Isentropic Compression of Substances Using Ultra-High Magnetic Field: Zero Isotherms of Protium and Deuterium in Pressure Range up to 5 Mbar

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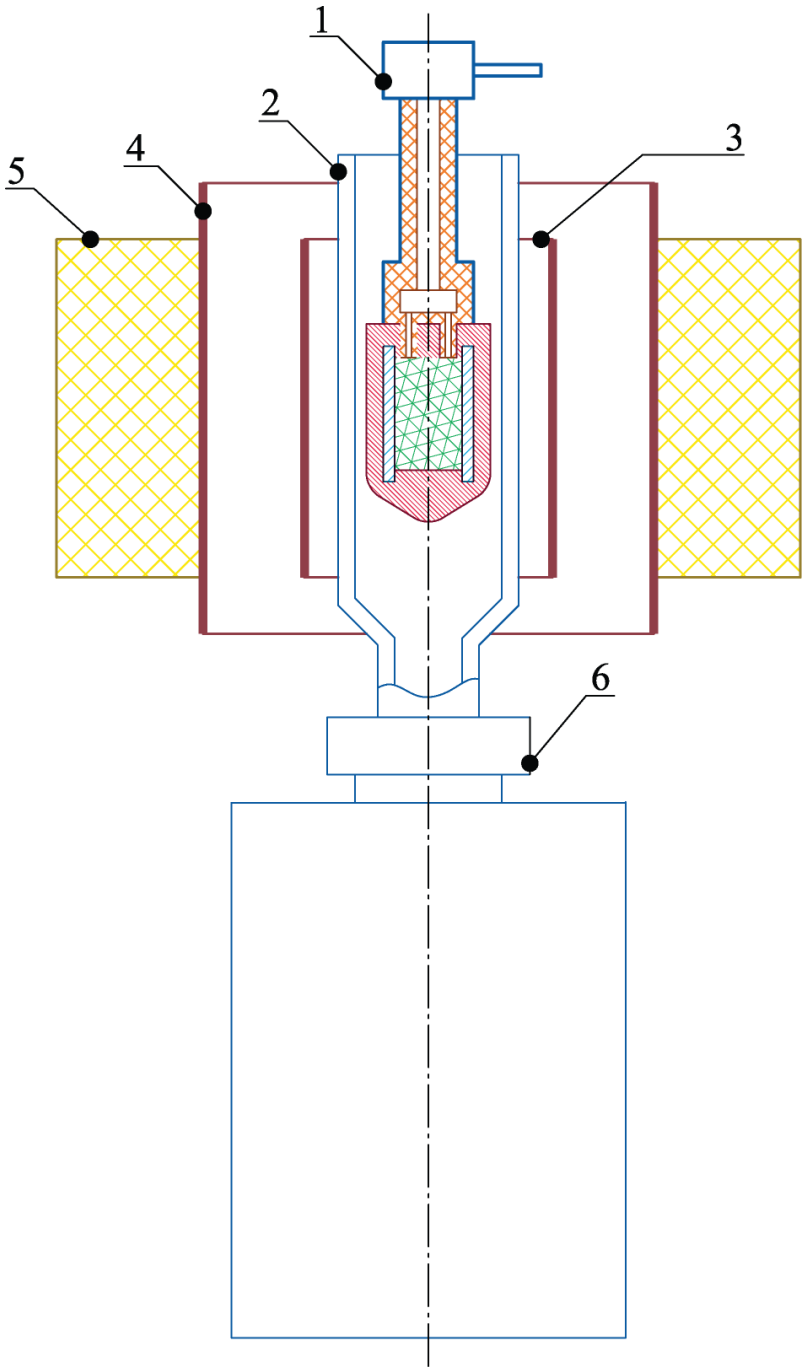
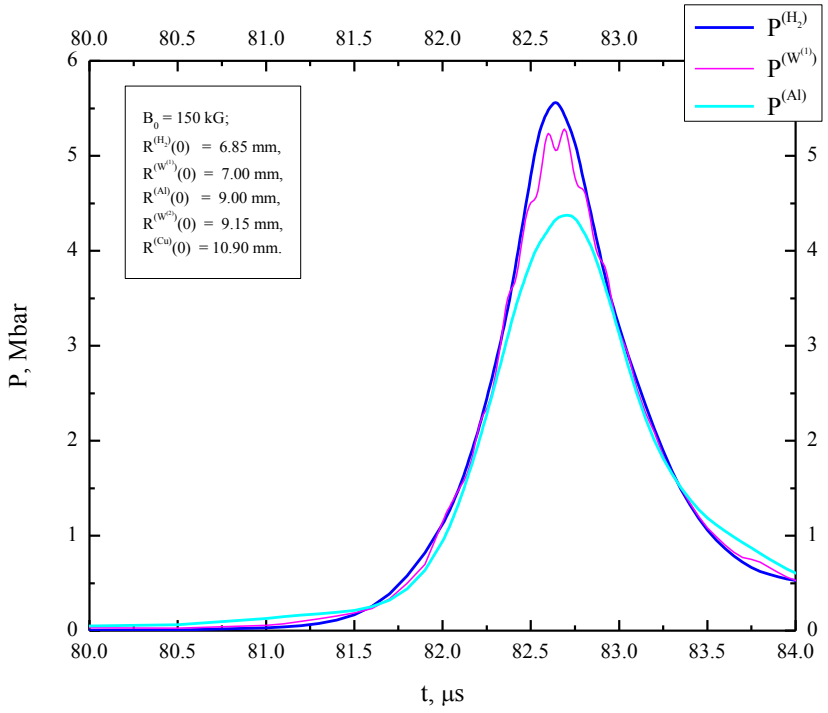
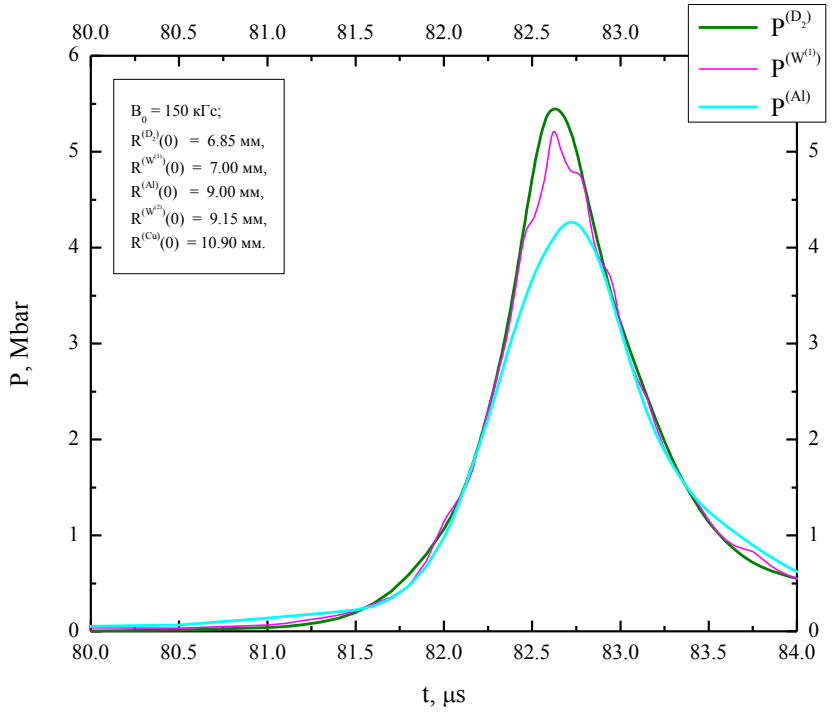


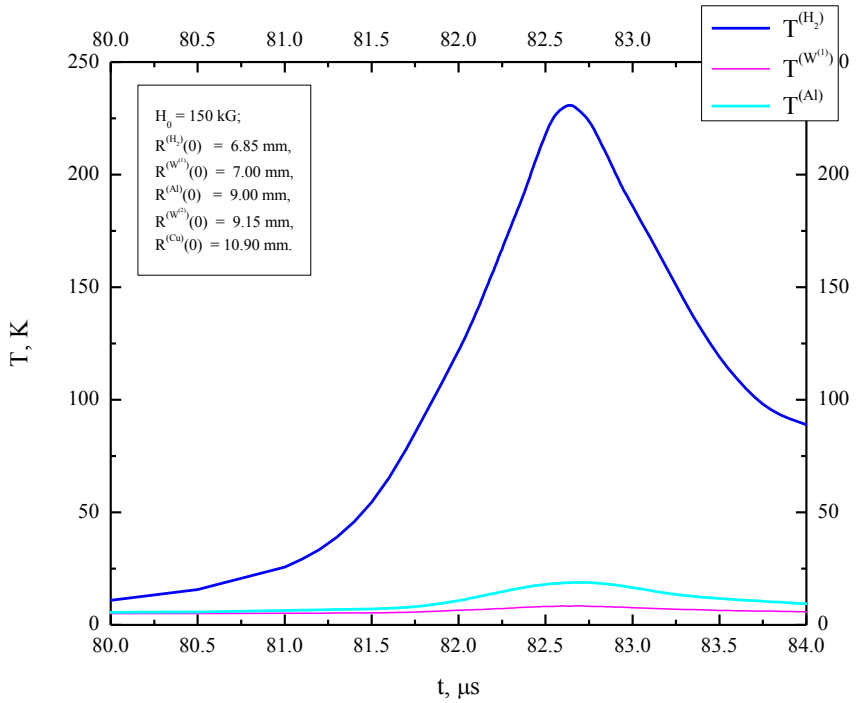
Compression device sketch:

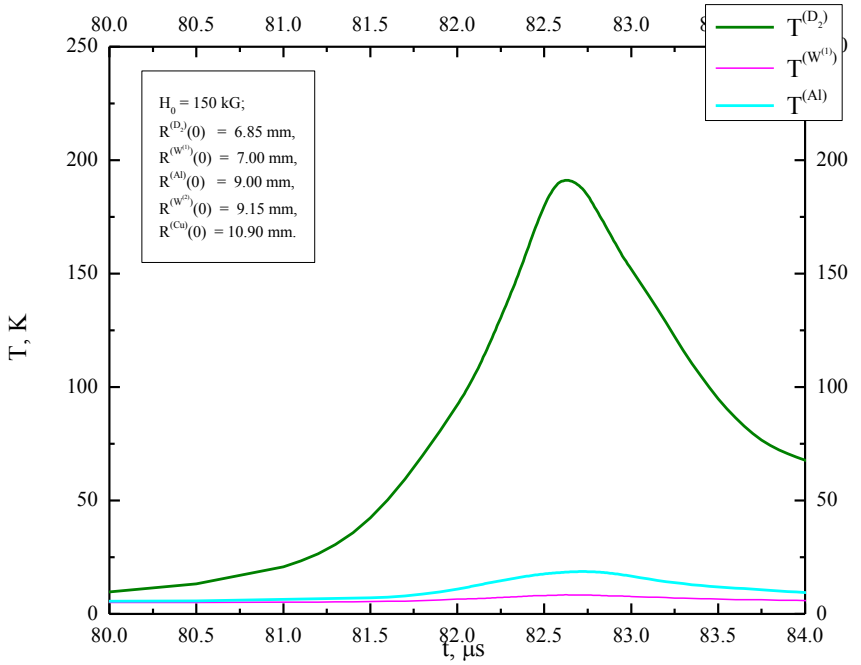
1 - cryogenic container with the compression chamber,
2 – pumped cryopipe for the coolant transport,
3 - the second cascade of the generator,
4 - solenoid of the generator seed field (the first cascade of the generator),
5 - ring HE-charge,
6 - cryogenic vessel.



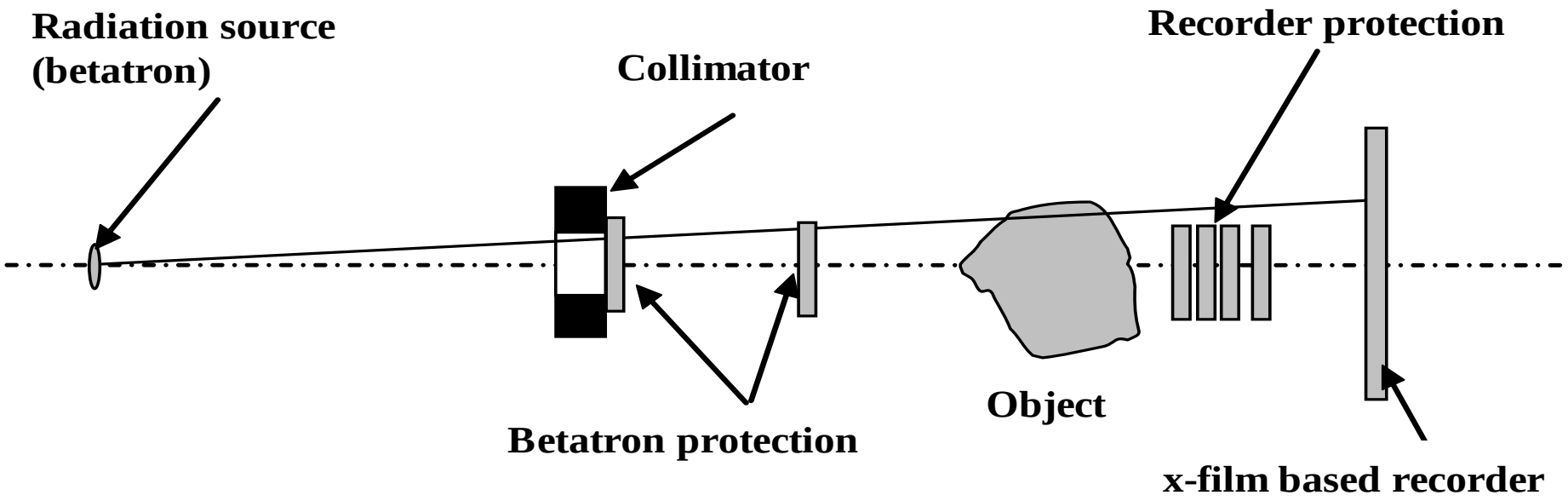


Pressures *P(↑□⇑)* vs. time for optimized compression device



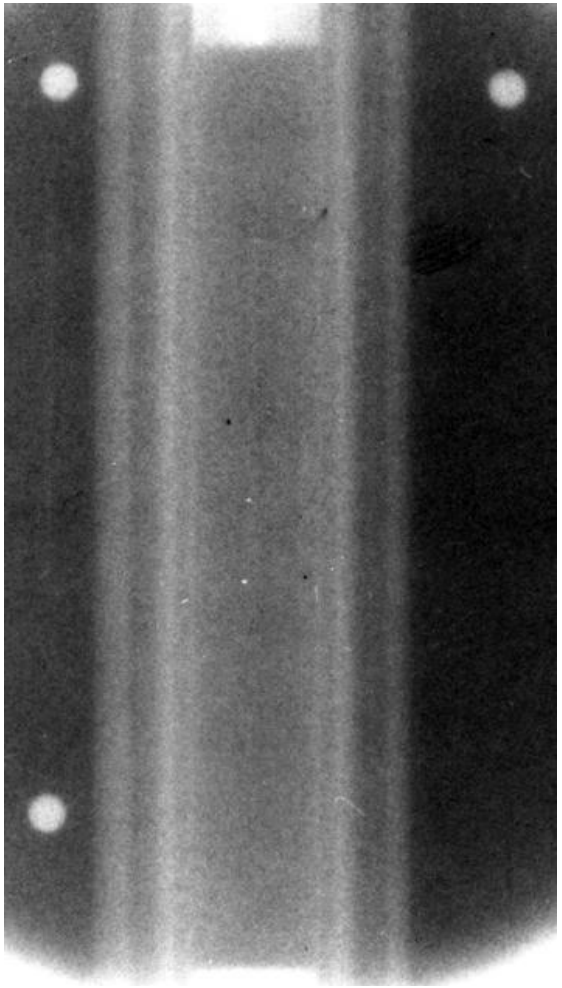


Temperature *T(↑□↑)* vs. time for optimized compression device

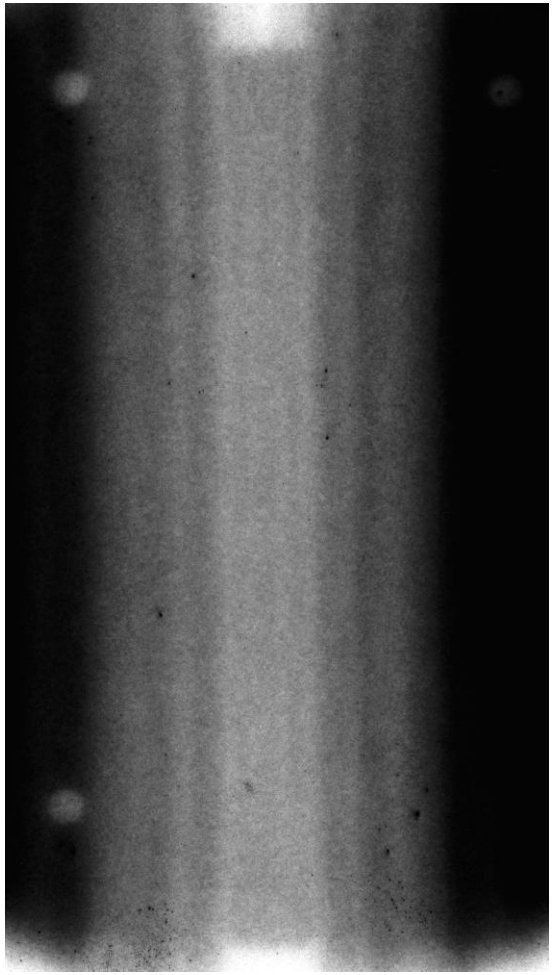


Scheme of x-ray radiography installation

a)

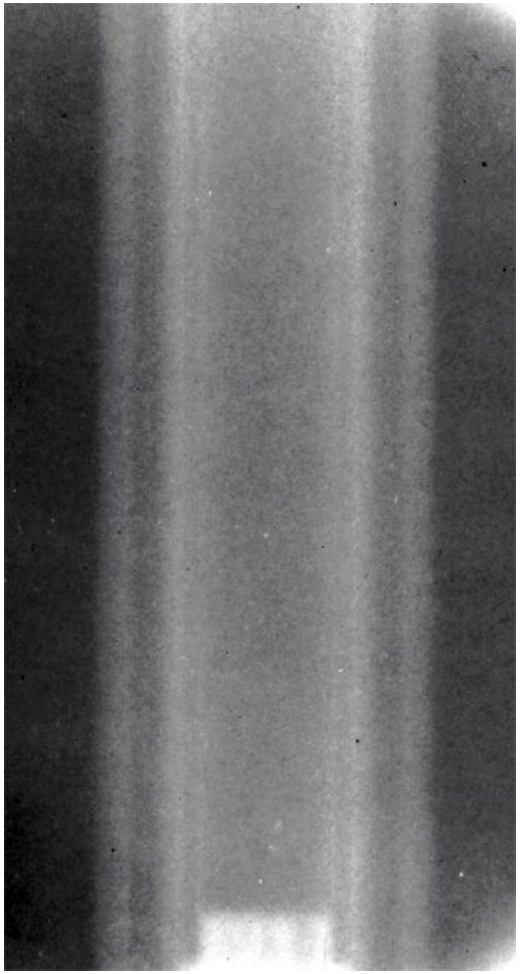


b)

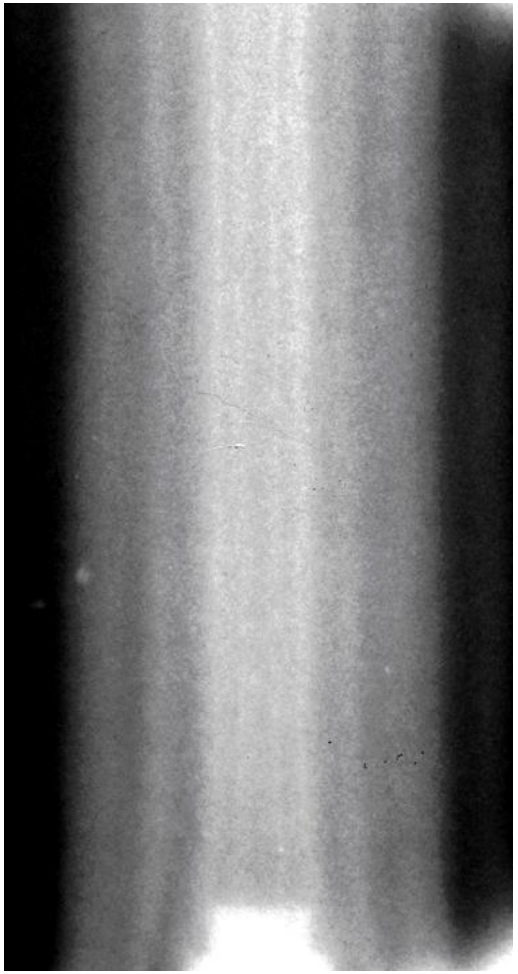


Experimental x-ray images of the central part of compressive device (experiment with H_2): a) – preliminary image (samples in the initial state, this image is used for adjustment of x-ray device), b) – compression moment

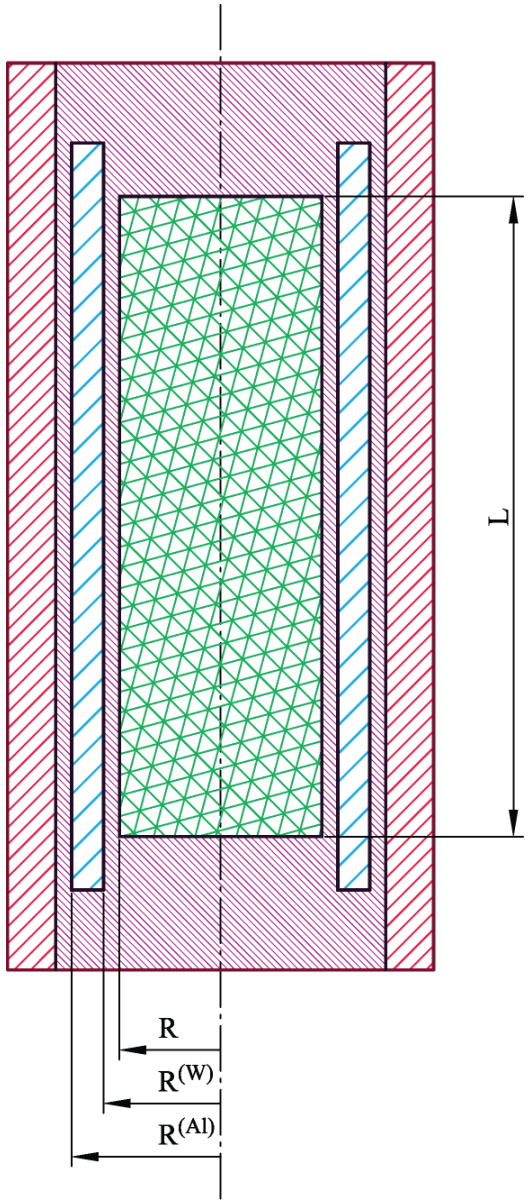
a)



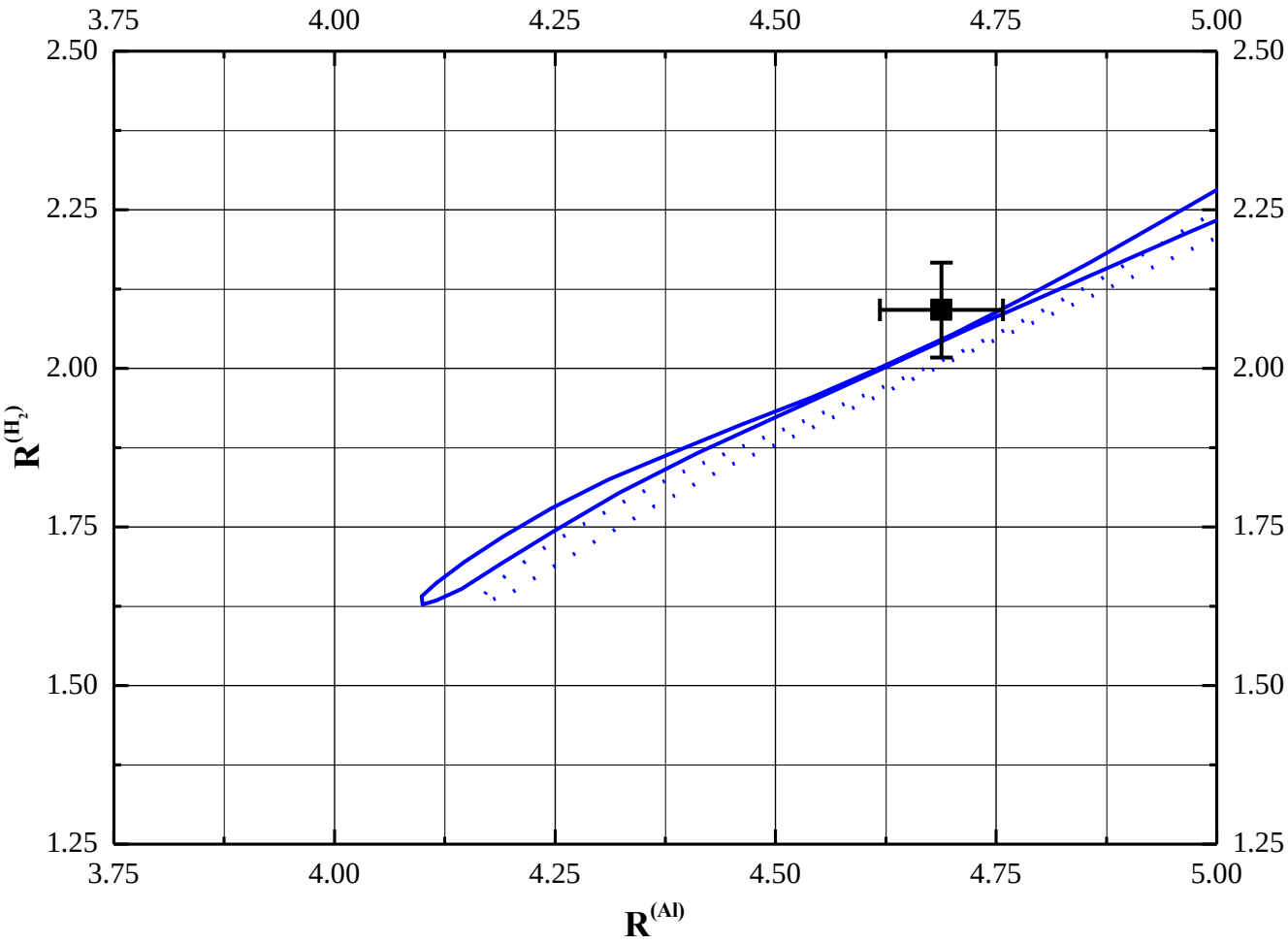
b)

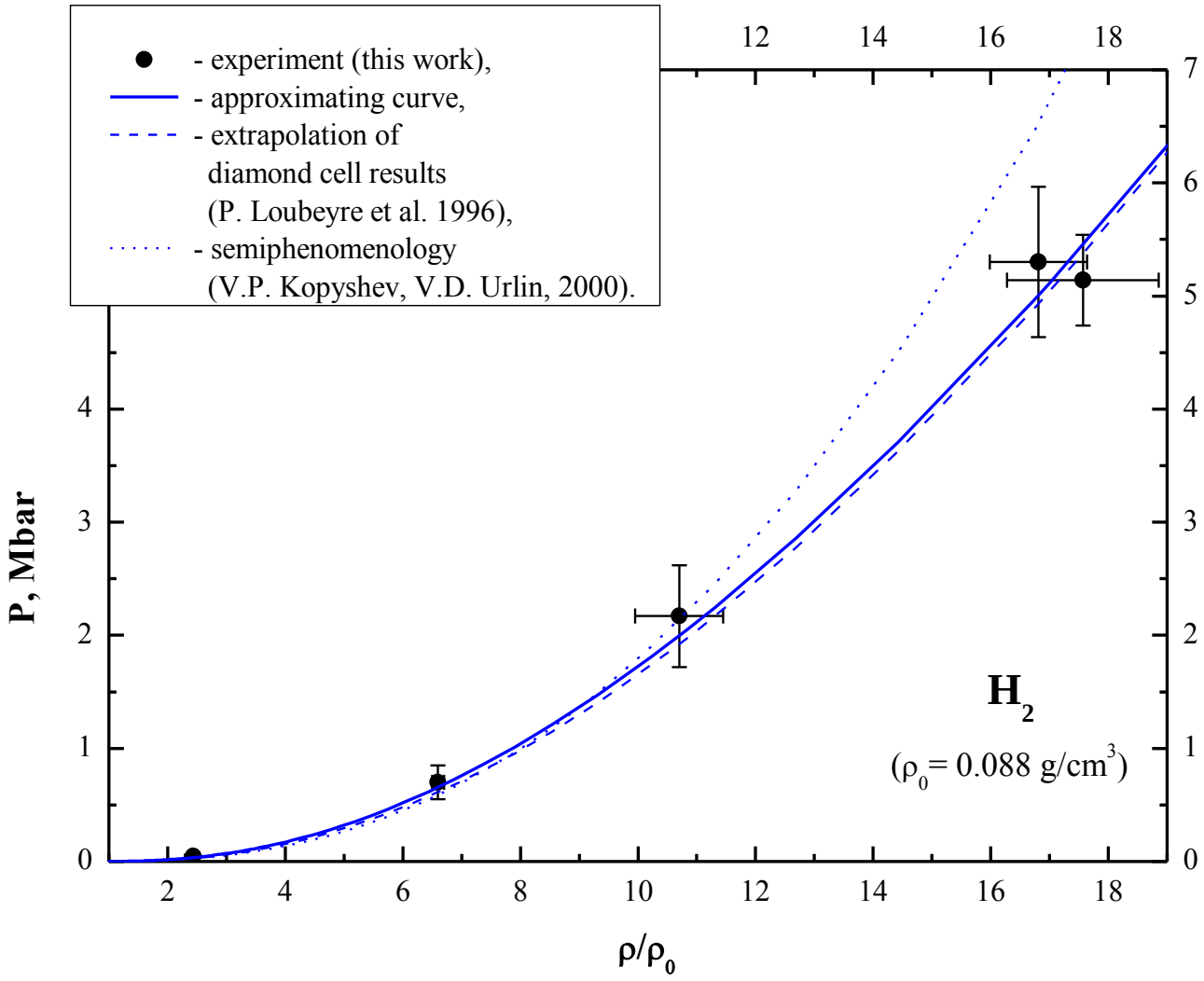


Experimental x-ray images of the central part of compressive device (experiment with D_2): a) – preliminary image, b) – compression moment

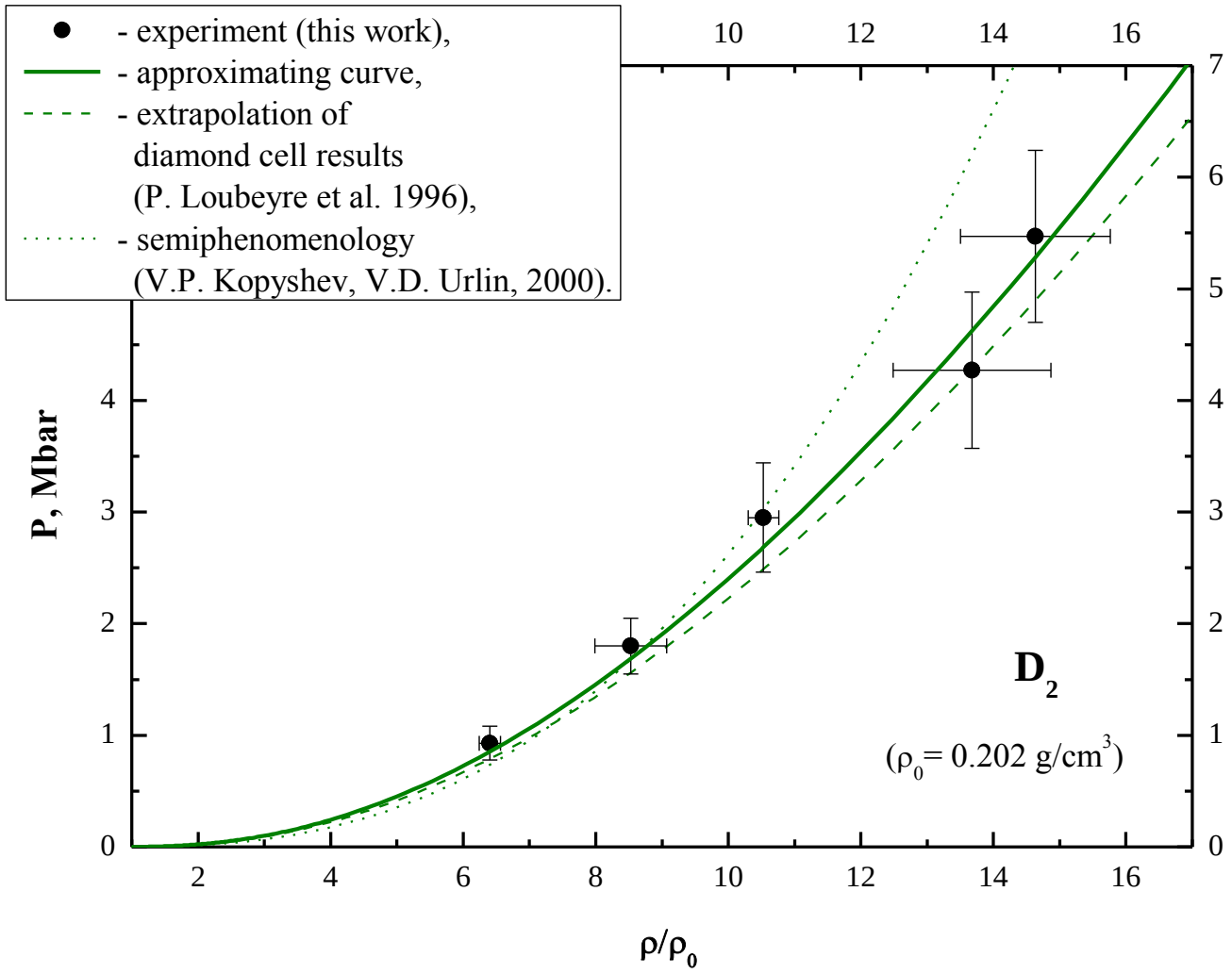


Compression chamber sketch

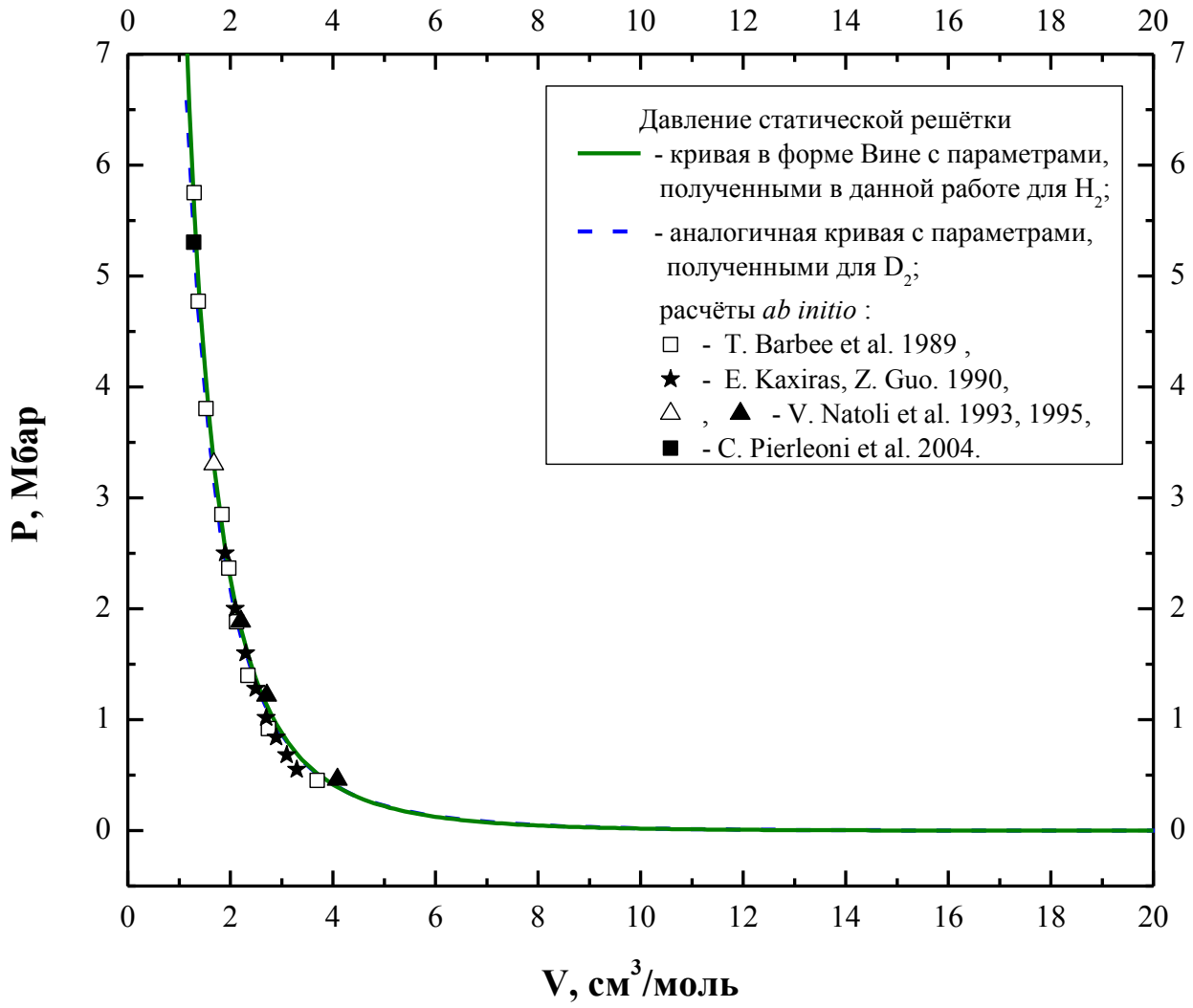

3.75
4.00
4.25
4.50
4.75
5.00
2.50
2.25
2.00
1.75
1.50
1.25
R(H2)
R(Al)



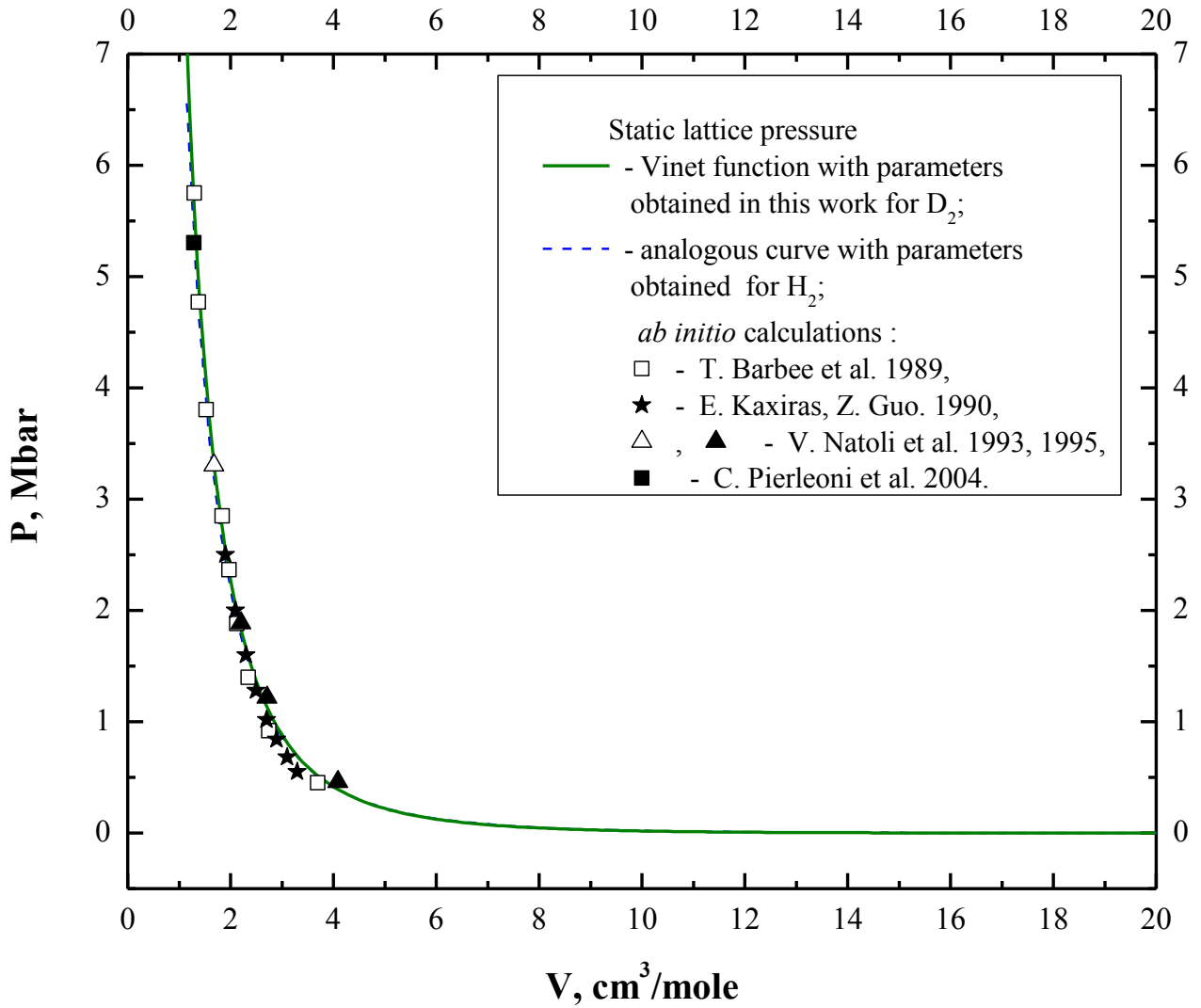
P-δ diagrams of H_2



P-δ diagrams of D_2



Сравнение экспериментальной построенной кривой «холодного» давления статической решётки для H_2 и D_2 с расчётами: ✂ - LDA молекулярный и атомарный кристалл, ☒ - PIMC молекулярный H_2, 🖱 🖮 - QMC атомарный и молекулярный кристалл соответственно, 🖉 - CEIMC атомарный H_2



Experiment based curves of static lattice pressure for H_2 and D_2 and theoretical results: : ✂ - LDA molecular and atomic solid, ☒ - PIMC molecular H_2, 🖱 ⌨ - QMC atomic and molecular solid correspondingly, ✎ - CEIMC atomic H_2

$$P_{s.l.} = 3K_0 (V/V_0)^{-2/3} [1 - (V/V_0)^{1/3}] \exp\{3(K_1 - 1)[1 - (V/V_0)^{1/3}]/2\}$$

$K_0^{(H_2)} = 0.744$ ГПа $\qquad K_0^{(D_2)} = 0.817$ ГПа

$K_1^{(H_2)} = 5.868$ $\qquad K_1^{(D_2)} = 5.959$

$V_0^{(H_2)} = 17.825$ см^3/моль $\qquad V_0^{(D_2)} = 16.875$ см^3/моль