, 0, 0) x, \frac{1}{2}, \frac{1}{2}$  | (7) $2(\frac{1}{2}, \frac{1}{2}, 0) x, x-\frac{1}{2}, \frac{1}{2}$                  | (8) $2 x, \bar{x}+\frac{1}{2}, \frac{1}{2}$                     |
| (9) $\bar{1} \frac{1}{2}, \frac{1}{2}, \frac{1}{2}$ | (10) $b x, y, 0$  | (11) $\bar{4}^+ \frac{1}{2}, \frac{1}{4}, z; \frac{1}{2}, \frac{1}{4}, \frac{1}{2}$ | (12) $\bar{4}^- 0, \frac{1}{4}, z; 0, \frac{1}{4}, \frac{1}{2}$ |
| (13) $m x, \frac{1}{2}, z$                          | (14) $n(0, \frac{1}{2}, \frac{1}{2}) \frac{1}{2}, y, z$ | (15) $d(-\frac{1}{2}, \frac{1}{4}, \frac{1}{2}) x+\frac{1}{2}, \bar{x}, z$          | (16) $d(\frac{1}{2}, \frac{1}{4}, \frac{1}{2}) x, x, z$         |

**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ;  $t(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ ; (2); (3); (5); (9)

**Positions**

Multiplicity,  
Wyckoff letter,  
Site symmetry

**Coordinates**

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

**Reflection conditions**

General:

32	<i>i</i>	1	(1) $x, y, z$	(2) $\bar{x}+\frac{1}{2}, \bar{y}, z+\frac{1}{2}$	(3) $\bar{y}+\frac{1}{2}, x+\frac{1}{2}, z+\frac{1}{2}$	(4) $y+\frac{1}{2}, \bar{x}+\frac{1}{2}, z+\frac{1}{2}$	$hkl : h+k+l=2n$
			(5) $\bar{x}+\frac{1}{2}, y, \bar{z}+\frac{1}{2}$	(6) $x, \bar{y}, \bar{z}$	(7) $y+\frac{1}{2}, x+\frac{1}{2}, \bar{z}+\frac{1}{2}$	(8) $\bar{y}+\frac{1}{2}, \bar{x}+\frac{1}{2}, \bar{z}+\frac{1}{2}$	$hk0 : h, k=2n$
			(9) $\bar{x}, \bar{y}, \bar{z}$	(10) $x+\frac{1}{2}, y, \bar{z}+\frac{1}{2}$	(11) $y+\frac{1}{2}, \bar{x}+\frac{1}{2}, \bar{z}+\frac{1}{2}$	(12) $\bar{y}+\frac{1}{2}, x+\frac{1}{2}, \bar{z}+\frac{1}{2}$	$0kl : k+l=2n$
			(13) $x+\frac{1}{2}, \bar{y}, z+\frac{1}{2}$	(14) $\bar{x}, y, z$	(15) $\bar{y}+\frac{1}{2}, \bar{x}+\frac{1}{2}, z+\frac{1}{2}$	(16) $y+\frac{1}{2}, x+\frac{1}{2}, z+\frac{1}{2}$	$hhl : 2h+l=4n$
							$00l : l=4n$
							$h00 : h=2n$
							$h\bar{h}0 : h=2n$

Special: as above, plus

16	<i>h</i>	$m$	$0, y, z$ $\frac{1}{2}, y, \bar{z}+\frac{1}{2}$	$\frac{1}{2}, \bar{y}, z+\frac{1}{2}$ $0, \bar{y}, \bar{z}$	$\bar{y}+\frac{1}{2}, \frac{1}{2}, z+\frac{1}{2}$ $y+\frac{1}{2}, \frac{1}{2}, \bar{z}+\frac{1}{2}$	$y+\frac{1}{2}, \frac{1}{2}, z+\frac{1}{2}$ $\bar{y}+\frac{1}{2}, \frac{1}{2}, \bar{z}+\frac{1}{2}$	no extra conditions
16	<i>g</i>	$..2$	$x, x+\frac{1}{2}, \frac{1}{2}$ $\bar{x}, \bar{x}+\frac{1}{2}, \frac{1}{2}$	$\bar{x}+\frac{1}{2}, \bar{x}+\frac{1}{2}, \frac{1}{2}$ $x+\frac{1}{2}, x+\frac{1}{2}, \frac{1}{2}$	$\bar{x}, x+\frac{1}{2}, \frac{1}{2}$ $x, \bar{x}+\frac{1}{2}, \frac{1}{2}$	$x+\frac{1}{2}, \bar{x}+\frac{1}{2}, \frac{1}{2}$ $\bar{x}+\frac{1}{2}, x+\frac{1}{2}, \frac{1}{2}$	$hkl : l=2n+1$ or $2h+l=4n$
16	<i>f</i>	$.2.$	$x, 0, 0$ $\bar{x}, 0, 0$	$\bar{x}+\frac{1}{2}, 0, \frac{1}{2}$ $x+\frac{1}{2}, 0, \frac{1}{2}$	$\frac{1}{2}, x+\frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, \bar{x}+\frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \bar{x}+\frac{1}{2}, \frac{1}{2}$ $\frac{1}{2}, x+\frac{1}{2}, \frac{1}{2}$	$hkl : l=2n+1$ or $h=2n$
8	<i>e</i>	$2mm$	$0, \frac{1}{2}, z$	$0, \frac{1}{2}, z+\frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \bar{z}+\frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \bar{z}+\frac{1}{2}$	$hkl : l=2n+1$ or $2h+l=4n$
8	<i>d</i>	$.2/m$	$0, 0, \frac{1}{2}$	$\frac{1}{2}, 0, 0$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$hkl : l=2n+1$ or $h, k=2n, h+k+l=4n$
8	<i>c</i>	$.2/m$	$0, 0, 0$	$\frac{1}{2}, 0, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	
4	<i>b</i>	$\bar{4}m2$	$0, \frac{1}{2}, \frac{1}{2}$	$0, \frac{1}{2}, \frac{1}{2}$	$\left\{ \begin{array}{l} \frac{1}{2}, \frac{1}{2}, \frac{1}{2} \\ \frac{1}{2}, \frac{1}{2}, \frac{1}{2} \end{array} \right\}$		$hkl : l=2n+1$ or $2h+l=4n$
4	<i>a</i>	$\bar{4}m2$	$0, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$			

**Symmetry of special projections**

Along [001]  $p4mm$   
 $a'=\frac{1}{2}a$   $b'=\frac{1}{2}b$   
Origin at  $\frac{1}{2}, 0, z$

Along [100]  $c2mm$   
 $a'=b$   $b'=c$   
Origin at  $x, \frac{1}{2}, \frac{1}{2}$

Along [110]  $c2mm$   
 $a'=\frac{1}{2}(-a+b)$   $b'=\frac{1}{2}c$   
Origin at  $x, x+\frac{1}{2}, \frac{1}{2}$

**Maximal non-isomorphic subgroups**

I	[2] $I4_122$	(1; 2; 3; 4; 5; 6; 7; 8)+
	[2] $I4_1/a\ 11(I4_1/a)$	(1; 2; 3; 4; 9; 10; 11; 12)+
	[2] $I4_1m\ d$	(1; 2; 3; 4; 13; 14; 15; 16)+
	[2] $I\bar{4}2d$	(1; 2; 5; 6; 11; 12; 15; 16)+
	[2] $I\bar{4}m\ 2$	(1; 2; 7; 8; 11; 12; 13; 14)+
	[2] $I2/a\ 2/m\ 1(Imma)$	(1; 2; 5; 6; 9; 10; 13; 14)+
	[2] $I2/a\ 12/d(Fddd)$	(1; 2; 7; 8; 9; 10; 15; 16)+

IIa none

IIb none

**Maximal isomorphic subgroups of lowest index**

IIc [3] $I4_1/a\ m\ d(c'=3c)$ ; [9] $I4_1/a\ m\ d(a'=3a, b'=3b)$

**Minimal non-isomorphic supergroups**

I	[3] $Fd\bar{3}m$
II	[2] $C4_2/a\ m\ d(2c'=c)(P4_2/n\ n\ m)$

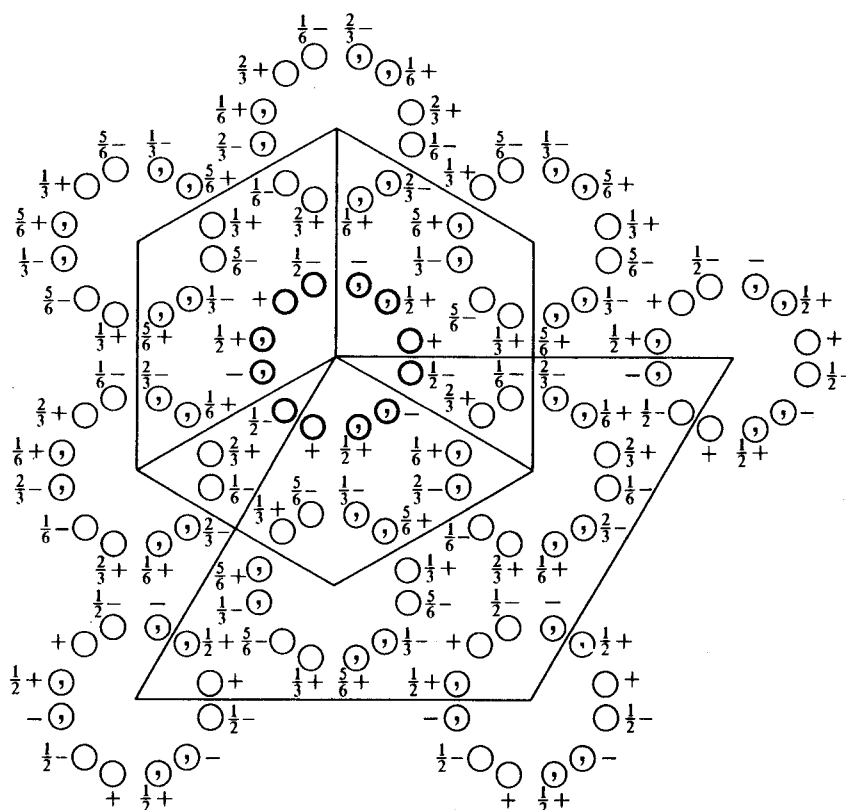
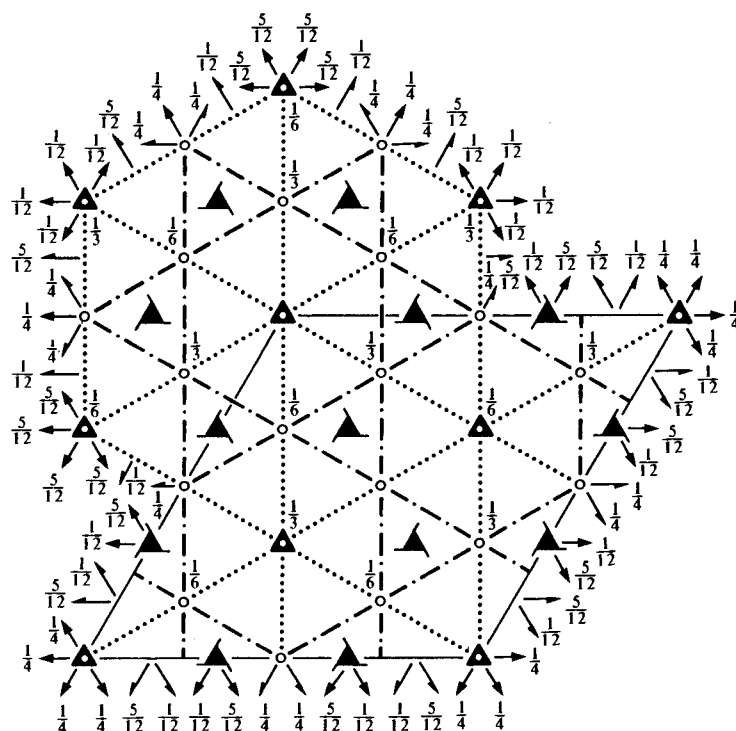
$R \bar{3} c$  $D_{3d}^6$  $\bar{3} m$ 

Trigonal

No. 167

 $R \bar{3} 2/c$ Patterson symmetry  $R \bar{3} m$ 

HEXAGONAL AXES

Origin at centre ( $\bar{3}$ ) at  $\bar{3}c$ Asymmetric unit  $0 \leq x \leq \frac{1}{2}$ ;  $0 \leq y \leq \frac{1}{2}$ ;  $0 \leq z \leq \frac{1}{2}$ ;  $x \leq (1+y)/2$ ;  $y \leq \min(1-x, (1+x)/2)$ 

Vertices  $0,0,0$   $\frac{1}{2},0,0$   $\frac{2}{3},\frac{1}{3},0$   $\frac{1}{3},\frac{2}{3},0$   $0,\frac{1}{2},0$   
 $0,0,\frac{1}{2}$   $\frac{1}{2},0,\frac{1}{2}$   $\frac{2}{3},\frac{1}{3},\frac{1}{2}$   $\frac{1}{3},\frac{2}{3},\frac{1}{2}$   $0,\frac{1}{2},\frac{1}{2}$

**Symmetry operations**

For (0,0,0)+ set

- |                                   |                                   |                                   |
|-----------------------------------|-----------------------------------|-----------------------------------|
| (1) 1                             | (2) $3^+ 0,0,z$                   | (3) $3^- 0,0,z$                   |
| (4) $\frac{2}{3} x,x,\frac{1}{3}$ | (5) $\frac{2}{3} x,0,\frac{1}{3}$ | (6) $\frac{2}{3} 0,y,\frac{1}{3}$ |
| (7) $\bar{1} 0,0,0$               | (8) $\bar{3}^+ 0,0,z; 0,0,0$      | (9) $\bar{3}^- 0,0,z; 0,0,0$      |
| (10) $c x,\bar{x},z$              | (11) $c x,2x,z$                   | (12) $c 2x,x,z$                   |

For  $(\frac{1}{3},\frac{1}{3},\frac{1}{3})$ + set

- |  |  |  |
|--|--|--|
| (1) $t(\frac{1}{3},\frac{1}{3},\frac{1}{3})$                             | (2) $3^+(0,0,\frac{1}{3}) \frac{1}{3},\frac{1}{3},z$                             | (3) $3^-(0,0,\frac{1}{3}) \frac{1}{3},\frac{1}{3},z$                           |
| (4) $\frac{2}{3}(\frac{1}{3},\frac{1}{3},0) x,x-\frac{1}{3},\frac{1}{3}$ | (5) $\frac{2}{3}(\frac{1}{3},0,0) x,\frac{1}{3},\frac{1}{3}$                     | (6) $\frac{2}{3} \frac{1}{3},y,\frac{1}{3}$                                    |
| (7) $\bar{1} \frac{1}{3},\frac{1}{3},\frac{1}{3}$                        | (8) $\bar{3}^+ \frac{1}{3},-\frac{1}{3},z; \frac{1}{3},-\frac{1}{3},\frac{1}{3}$ | (9) $\bar{3}^- \frac{1}{3},\frac{1}{3},z; \frac{1}{3},\frac{1}{3},\frac{1}{3}$ |
| (10) $g(\frac{1}{3},-\frac{1}{3},\frac{1}{3}) x+\frac{1}{3},\bar{x},z$   | (11) $g(\frac{1}{3},\frac{1}{3},\frac{1}{3}) x,2x-\frac{1}{3},z$                 | (12) $g(\frac{1}{3},\frac{1}{3},\frac{1}{3}) 2x,x,z$                           |

For  $(\frac{1}{3},\frac{2}{3},\frac{1}{3})$ + set

- |  |  |  |
|--|--|--|
| (1) $t(\frac{1}{3},\frac{2}{3},\frac{1}{3})$                             | (2) $3^+(0,0,\frac{1}{3}) 0,\frac{1}{3},z$                                     | (3) $3^-(0,0,\frac{1}{3}) \frac{1}{3},\frac{1}{3},z$                             |
| (4) $\frac{2}{3}(\frac{1}{3},\frac{2}{3},0) x,x+\frac{1}{3},\frac{1}{3}$ | (5) $\frac{2}{3} x,\frac{1}{3},\frac{1}{3}$                                    | (6) $\frac{2}{3}(0,\frac{1}{3},0) \frac{1}{3},y,\frac{1}{3}$                     |
| (7) $\bar{1} \frac{1}{3},\frac{2}{3},\frac{1}{3}$                        | (8) $\bar{3}^+ \frac{1}{3},\frac{1}{3},z; \frac{2}{3},\frac{1}{3},\frac{1}{3}$ | (9) $\bar{3}^- -\frac{1}{3},\frac{1}{3},z; -\frac{1}{3},\frac{1}{3},\frac{1}{3}$ |
| (10) $g(-\frac{1}{3},\frac{1}{3},\frac{1}{3}) x+\frac{1}{3},\bar{x},z$   | (11) $g(\frac{1}{3},\frac{2}{3},\frac{1}{3}) x,2x,z$                           | (12) $g(\frac{1}{3},\frac{1}{3},\frac{1}{3}) 2x-\frac{1}{3},x,z$                 |

**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ;  $t(\frac{1}{3},\frac{1}{3},\frac{1}{3})$ ; (2); (4); (7)**Positions**Multiplicity,  
Wyckoff letter,  
Site symmetry

Coordinates

Reflection conditions

Wykonal. klatki, Site symmetry		(0,0,0)+	$(\frac{1}{3},\frac{1}{3},\frac{1}{3})$ +	$(\frac{1}{3},\frac{2}{3},\frac{1}{3})$ +
36	$f$ 1	(1) $x,y,z$ (4) $y,x,\bar{z}+\frac{1}{2}$ (7) $\bar{x},\bar{y},\bar{z}$ (10) $\bar{y},\bar{x},z+\frac{1}{2}$	(2) $\bar{y},x-y,z$ (5) $x-y,\bar{y},\bar{z}+\frac{1}{2}$ (8) $y,\bar{x}+y,\bar{z}$ (11) $\bar{x}+y,y,z+\frac{1}{2}$	(3) $\bar{x}+y,\bar{x},z$ (6) $\bar{x},\bar{x}+y,\bar{z}+\frac{1}{2}$ (9) $x-y,x,\bar{z}$ (12) $x,x-y,z+\frac{1}{2}$

General:

$hkil : -h+k+l = 3n$   
 $hki0 : -h+k = 3n$   
 $hh2hl : l = 3n$   
 $h\bar{h}0l : h+l = 3n, l = 2n$   
 $000l : l = 6n$   
 $h\bar{h}00 : h = 3n$

Special: as above, plus

no extra conditions

18	$e$	.2	$x,0,\frac{1}{3}$	$0,x,\frac{1}{3}$	$\bar{x},\bar{x},\frac{1}{3}$	$\bar{x},0,\frac{1}{3}$	$0,\bar{x},\frac{1}{3}$	$x,x,\frac{1}{3}$
18	$d$	$\bar{1}$	$\frac{1}{3},0,0$	$0,\frac{1}{3},0$	$\frac{1}{3},\frac{1}{3},0$	$0,\frac{1}{3},\frac{1}{3}$	$\frac{1}{3},0,\frac{1}{3}$	$\frac{1}{3},\frac{1}{3},\frac{1}{3}$
12	$c$	3.	$0,0,z$	$0,0,\bar{z}+\frac{1}{3}$	$0,0,\bar{z}$	$0,0,z+\frac{1}{3}$		
6	$b$	$\bar{3}$ .	$0,0,0$	$0,0,\frac{1}{3}$				
6	$a$	32	$0,0,\frac{1}{3}$	$0,0,\frac{1}{3}$				

 $hkil : l = 2n$  $hkil : l = 2n$  $hkil : l = 2n$  $hkil : l = 2n$ **Symmetry of special projections**Along [001]  $p6mm$  $a' = \frac{1}{3}(2a+b)$   $b' = \frac{1}{3}(-a+b)$ 

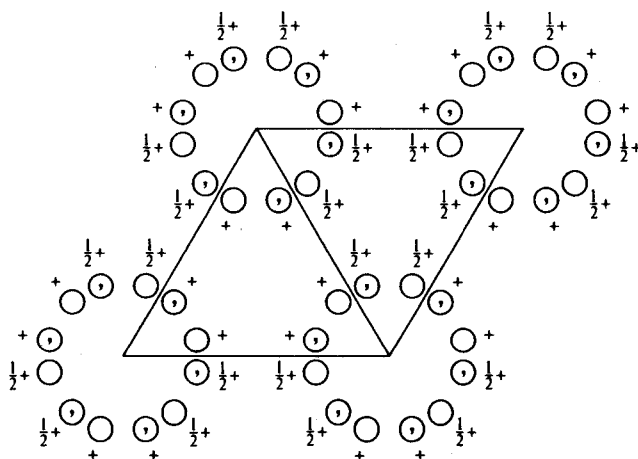
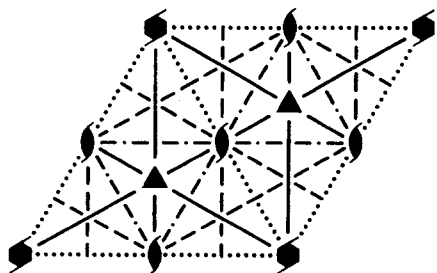
Origin at 0,0,z

Along [100]  $p2$  $a' = \frac{1}{3}(2a+4b+c)$   $b' = \frac{1}{3}(-a-2b+c)$ Origin at  $x,0,0$ Along [210]  $p2gm$  $a' = \frac{1}{3}b$   $b' = \frac{1}{3}c$ Origin at  $x,\frac{1}{3}x,0$

$P 6_3 m c$  $C_{6v}^4$  $6 m m$ 

Hexagonal

No. 186

 $P 6_3 m c$ Patterson symmetry  $P 6/m m m$ Origin on  $3 m 1$  on  $6_3 m c$ Asymmetric unit  $0 \leq x \leq \frac{1}{2}; 0 \leq y \leq \frac{1}{2}; 0 \leq z \leq 1; x \leq (1+y)/2; y \leq x/2$ 

Vertices  $0,0,0 \quad \frac{1}{2},0,0 \quad \frac{2}{3},\frac{1}{3},0$   
 $0,0,1 \quad \frac{1}{2},0,1 \quad \frac{2}{3},\frac{1}{3},1$

Symmetry operations

- |                                |                                  |                                  |
|--------------------------------|----------------------------------|----------------------------------|
| (1) 1                          | (2) $3^+ 0,0,z$                  | (3) $3^- 0,0,z$                  |
| (4) $2(0,0,\frac{1}{2}) 0,0,z$ | (5) $6^-(0,0,\frac{1}{2}) 0,0,z$ | (6) $6^+(0,0,\frac{1}{2}) 0,0,z$ |
| (7) $m x,\bar{x},z$            | (8) $m x,2x,z$                   | (9) $m 2x,x,z$                   |
| (10) $c x,x,z$                 | (11) $c x,0,z$                   | (12) $c 0,y,z$                   |



**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ; (2); (4); (7)

### Positions

Multiplicity,  
Wyckoff letter,  
Site symmetry

Coordinates

Reflection conditions

12	$d$	1	(1) $x, y, z$	(2) $\bar{y}, x-y, z$	(3) $\bar{x}+y, \bar{x}, z$
			(4) $\bar{x}, \bar{y}, z+\frac{1}{2}$	(5) $y, \bar{x}+y, z+\frac{1}{2}$	(6) $x-y, x, z+\frac{1}{2}$
			(7) $\bar{y}, \bar{x}, z$	(8) $\bar{x}+y, y, z$	(9) $x, x-y, z$
			(10) $y, x, z+\frac{1}{2}$	(11) $x-y, \bar{y}, z+\frac{1}{2}$	(12) $\bar{x}, \bar{x}+y, z+\frac{1}{2}$

General:

$$hh\bar{2}hl: l = 2n$$

$$000l: l = 2n$$

Special: as above, plus

6  $c$   $.m.$   $x, \bar{x}, z$   $x, 2x, z$   $2\bar{x}, \bar{x}, z$   $\bar{x}, x, z+\frac{1}{2}$   $\bar{x}, 2\bar{x}, z+\frac{1}{2}$   $2x, x, z+\frac{1}{2}$

no extra conditions

2  $b$   $3m.$   $\frac{1}{2}, \frac{1}{2}, z$   $\frac{3}{2}, \frac{1}{2}, z+\frac{1}{2}$

$$hkil: l = 2n$$

$$\text{or } h-k = 3n+1$$

$$\text{or } h-k = 3n+2$$

2  $a$   $3m.$   $0, 0, z$   $0, 0, z+\frac{1}{2}$

$$hkil: l = 2n$$

### Symmetry of special projections

Along [001]  $p 6m m$

$$a' = a \quad b' = b$$

Origin at  $0, 0, z$

Along [100]  $p 1g 1$

$$a' = \frac{1}{2}(a+2b) \quad b' = c$$

Origin at  $x, 0, 0$

Along [210]  $p 1m 1$

$$a' = \frac{1}{2}b \quad b' = \frac{1}{2}c$$

Origin at  $x, \frac{1}{2}x, 0$

### Maximal non-isomorphic subgroups

I	[2] $P 6_3 1 1 (P 6_3)$	1; 2; 3; 4; 5; 6
	[2] $P 3m 1$	1; 2; 3; 7; 8; 9
	[2] $P 3 1 c$	1; 2; 3; 10; 11; 12
	[3] $P 2_1 m c (C m c 2_1)$	1; 4; 7; 10
	[3] $P 2_1 m c (C m c 2_1)$	1; 4; 8; 11
	[3] $P 2_1 m c (C m c 2_1)$	1; 4; 9; 12

IIa none

IIb [3] $H 6_3 m c (a' = 3a, b' = 3b) (P 6_3 c m)$

### Maximal isomorphic subgroups of lowest index

IIc [3] $P 6_3 m c (c' = 3c)$ ; [4] $P 6_3 m c (a' = 2a, b' = 2b)$

### Minimal non-isomorphic supergroups

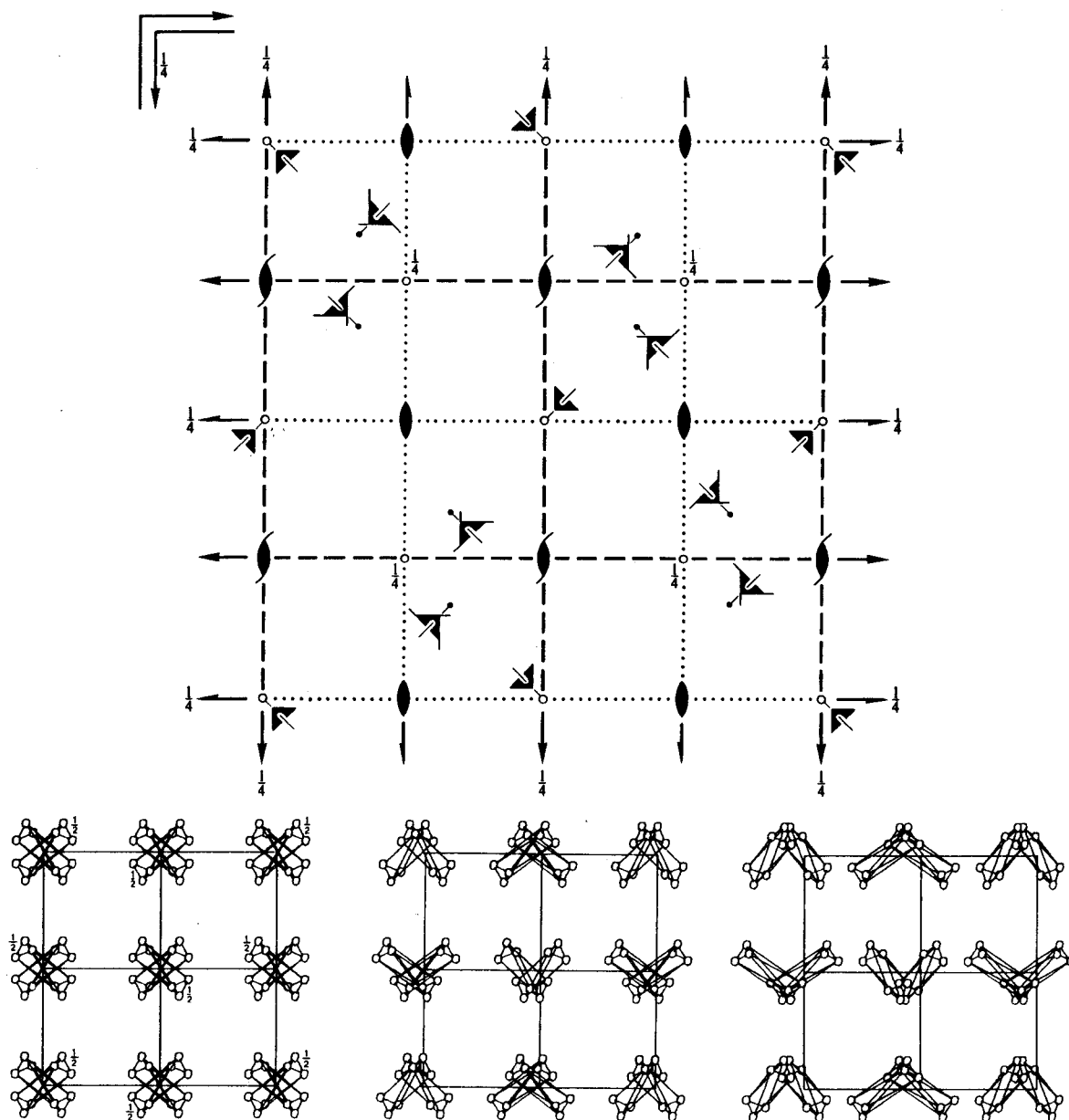
I [2] $P 6_3 / m m c$

II [3] $H 6_3 m c (P 6_3 c m)$ ; [2] $P 6m m (2c' = c)$

$Ia\bar{3}$  $T_h^7$  $m\bar{3}$ 

Cubic

No. 206

 $I2_1/a\bar{3}$ Patterson symmetry  $Im\bar{3}$ Origin at centre ( $\bar{3}$ )Asymmetric unit  $0 \leq x \leq \frac{1}{2}; 0 \leq y \leq \frac{1}{2}; 0 \leq z \leq \frac{1}{2}; z \leq \min(x, \frac{1}{2}-x, y, \frac{1}{2}-y)$ Vertices  $0,0,0 \quad \frac{1}{2},0,0 \quad \frac{1}{2},\frac{1}{2},0 \quad 0,\frac{1}{2},0 \quad \frac{1}{2},\frac{1}{2},\frac{1}{2}$ 

Symmetry operations

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

- |                                     |  |   |   |
|-------------------------------------|--|---|---|
| (1) 1                               | (2) $2(0,0,\frac{1}{2}) \quad \frac{1}{2},0,z$   | (3) $2(0,\frac{1}{2},0) \quad 0,y,\frac{1}{2}$  | (4) $2(\frac{1}{2},0,0) \quad x,\frac{1}{2},0$  |
| (5) $3^+ \quad x,x,x$               | (6) $3^+ \quad \bar{x}+\frac{1}{2},x,\bar{x}$  | (7) $3^+ \quad x+\frac{1}{2},\bar{x}-\frac{1}{2},\bar{x}$   | (8) $3^+ \quad \bar{x},\bar{x}+\frac{1}{2},x$   |
| (9) $3^- \quad x,x,x$               | (10) $3^-(-\frac{1}{2},\frac{1}{2},\frac{1}{2}) \quad x+\frac{1}{2},\bar{x}+\frac{1}{2},\bar{x}$ | (11) $3^-(-\frac{1}{2},\frac{1}{2},-\frac{1}{2}) \quad \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$ | (12) $3^-(-\frac{1}{2},-\frac{1}{2},\frac{1}{2}) \quad \bar{x}-\frac{1}{2},x+\frac{1}{2},\bar{x}$ |
| (13) $\bar{1} \quad 0,0,0$          | (14) $a \quad x,y,\frac{1}{2}$   | (15) $c \quad x,\frac{1}{2},z$  | (16) $b \quad \frac{1}{2},y,z$  |
| (17) $\bar{3}^+ \quad x,x,x; 0,0,0$ | (18) $\bar{3}^+ \quad \bar{x}-\frac{1}{2},x+1,\bar{x}; 0,\frac{1}{2},\frac{1}{2}$                | (19) $\bar{3}^+ \quad x+\frac{1}{2},\bar{x}+\frac{1}{2},\bar{x}; \frac{1}{2},\frac{1}{2},0$       | (20) $\bar{3}^+ \quad \bar{x}+1,\bar{x}+\frac{1}{2},x; \frac{1}{2},0,\frac{1}{2}$                 |
| (21) $\bar{3}^- \quad x,x,x; 0,0,0$ | (22) $\bar{3}^- \quad x+\frac{1}{2},\bar{x}-\frac{1}{2},\bar{x}; 0,0,\frac{1}{2}$                | (23) $\bar{3}^- \quad \bar{x},\bar{x}+\frac{1}{2},x; 0,\frac{1}{2},0$                             | (24) $\bar{3}^- \quad \bar{x}+\frac{1}{2},x,\bar{x}; \frac{1}{2},0,0$                             |

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

- |   |  |   |   |
|---|--|---|---|
| (1) $i(\frac{1}{2},\frac{1}{2},\frac{1}{2})$                      | (2) $2 \quad 0,\frac{1}{2},z$  | (3) $2 \quad \frac{1}{2},y,0$   | (4) $2 \quad x,0,\frac{1}{2}$   |
| (5) $3^+(\frac{1}{2},\frac{1}{2},\frac{1}{2}) \quad x,x,x$        | (6) $3^+(\frac{1}{2},-\frac{1}{2},\frac{1}{2}) \quad \bar{x}-\frac{1}{2},x+\frac{1}{2},\bar{x}$        | (7) $3^+(-\frac{1}{2},\frac{1}{2},\frac{1}{2}) \quad x+\frac{1}{2},\bar{x}+\frac{1}{2},\bar{x}$         | (8) $3^+(\frac{1}{2},\frac{1}{2},-\frac{1}{2}) \quad \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$   |
| (9) $3^-(\frac{1}{2},\frac{1}{2},\frac{1}{2}) \quad x,x,x$        | (10) $3^-(\frac{1}{2},-\frac{1}{2},-\frac{1}{2}) \quad x+\frac{1}{2},\bar{x}+\frac{1}{2},\bar{x}$      | (11) $3^-(-\frac{1}{2},-\frac{1}{2},\frac{1}{2}) \quad \bar{x}+\frac{1}{2},\bar{x}+\frac{1}{2},x$       | (12) $3^-(-\frac{1}{2},\frac{1}{2},-\frac{1}{2}) \quad \bar{x}-\frac{1}{2},x+\frac{1}{2},\bar{x}$ |
| (13) $\bar{1} \quad \frac{1}{2},\frac{1}{2},\frac{1}{2}$          | (14) $b \quad x,y,0$   | (15) $a \quad x,0,z$  | (16) $c \quad 0,y,z$  |
| (17) $\bar{3}^+ \quad x,x,x; \frac{1}{2},\frac{1}{2},\frac{1}{2}$ | (18) $\bar{3}^+ \quad \bar{x}-\frac{1}{2},x,\bar{x}; -\frac{1}{2},-\frac{1}{2},\frac{1}{2}$            | (19) $\bar{3}^+ \quad x-\frac{1}{2},\bar{x}+\frac{1}{2},\bar{x}; -\frac{1}{2},\frac{1}{2},-\frac{1}{2}$ | (20) $\bar{3}^+ \quad \bar{x},\bar{x}-\frac{1}{2},x; \frac{1}{2},-\frac{1}{2},-\frac{1}{2}$       |
| (21) $\bar{3}^- \quad x,x,x; \frac{1}{2},\frac{1}{2},\frac{1}{2}$ | (22) $\bar{3}^- \quad x+\frac{1}{2},\bar{x}-\frac{1}{2},\bar{x}; \frac{1}{2},-\frac{1}{2},\frac{1}{2}$ | (23) $\bar{3}^- \quad \bar{x},\bar{x}+\frac{1}{2},x; -\frac{1}{2},\frac{1}{2},\frac{1}{2}$              | (24) $\bar{3}^- \quad \bar{x}+\frac{1}{2},x,\bar{x}; \frac{1}{2},\frac{1}{2},-\frac{1}{2}$        |

**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ;  $t(\frac{1}{2},\frac{1}{2},\frac{1}{2})$ ; (2); (3); (5); (13)

**Positions**

Multiplicity,  
Wyckoff letter,  
Site symmetry

**Coordinates**

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

**Reflection conditions**

$h,k,l$  cyclically permutable

General:

48	<i>e</i>	1	(1) $x,y,z$	(2) $\bar{x}+\frac{1}{2},\bar{y},z+\frac{1}{2}$	(3) $\bar{x},y+\frac{1}{2},\bar{z}+\frac{1}{2}$	(4) $x+\frac{1}{2},\bar{y}+\frac{1}{2},\bar{z}$
			(5) $z,x,y$	(6) $z+\frac{1}{2},\bar{x}+\frac{1}{2},\bar{y}$	(7) $\bar{z}+\frac{1}{2},\bar{x},y+\frac{1}{2}$	(8) $\bar{z},x+\frac{1}{2},\bar{y}+\frac{1}{2}$
			(9) $y,z,x$	(10) $\bar{y},z+\frac{1}{2},\bar{x}+\frac{1}{2}$	(11) $y+\frac{1}{2},\bar{z}+\frac{1}{2},\bar{x}$	(12) $\bar{y}+\frac{1}{2},\bar{z},x+\frac{1}{2}$
			(13) $\bar{x},\bar{y},\bar{z}$	(14) $x+\frac{1}{2},y,\bar{z}+\frac{1}{2}$	(15) $x,\bar{y}+\frac{1}{2},z+\frac{1}{2}$	(16) $\bar{x}+\frac{1}{2},y+\frac{1}{2},z$
			(17) $\bar{z},\bar{x},\bar{y}$	(18) $\bar{z}+\frac{1}{2},x+\frac{1}{2},y$	(19) $z+\frac{1}{2},x,\bar{y}+\frac{1}{2}$	(20) $z,\bar{x}+\frac{1}{2},y+\frac{1}{2}$
			(21) $\bar{y},\bar{z},\bar{x}$	(22) $y,\bar{z}+\frac{1}{2},x+\frac{1}{2}$	(23) $\bar{y}+\frac{1}{2},z+\frac{1}{2},x$	(24) $y+\frac{1}{2},z,\bar{x}+\frac{1}{2}$

$hkl : h+k+l=2n$

$0kl : k,l=2n$

$hhl : l=2n$

$h00 : h=2n$

Special: as above, plus

24	<i>d</i>	2..	$x,0,\frac{1}{2}$	$\bar{x}+\frac{1}{2},0,\frac{1}{2}$	$\frac{1}{2},x,0$	$\frac{1}{2},\bar{x}+\frac{1}{2},0$	$0,\frac{1}{2},x$	$0,\frac{1}{2},\bar{x}+\frac{1}{2}$
			$\bar{x},0,\frac{1}{2}$	$x+\frac{1}{2},0,\frac{1}{2}$	$\frac{1}{2},\bar{x},0$	$\frac{1}{2},x+\frac{1}{2},0$	$0,\frac{1}{2},\bar{x}$	$0,\frac{1}{2},x+\frac{1}{2}$

no extra conditions

16	<i>c</i>	.3.	$x,x,x$	$\bar{x}+\frac{1}{2},\bar{x},x+\frac{1}{2}$	$\bar{x},x+\frac{1}{2},\bar{x}+\frac{1}{2}$	$x+\frac{1}{2},\bar{x}+\frac{1}{2},\bar{x}$
			$\bar{x},\bar{x},\bar{x}$	$x+\frac{1}{2},x,\bar{x}+\frac{1}{2}$	$x,\bar{x}+\frac{1}{2},x+\frac{1}{2}$	$\bar{x}+\frac{1}{2},x+\frac{1}{2},x$

no extra conditions

8	<i>b</i>	. $\bar{3}$ .	$\frac{1}{2},\frac{1}{2},\frac{1}{2}$	$\frac{1}{2},\frac{1}{2},\frac{1}{2}$	$\frac{1}{2},\frac{1}{2},\frac{1}{2}$	$\frac{1}{2},\frac{1}{2},\frac{1}{2}$
---	----------	---------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------

$hkl : k,l=2n$

8	<i>a</i>	. $\bar{3}$ .	$0,0,0$	$\frac{1}{2},0,\frac{1}{2}$	$0,\frac{1}{2},\frac{1}{2}$	$\frac{1}{2},\frac{1}{2},0$
---	----------	---------------	---------	-----------------------------	-----------------------------	-----------------------------

$hkl : k,l=2n$

**Symmetry of special projections**

Along [001]  $p2mm$

$a'=\frac{1}{2}a$   $b'=\frac{1}{2}b$

Origin at  $0,0,z$

Along [111]  $p\bar{6}$

$a'=\frac{1}{3}(2a-b-c)$   $b'=\frac{1}{3}(-a+2b-c)$

Origin at  $x,x,x$

Along [110]  $p2mg$

$a'=\frac{1}{2}(-a+b)$   $b'=\frac{1}{2}c$

Origin at  $x,x,0$

**Maximal non-isomorphic subgroups**

I [3]Ia1 (*Ibca*) (1; 2; 3; 4; 13; 14; 15; 16)+

[4]I1 $\bar{3}$  (*R $\bar{3}$* ) (1; 5; 9; 13; 17; 21)+

[4]I1 $\bar{3}$  (*R $\bar{3}$* ) (1; 6; 12; 13; 18; 24)+

[4]I1 $\bar{3}$  (*R $\bar{3}$* ) (1; 7; 10; 13; 19; 22)+

[4]I1 $\bar{3}$  (*R $\bar{3}$* ) (1; 8; 11; 13; 20; 23)+

[2]I2 $\bar{1}3$  (1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12)+

IIa [2]Pa $\bar{3}$  1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24

[2]Pa $\bar{3}$  1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; (13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24)+ $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$

IIb none

**Maximal isomorphic subgroups of lowest index**

IIc [27]Ia $\bar{3}$  ( $a'=3a, b'=3b, c'=3c$ )

**Minimal non-isomorphic supergroups**

I [2]Ia $\bar{3}d$

II [4]Pm $\bar{3}$  ( $2a'=a, 2b'=b, 2c'=c$ )