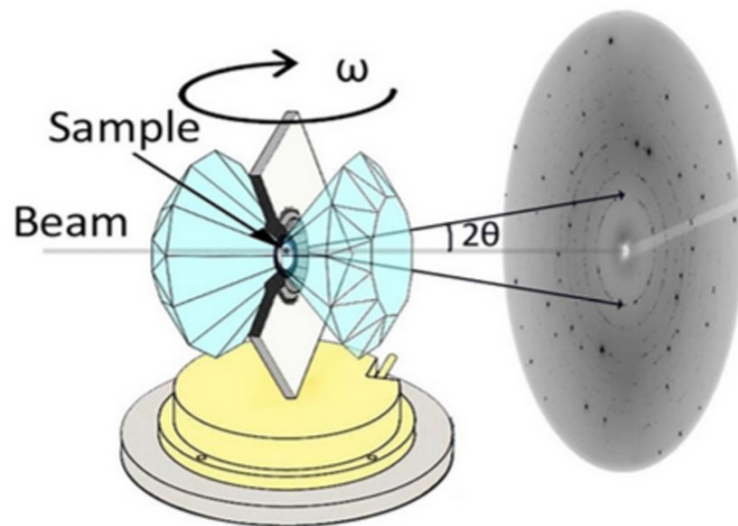


# High Pressure Single Crystal X-ray Diffraction

## *Introduction*

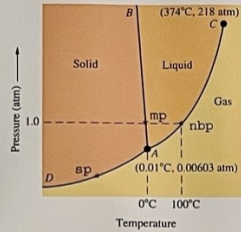
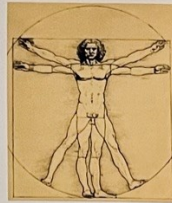


Haozhe Wang  
Advisor: Prof. Weiwei Xie

# Pressure range, 0 to 10 GPa



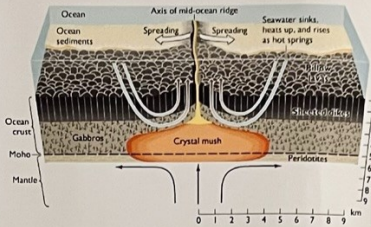
$10^{-22}$   
Intergalactic void



$6 \times 10^{-3}$   
Water triple point



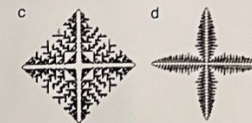
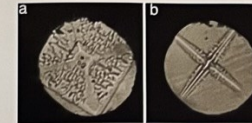
$10^{-16}$   
Lowest Lab P



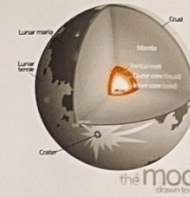
$2 \times 10^3$   
Bottom of Ocean crust



$1.7 \times 10^3$   
Gas loading



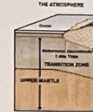
$10^4$   
Water solidifies



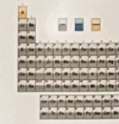
$5-6 \times 10^4$   
Moon core



$3 \times 10^4$   
Hydrothermal DAC



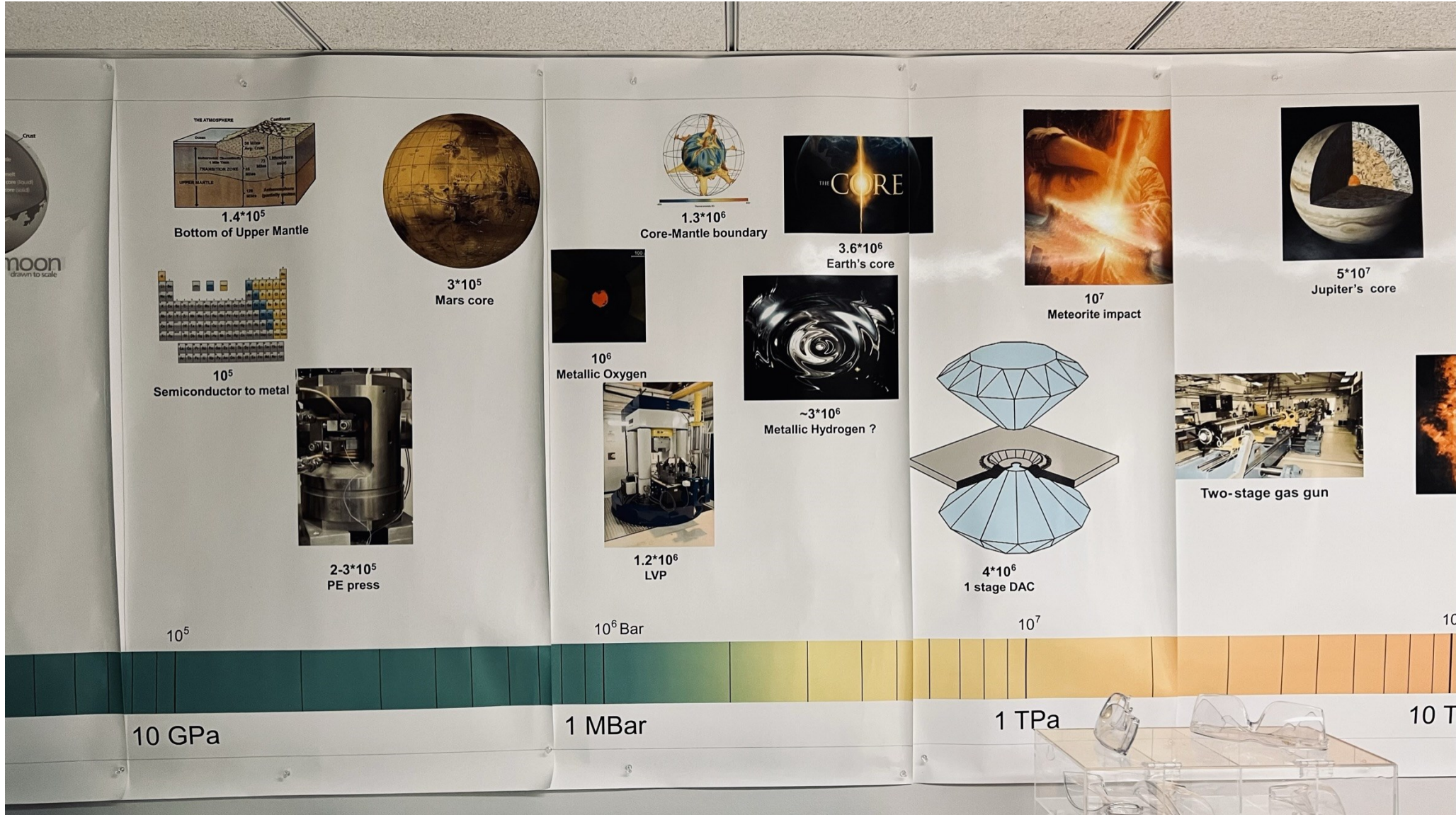
$1.4 \times 10^5$   
Bottom of U



$10^5$   
Semiconductor



# Pressure range, 10 GPa to 10 TPa



# Pressure range, > 10 TPa



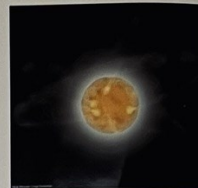
$10^7$   
Meteorite impact



$5 \times 10^7$   
Jupiter's core



$2.5 \times 10^{11}$   
Sun's core



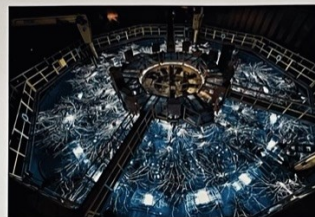
$10^{30}$   
Neutron star



Two-stage gas gun



Detonation



$10^9$   
Z-machine



$10^{11}$   
National Ignition Facility

$10^8$

$10^9$

$10^{10}$

$10^{11}$

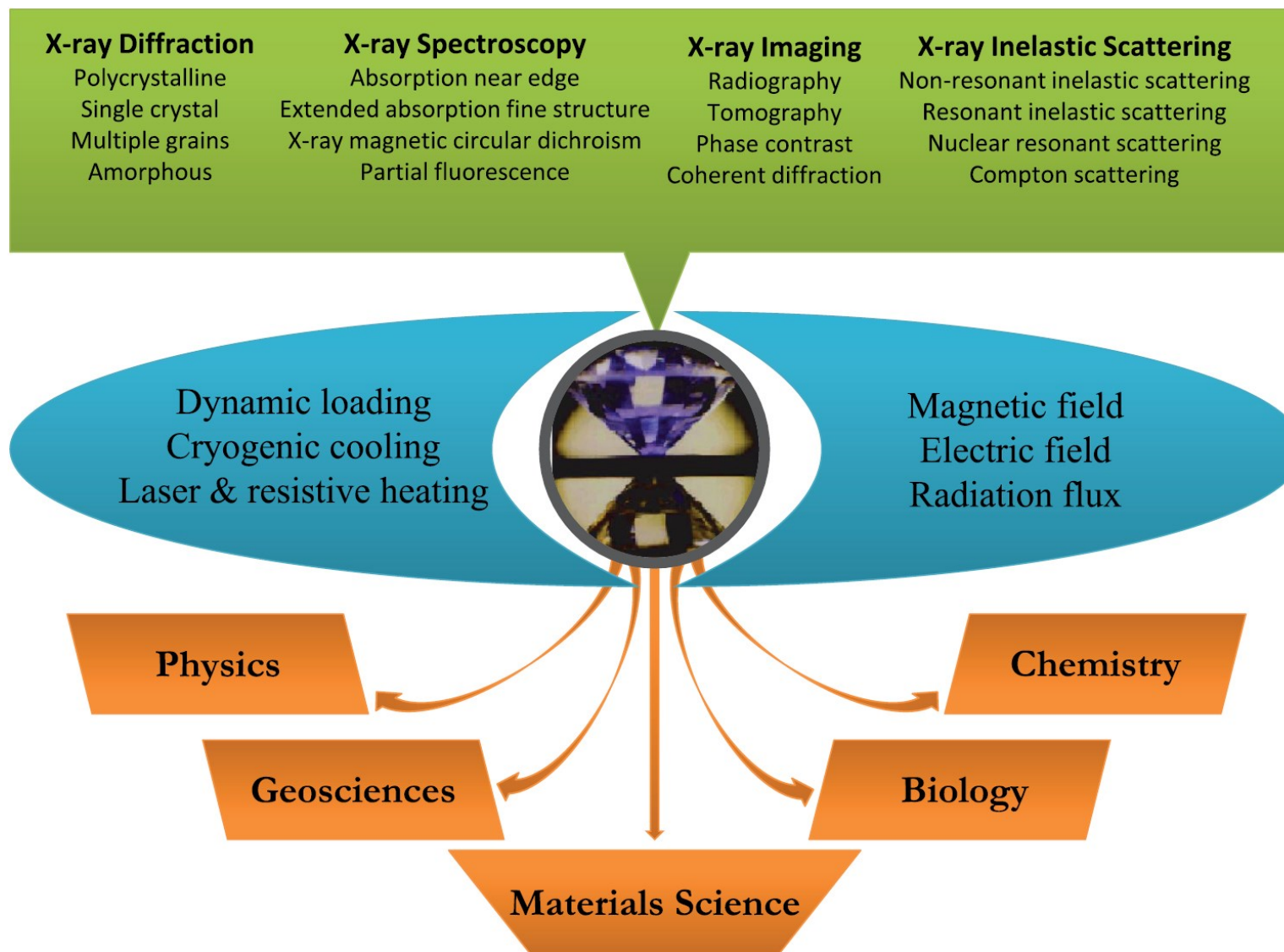
$10^{15}$

$10^{20}$  Bar

10 TPa

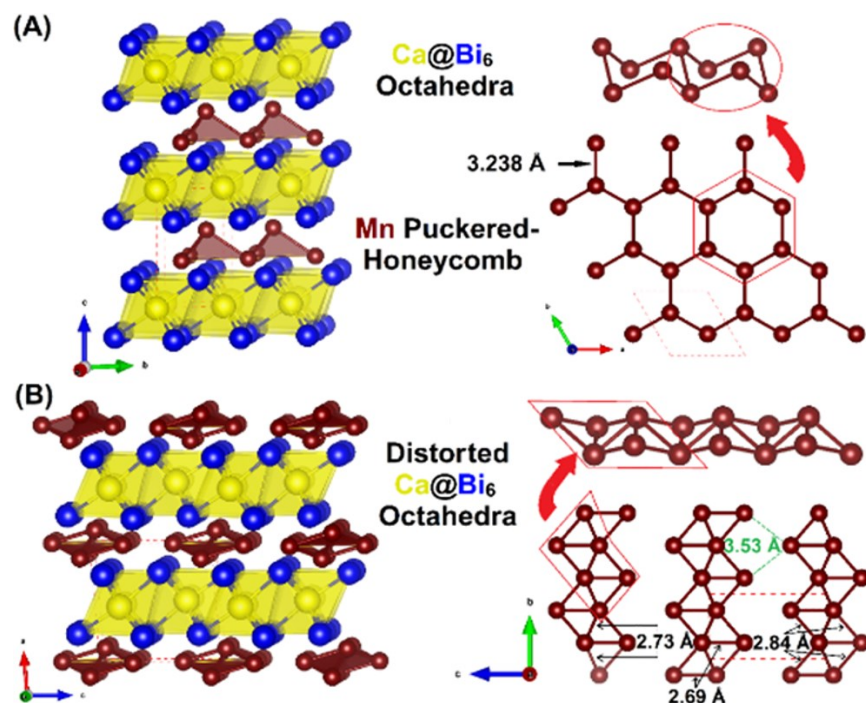
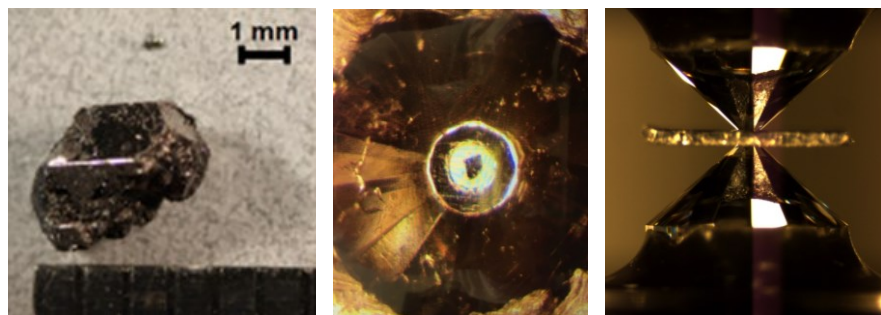
1 GBar

# Various X-ray probes under extreme conditions

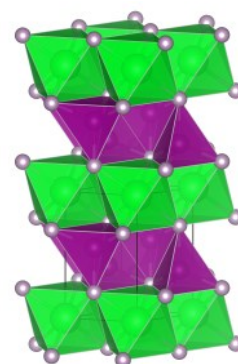


# Novel quantum materials under high pressure

CaMn<sub>2</sub>Bi<sub>2</sub>

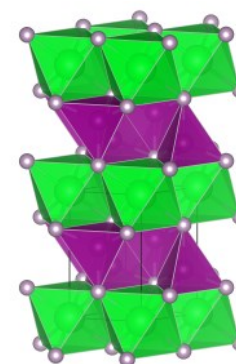


CaMn<sub>2</sub>P<sub>2</sub>

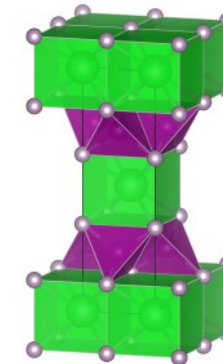


Trigonal  
*P*-3 *m* 1 (164)  
60 cm<sup>3</sup>/mol

SrMn<sub>2</sub>P<sub>2</sub>

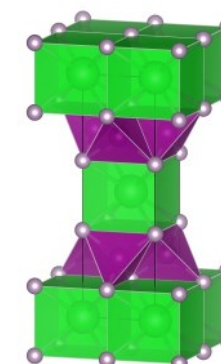


*ambient pressure*  
64 cm<sup>3</sup>/mol



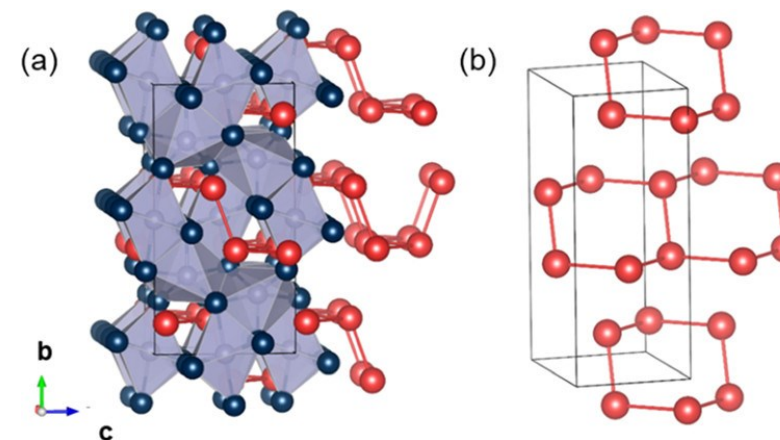
*high pressure*  
60 cm<sup>3</sup>/mol

BaMn<sub>2</sub>P<sub>2</sub>

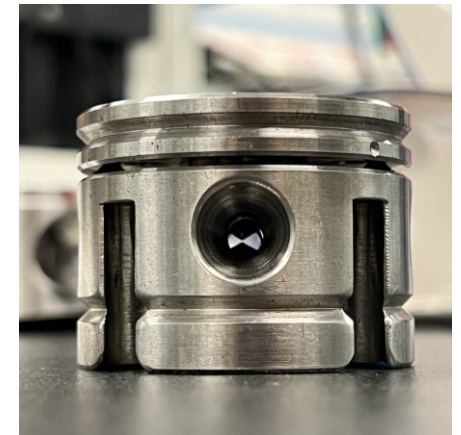
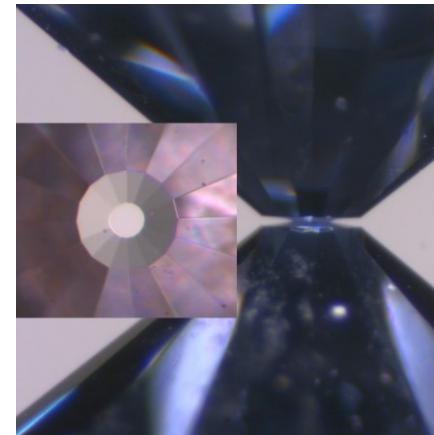
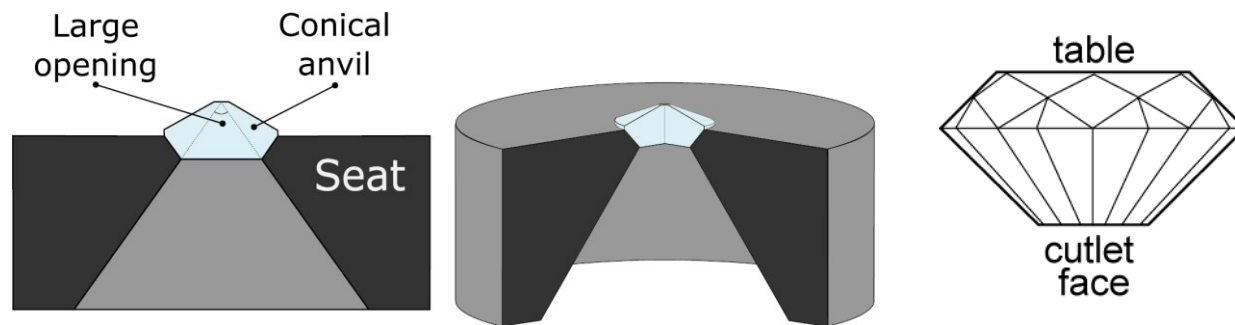
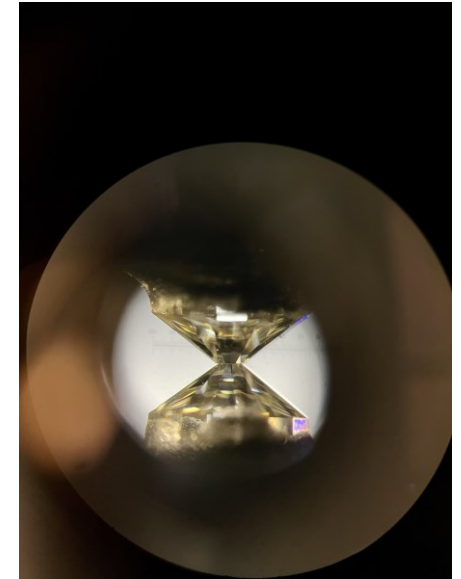
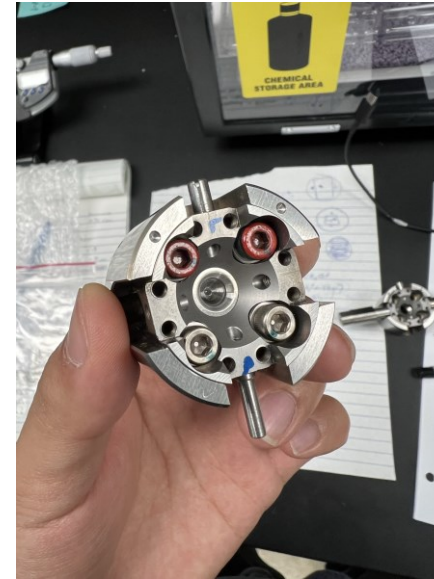
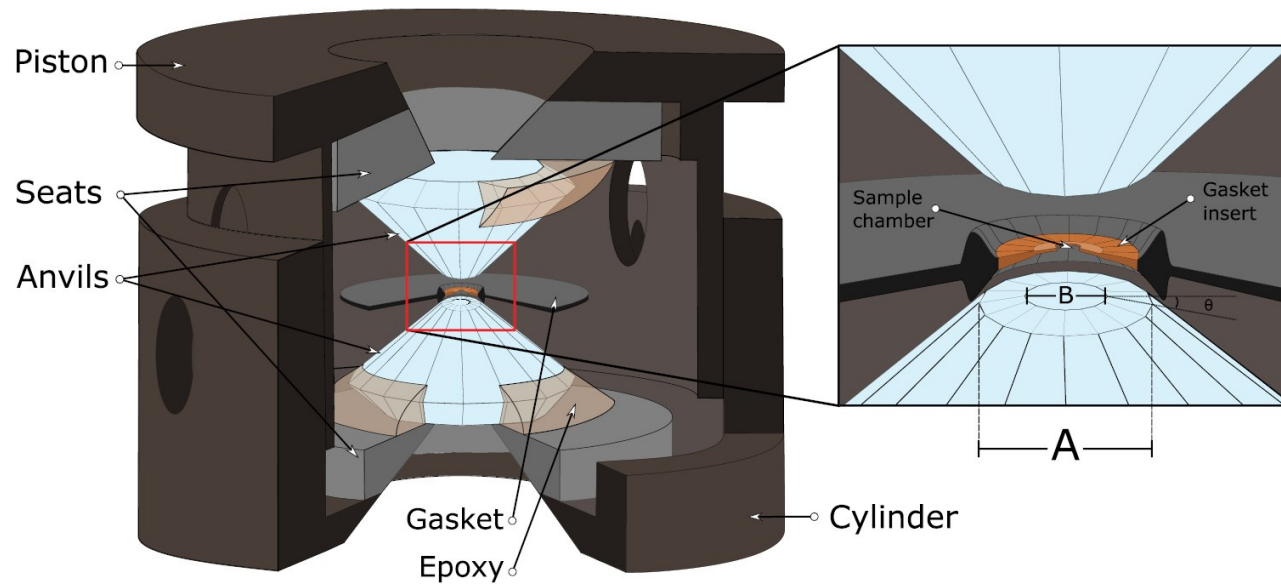


Tetragonal  
*I*4/*m m m* (139)  
64 cm<sup>3</sup>/mol

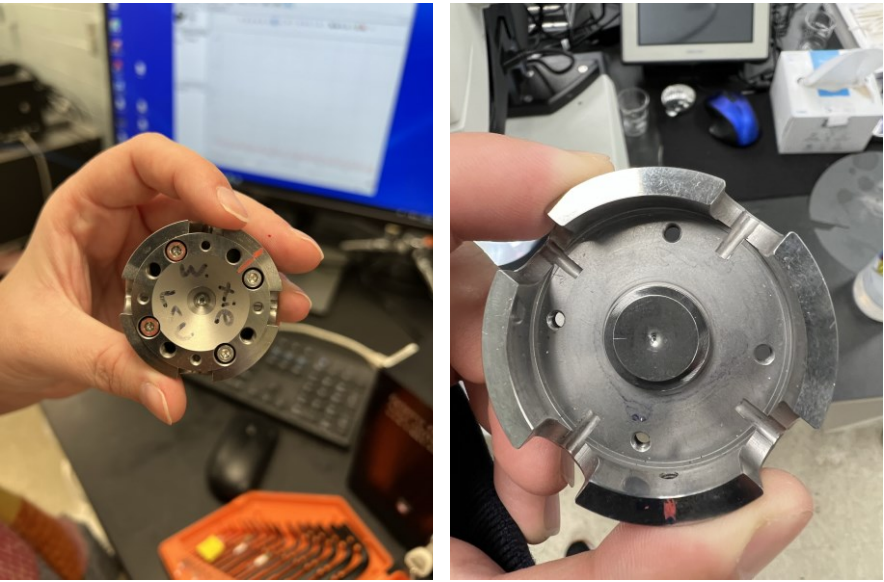
Eu<sub>2</sub>Mg<sub>3</sub>Bi<sub>4</sub>



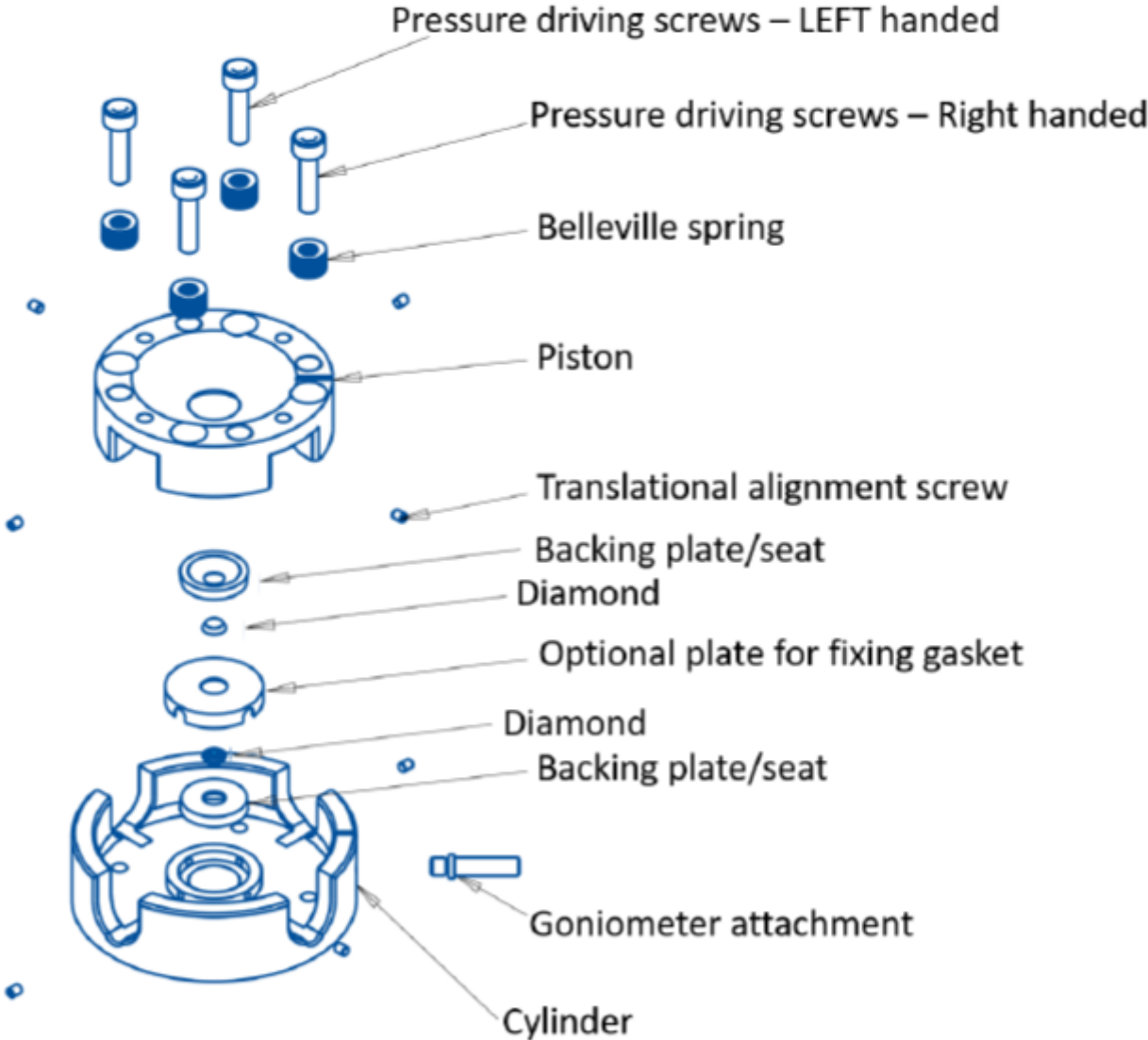
# Diamond anvil cell (DAC)



# Components of One20 DAC

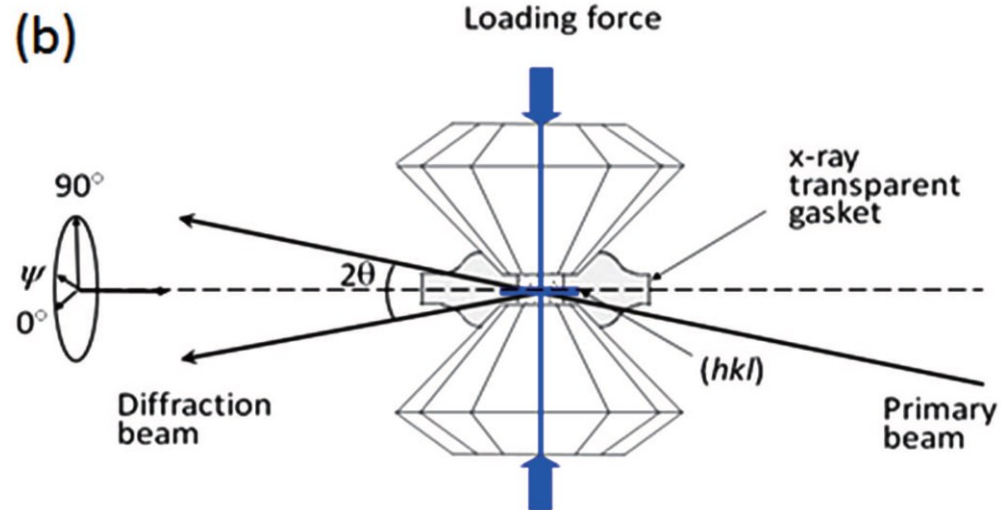
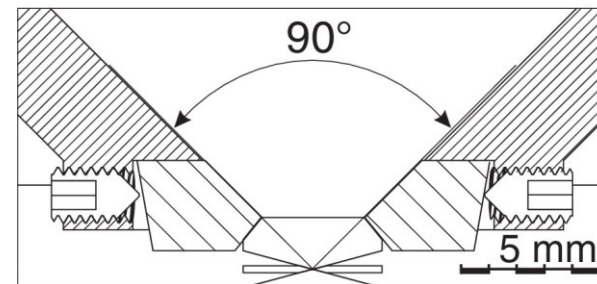
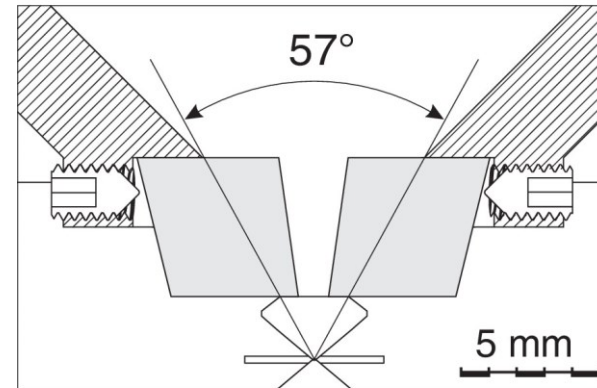
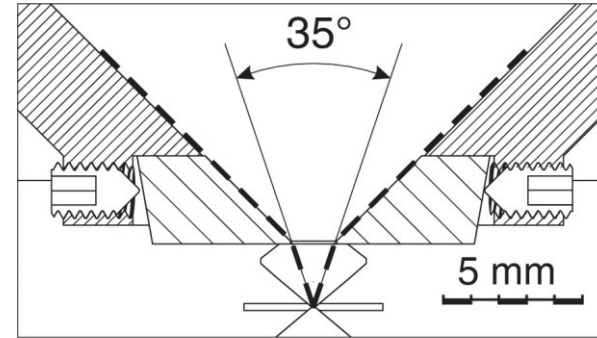
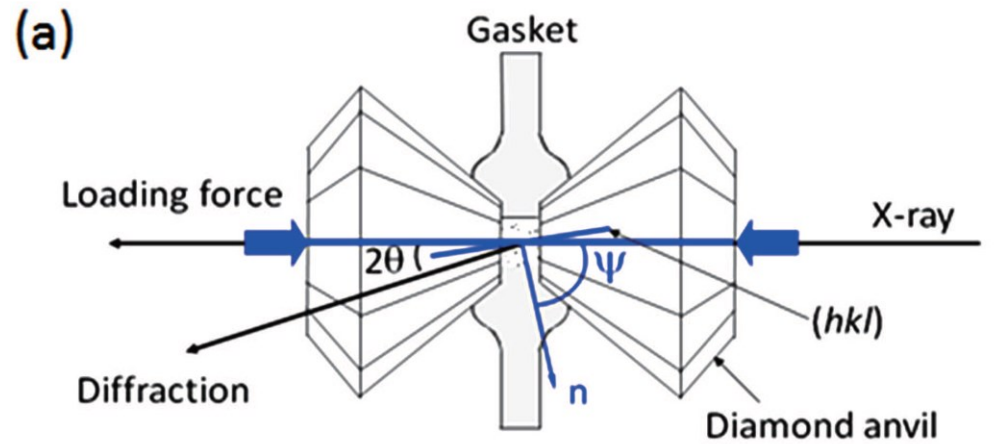


One20 DAC

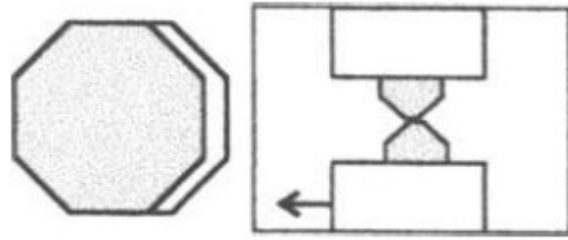




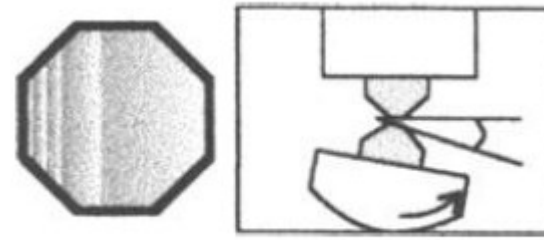
# Wide opening of DAC



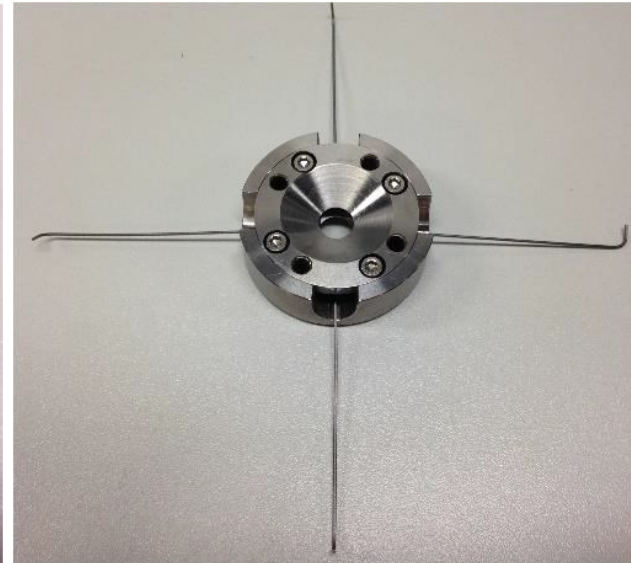
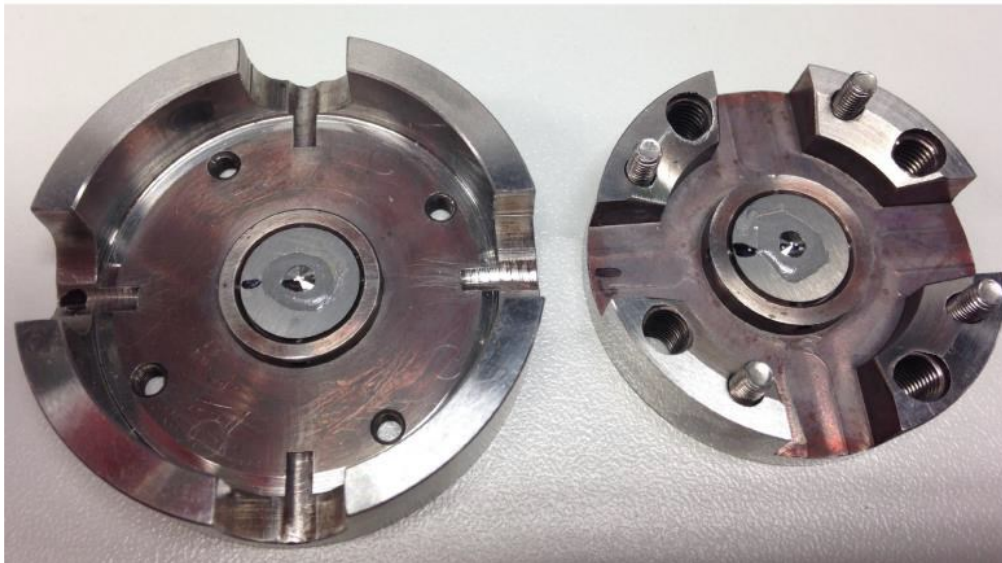
# DAC loading: alignment



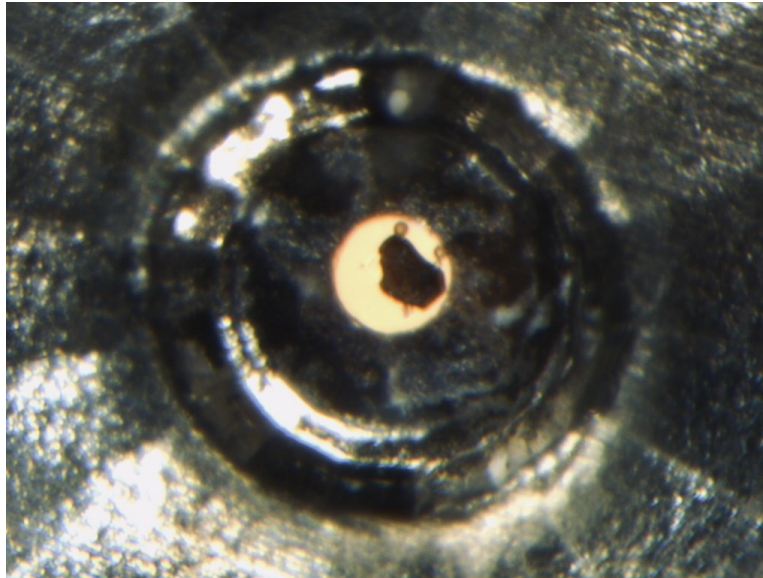
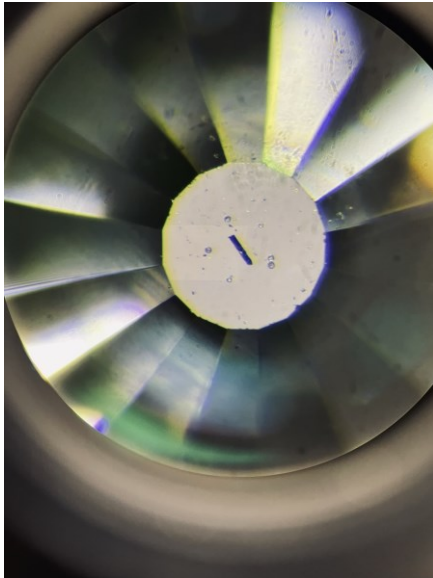
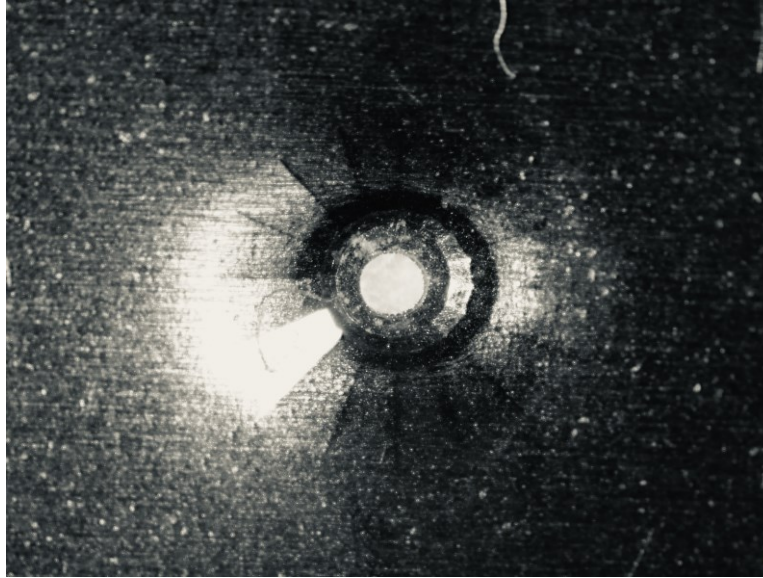
horizontal alignment



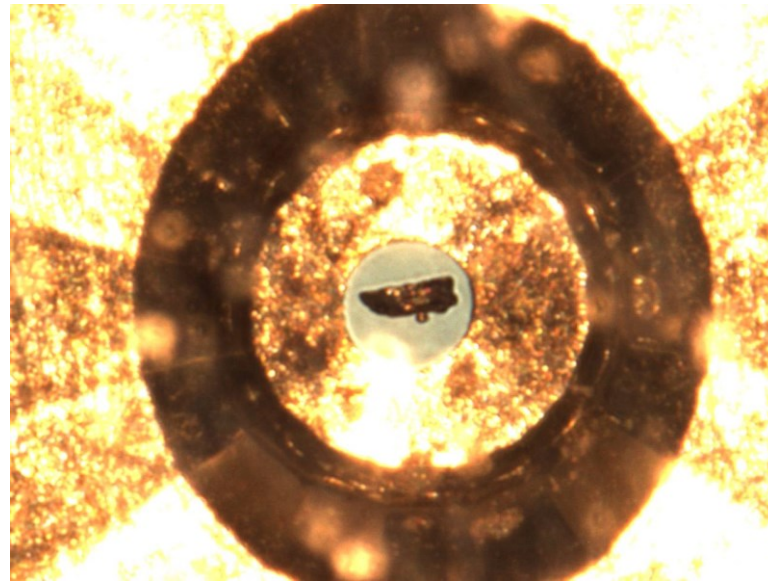
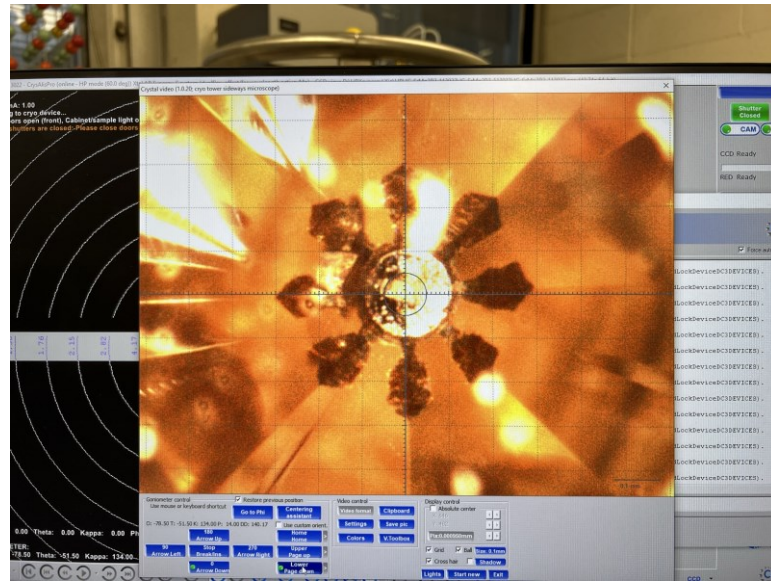
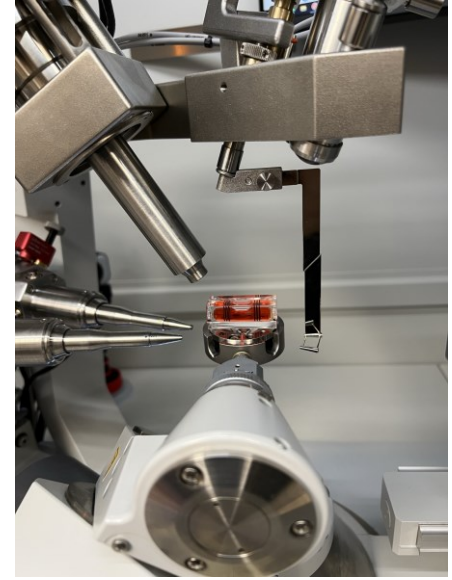
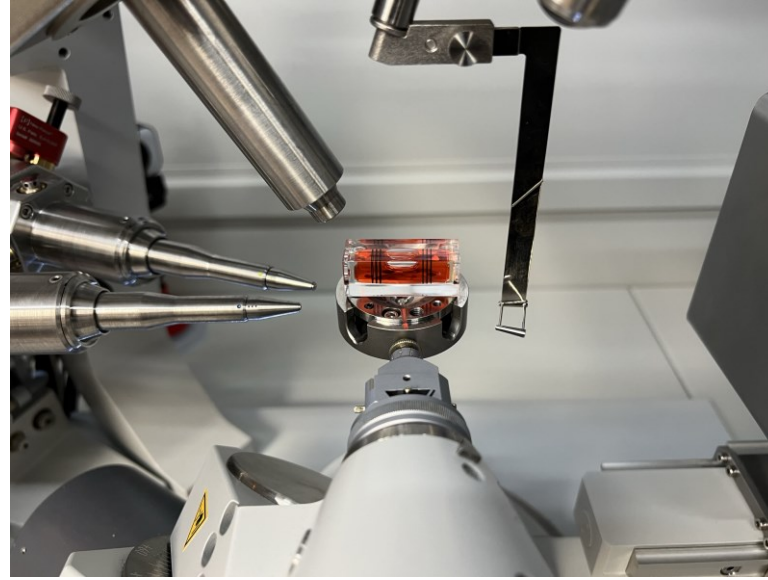
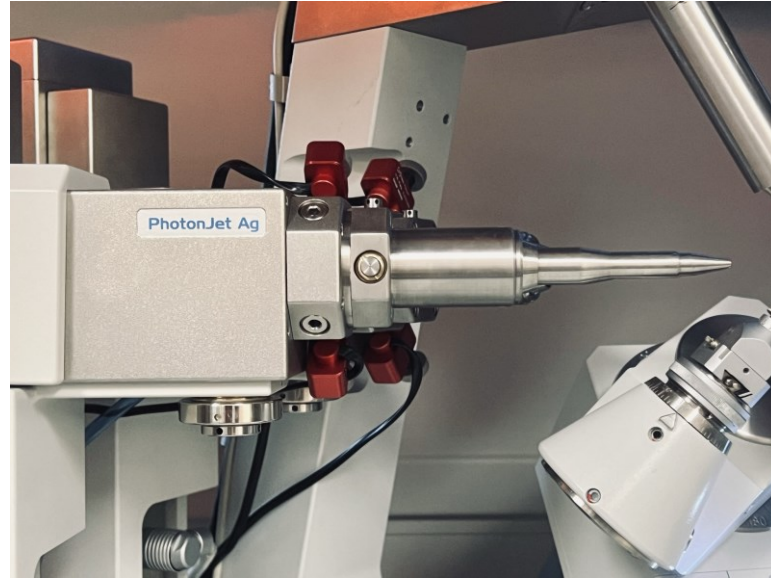
tilt alignment



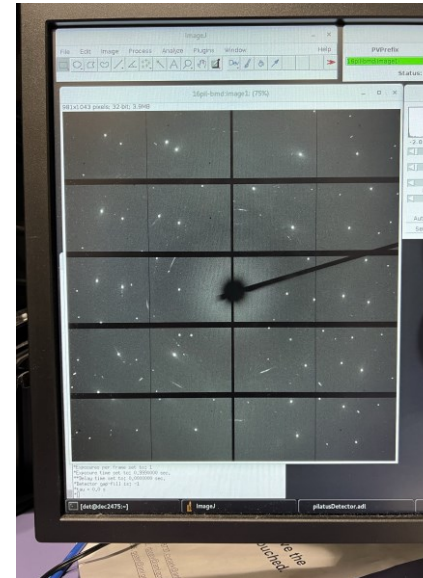
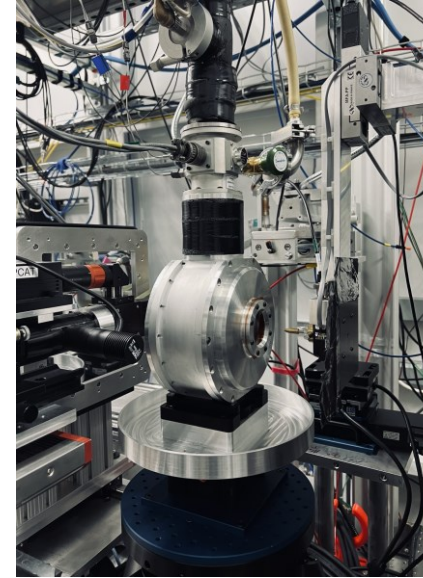
# DAC loading: gasket and sample loading



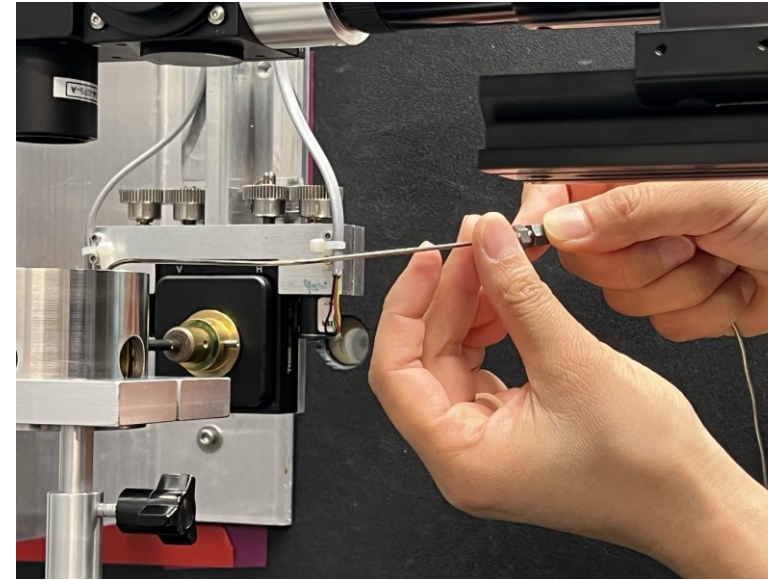
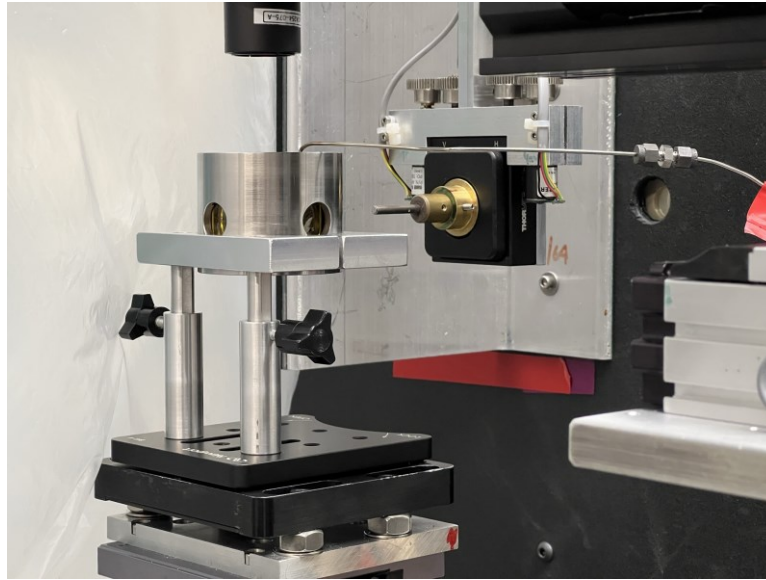
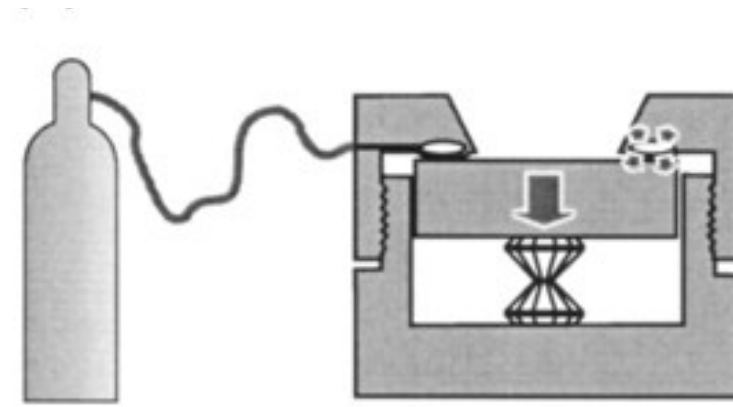
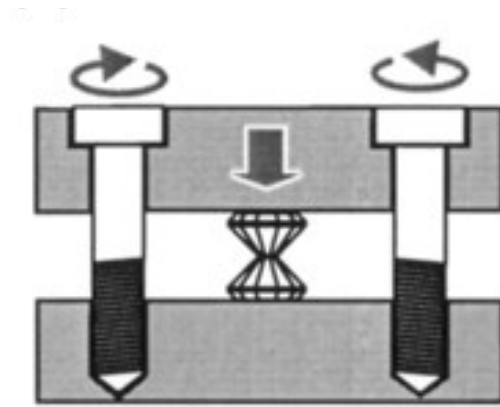
# DAC alignment on the goniometer



# HP-SCXRD experiments on 16-BMD



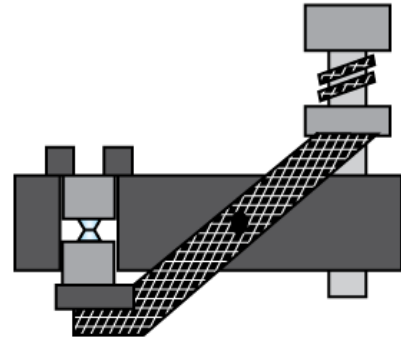
# Inflatable membrane



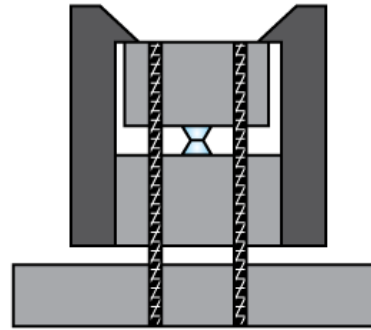
**Thanks for your attention!**  
Questions?



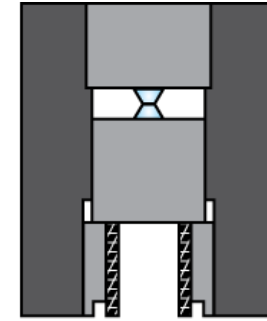
# Applying the force, DAC



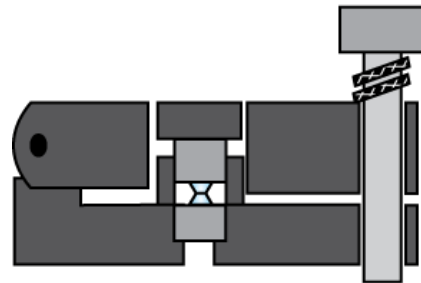
1st class lever drive



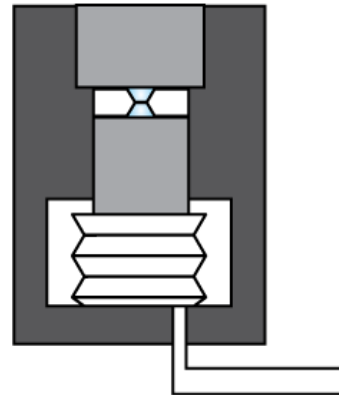
Pin - guide screw drive



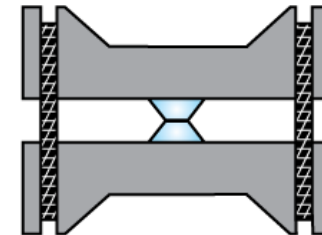
Screw piston drive



2nd class lever drive



Fluid - bellows drive



pull - platen drive

six basis ways of providing force in the DAC (Bassett, 1979)