

*P*23

$T^1$

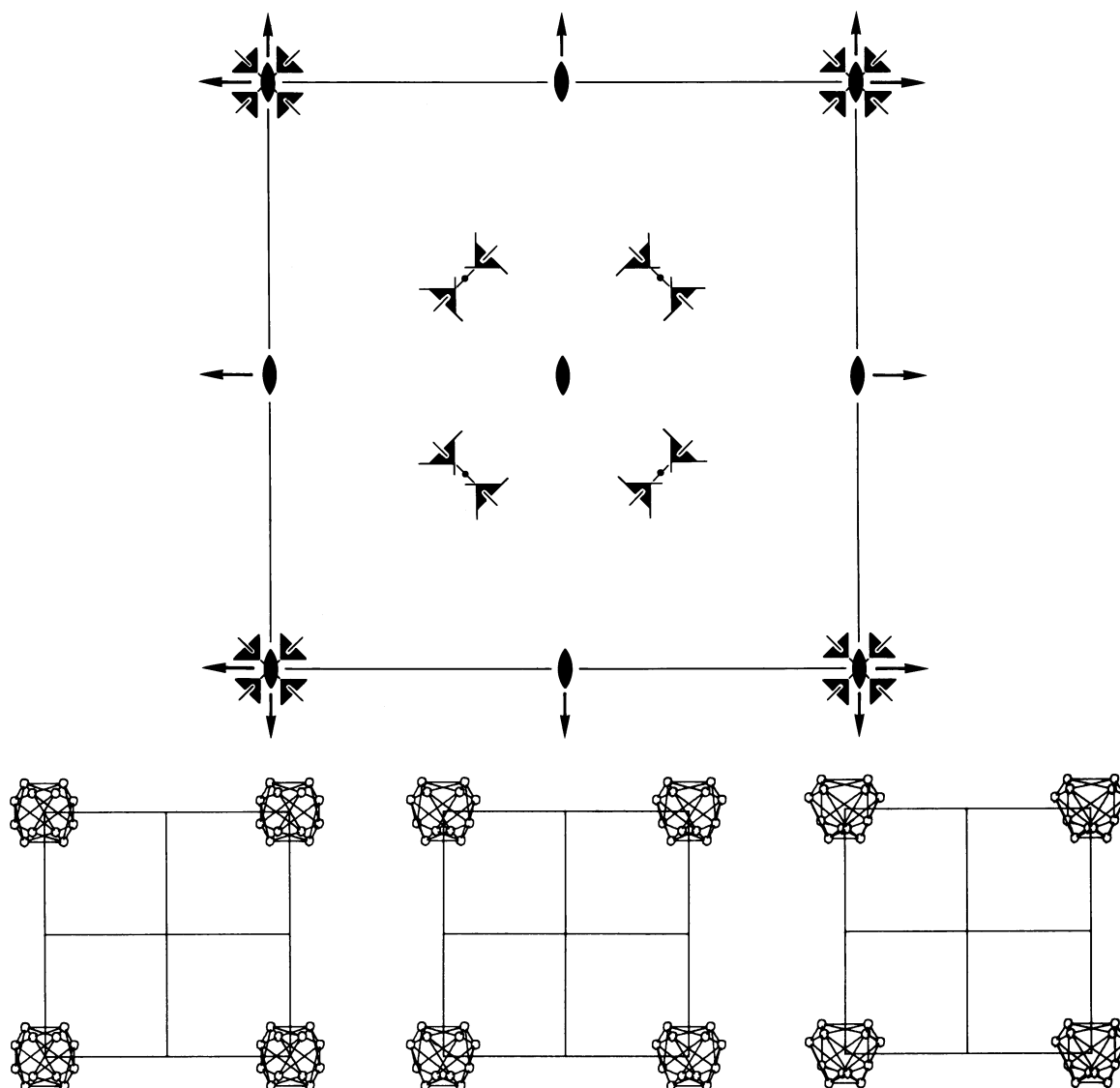
23

Cubic

No. 195

*P*23

Patterson symmetry  $Pm\bar{3}$



Origin at 23

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

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

Symmetry operations

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

**Generators selected** (1);  $t(1,0,0)$ ;  $t(0,1,0)$ ;  $t(0,0,1)$ ; (2); (3); (5)

**Positions**

Multiplicity, Wyckoff letter, Site symmetry		Coordinates				Reflection conditions	
						$h, k, l$ cyclically permutable	
						General:	
12	$j$ 1	(1) $x, y, z$ (5) $z, x, y$ (9) $y, z, x$	(2) $\bar{x}, \bar{y}, z$ (6) $z, \bar{x}, \bar{y}$ (10) $\bar{y}, z, \bar{x}$	(3) $\bar{x}, y, \bar{z}$ (7) $\bar{z}, \bar{x}, y$ (11) $y, \bar{z}, \bar{x}$	(4) $x, \bar{y}, \bar{z}$ (8) $\bar{z}, x, \bar{y}$ (12) $\bar{y}, \bar{z}, x$	no conditions	
						Special: no extra conditions	
6	$i$ 2..	$x, \frac{1}{2}, \frac{1}{2}$	$\bar{x}, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, x, \frac{1}{2}$	$\frac{1}{2}, \bar{x}, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, x$	$\frac{1}{2}, \frac{1}{2}, \bar{x}$
6	$h$ 2..	$x, \frac{1}{2}, 0$	$\bar{x}, \frac{1}{2}, 0$	$0, x, \frac{1}{2}$	$0, \bar{x}, \frac{1}{2}$	$\frac{1}{2}, 0, x$	$\frac{1}{2}, 0, \bar{x}$
6	$g$ 2..	$x, 0, \frac{1}{2}$	$\bar{x}, 0, \frac{1}{2}$	$\frac{1}{2}, x, 0$	$\frac{1}{2}, \bar{x}, 0$	$0, \frac{1}{2}, x$	$0, \frac{1}{2}, \bar{x}$
6	$f$ 2..	$x, 0, 0$	$\bar{x}, 0, 0$	$0, x, 0$	$0, \bar{x}, 0$	$0, 0, x$	$0, 0, \bar{x}$
4	$e$ .3.	$x, x, x$	$\bar{x}, \bar{x}, x$	$\bar{x}, x, \bar{x}$	$x, \bar{x}, \bar{x}$		
3	$d$ 222..	$\frac{1}{2}, 0, 0$	$0, \frac{1}{2}, 0$	$0, 0, \frac{1}{2}$			
3	$c$ 222..	$0, \frac{1}{2}, \frac{1}{2}$	$\frac{1}{2}, 0, \frac{1}{2}$	$\frac{1}{2}, \frac{1}{2}, 0$			
1	$b$ 23.	$\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$					
1	$a$ 23.	$0, 0, 0$					

**Symmetry of special projections**

Along [001] $p2mm$ $\mathbf{a}' = \mathbf{a}$ $\mathbf{b}' = \mathbf{b}$ Origin at 0, 0, z	Along [111] $p3$ $\mathbf{a}' = \frac{1}{3}(2\mathbf{a} - \mathbf{b} - \mathbf{c})$ $\mathbf{b}' = \frac{1}{3}(-\mathbf{a} + 2\mathbf{b} - \mathbf{c})$ Origin at $x, x, x$	Along [110] $p1m1$ $\mathbf{a}' = \frac{1}{2}(-\mathbf{a} + \mathbf{b})$ $\mathbf{b}' = \mathbf{c}$ Origin at $x, x, 0$
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**Maximal non-isomorphic subgroups**

**I**    [3]  $P21$  ( $P222, 16$ )    1; 2; 3; 4  
       { [4]  $P13$  ( $R3, 146$ )    1; 5; 9  
       [4]  $P13$  ( $R3, 146$ )    1; 6; 12  
       [4]  $P13$  ( $R3, 146$ )    1; 7; 10  
       [4]  $P13$  ( $R3, 146$ )    1; 8; 11

**IIa**    none

**IIb**    [2]  $F23$  ( $\mathbf{a}' = 2\mathbf{a}, \mathbf{b}' = 2\mathbf{b}, \mathbf{c}' = 2\mathbf{c}$ ) (196); [4]  $I2_13$  ( $\mathbf{a}' = 2\mathbf{a}, \mathbf{b}' = 2\mathbf{b}, \mathbf{c}' = 2\mathbf{c}$ ) (199); [4]  $I23$  ( $\mathbf{a}' = 2\mathbf{a}, \mathbf{b}' = 2\mathbf{b}, \mathbf{c}' = 2\mathbf{c}$ ) (197)

**Maximal isomorphic subgroups of lowest index**

**IIc**    [27]  $P23$  ( $\mathbf{a}' = 3\mathbf{a}, \mathbf{b}' = 3\mathbf{b}, \mathbf{c}' = 3\mathbf{c}$ ) (195)

**Minimal non-isomorphic supergroups**

**I**    [2]  $Pm\bar{3}$  (200); [2]  $Pn\bar{3}$  (201); [2]  $P432$  (207); [2]  $P4_232$  (208); [2]  $P\bar{4}3m$  (215); [2]  $P\bar{4}3n$  (218)  
**II**    [2]  $I23$  (197); [4]  $F23$  (196)