

FZM 419

10

# *32 Point Groups*

- Kristal yapılar 3B periyodiktir ve Birim Hücre (neyin öteleneceği) ve Kristal Örgü (nasıl öteleneceği) belirtilerek ayarlanır.
- Bir kristalin simetrisi, BİRİM HÜCRESİ ve KRİSTAL Örgünün simetrilerinin üst üste gelmesidir.
- Bir Kristal Örgü yalnızca sınırlı simetri öğelerine (ayna düzlemleri, ters çevirme ve 2,3,4,6 kat eksenleri) sahip olabilir. Bu kristaller nedeniyle olası simetri üzerinde aynı kısıtlamaya sahip
- Örgünün simetrisine göre, tüm kristaller kristal sistemlere (4 2D kristal sistemi ve 7 3D kristal sistemi) bölünür. Örgüler 5 (2D) veya 14 (3D) Bravais örgü tiplerine bölünmüştür.

# Nokta simetri grupları (kristal sınıfları)

- KRİSTAL SİSTEM, bir kafesin simetrisidir. Bir kristalin simetrisi yalnızca daha düşük olabilir (yani kristal, kendi kafesine göre aynı veya daha az simetri işlemine sahip olabilir). Sınırlı sayıda kristal sistemi olduğu düşünüldüğünde, bir kristalin tüm olası nokta simetri kombinasyonlarını listeleyebiliriz. Her simetri, bir nokta simetri grubu olarak adlandırılır

**CRYSTAL SYSTEM (THE SYMMETRY GROUP OF A CRYSTAL LATTICE , HOLOHEDRY)**

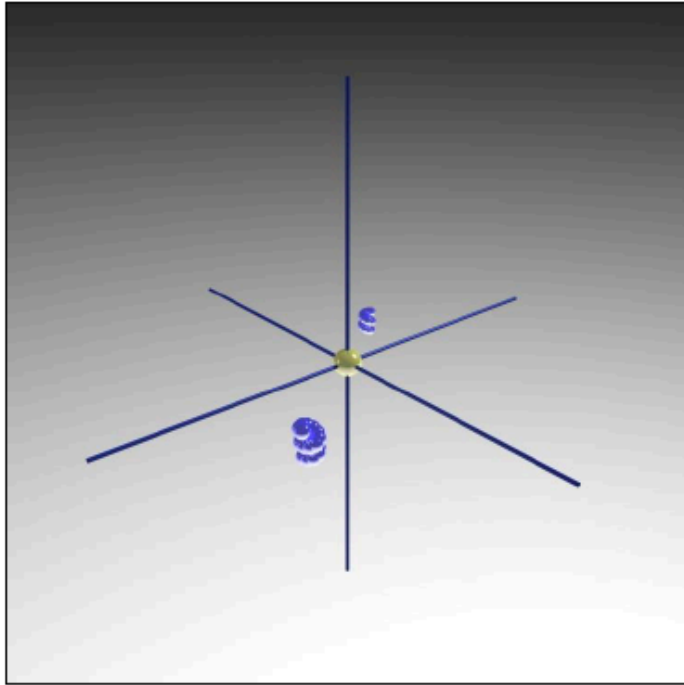
**TAKING OUT A SYMMETRY ELEMENT**

**Getting a symmetry group for a crystal**

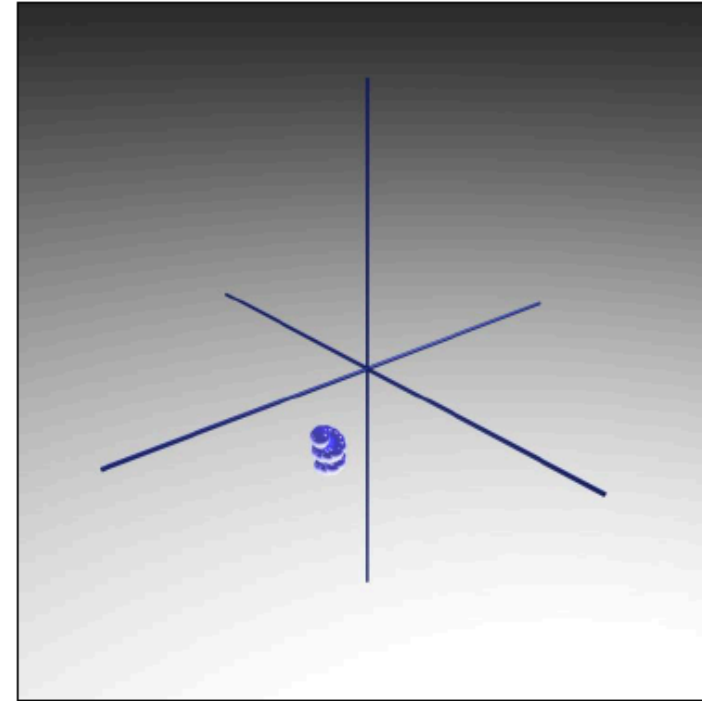
- Simetri grubu nedir?
- Simetri grubu, her biri belirli simetri işlemini (döndürme, yansıma, ters çevirme, döndürme ve çevirme) temsil eden hareketlerin bir GRUBU'dur (matematiksel anlamda). GRUP  $(G_1, G_2, \dots, G_n)$  öğeleri aşağıdaki koşulları sağlamalıdır:
  1. Kapalılık:
    - herhangi bir çift elemanın kombinasyonu grubun başka bir elemanını verir, yani  $G_i * G_j$  aynı gruba aittir
  2. Birim elemanın varlığı  $I$ 
    - $I * G_i = G_i$  özelliğine sahip eleman
  3. Birleşme
    - grubun herhangi üç ögesi için:  $(G_i * G_j) * G_k = G_i * (G_j * G_k)$  sağlar
  4. Elemanların ters çevrilebilirliği  
her elemanın ters çevirme elemanı vardır, yani  $G_i G_i^{-1} = I$

# Triklinik Sistem

## *HOLOHEDRY GROUP*



Taking out  
the inversion



The group has the centre of  
inversion only.  
The group name is

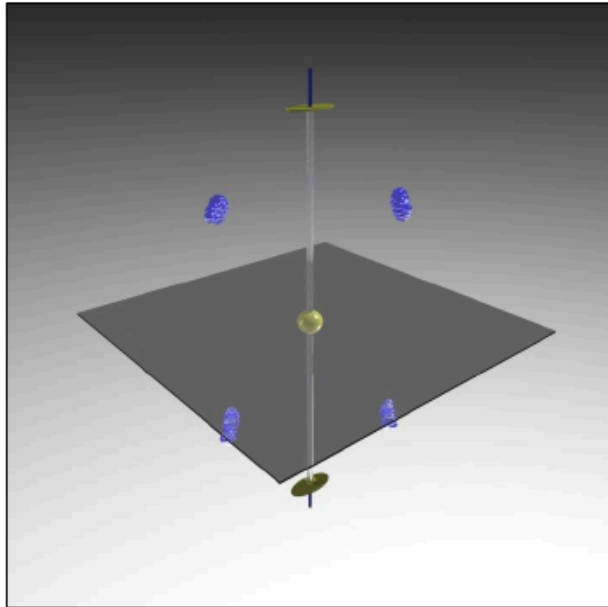
$\bar{1}$

The group does not have any  
symmetry elements

1

# Monoklinik Sistem

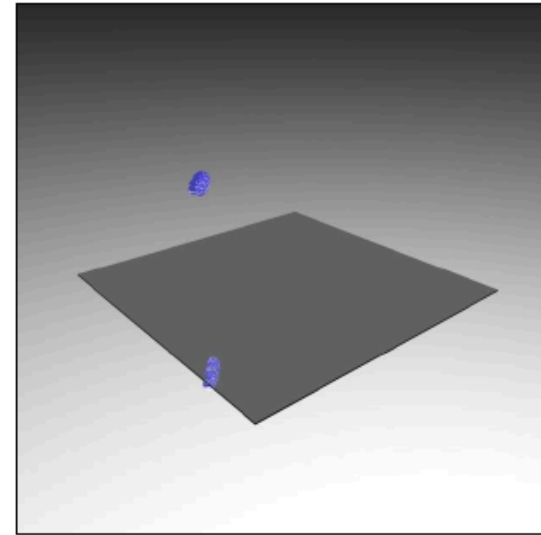
## HOLOHEDRY GROUP



The group has the mirror plane  
and two fold axis.

$2/m$

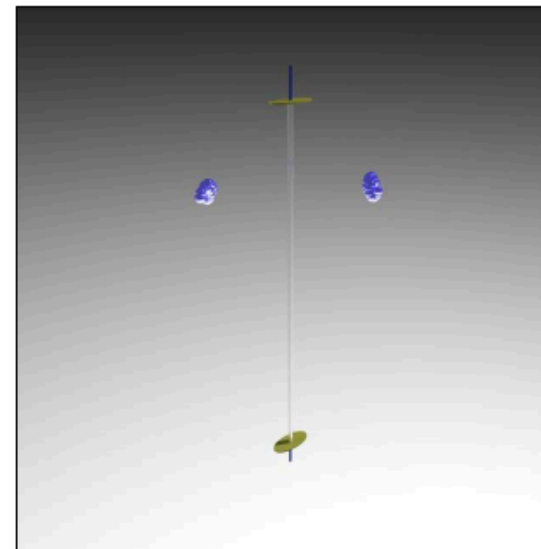
Taking out 2



$m$



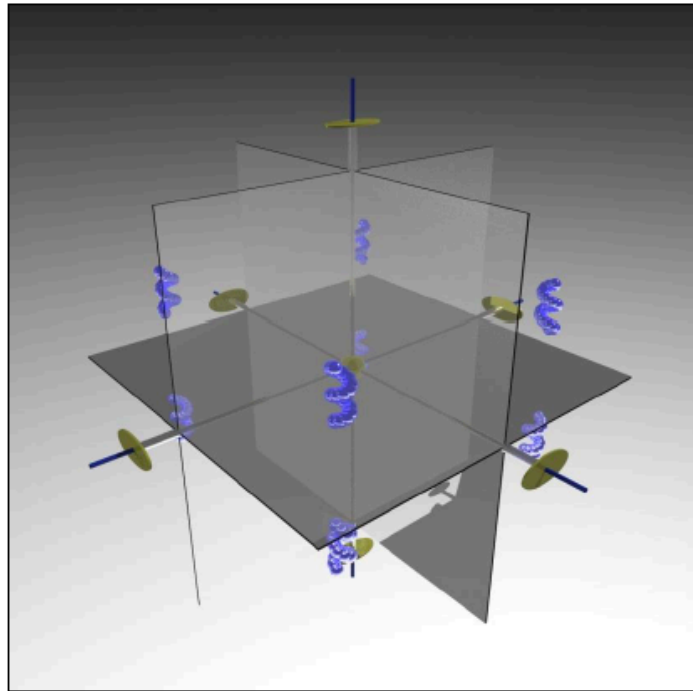
Taking out  $m$



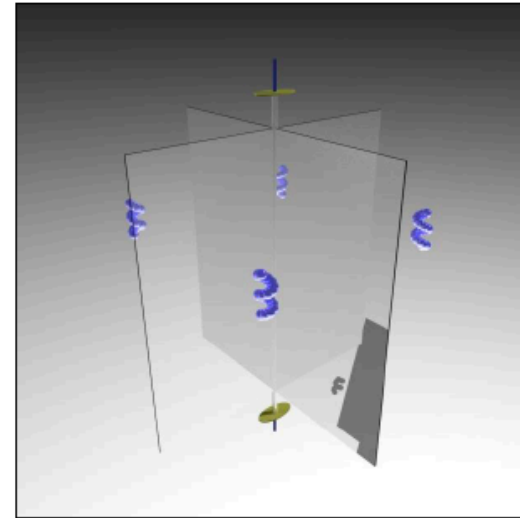
2

# Ortorombik Sistem

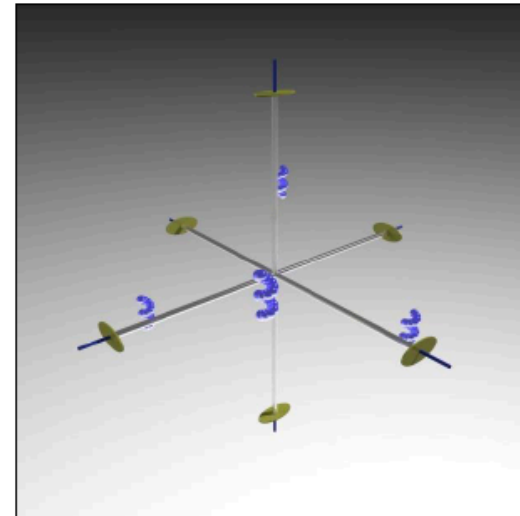
**HOLOHEDRY GROUP**



*mmm*



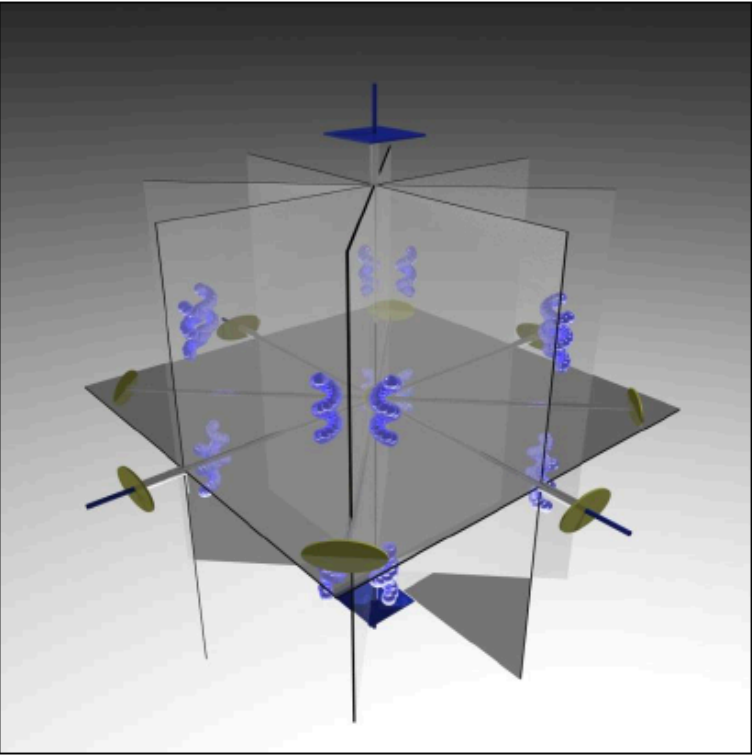
*mm2*



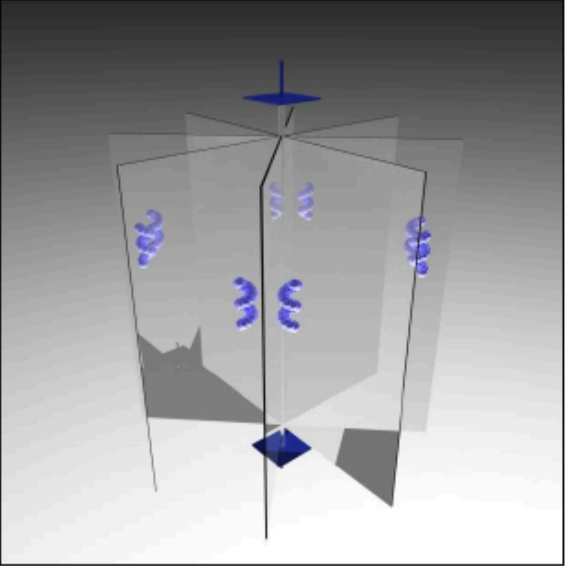
*222*

# Tetragonal Sistem

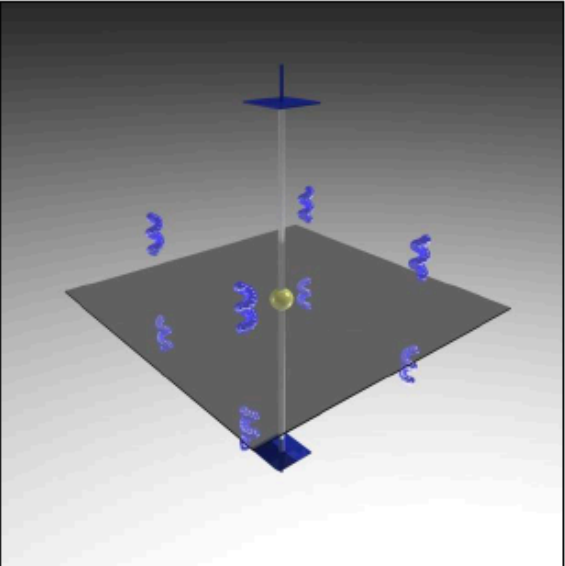
**HOLOHEDRY GROUP**



$4/mmm$



$4mm$

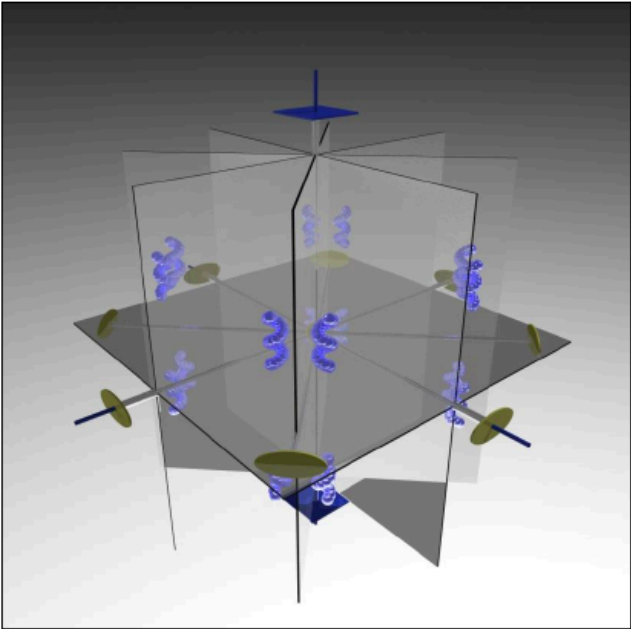


$4/m$

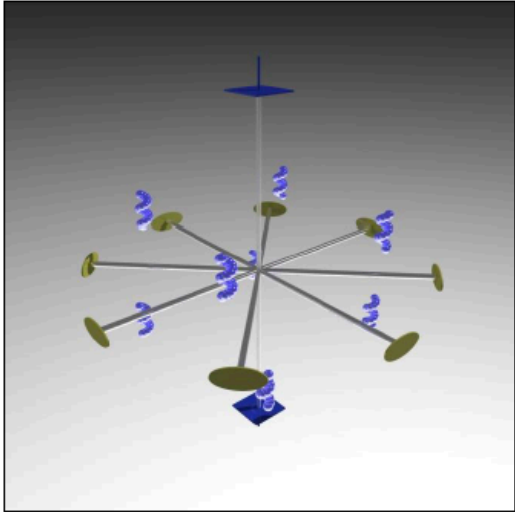
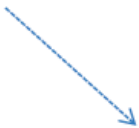
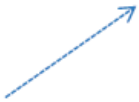


# Tetragonal Sistem

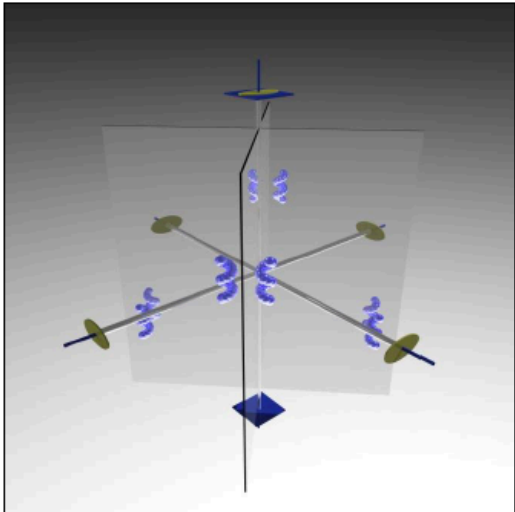
**HOLOHEDRY GROUP**



$4/m\bar{3}m$



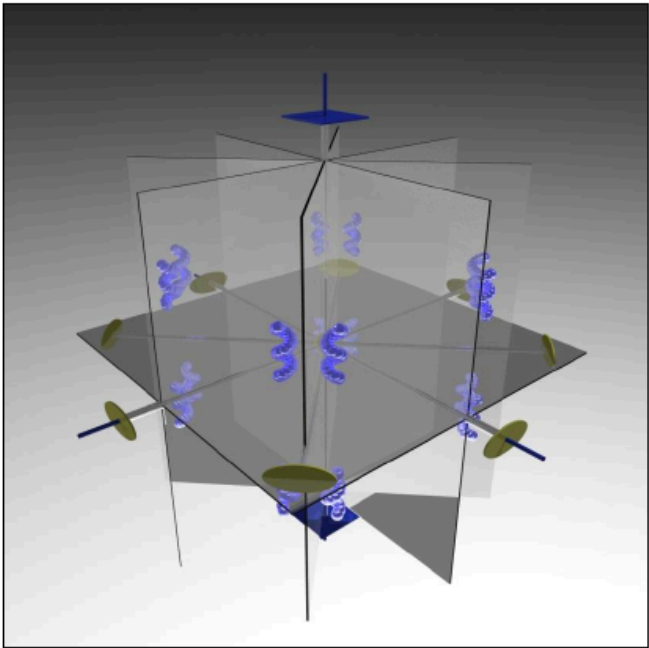
$422$



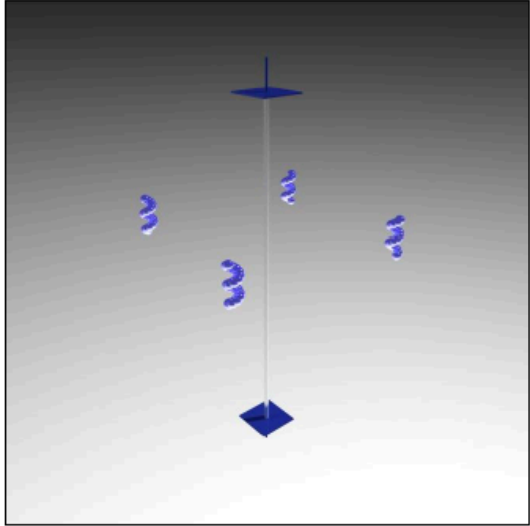
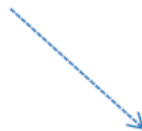
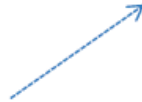
$\bar{4}2m$

# Tetragonal System

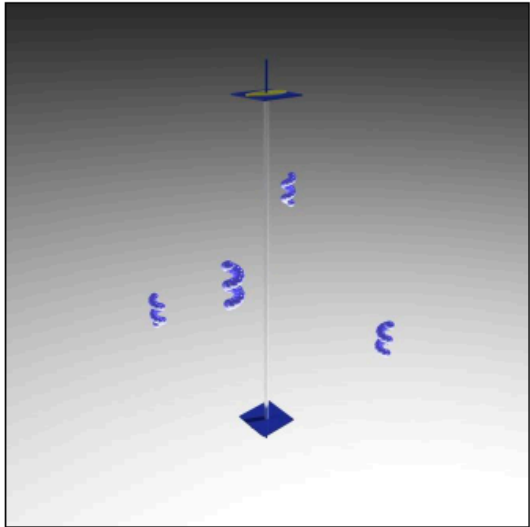
**HOLOHEDRY GROUP**



$4/mmm$



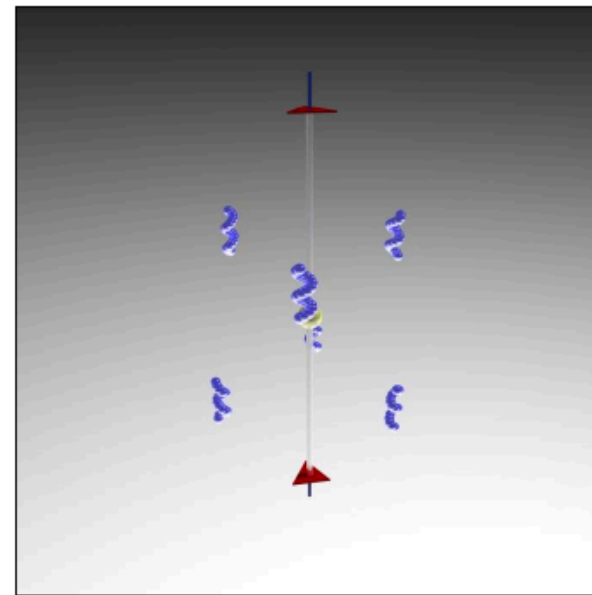
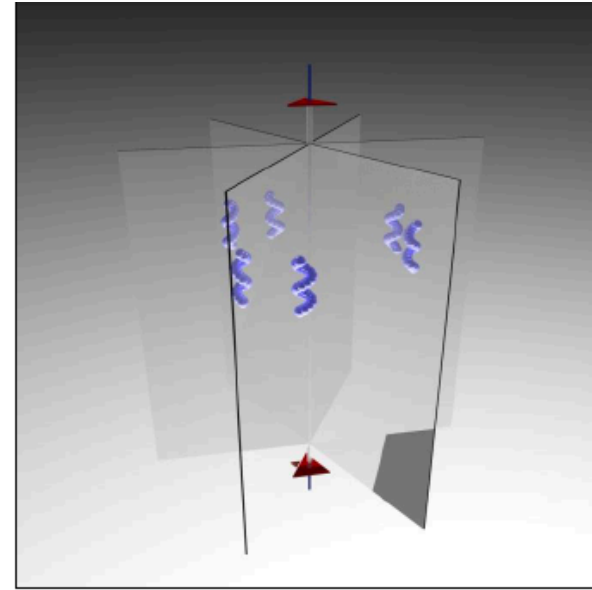
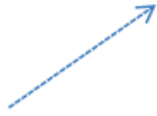
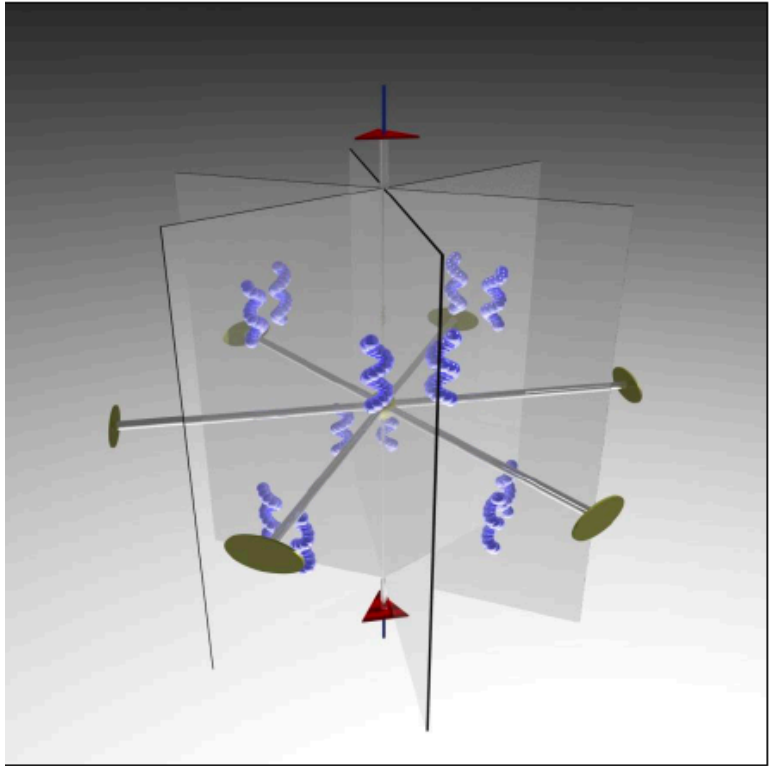
4



$\bar{4}$

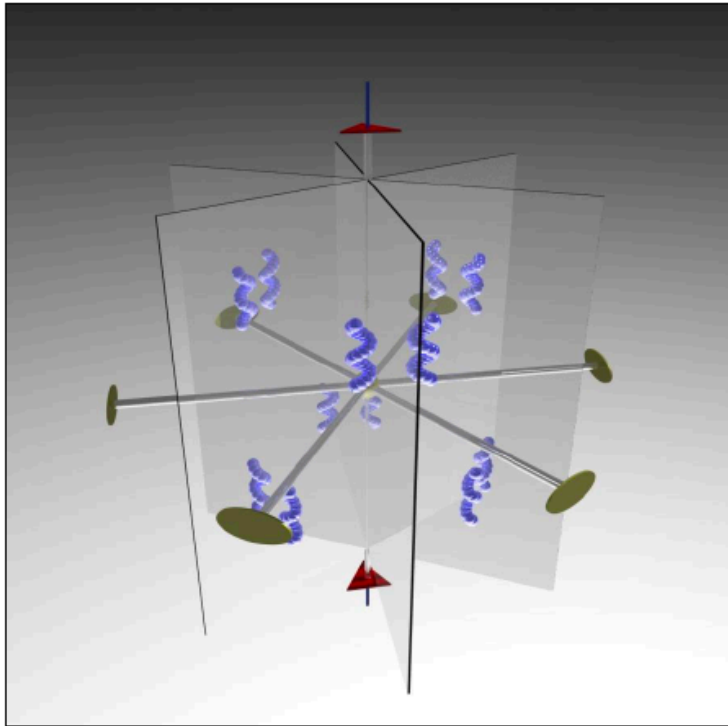
# Rhombohedral

*HOLOHEDRY GROUP*

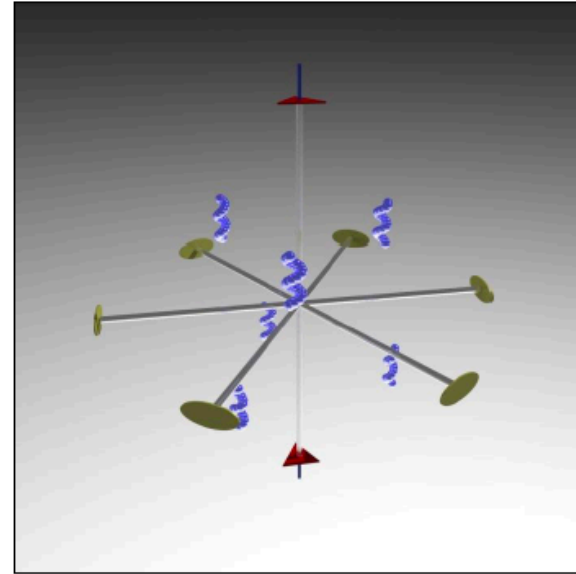


# Rhombohedral

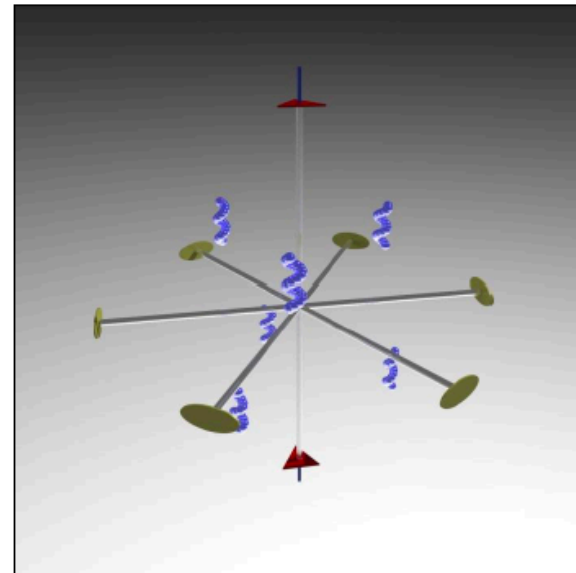
**HOLOHEDRY GROUP**



$\bar{3}m$



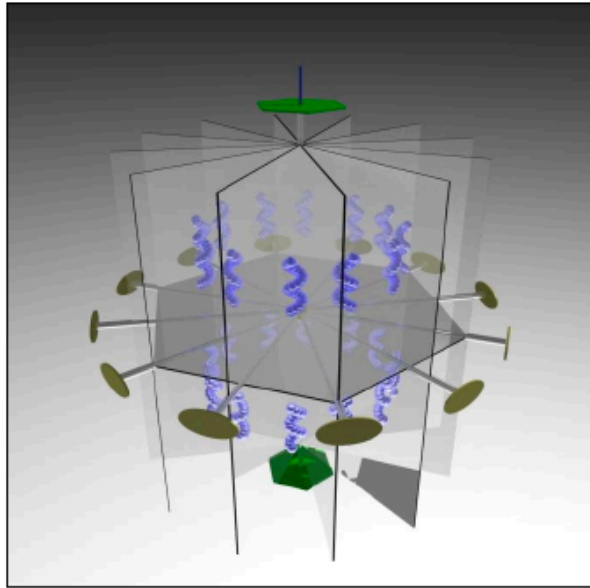
32



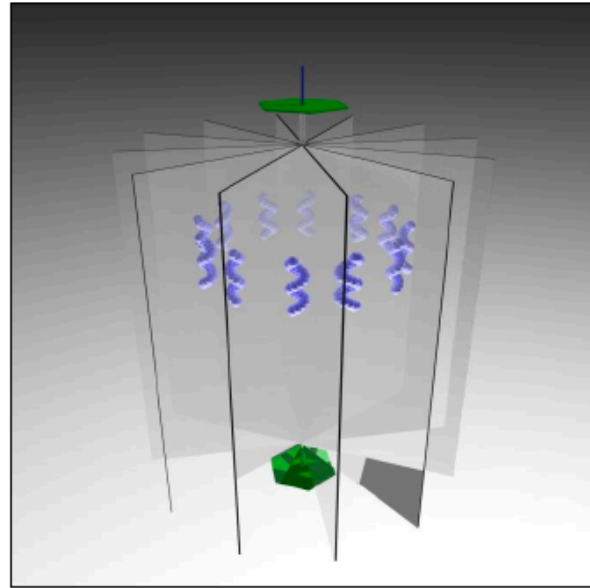
3

# Hexagonal

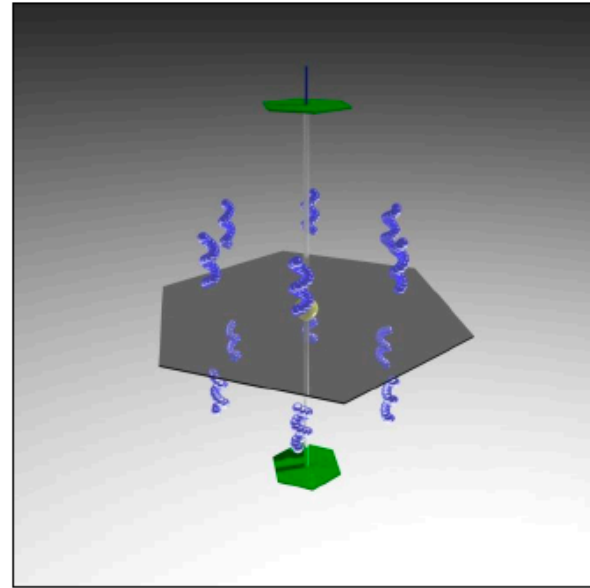
## HOLOHEDRY GROUP



$6/mmm$

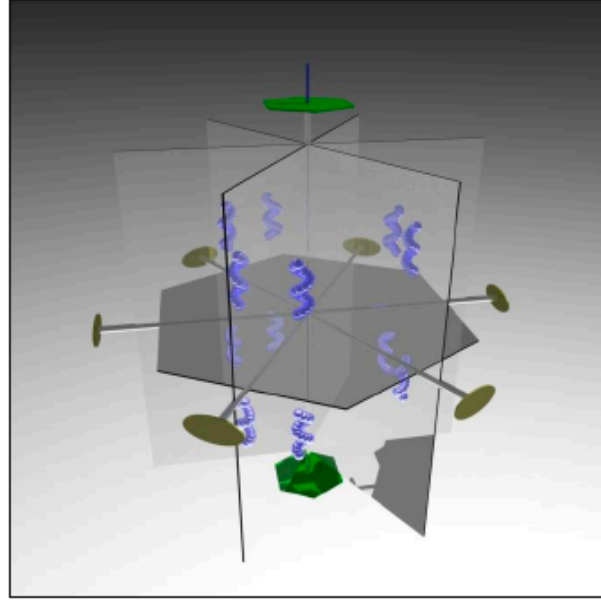
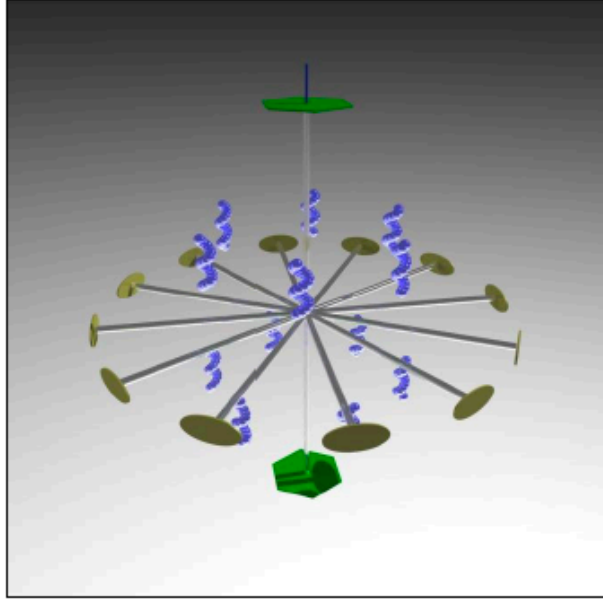


$6mm$



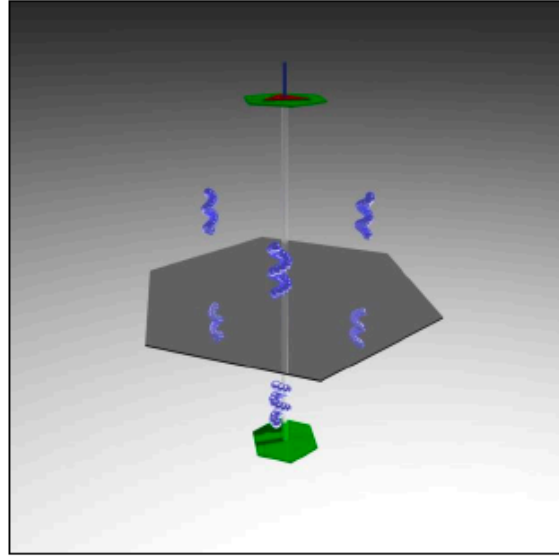
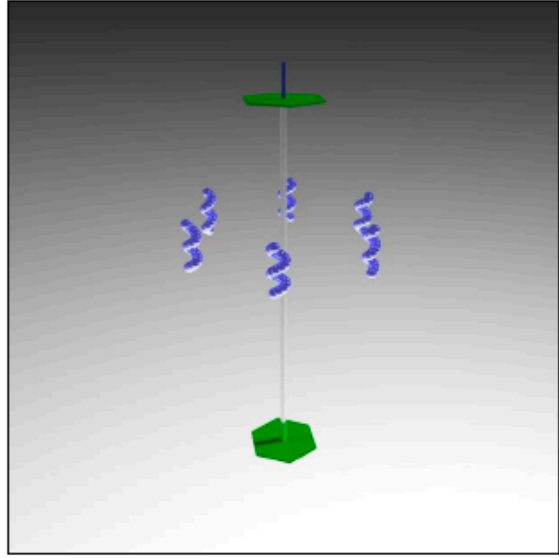
$6/m$

622



$\bar{6}m2$

6

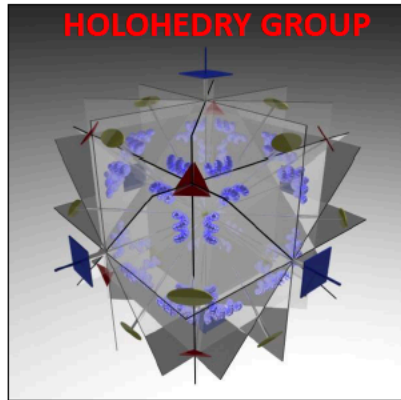


$\bar{6}$

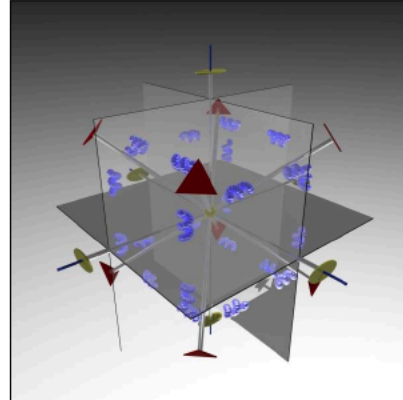
# Kübik

$m\bar{3}m$

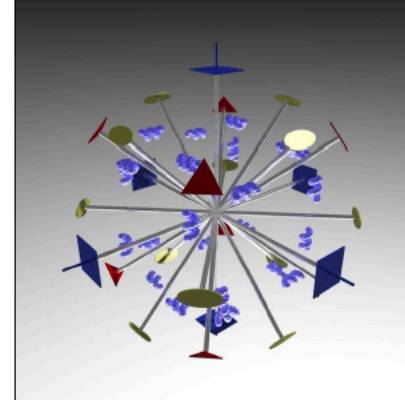
HOLOHEDRY GROUP



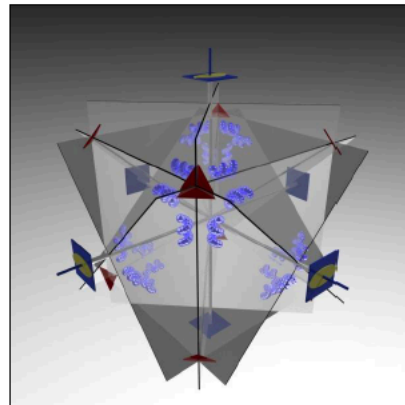
$m\bar{3}$



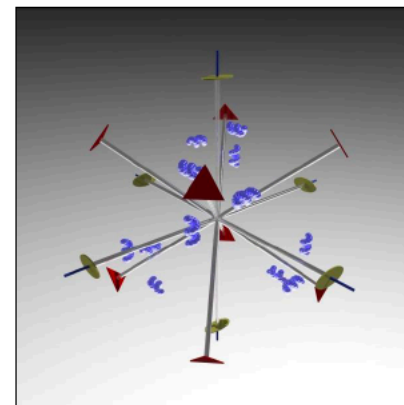
432



$\bar{4}3m$



23



# KRİSTALLERDE 32 NOKTALI SİMETRİ GRUBU ÖZETİ

Triclinic	Monoclinic	Orthorhombic	Tetragonal	Rhombohedral	Hexagonal	Cubic
$\bar{1}$	$2/m$	$mmm$	$4/mmm$	$\bar{3}m$	$6/mmm$	$m\bar{3}m$
		$mm2$	$4mm$	$3m$	$6mm$	
			$4/m$	$\bar{3}$	$6/m$	$m\bar{3}$
1	2	222	422	32	622	432
	$m$		$\bar{4}2m$		$\bar{6}2m$	$\bar{4}3m$
			4	3	6	23
			$\bar{4}$		$\bar{6}$	