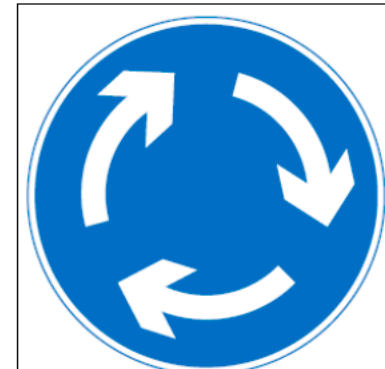
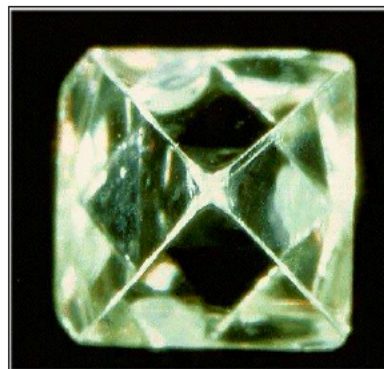
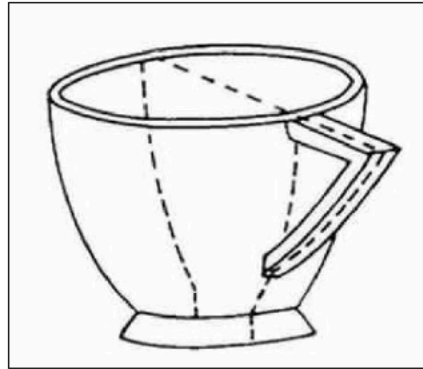
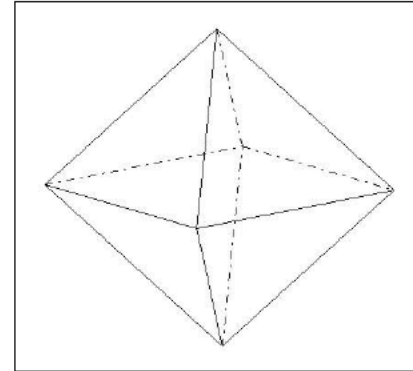
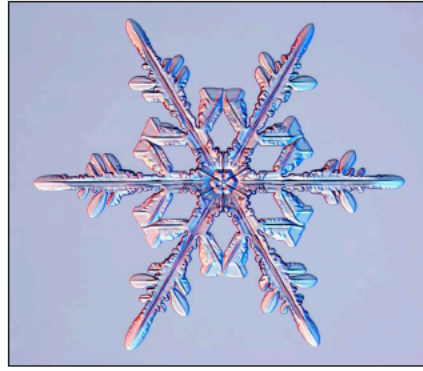


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Kristalografide simetri

- Simetri nedir?
- Simetri, bir nesnenin belirli bir hareket türünden sonra deęişmeden (deęişmez) kalması özelliğidir.

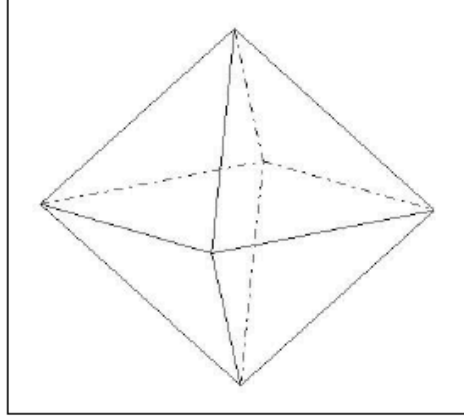


Simetri işlemi

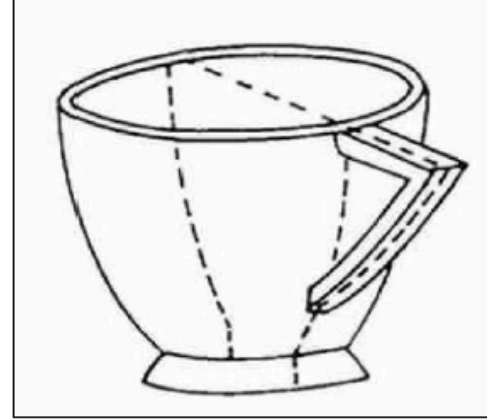
- Simetri işlemi, nesneyi deęişmeden tutan harekettir



Rotation by 60 degrees



Rotation by 90 degrees
around the vertical axis



Reflection in the plane
through the middle

"Deęişmemiş", iki nesneyi herhangi bir fiziksel deneyden ayırt etmenin mümkün olmadığı anlamına gelir

Simetri işlemi türleri

• 1. Nokta simetrisi: EN AZ bir nokta, nesnenin hareketi sırasında sabitlenir

- Rotasyon
- Yansıma
- İncersiyon (Ters çevirme)
- Yukarıdakilerin kombinasyonu

2. Uzay simetrisi: nesnenin hareketi sırasında hiçbir nokta sabitlenmez

Öteleme (örgü ötelemesi)

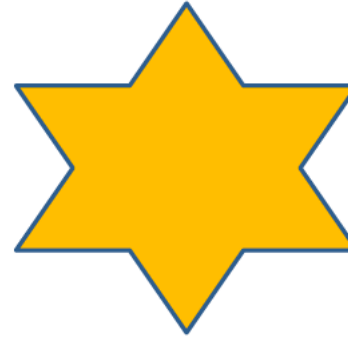
Öteleme ve her türlü nokta simetri işlemlerinin kombinasyonu

Dönme simetrisi

- Hareket: a açısına göre seçilen yön etrafında döner. Dönme eksenini (simetri elemanı) $n = 360 / a$ ile n -KATLAMA SİMETRİ EKSENİ olarak adlandırılır. Bu simetri " n " olarak belirlenmiştir



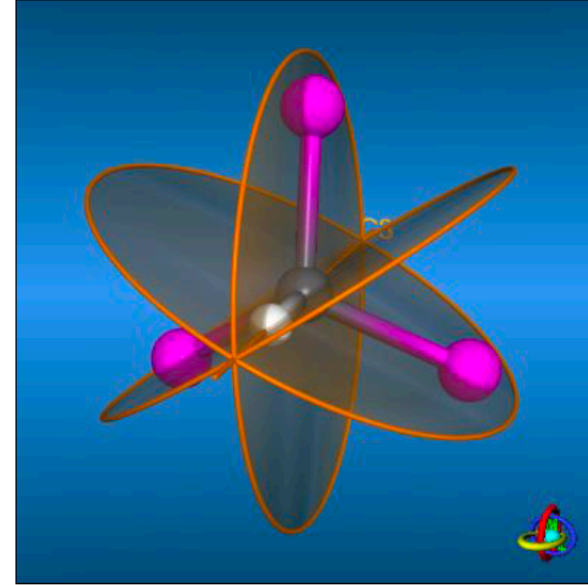
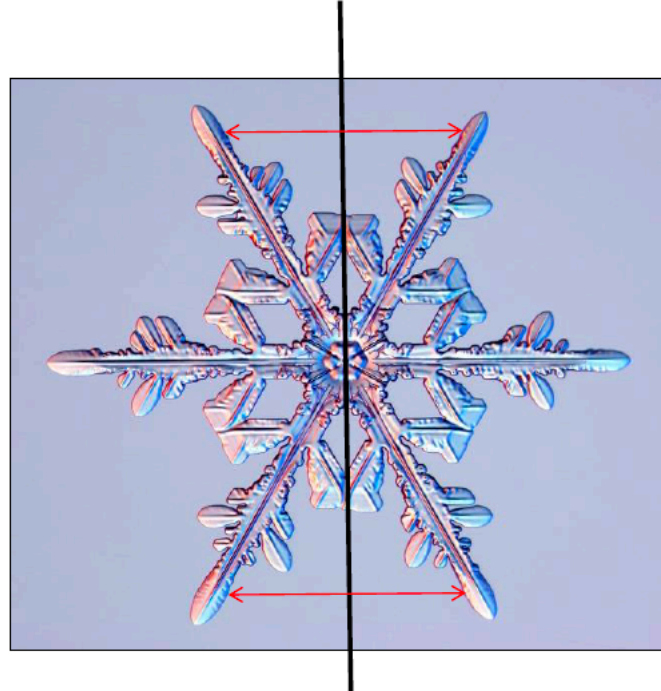
$4 (\alpha = 90 \text{ deg})$

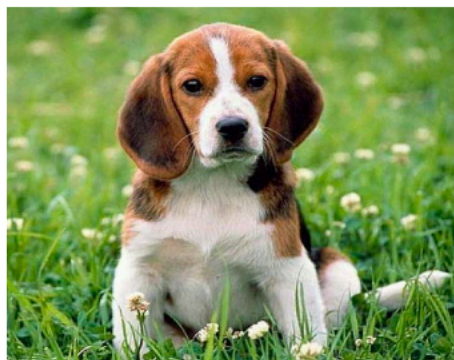
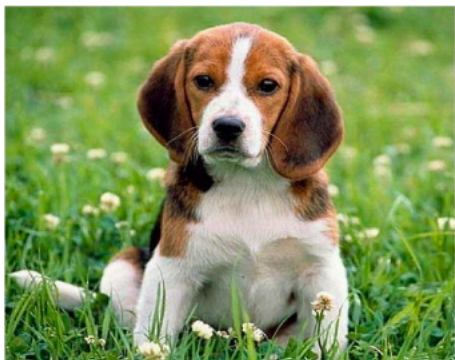


$6 (\alpha = 60 \text{ deg})$

Yansima simetrisi

- Hareket: aynadaki yansima. Her nokta kendi ayna yansimasıyla deęiştirilir. Ayna, Ayna Düzlemi olarak adlandırılır ve "m" ile gösterilir.





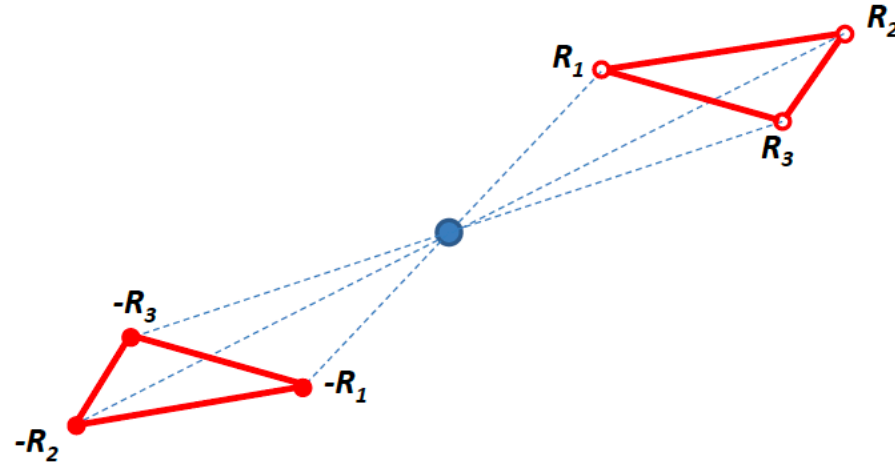
Inversiyon (dönme)

- Hareket: orijine göre ters çevirme (ters çevirme merkezi). Her nokta ters çevrilmiş nokta ile değiştirilir.











XYZ



$-X -Y -Z$

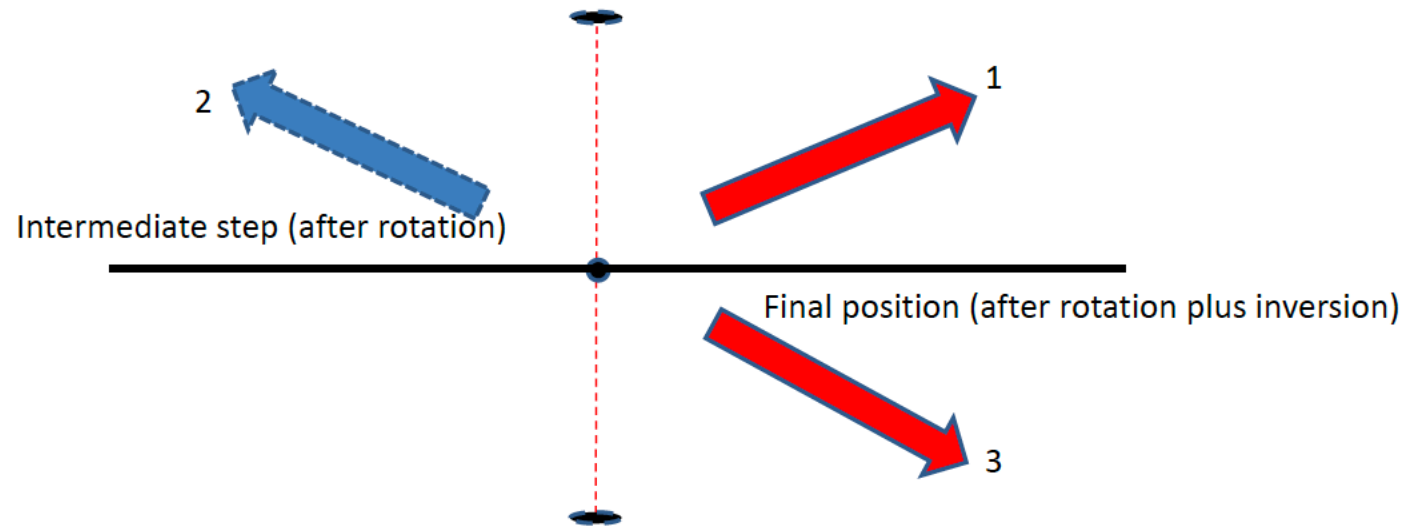


Simetri eksenlerinin ve aynanın tanımı

n	<i>Designation of an axis</i>	
2		
3		
4		
6		
m		

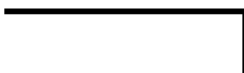



2-kat dönüş eksenini (*2-fold rotoinversion axis*)

- Bazı simetri işlemlerini birleştirmek mümkündür. Örnek olarak, döndürme ve ters çevirmenin bir kombinasyonu, dönme ters çevirme ile ilişkili simetriyi verir.

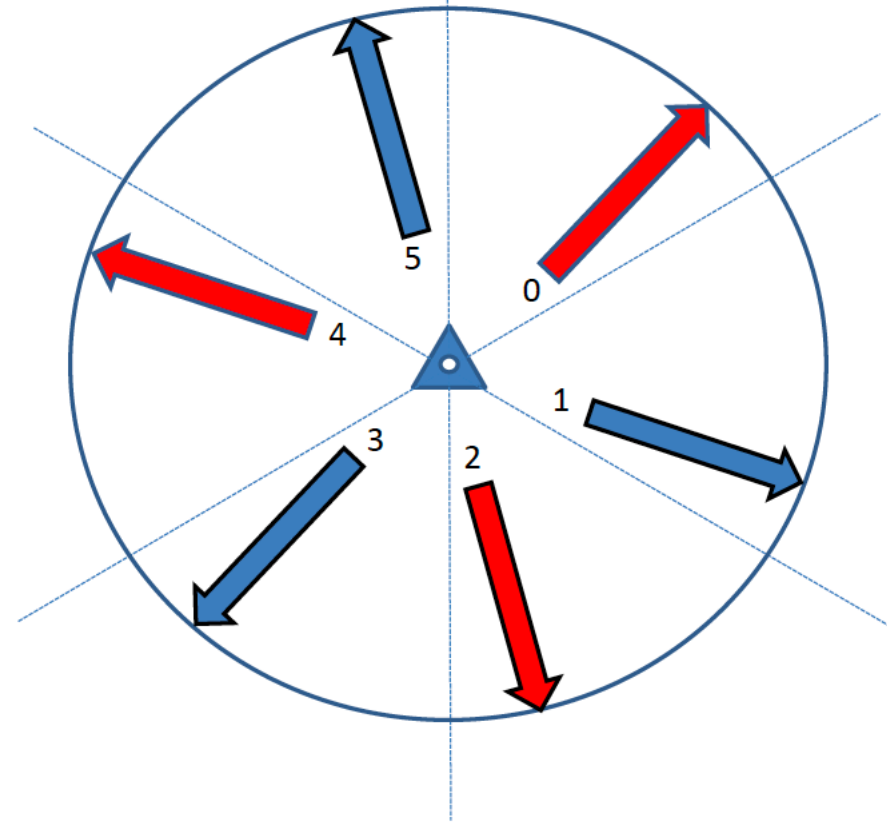


2-fold rotoinversion axis is equivalent to the mirror plane perpendicular to the axis

Rotoinversiyon eksenlerinin belirlenmesi

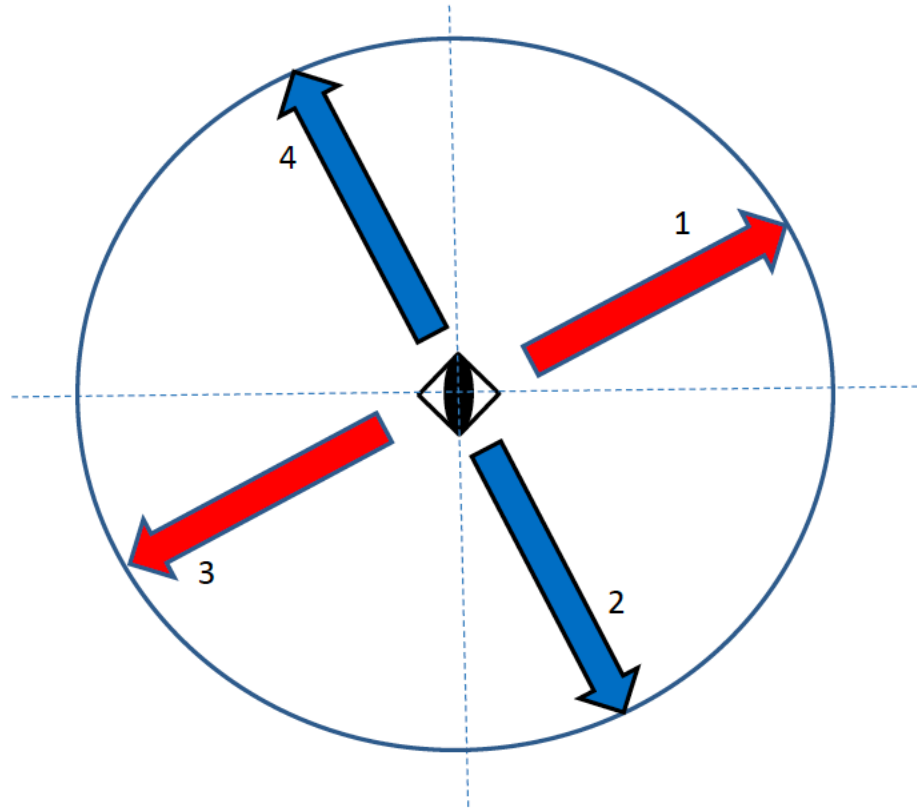
n	<i>Designation of an axis</i>
$\bar{2} \equiv m$	
$\bar{3}$	
$\bar{4}$	
$\bar{6}$	

3-fold rotoinversion axis, $\bar{3}$

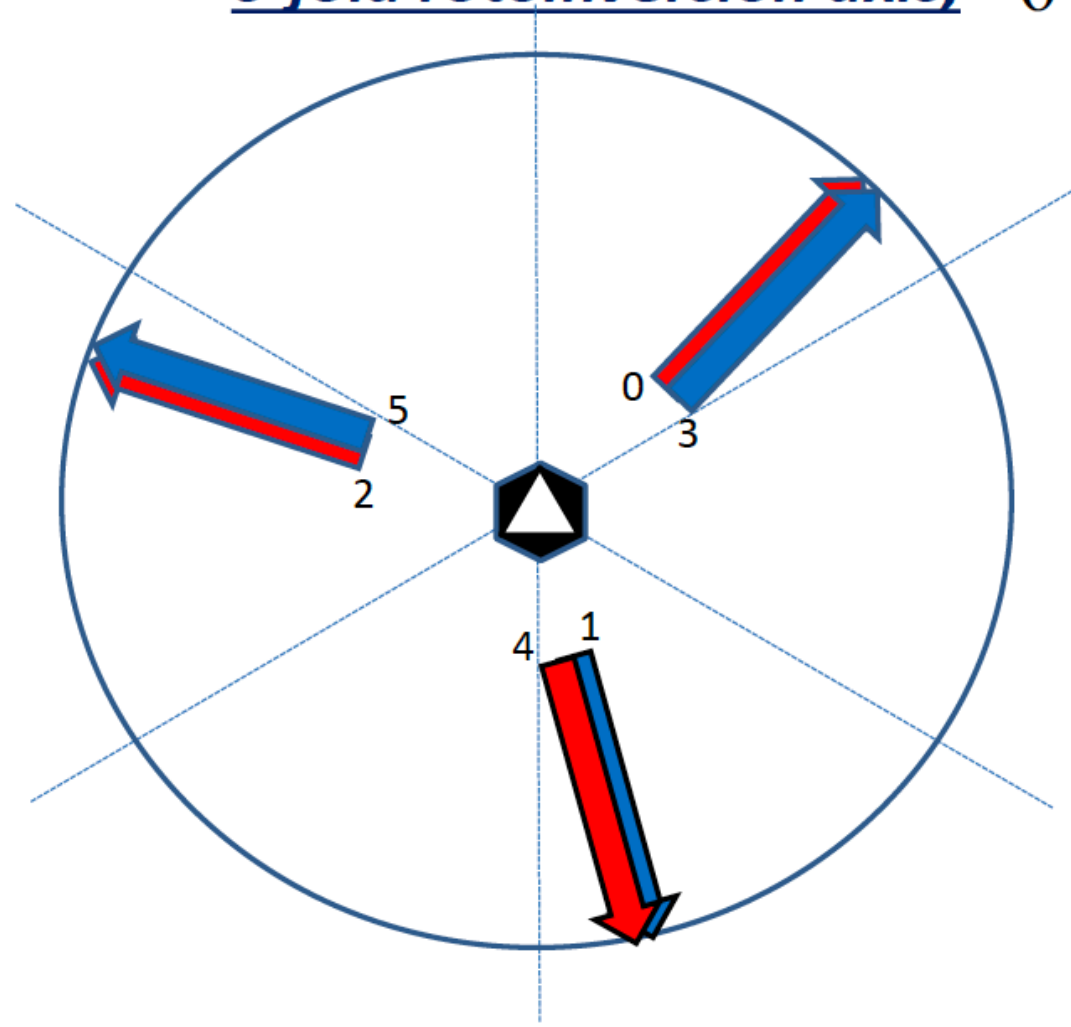


3-fold rotoinversion axis is equivalent to independent existence of 3 fold axis and inversion

4-fold rotoinversion axis, $\bar{4}$

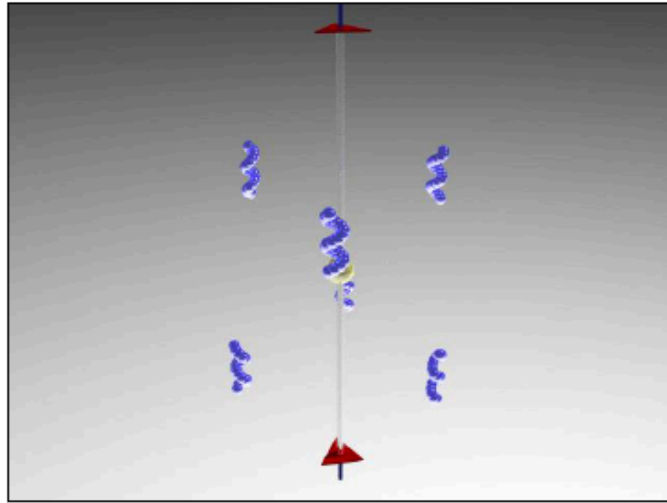


6-fold rotoinversion axis, $\bar{6}$

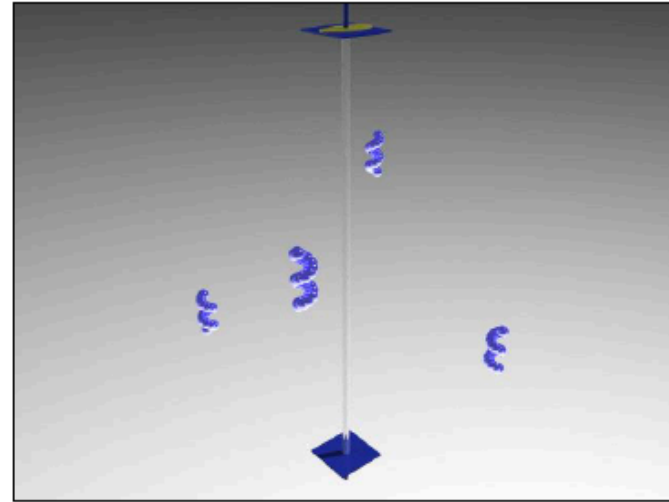


6 katlı dönüş eksenini, 3 kat eksenini ve ayna düzleminin bağımsız varlığına eşdeğerdir

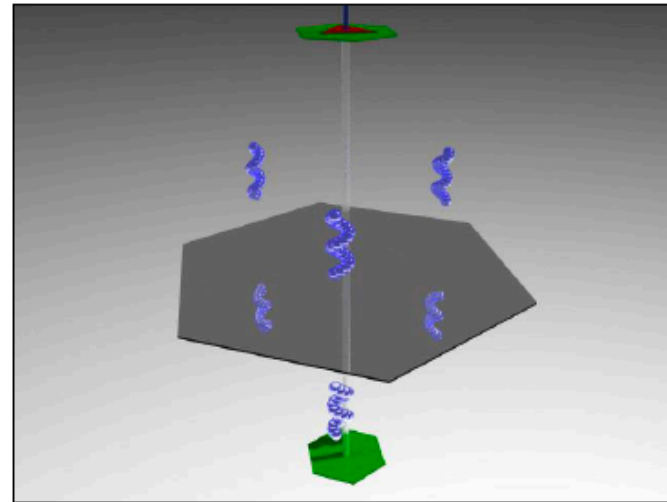
3 fold rotoinversion axis



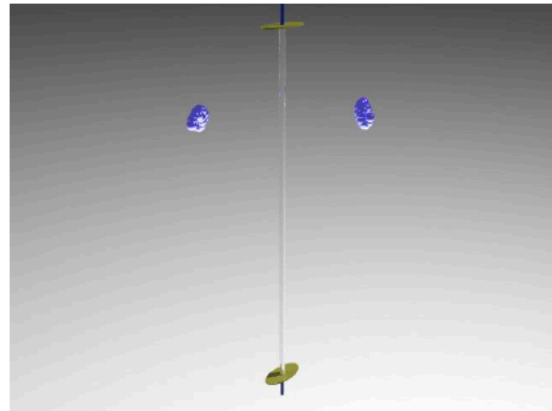
4 fold rotoinversion axis



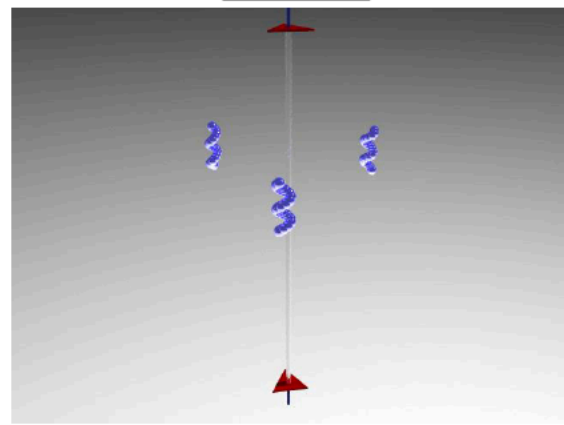
6 fold rotoinversion axis



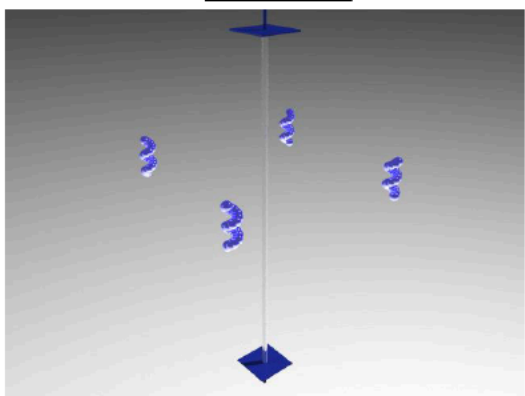
2 fold axis



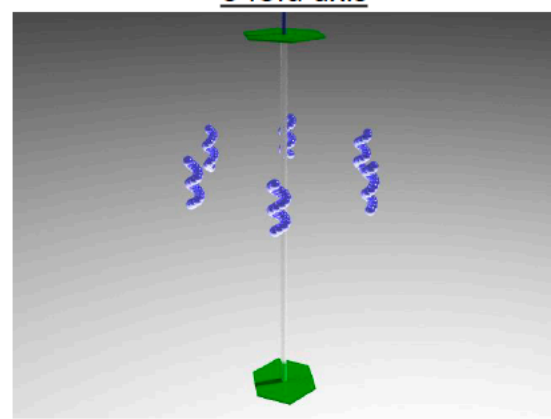
3 fold axis



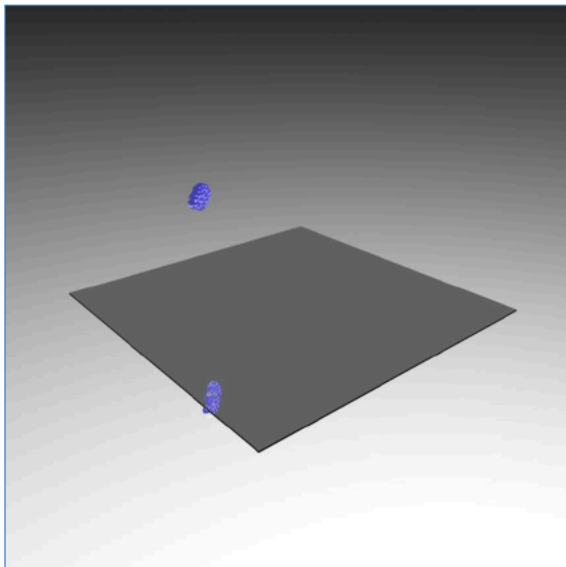
4 fold axis



6 fold axis



Mirror plane



Centre of inversion

