55th meeting of the PAC for Condensed Matter Physics

High pressure effect on internal structure and atomic dynamics of pharmaceutical compounds

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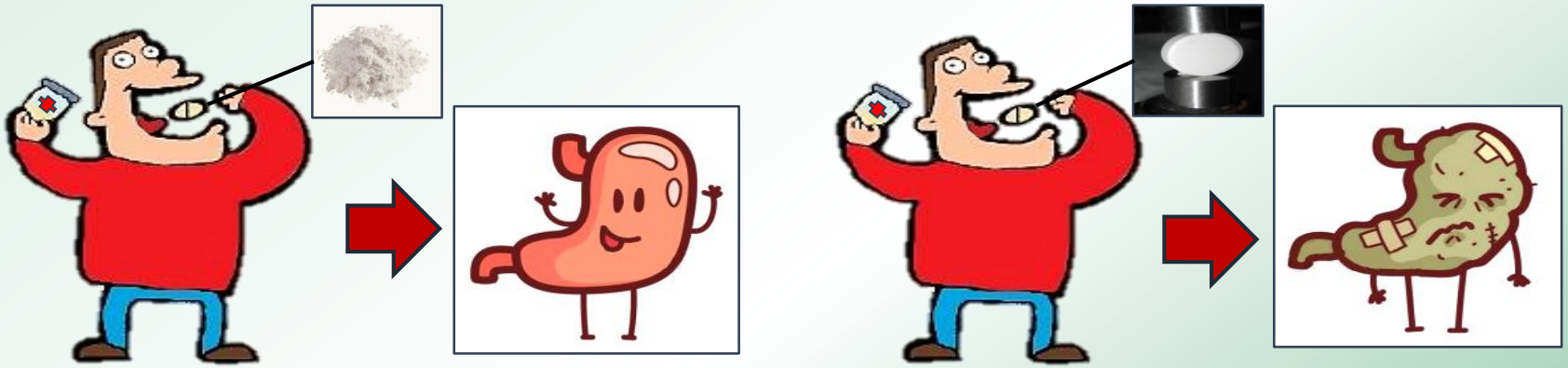
Study of the properties of pharmaceutical compounds

The study of pressure-induced changes in the crystal structure and atomic dynamics **in complex molecular crystals** is **an urgent task** of condensed matter physics and organic chemistry.

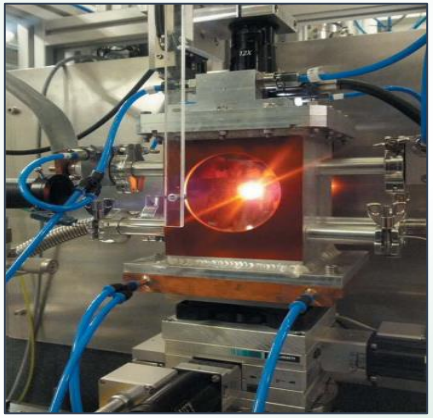
Moreover **structural studies of molecular crystals are extremely important for optimizing the process of pharmacological production**, where complex molecular components under additional mechanical influences (grinding or tableting) in the initial substance may develop **irreversible polymorphic phase transitions** or **amorphization**, which may lead to **significant changes** in the physical, chemical and pharmaceutical properties of **the pharmacological material.**

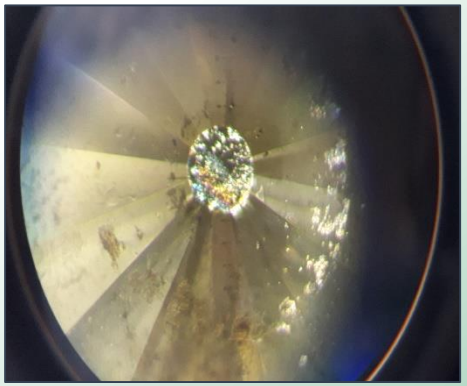
The harm of irreversible phase transition of pharmaceutical compound developed under high pressure



Experimental base

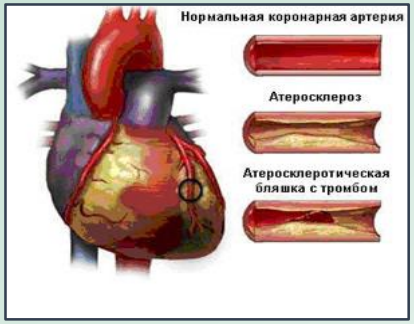
LabRAM spectrometer Horiba, FLNP JINR (Dubna, Russia)

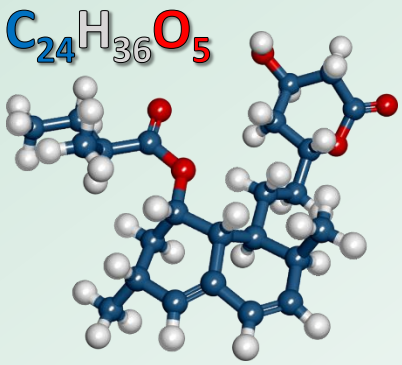




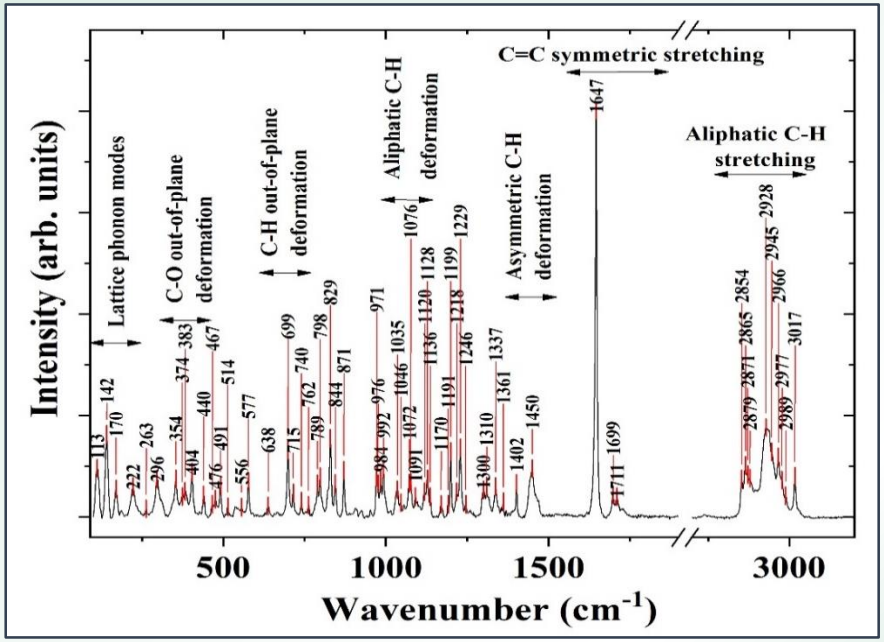
Extreme Conditions Beamline (ECB) P02.2, PETRA-III DESY (Hamburg, Germany)

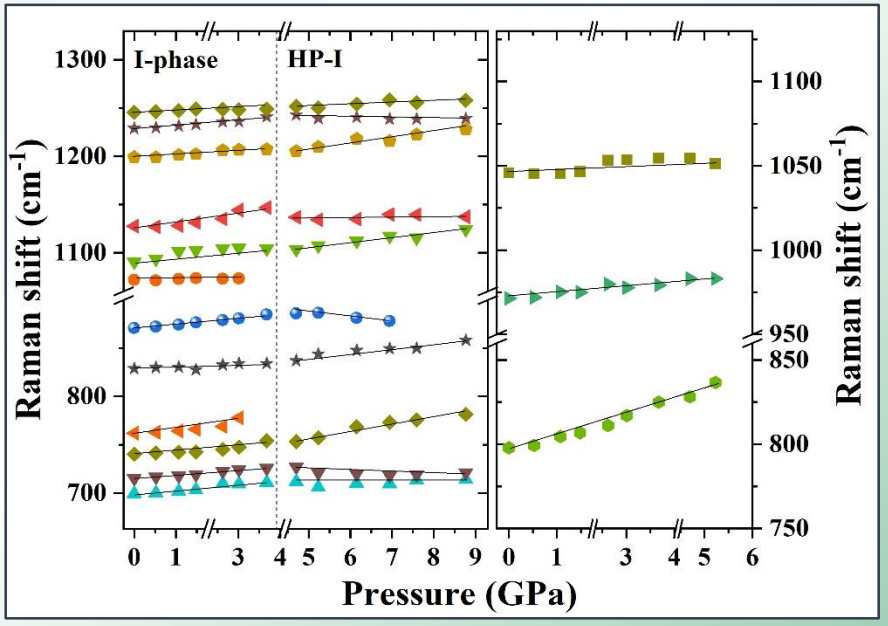
Atomic dynamics of lovastatin





Raman, cm^{-1}	Vibrational modes assignment
113, 142, 170	Lattice phonon modes
222, 263 (vw), 296	CH_3 torsional vibration
354, 374(sh), 383, 404	C-O out-of-plane deformation
404, 440, 467(sh), 476, 491	Aliphatic C-CH_3 stretches/ring deformation/ C-O in-plane deformation
638(w)	O-H out-of-plane deformation
829, 844, 871	Aliphatic C-CH_3 stretches
971, 976(sh), 984, 992	Out-of-plane C-H deformation in *cis*-vinylenes
1035, 1072, 1076	Aliphatic C-H deformation
1120, 1128, 1136, 1170	Coupled C-O stretches
1402, 1450	Asymmetric C-H deformation
1647(s), 1699, 1711	C=C sym stretching in dienes, C=O in esters
2865, 2928(br), 2945(sh), 2966	Aliphatic C-H stretching (sym and asym in CH_2 and CH_3)

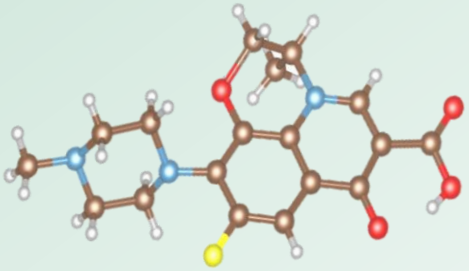




Internal structure and atomic dynamics of ofloxacin

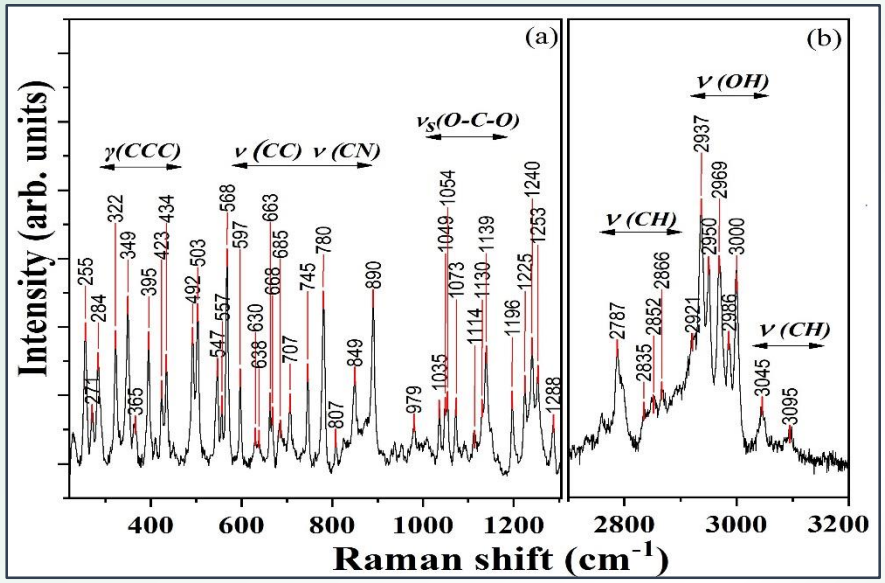
fighting bacterial infections

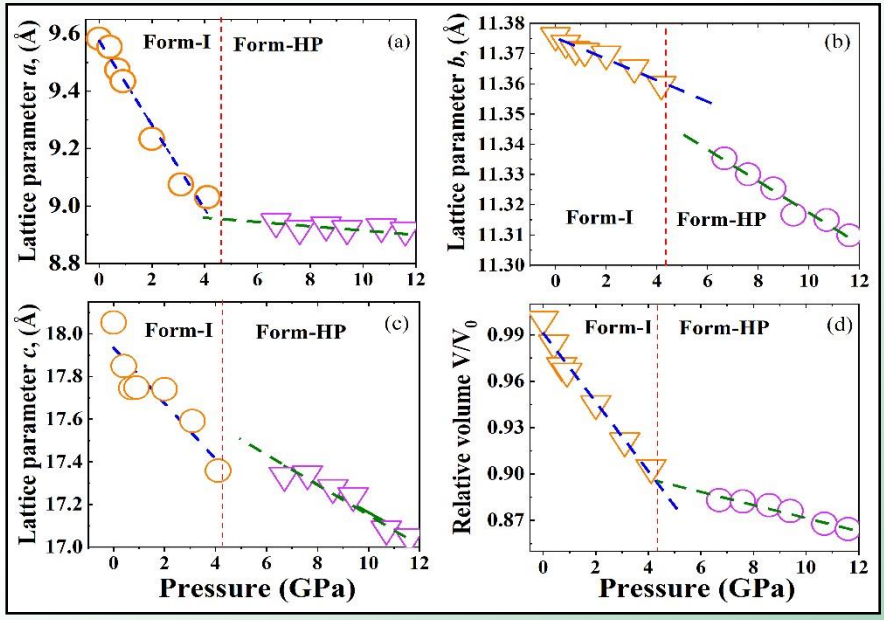
$C_{18}H_{20}FN_3O_4$



Raman, cm^{-1}	Vibrational modes assignment
434, 452	γ(CCC) out-of-plane deformations
550, 785, 1051, 1401	CC, CN stretching vibrations from A and B rings
1250	υ_s O-C-O
1387, 1400	the bending vibration of OH group
1453, 1469, 1486	υ CH bending vibrations
2786	υ (CH) stretching vibration of N–CH_3
2968, 2985	and antisymmetric stretching vibrations
3043	υ(CH) stretching vibration

Compressibility coefficients		
Form	Initial form	HP-form
k_a, Å	0.0153(2)	0.0415(1)
k_b, Å	0.0038(4)	0.0047(3)
k_c, Å	0.0073(2)	0.0037(4)
B_0, GPa	32(2)	57(3)





Kichanov, S.E., Belozerova, N.M., Dyussembekova, et al., "The pressure-induced changes of crystal structure and vibrational spectra of ofloxacin", Journal of Molecular Structure (2021). [under revision]

Thank you for attention!