

## Symmetry Classification for Serial Crystallography Experiments

Groups with white backgrounds are merohedral and will exhibit indexing ambiguities. Chiral groups are shown in bold, centrosymmetric groups are underlined.

Move downwards or follow grey arrows to find supergroups which can be accessed with only rotation operations. Do not cross vertical or thick black horizontal lines unless following a grey arrow. When you reach a cell with a shaded background, you have found the corresponding "source symmetry". A partial ambiguity resolution could be attempted into any intermediate group you can reach.

Point Groups	Space Groups		
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### Triclinic lattice

$\bar{1}$	<b>1</b>	$P\bar{1}$	<b>P1</b>
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### Monoclinic lattice

	m		Pm, Pc, Cm, Cc
<b>2</b>	<u>2/m</u>	<b>P2, P2<sub>1</sub>, C2</b>	<u>P2/m, P2<sub>1</sub>/m, C2/m, P2/c, P2<sub>1</sub>/c, C2/c</u>

### Orthorhombic lattice

	mm2		Pmm2, Pmc2 <sub>1</sub> , Pcc2, Pma2, Pca2 <sub>1</sub> , Pnc2, Pmn2 <sub>1</sub> , Pba2, Pna2 <sub>1</sub> , Pnn2, Cmm2, Cmc2 <sub>1</sub> , Ccc2, Amm2, Aem2, Ama2, Aea2, Fmm2, Fdd2, Imm2, Iba2, Ima2
<b>222</b>	<u>mmm</u>	<b>P222, P222<sub>1</sub>, P2<sub>1</sub>2<sub>1</sub>2, P2<sub>1</sub>2<sub>1</sub>2<sub>1</sub>, C222<sub>1</sub>, C222, F222, I222, I2<sub>1</sub>2<sub>1</sub>2<sub>1</sub></b>	<u>Pmmm, Pnnn, Pccm, Pban, Pmma, Pnna, Pmna, Pcca, Pbam, Pccn, Pbcm, Pnnm, Pmmn, Pbcn, Pbca, Pnma, Cmcn, Cmce, Cmmm, Cccm, Cmme, Ccce, Fmmm, Fddd, Immm, Ibam, Ibca, Imma</u>

### Tetragonal lattice

4	$\bar{4}$			4mm	P4, P4 <sub>1</sub> , P4 <sub>2</sub> , P4 <sub>3</sub> , I4, I4 <sub>1</sub>	P $\bar{4}$ , I $\bar{4}$			P4mm, P4bm, P4 <sub>2</sub> cm, P4 <sub>2</sub> nm, P4cc, P4nc, P4 <sub>2</sub> mc, P4 <sub>2</sub> bc, I4mm, I4cm, I4 <sub>1</sub> md, I4 <sub>1</sub> cd
	$\bar{4}2m$	$\bar{4}m2$	$\underline{4/m}$			P $\bar{4}2m$ , P $\bar{4}2c$ , P $\bar{4}2_1m$ , P $\bar{4}2_1c$ , I $\bar{4}2m$ , I $\bar{4}2d$	P $\bar{4}m2$ , P $\bar{4}c2$ , P $\bar{4}b2$ , P $\bar{4}n2$ , I $\bar{4}m2$ , I $\bar{4}c2$	$\underline{P4/m}$ , $\underline{P4_2/m}$ , $\underline{P4/n}$ , $\underline{P4_2/n}$ , $\underline{I4/m}$ , $\underline{I4_1/a}$	
422	$\underline{4/mmm}$				P422, P42 <sub>1</sub> 2, P4 <sub>1</sub> 22, P4 <sub>1</sub> 2 <sub>1</sub> 2, P4 <sub>2</sub> 22, P4 <sub>2</sub> 2 <sub>1</sub> 2, P4 <sub>3</sub> 22, P4 <sub>3</sub> 2 <sub>1</sub> 2, I422, I4 <sub>1</sub> 22	$\underline{P4/mmm}$ , $\underline{P4/mcc}$ , $\underline{P4/nbm}$ , $\underline{P4/nnc}$ , $\underline{P4/mbm}$ , $\underline{P4/mnc}$ , $\underline{P4/nmm}$ , $\underline{P4/ncc}$ , $\underline{P4_2/mmc}$ , $\underline{P4_2/mcm}$ , $\underline{P4_2/nbc}$ , $\underline{P4_2/nnm}$ , $\underline{P4_2/mbc}$ , $\underline{P4_2/mnm}$ , $\underline{P4_2/nmc}$ , $\underline{P4_2/ncm}$ , $\underline{I4/mmm}$ , $\underline{I4/mcm}$ , $\underline{I4_1/amd}$ , $\underline{I4_1/acd}$			

### Rhombohedral lattice

<b>3</b>	$\bar{3}$	3m	<b>R3 (H3)</b>	$R\bar{3} (H\bar{3})$	R3m (H3m), R3c (H3c)
<b>32</b>	<u><math>\bar{3}m</math></u>		<b>R32 (H32)</b>	<u><math>R\bar{3}m (H\bar{3}m), R\bar{3}c (H\bar{3}c)</math></u>	

Hexagonal lattice

3			$\bar{3}$					P3, P3 <sub>1</sub> , P3 <sub>2</sub>			$P\bar{3}$					P6mm, P6cc, P6 <sub>3</sub> cm, P6 <sub>3</sub> mc	
6	312	321	<div><div>3m1</div><div><math>\bar{6}</math></div><div>31m</div></div>				$\frac{6}{m}$	6mm	P6, P6 <sub>1</sub> , P6 <sub>5</sub> , P6 <sub>2</sub> , P6 <sub>4</sub> , P6 <sub>3</sub>	P312, P3 <sub>1</sub> 12, P3 <sub>2</sub> 12	P321, P3 <sub>1</sub> 21, P3 <sub>2</sub> 21	<div><div>P3m1, P3c1</div><div><math>P\bar{6}</math></div><div>P31m, P31c</div></div>					$\frac{P6/m, P6_3/m}{}$
			$\bar{3}m1$	$\bar{6}m2$	$\bar{6}2m$	$\bar{3}1m$						$\bar{P}3m1, \bar{P}3c1$	$P\bar{6}m2, P\bar{6}c2$	$P\bar{6}2m, P\bar{6}2c$	$\bar{P}31m, \bar{P}31c$		
			622			$\frac{6}{mmm}$						P622, P6 <sub>1</sub> 22, P6 <sub>5</sub> 22, P6 <sub>2</sub> 22, P6 <sub>4</sub> 22, P6 <sub>3</sub> 22			$\frac{P6}{mmm}, \frac{P6}{mcc}, \frac{P6_3}{mcm}, \frac{P6_3}{mmc}$		

Cubic lattice

23	$\bar{4}3m$	$m\bar{3}$	P23, F23, I23, P2 <sub>1</sub> 3, I2 <sub>1</sub> 3	$P\bar{4}3m, F\bar{4}3m, I\bar{4}3m, P\bar{4}3n, F\bar{4}3c, I\bar{4}3d$	$\bar{P}m\bar{3}, \bar{P}n\bar{3}, \bar{F}m\bar{3}, \bar{F}d\bar{3}, \bar{I}m\bar{3}, \bar{P}a\bar{3}, \bar{I}a\bar{3}$
432	$\bar{m}\bar{3}m$		P432, P4 <sub>2</sub> 32, F432, F4 <sub>1</sub> 32, I432, P4 <sub>3</sub> 32, P4 <sub>1</sub> 32, I4 <sub>1</sub> 32	$\bar{P}m\bar{3}m, \bar{P}n\bar{3}n, \bar{P}m\bar{3}n, \bar{P}n\bar{3}m, \bar{F}m\bar{3}m, \bar{F}m\bar{3}c, \bar{F}d\bar{3}m, \bar{F}d\bar{3}c, \bar{I}m\bar{3}m, \bar{I}a\bar{3}d$	

Laue Classes

$\bar{1}$	$\bar{1}$
$\bar{2}/m$	2 m
$\bar{m}m\bar{m}$	222 mm2
$\bar{4}/m$	4 $\bar{4}$
$\bar{4}/m\bar{m}\bar{m}$	422 $\bar{4}2m$ $\bar{4}m2$ 4mm

$\bar{3}$	3
$\bar{3}m$	32 3m
$\bar{3}m1$	321 3m1
$\bar{3}1m$	312 31m

$\bar{6}/m$	6	$\bar{6}$
$\bar{6}/m\bar{m}\bar{m}$	622	$\bar{6}m2$ $\bar{6}2m$ 6mm
$\bar{m}\bar{3}$	23	
$\bar{m}\bar{3}m$	432	$\bar{4}3m$

Pseudo-merohedral Possibilities

Triclinic with $a \approx b, \alpha \approx \beta \approx 90^\circ$	1 = 2	$\bar{1} \Rightarrow 2/m$
Triclinic with $a \approx b \approx c, \alpha \approx \beta \approx \gamma$	1 = 3 <sub>R</sub>	$\bar{1} \Rightarrow \bar{3}_R$
Triclinic with $\alpha \approx \beta \approx \gamma \approx 90^\circ$	1 = 222	$\bar{1} \Rightarrow \bar{m}m\bar{m}$
Orthorhombic with $a \approx b$	222 = 422	mm2 $\Rightarrow$ 4mm $\bar{m}m\bar{m} \Rightarrow \bar{4}/m\bar{m}\bar{m}$

Monoclinic with $\beta \approx 90^\circ$	2 = 222	m $\Rightarrow$ mm2	$\bar{2}/m \Rightarrow \bar{m}m\bar{m}$
Monoclinic with $\beta \approx 120^\circ$	2 = 6	m $\Rightarrow \bar{6}$	$\bar{2}/m \Rightarrow \bar{6}/m$
Tetragonal with $(a=)b \approx c$	422 $\Rightarrow$ 432	$\bar{4}2m \Rightarrow \bar{4}3m$	$\bar{4}/m\bar{m}\bar{m} \Rightarrow \bar{m}\bar{3}m$
Other tetragonal point groups must go via 422 or $\bar{4}/m\bar{m}\bar{m}$ .			