

$F4_132$

O^4

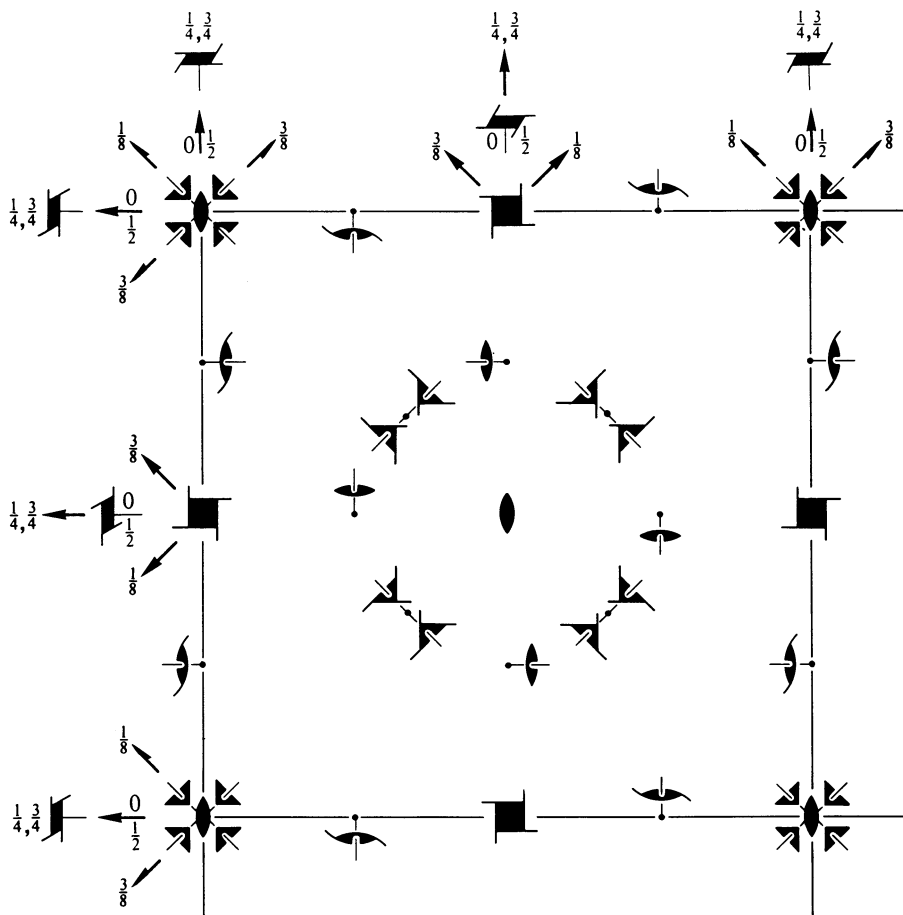
432

Cubic

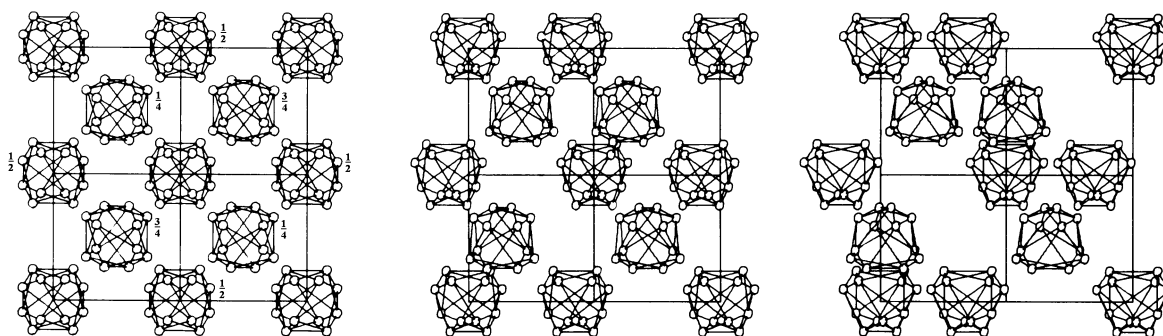
No. 210

$F4_132$

Patterson symmetry $Fm\bar{3}m$



Upper left quadrant only



Origin at 23

Asymmetric unit $0 \leq x \leq \frac{1}{2}; -\frac{1}{8} \leq y \leq \frac{1}{8}; -\frac{1}{8} \leq z \leq \frac{1}{8}; y \leq \min(x, \frac{1}{2} - x); -y \leq z \leq \min(x, \frac{1}{2} - x)$

Vertices
 $0, 0, 0$ $\frac{1}{8}, \frac{1}{8}, \frac{1}{8}$ $\frac{1}{8}, \frac{1}{8}, -\frac{1}{8}$ $\frac{1}{8}, -\frac{1}{8}, \frac{1}{8}$
 $\frac{1}{2}, 0, 0$ $\frac{3}{8}, \frac{1}{8}, \frac{1}{8}$ $\frac{3}{8}, \frac{1}{8}, -\frac{1}{8}$ $\frac{3}{8}, -\frac{1}{8}, \frac{1}{8}$

Symmetry operations

For (0,0,0)+ set

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

Symmetry operations (continued)

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

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

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

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

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

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

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

Positions

Multiplicity, Wyckoff letter, Site symmetry	(0, 0, 0) ⁺	(0, $\frac{1}{2}$, $\frac{1}{2}$) ⁺	($\frac{1}{2}$, 0, $\frac{1}{2}$) ⁺	($\frac{1}{2}$, $\frac{1}{2}$, 0) ⁺	Reflection conditions
					h, k, l permutable
					General:

96	$h\ 1$	(1) x, y, z	(2) $\bar{x}, \bar{y} + \frac{1}{2}, z + \frac{1}{2}$	(3) $\bar{x} + \frac{1}{2}, y + \frac{1}{2}, \bar{z}$	(4) $x + \frac{1}{2}, \bar{y}, \bar{z} + \frac{1}{2}$	$hkl : h + k = 2n$ and $h + l, k + l = 2n$
		(5) z, x, y	(6) $z + \frac{1}{2}, \bar{x}, \bar{y} + \frac{1}{2}$	(7) $\bar{z}, \bar{x} + \frac{1}{2}, y + \frac{1}{2}$	(8) $\bar{z} + \frac{1}{2}, x + \frac{1}{2}, \bar{y}$	$0kl : k, l = 2n$
		(9) y, z, x	(10) $\bar{y} + \frac{1}{2}, z + \frac{1}{2}, \bar{x}$	(11) $y + \frac{1}{2}, \bar{z}, \bar{x} + \frac{1}{2}$	(12) $\bar{y}, \bar{z} + \frac{1}{2}, x + \frac{1}{2}$	$hhl : h + l = 2n$
		(13) $y + \frac{3}{4}, x + \frac{1}{4}, \bar{z} + \frac{3}{4}$	(14) $\bar{y} + \frac{1}{4}, \bar{x} + \frac{1}{4}, \bar{z} + \frac{1}{4}$	(15) $y + \frac{1}{4}, \bar{x} + \frac{3}{4}, z + \frac{3}{4}$	(16) $\bar{y} + \frac{3}{4}, x + \frac{3}{4}, z + \frac{1}{4}$	$h00 : h = 4n$
		(17) $x + \frac{3}{4}, z + \frac{1}{4}, \bar{y} + \frac{3}{4}$	(18) $\bar{x} + \frac{3}{4}, z + \frac{3}{4}, y + \frac{1}{4}$	(19) $\bar{x} + \frac{1}{4}, \bar{z} + \frac{1}{4}, \bar{y} + \frac{1}{4}$	(20) $x + \frac{1}{4}, \bar{z} + \frac{3}{4}, y + \frac{3}{4}$	
		(21) $z + \frac{3}{4}, y + \frac{1}{4}, \bar{x} + \frac{3}{4}$	(22) $z + \frac{1}{4}, \bar{y} + \frac{3}{4}, x + \frac{3}{4}$	(23) $\bar{z} + \frac{3}{4}, y + \frac{3}{4}, x + \frac{1}{4}$	(24) $\bar{z} + \frac{1}{4}, \bar{y} + \frac{1}{4}, \bar{x} + \frac{1}{4}$	

Special: as above, plus

48	$g\ \dots 2$	$\frac{1}{8}, y, \bar{y} + \frac{1}{4}$	$\frac{7}{8}, \bar{y} + \frac{1}{2}, \bar{y} + \frac{3}{4}$	$\frac{3}{8}, y + \frac{1}{2}, y + \frac{3}{4}$	$\frac{5}{8}, \bar{y}, y + \frac{1}{4}$	no extra conditions
		$\bar{y} + \frac{1}{4}, \frac{1}{8}, y$	$\bar{y} + \frac{3}{4}, \frac{7}{8}, \bar{y} + \frac{1}{2}$	$y + \frac{3}{4}, \frac{3}{8}, y + \frac{1}{2}$	$y + \frac{1}{4}, \frac{5}{8}, \bar{y}$	
		$y, \bar{y} + \frac{1}{4}, \frac{1}{8}$	$\bar{y} + \frac{1}{2}, \bar{y} + \frac{3}{4}, \frac{7}{8}$	$y + \frac{1}{2}, y + \frac{3}{4}, \frac{3}{8}$	$\bar{y}, y + \frac{1}{4}, \frac{5}{8}$	

48	$f\ 2..$	$x, 0, 0$	$\bar{x}, \frac{1}{2}, \frac{1}{2}$	$0, x, 0$	$\frac{1}{2}, \bar{x}, \frac{1}{2}$	$0, 0, x$	$\frac{1}{2}, \frac{1}{2}, \bar{x}$	$hkl : h = 2n + 1$ or $h + k + l = 4n$
		$\frac{3}{4}, x + \frac{1}{4}, \frac{3}{4}$	$\frac{1}{4}, \bar{x} + \frac{1}{4}, \frac{1}{4}$	$x + \frac{3}{4}, \frac{1}{4}, \frac{3}{4}$	$\bar{x} + \frac{3}{4}, \frac{3}{4}, \frac{1}{4}$	$\frac{3}{4}, \frac{1}{4}, \bar{x} + \frac{3}{4}$	$\frac{1}{4}, \frac{3}{4}, x + \frac{3}{4}$	

32	$e\ .3.$	x, x, x	$\bar{x}, \bar{x} + \frac{1}{2}, x + \frac{1}{2}$	$\bar{x} + \frac{1}{2}, x + \frac{1}{2}, \bar{x}$	$x + \frac{1}{2}, \bar{x}, \bar{x} + \frac{1}{2}$	$0kl : k + l = 4n$
		$x + \frac{3}{4}, x + \frac{1}{4}, \bar{x} + \frac{3}{4}$	$\bar{x} + \frac{1}{4}, \bar{x} + \frac{1}{4}, \bar{x} + \frac{1}{4}$	$x + \frac{1}{4}, \bar{x} + \frac{3}{4}, x + \frac{3}{4}$	$\bar{x} + \frac{3}{4}, x + \frac{3}{4}, x + \frac{1}{4}$	

16	$d\ .32$	$\frac{5}{8}, \frac{5}{8}, \frac{5}{8}$	$\frac{3}{8}, \frac{7}{8}, \frac{1}{8}$	$\frac{7}{8}, \frac{1}{8}, \frac{3}{8}$	$\frac{1}{8}, \frac{3}{8}, \frac{7}{8}$	} $hkl : h = 2n + 1$ or $h, k, l = 4n + 2$ or $h, k, l = 4n$
16	$c\ .32$	$\frac{1}{8}, \frac{1}{8}, \frac{1}{8}$	$\frac{7}{8}, \frac{3}{8}, \frac{5}{8}$	$\frac{3}{8}, \frac{5}{8}, \frac{7}{8}$	$\frac{5}{8}, \frac{7}{8}, \frac{3}{8}$	

8	$b\ 23.$	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{4}, \frac{3}{4}, \frac{1}{4}$	} $hkl : h = 2n + 1$ or $h + k + l = 4n$
8	$a\ 23.$	$0, 0, 0$	$\frac{3}{4}, \frac{1}{4}, \frac{3}{4}$	

Symmetry of special projections

Along [001] $p4mm$
 $\mathbf{a}' = \frac{1}{2}\mathbf{a}$ $\mathbf{b}' = \frac{1}{2}\mathbf{b}$
 Origin at $\frac{1}{4}, 0, z$

Along [111] $p3m1$
 $\mathbf{a}' = \frac{1}{6}(2\mathbf{a} - \mathbf{b} - \mathbf{c})$ $\mathbf{b}' = \frac{1}{6}(-\mathbf{a} + 2\mathbf{b} - \mathbf{c})$
 Origin at x, x, x

Along [110] $c2mm$
 $\mathbf{a}' = \frac{1}{2}(-\mathbf{a} + \mathbf{b})$ $\mathbf{b}' = \mathbf{c}$
 Origin at $x, x, \frac{1}{8}$

Maximal non-isomorphic subgroups

- I** $[2] F 231 (F 23, 196)$ $(1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12)+$
 $\left\{ \begin{array}{l} [3] F 4_1 12 (I 4_1 22, 98) \quad (1; 2; 3; 4; 13; 14; 15; 16)+ \\ [3] F 4_1 12 (I 4_1 22, 98) \quad (1; 2; 3; 4; 17; 18; 19; 20)+ \\ [3] F 4_1 12 (I 4_1 22, 98) \quad (1; 2; 3; 4; 21; 22; 23; 24)+ \\ [4] F 132 (R 32, 155) \quad (1; 5; 9; 14; 19; 24)+ \\ [4] F 132 (R 32, 155) \quad (1; 6; 12; 13; 18; 24)+ \\ [4] F 132 (R 32, 155) \quad (1; 7; 10; 13; 19; 22)+ \\ [4] F 132 (R 32, 155) \quad (1; 8; 11; 14; 18; 22)+ \end{array} \right.$
- IIa** $\left\{ \begin{array}{l} [4] P 4_1 32 (213) \quad 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14; 15; 16; 17; 18; 19; 20; 21; 22; 23; 24 \\ [4] P 4_1 32 (213) \quad 1; 2; 3; 4; 13; 14; 15; 16; (9; 10; 11; 12; 17; 18; 19; 20) + (0, \frac{1}{2}, \frac{1}{2}); (5; 6; 7; 8; 21; 22; 23; \\ 24) + (\frac{1}{2}, 0, \frac{1}{2}) \\ [4] P 4_1 32 (213) \quad 1; 2; 3; 4; 17; 18; 19; 20; (9; 10; 11; 12; 21; 22; 23; 24) + (\frac{1}{2}, 0, \frac{1}{2}); (5; 6; 7; 8; 13; 14; 15; \\ 16) + (\frac{1}{2}, \frac{1}{2}, 0) \\ [4] P 4_1 32 (213) \quad 1; 2; 3; 4; 21; 22; 23; 24; (5; 6; 7; 8; 17; 18; 19; 20) + (0, \frac{1}{2}, \frac{1}{2}); (9; 10; 11; 12; 13; 14; 15; \\ 16) + (\frac{1}{2}, \frac{1}{2}, 0) \\ [4] P 4_3 32 (212) \quad 1; 5; 9; 14; 19; 24; (4; 6; 11; 16; 18; 23) + (0, \frac{1}{2}, \frac{1}{2}); (3; 8; 10; 15; 20; 22) + (\frac{1}{2}, 0, \frac{1}{2}); (2; 7; 12; \\ 13; 17; 21) + (\frac{1}{2}, \frac{1}{2}, 0) \\ [4] P 4_3 32 (212) \quad 1; 6; 12; 13; 18; 24; (4; 5; 10; 15; 19; 23) + (0, \frac{1}{2}, \frac{1}{2}); (3; 7; 11; 16; 17; 22) + (\frac{1}{2}, 0, \frac{1}{2}); (2; 8; 9; \\ 14; 20; 21) + (\frac{1}{2}, \frac{1}{2}, 0) \\ [4] P 4_3 32 (212) \quad 1; 7; 10; 13; 19; 22; (4; 8; 12; 15; 18; 21) + (0, \frac{1}{2}, \frac{1}{2}); (3; 6; 9; 16; 20; 24) + (\frac{1}{2}, 0, \frac{1}{2}); (2; 5; 11; \\ 14; 17; 23) + (\frac{1}{2}, \frac{1}{2}, 0) \\ [4] P 4_3 32 (212) \quad 1; 8; 11; 14; 18; 22; (4; 7; 9; 16; 19; 21) + (0, \frac{1}{2}, \frac{1}{2}); (3; 5; 12; 15; 17; 24) + (\frac{1}{2}, 0, \frac{1}{2}); (2; 6; 10; \\ 13; 20; 23) + (\frac{1}{2}, \frac{1}{2}, 0) \end{array} \right.$
- IIb** none

Maximal isomorphic subgroups of lowest index

- IIc** $[27] F 4_1 32 (\mathbf{a}' = 3\mathbf{a}, \mathbf{b}' = 3\mathbf{b}, \mathbf{c}' = 3\mathbf{c}) (210)$

Minimal non-isomorphic supergroups

- I** $[2] F d \bar{3} m (227); [2] F d \bar{3} c (228)$
II $[2] P 4_2 32 (\mathbf{a}' = \frac{1}{2}\mathbf{a}, \mathbf{b}' = \frac{1}{2}\mathbf{b}, \mathbf{c}' = \frac{1}{2}\mathbf{c}) (208)$