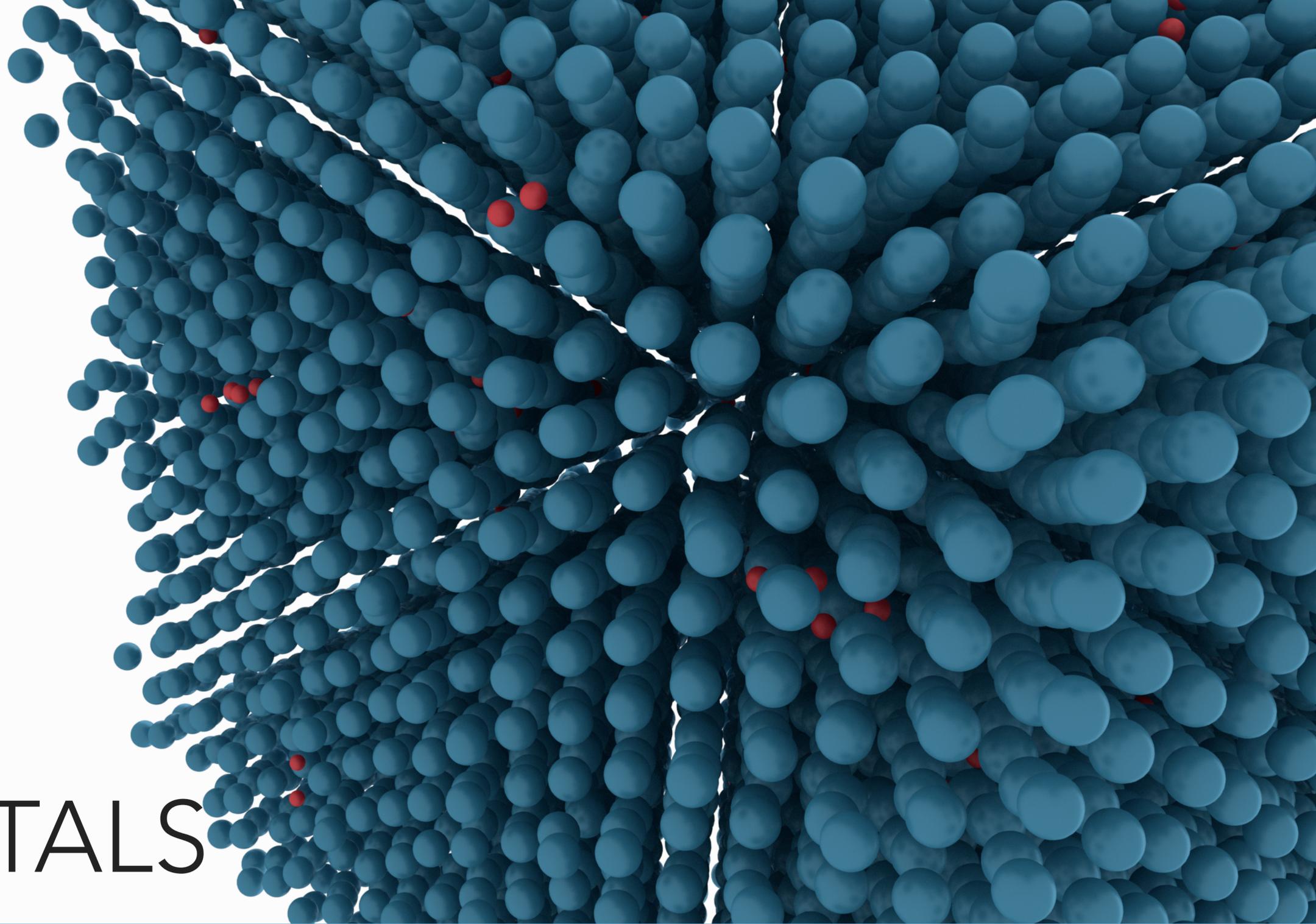
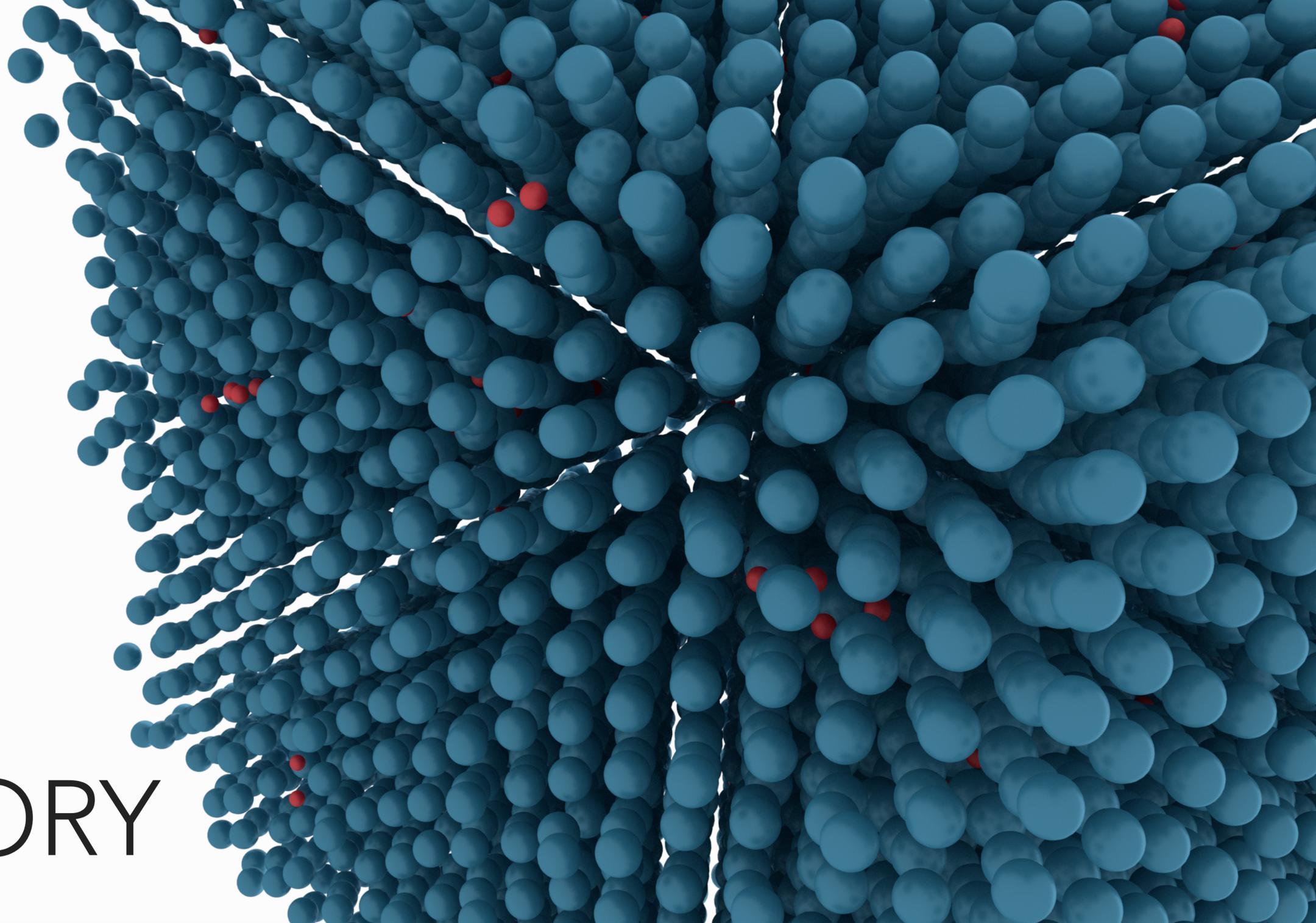


# ANOMALOUS DYNAMICS AND PHASE BEHAVIOUR OF DOPANTS IN WEAK CRYSTALS

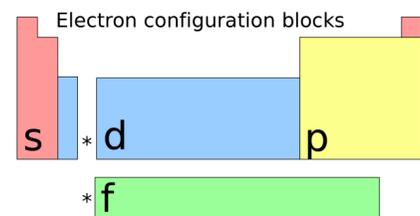


# ENTROPIC CRYSTALS AND THE FAILURE OF LATTICE THEORY



# Periodic Table of the Elements

Group 1																	18	
Period 1	1.008 1312.0 <b>H</b> Hydrogen 1s <sup>1</sup>																	4.0026 2372.3 <b>He</b> Helium 1s <sup>2</sup>
2	6.94 520.2 <b>Li</b> Lithium 1s <sup>2</sup> 2s <sup>1</sup>	9.0122 899.5 <b>Be</b> Beryllium 1s <sup>2</sup> 2s <sup>2</sup>											10.81 800.6 <b>B</b> Boron 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>1</sup>	12.011 1086.5 <b>C</b> Carbon 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>2</sup>	14.007 1402.3 <b>N</b> Nitrogen 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>3</sup>	15.999 1313.9 <b>O</b> Oxygen 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>4</sup>	18.998 1681.0 <b>F</b> Fluorine 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>5</sup>	20.180 2080.7 <b>Ne</b> Neon 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup>
3	22.990 495.8 <b>Na</b> Sodium [Ne] 3s <sup>1</sup>	24.305 737.7 <b>Mg</b> Magnesium [Ne] 3s <sup>2</sup>											26.982 577.5 <b>Al</b> Aluminium [Ne] 3s <sup>2</sup> 3p <sup>1</sup>	28.085 786.5 <b>Si</b> Silicon [Ne] 3s <sup>2</sup> 3p <sup>2</sup>	30.974 1011.8 <b>P</b> Phosphorus [Ne] 3s <sup>2</sup> 3p <sup>3</sup>	32.06 999.6 <b>S</b> Sulfur [Ne] 3s <sup>2</sup> 3p <sup>4</sup>	35.45 1251.2 <b>Cl</b> Chlorine [Ne] 3s <sup>2</sup> 3p <sup>5</sup>	39.948 1520.6 <b>Ar</b> Argon [Ne] 3s <sup>2</sup> 3p <sup>6</sup>
4	39.098 418.8 <b>K</b> Potassium [Ar] 4s <sup>1</sup>	40.078 589.8 <b>Ca</b> Calcium [Ar] 4s <sup>2</sup>	44.956 633.1 <b>Sc</b> Scandium [Ar] 3d <sup>1</sup> 4s <sup>2</sup>	47.867 658.8 <b>Ti</b> Titanium [Ar] 3d <sup>2</sup> 4s <sup>2</sup>	50.942 650.9 <b>V</b> Vanadium [Ar] 3d <sup>3</sup> 4s <sup>2</sup>	51.996 652.9 <b>Cr</b> Chromium [Ar] 3d <sup>5</sup> 4s <sup>1</sup>	54.938 717.3 <b>Mn</b> Manganese [Ar] 3d <sup>5</sup> 4s <sup>2</sup>	55.845 762.5 <b>Fe</b> Iron [Ar] 3d <sup>6</sup> 4s <sup>2</sup>	58.933 760.4 <b>Co</b> Cobalt [Ar] 3d <sup>7</sup> 4s <sup>2</sup>	58.693 737.1 <b>Ni</b> Nickel [Ar] 3d <sup>8</sup> 4s <sup>2</sup>	63.546 745.5 <b>Cu</b> Copper [Ar] 3d <sup>10</sup> 4s <sup>1</sup>	65.38 906.4 <b>Zn</b> Zinc [Ar] 3d <sup>10</sup> 4s <sup>2</sup>	69.723 578.8 <b>Ga</b> Gallium [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>	72.630 762.0 <b>Ge</b> Germanium [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>2</sup>	74.922 947.0 <b>As</b> Arsenic [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>3</sup>	78.971 941.0 <b>Se</b> Selenium [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>4</sup>	79.904 1139.9 <b>Br</b> Bromine [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>5</sup>	83.798 1350.8 <b>Kr</b> Krypton [Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>6</sup>
5	85.468 403.0 <b>Rb</b> Rubidium [Kr] 5s <sup>1</sup>	87.62 549.5 <b>Sr</b> Strontium [Kr] 5s <sup>2</sup>	88.906 600.0 <b>Y</b> Yttrium [Kr] 4d <sup>1</sup> 5s <sup>2</sup>	91.224 640.1 <b>Zr</b> Zirconium [Kr] 4d <sup>2</sup> 5s <sup>2</sup>	92.906 652.1 <b>Nb</b> Niobium [Kr] 4d <sup>4</sup> 5s <sup>1</sup>	95.95 684.3 <b>Mo</b> Molybdenum [Kr] 4d <sup>5</sup> 5s <sup>1</sup>	(98) 702.0 <b>Tc</b> Technetium [Kr] 4d <sup>5</sup> 5s <sup>2</sup>	101.07 710.2 <b>Ru</b> Ruthenium [Kr] 4d <sup>7</sup> 5s <sup>1</sup>	102.91 719.7 <b>Rh</b> Rhodium [Kr] 4d <sup>8</sup> 5s <sup>1</sup>	106.42 804.4 <b>Pd</b> Palladium [Kr] 4d <sup>10</sup>	107.87 731.0 <b>Ag</b> Silver [Kr] 4d <sup>10</sup> 5s <sup>1</sup>	112.41 867.8 <b>Cd</b> Cadmium [Kr] 4d <sup>10</sup> 5s <sup>2</sup>	114.82 558.3 <b>In</b> Indium [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>	118.71 708.6 <b>Sn</b> Tin [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>2</sup>	121.76 834.0 <b>Sb</b> Antimony [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>3</sup>	127.60 869.3 <b>Te</b> Tellurium [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>4</sup>	126.90 1008.4 <b>I</b> Iodine [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>5</sup>	131.29 1170.4 <b>Xe</b> Xenon [Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>6</sup>
6	132.91 375.7 <b>Cs</b> Cæesium [Xe] 6s <sup>1</sup>	137.33 502.9 <b>Ba</b> Barium [Xe] 6s <sup>2</sup>	138.91 538.1 <b>La</b> Lanthanum [Xe] 5d <sup>1</sup> 6s <sup>2</sup>	* 178.49 658.5 <b>Hf</b> Hafnium [Xe] 4f <sup>14</sup> 5d <sup>2</sup> 6s <sup>2</sup>	* 180.95 761.0 <b>Ta</b> Tantalum [Xe] 4f <sup>14</sup> 5d <sup>3</sup> 6s <sup>2</sup>	* 183.84 770.0 <b>W</b> Tungsten [Xe] 4f <sup>14</sup> 5d <sup>4</sup> 6s <sup>2</sup>	* 186.21 760.0 <b>Re</b> Rhenium [Xe] 4f <sup>14</sup> 5d <sup>5</sup> 6s <sup>2</sup>	* 190.23 840.0 <b>Os</b> Osmium [Xe] 4f <sup>14</sup> 5d <sup>6</sup> 6s <sup>2</sup>	* 192.22 880.0 <b>Ir</b> Iridium [Xe] 4f <sup>14</sup> 5d <sup>7</sup> 6s <sup>2</sup>	* 195.08 870.0 <b>Pt</b> Platinum [Xe] 4f <sup>14</sup> 5d <sup>9</sup> 6s <sup>1</sup>	* 196.97 890.1 <b>Au</b> Gold [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>1</sup>	* 200.59 1007.1 <b>Hg</b> Mercury [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup>	* 204.38 589.4 <b>Tl</b> Thallium [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>1</sup>	* 207.2 715.6 <b>Pb</b> Lead [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>2</sup>	* 208.98 703.0 <b>Bi</b> Bismuth [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>3</sup>	(210) 812.1 <b>Po</b> Polonium [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>4</sup>	(210) 890.0 <b>At</b> Astatine [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>5</sup>	(220) 1037.0 <b>Rn</b> Radon [Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>6</sup>
7	(223) 380.0 <b>Fr</b> Francium [Rn] 7s <sup>1</sup>	(226) 509.3 <b>Ra</b> Radium [Rn] 7s <sup>2</sup>	(227) 499.0 <b>Ac</b> Actinium [Rn] 6d <sup>1</sup> 7s <sup>2</sup>	* (261) 580.0 <b>Rf</b> Rutherfordium [Rn] 5f <sup>14</sup> 6d <sup>2</sup> 7s <sup>2</sup>	* (262) <b>Db</b> Dubnium [Rn] 5f <sup>14</sup> 6d <sup>3</sup> 7s <sup>2</sup>	* (266) <b>Sg</b> Seaborgium [Rn] 5f <sup>14</sup> 6d <sup>4</sup> 7s <sup>2</sup>	* (264) <b>Bh</b> Bohrium [Rn] 5f <sup>14</sup> 6d <sup>5</sup> 7s <sup>2</sup>	* (277) <b>Hs</b> Hassium [Rn] 5f <sup>14</sup> 6d <sup>6</sup> 7s <sup>2</sup>	* (268) <b>Mt</b> Meitnerium [Rn] 5f <sup>14</sup> 6d <sup>7</sup> 7s <sup>2</sup>	* (271) <b>Ds</b> Darmstadtium [Rn] 5f <sup>14</sup> 6d <sup>8</sup> 7s <sup>2</sup>	* (272) <b>Rg</b> Roentgenium [Rn] 5f <sup>14</sup> 6d <sup>9</sup> 7s <sup>2</sup>	* (285) <b>Cn</b> Copernicium [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup>	* (284) <b>Nh</b> Nihonium [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup> 7p <sup>1</sup>	* (289) <b>Fl</b> Flerovium [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup> 7p <sup>2</sup>	* (288) <b>Mc</b> Moscovium [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup> 7p <sup>3</sup>	* (292) <b>Lv</b> Livermorium [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup> 7p <sup>4</sup>	* (294) <b>Ts</b> Tennessine [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup> 7p <sup>5</sup>	* (294) <b>Og</b> Oganesson [Rn] 5f <sup>14</sup> 6d <sup>10</sup> 7s <sup>2</sup> 7p <sup>6</sup>



## Notes

- 1 kJ/mol ≈ 96.485 eV
- all elements are implied to have an oxidation state of zero.

by Robert Campion / updated 2016, 2018

* 140.12 534.4 <b>Ce</b> Cerium [Xe] 4f <sup>1</sup> 5d <sup>1</sup> 6s <sup>2</sup>	* 140.91 527.0 <b>Pr</b> Praseodymium [Xe] 4f <sup>3</sup> 6s <sup>2</sup>	* 144.24 533.1 <b>Nd</b> Neodymium [Xe] 4f <sup>4</sup> 6s <sup>2</sup>	* (145) 540.0 <b>Pm</b> Promethium [Xe] 4f <sup>6</sup> 6s <sup>2</sup>	* 150.36 544.5 <b>Sm</b> Samarium [Xe] 4f <sup>6</sup> 6s <sup>2</sup>	* 151.96 547.1 <b>Eu</b> Europium [Xe] 4f <sup>7</sup> 6s <sup>2</sup>	* 157.25 593.4 <b>Gd</b> Gadolinium [Xe] 4f <sup>7</sup> 5d <sup>1</sup> 6s <sup>2</sup>	* 158.93 565.8 <b>Tb</b> Terbium [Xe] 4f <sup>9</sup> 6s <sup>2</sup>	* 162.50 573.0 <b>Dy</b> Dysprosium [Xe] 4f <sup>10</sup> 6s <sup>2</sup>	* 164.93 581.0 <b>Ho</b> Holmium [Xe] 4f <sup>11</sup> 6s <sup>2</sup>	* 167.25 589.3 <b>Er</b> Erbium [Xe] 4f <sup>12</sup> 6s <sup>2</sup>	* 168.93 596.7 <b>Tm</b> Thulium [Xe] 4f <sup>13</sup> 6s <sup>2</sup>	* 173.05 603.4 <b>Yb</b> Ytterbium [Xe] 4f <sup>14</sup> 6s <sup>2</sup>	* 174.97 523.5 <b>Lu</b> Lutetium [Xe] 4f <sup>14</sup> 5d <sup>1</sup> 6s <sup>2</sup>
* 232.04 587.0 <b>Th</b> Thorium [Rn] 6d <sup>2</sup> 7s <sup>2</sup>	* 231.04 568.0 <b>Pa</b> Protactinium [Rn] 5f <sup>2</sup> 6d <sup>1</sup> 7s <sup>2</sup>	* 238.03 597.6 <b>U</b> Uranium [Rn] 5f <sup>3</sup> 6d <sup>1</sup> 7s <sup>2</sup>	* (237) 604.5 <b>Np</b> Neptunium [Rn] 5f <sup>4</sup> 6d <sup>1</sup> 7s <sup>2</sup>	* (244) 584.7 <b>Pu</b> Plutonium [Rn] 5f <sup>6</sup> 7s <sup>2</sup>	* (243) 578.0 <b>Am</b> Americium [Rn] 5f <sup>7</sup> 7s <sup>2</sup>	* (247) 581.0 <b>Cm</b> Curium [Rn] 5f <sup>7</sup> 6d <sup>1</sup> 7s <sup>2</sup>	* (247) 601.0 <b>Bk</b> Berkelium [Rn] 5f <sup>9</sup> 7s <sup>2</sup>	* (251) 608.0 <b>Cf</b> Californium [Rn] 5f <sup>10</sup> 7s <sup>2</sup>	* (252) 619.0 <b>Es</b> Einsteinium [Rn] 5f <sup>11</sup> 6s <sup>2</sup>	* (257) 627.0 <b>Fm</b> Fermium [Rn] 5f <sup>12</sup> 7s <sup>2</sup>	* (258) 635.0 <b>Md</b> Mendelevium [Rn] 5f <sup>13</sup> 7s <sup>2</sup>	* (259) 642.0 <b>No</b> Nobelium [Rn] 5f <sup>14</sup> 7s <sup>2</sup>	* (262) 470.0 <b>Lr</b> Lawrencium [Rn] 5f <sup>14</sup> 7s <sup>2</sup> 7p <sup>1</sup>

alkali metals   alkaline earth metals   lanthanides   transition metals   unknown properties   post-transition metals   metalloids   reactive nonmetals   noble gases  
actinides



# Periodic Table of the Elements

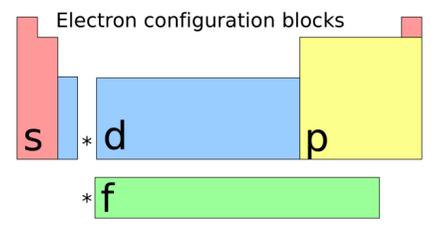
Group 1	Group 2	Group 3
Period 1 1.008 1312.0 2.20 <b>H</b> Hydrogen 1s <sup>1</sup>		
Period 2 6.94 520.2 0.98 <b>Li</b> Lithium 1s <sup>2</sup> 2s <sup>1</sup>	9.0122 899.5 1.57 <b>Be</b> Beryllium 1s <sup>2</sup> 2s <sup>2</sup>	
Period 3 22.990 495.8 0.93 <b>Na</b> Sodium [Ne] 3s <sup>1</sup>		
Period 4 39.098 418.8 0.82 <b>K</b> Potassium [Ar] 4s <sup>1</sup>	40.078 589.8 1.00 <b>Ca</b> Calcium [Ar] 4s <sup>2</sup>	44.956 633.1 1.36 <b>Sc</b> Scandium [Ar] 3d <sup>1</sup> 4s <sup>2</sup>
Period 5 85.468 403.0 0.82 <b>Rb</b> Rubidium [Kr] 5s <sup>1</sup>	87.62 549.5 0.95 <b>Sr</b> Strontium [Kr] 5s <sup>2</sup>	88.906 600.0 1.22 <b>Y</b> Yttrium [Kr] 4d <sup>1</sup> 5s <sup>2</sup>
Period 6 132.91 375.7 0.79 <b>Cs</b> Cæesium [Xe] 6s <sup>1</sup>	137.33 502.9 0.89 <b>Ba</b> Barium [Xe] 6s <sup>2</sup>	138.91 538.1 1.10 <b>La</b> Lanthanum [Xe] 5d <sup>1</sup> 6s <sup>2</sup>
Period 7 (223) 380.0 0.70 <b>Fr</b> Francium [Rn] 7s <sup>1</sup>	(226) 509.3 0.90 <b>Ra</b> Radium [Rn] 7s <sup>2</sup>	(227) 499.0 1.10 <b>Ac</b> Actinium [Rn] 6d <sup>1</sup> 7s <sup>2</sup>

4	5	6	7	8	9
47.867 658.8 1.54 <b>Ti</b> Titanium [Ar] 3d <sup>2</sup> 4s <sup>2</sup>	50.942 650.9 1.63 <b>V</b> Vanadium [Ar] 3d <sup>3</sup> 4s <sup>2</sup>	51.996 652.9 1.66 <b>Cr</b> Chromium [Ar] 3d <sup>5</sup> 4s <sup>1</sup>	54.938 717.3 1.55 <b>Mn</b> Manganese [Ar] 3d <sup>5</sup> 4s <sup>2</sup>	55.845 762.5 1.83 <b>Fe</b> Iron [Ar] 3d <sup>6</sup> 4s <sup>2</sup>	
91.224 640.1 1.33 <b>Zr</b> Zirconium [Kr] 4d <sup>2</sup> 5s <sup>2</sup>	92.906 652.1 1.60 <b>Nb</b> Niobium [Kr] 4d <sup>4</sup> 5s <sup>1</sup>	95.95 684.3 2.16 <b>Mo</b> Molybdenum [Kr] 4d <sup>5</sup> 5s <sup>1</sup>			
178.49 658.5 1.30 <b>Hf</b> Hafnium [Xe] 4f <sup>14</sup> 5d <sup>2</sup> 6s <sup>2</sup>	180.95 761.0 1.50 <b>Ta</b> Tantalum [Xe] 4f <sup>14</sup> 5d <sup>3</sup> 6s <sup>2</sup>	183.84 770.0 2.36 <b>W</b> Tungsten [Xe] 4f <sup>14</sup> 5d <sup>4</sup> 6s <sup>2</sup>			
(261) 580.0 <b>Rf</b> Rutherfordium [Rn] 5f <sup>14</sup> 6d <sup>2</sup> 7s <sup>2</sup>	(262) <b>Db</b> Dubnium [Rn] 5f <sup>14</sup> 6d <sup>3</sup> 7s <sup>2</sup>	(266) <b>Sg</b> Seaborgium [Rn] 5f <sup>14</sup> 6d <sup>4</sup> 7s <sup>2</sup>			

metastable crystals or glasses. For instance, the high-temperature crystal structures of all the metallic elements on the left-hand side of the periodic table (groups IA, IIA, IIIB–VIB) with the exception of Mg, together with almost all the lanthanides and actinides are known to be bcc near the melting line at low pressure. Most,

“Should All Crystals Be bcc? Landau Theory of Solidification and Crystal Nucleation”  
Alexander & McTague, *Physical Review Letters* (1978)

(271) 110 <b>Ds</b> Darmstadtium	(272) 111 <b>Rg</b> Roentgenium	(285) 112 <b>Cn</b> Copernicium
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Notes  
• 1 kJ/mol ≈ 96.485 eV  
• all elements are implied to have an oxidation state of zero.

140.12 534.4 1.12 <b>Ce</b> Cerium [Xe] 4f <sup>1</sup> 5d <sup>1</sup> 6s <sup>2</sup>	140.91 527.0 1.13 <b>Pr</b> Praseodymium [Xe] 4f <sup>3</sup> 6s <sup>2</sup>	144.24 533.1 1.14 <b>Nd</b> Neodymium [Xe] 4f <sup>4</sup> 6s <sup>2</sup>	(145) 540.0 <b>Pm</b> Promethium [Xe] 4f <sup>6</sup> 6s <sup>2</sup>	150.36 544.5 1.17 <b>Sm</b> Samarium [Xe] 4f <sup>6</sup> 6s <sup>2</sup>	151.96 547.1 <b>Eu</b> Europium [Xe] 4f <sup>7</sup> 6s <sup>2</sup>	157.25 593.4 1.20 <b>Gd</b> Gadolinium [Xe] 4f <sup>7</sup> 5d <sup>1</sup> 6s <sup>2</sup>	158.93 565.8 <b>Tb</b> Terbium [Xe] 4f <sup>9</sup> 6s <sup>2</sup>	162.50 573.0 1.22 <b>Dy</b> Dysprosium [Xe] 4f <sup>10</sup> 6s <sup>2</sup>	164.93 581.0 1.23 <b>Ho</b> Holmium [Xe] 4f <sup>11</sup> 6s <sup>2</sup>	167.25 589.3 1.24 <b>Er</b> Erbium [Xe] 4f <sup>12</sup> 6s <sup>2</sup>	168.93 596.7 1.25 <b>Tm</b> Thulium [Xe] 4f <sup>13</sup> 6s <sup>2</sup>	173.05 603.4 <b>Yb</b> Ytterbium [Xe] 4f <sup>14</sup> 6s <sup>2</sup>	174.97 523.5 1.27 <b>Lu</b> Lutetium [Xe] 4f <sup>14</sup> 5d <sup>1</sup> 6s <sup>2</sup>
232.04 587.0 1.30 <b>Th</b> Thorium [Rn] 6d <sup>2</sup> 7s <sup>2</sup>	231.04 568.0 1.50 <b>Pa</b> Protactinium [Rn] 5f <sup>2</sup> 6d <sup>1</sup> 7s <sup>2</sup>	238.03 597.6 1.38 <b>U</b> Uranium [Rn] 5f <sup>3</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(237) 604.5 1.36 <b>Np</b> Neptunium [Rn] 5f <sup>4</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(244) 584.7 1.28 <b>Pu</b> Plutonium [Rn] 5f <sup>6</sup> 7s <sup>2</sup>	(243) 578.0 1.30 <b>Am</b> Americium [Rn] 5f <sup>7</sup> 7s <sup>2</sup>	(247) 581.0 1.30 <b>Cm</b> Curium [Rn] 5f <sup>7</sup> 6d <sup>1</sup> 7s <sup>2</sup>	(247) 601.0 1.30 <b>Bk</b> Berkelium [Rn] 5f <sup>9</sup> 7s <sup>2</sup>	(251) 608.0 1.30 <b>Cf</b> Californium [Rn] 5f <sup>10</sup> 7s <sup>2</sup>	(252) 619.0 1.30 <b>Es</b> Einsteinium [Rn] 5f <sup>11</sup> 6s <sup>2</sup>	(257) 627.0 1.30 <b>Fm</b> Fermium [Rn] 5f <sup>12</sup> 7s <sup>2</sup>	(258) 635.0 1.30 <b>Md</b> Mendelevium [Rn] 5f <sup>13</sup> 7s <sup>2</sup>	(259) 642.0 1.30 <b>No</b> Nobelium [Rn] 5f <sup>14</sup> 7s <sup>2</sup>	(262) 470.0 <b>Lr</b> Lawrencium [Rn] 5f <sup>14</sup> 7s <sup>2</sup> 7p <sup>1</sup>

- alkali metals
- alkaline earth metals
- lanthanides
- actinides
- transition metals
- unknown properties
- post-transition metals
- metalloids
- reactive nonmetals
- noble gases

in Hf, Zr and Ti. The bcc structure in these elements is stabilized at high temperatures only by the entropy contribution. The same applies for  $\delta$ -Fe, Na, Li (and for many bcc alloys). We shall now examine the reasons for

"Physical Metallurgy"

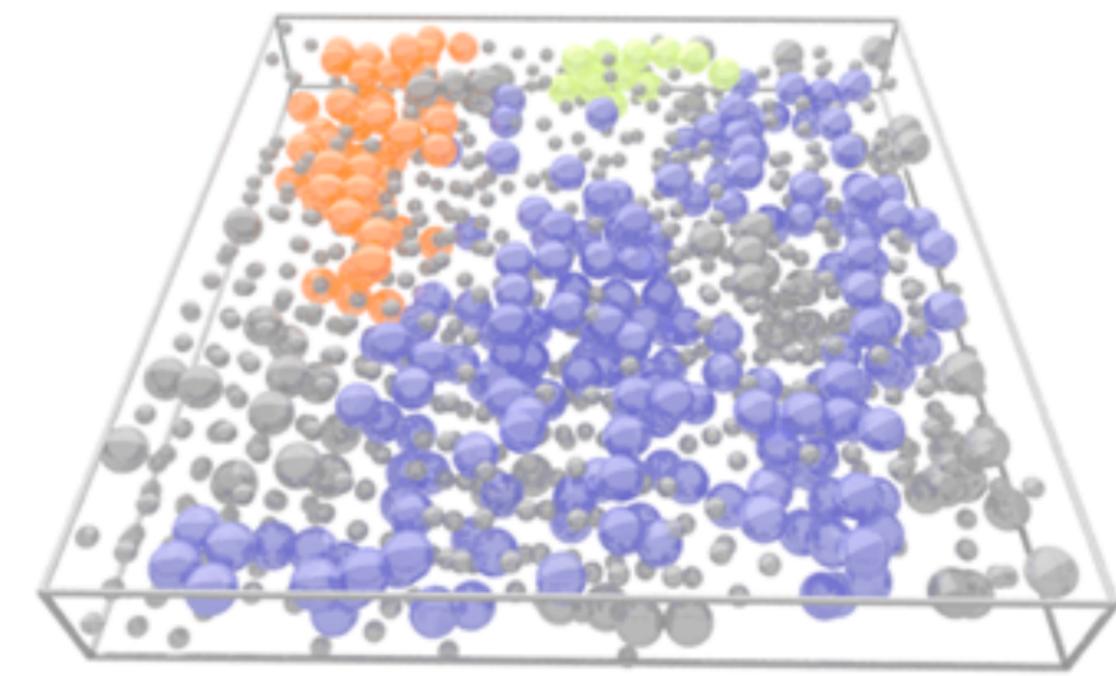
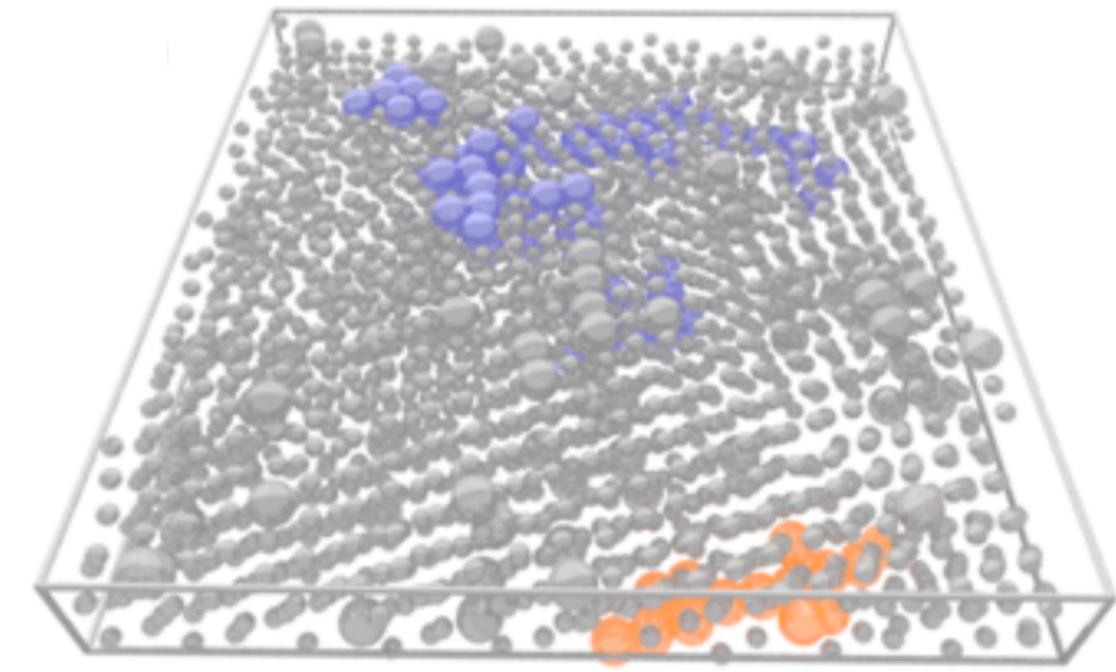
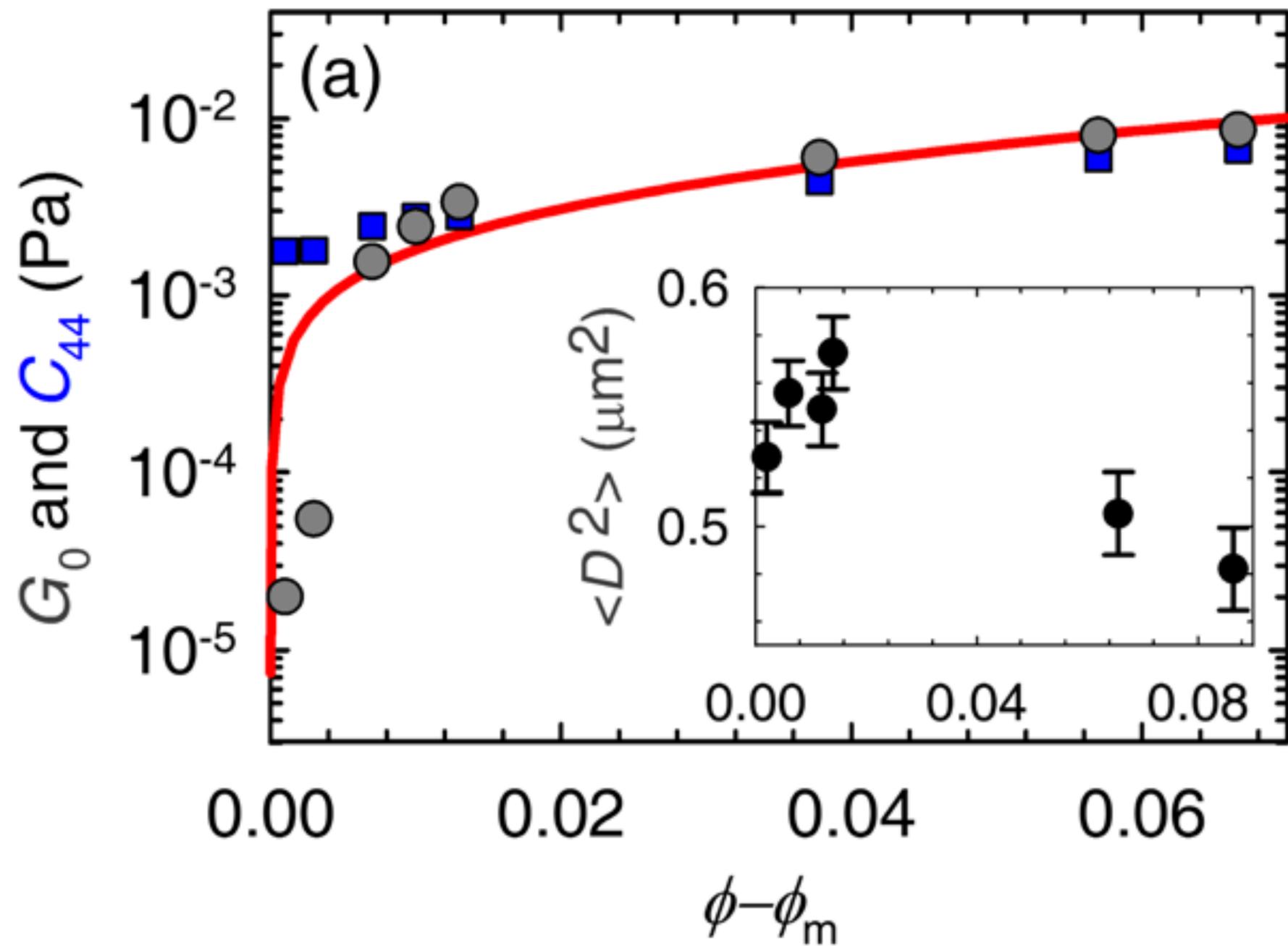
Peter Haasen, *Third Edition* (1996)

curs with great ease. There is thus strong evidence that bcc is favored by a universal factor.

sion that bcc should be favored near the melting line when the first-order character of the transition is not too pronounced. This is presumably

"Should All Crystals Be bcc? Landau Theory of Solidification and Crystal Nucleation "

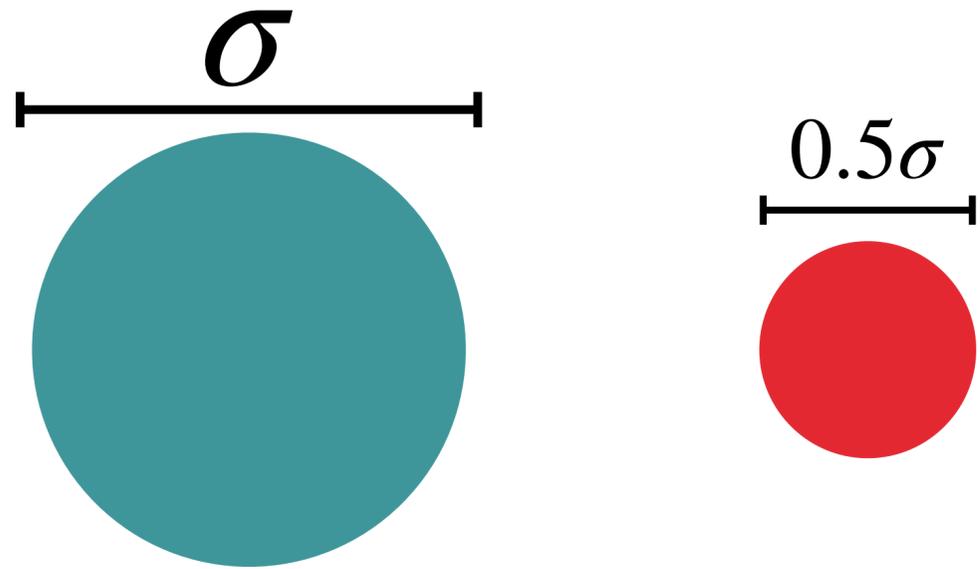
Alexander & McTague, *Physical Review Letters* (1978)



"Direct Observation of Entropic Stabilization of bcc Crystals Near Melting"

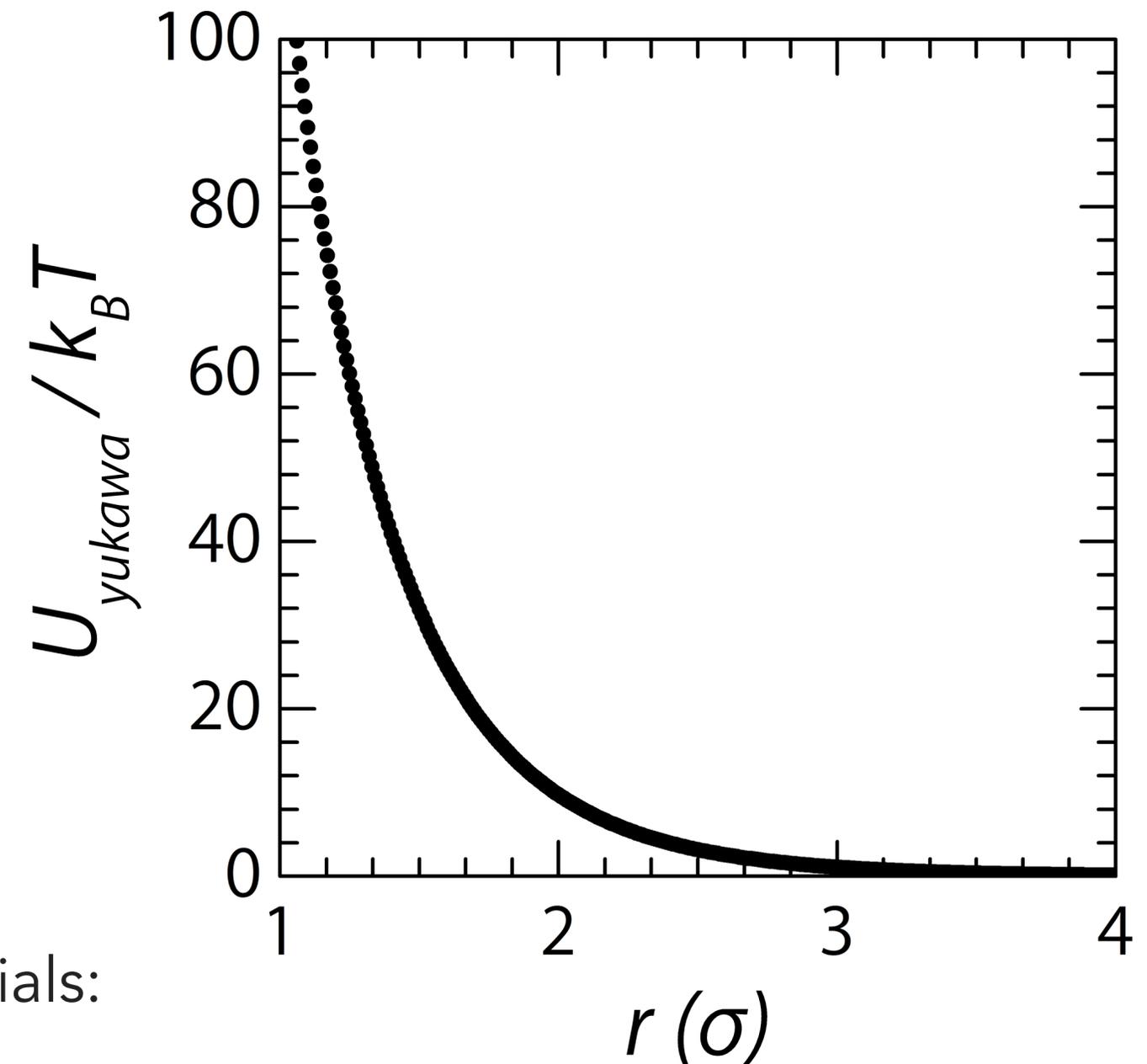
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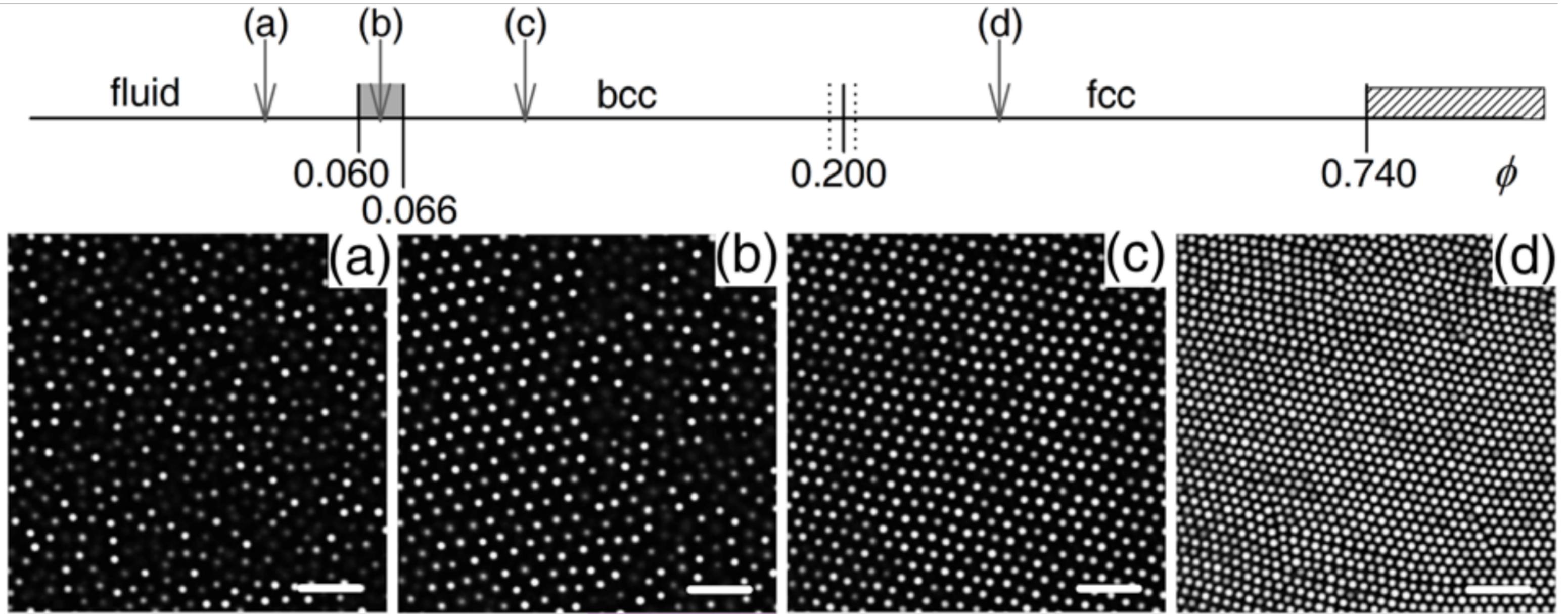


- ▶ Brownian Dynamics with HOOMD-Blue
- ▶ Interstitial to Base particle ratio: 0.5
- ▶ Particles interact with purely repulsive Yukawa potentials:

$$U_{Yukawa}(r) = \varepsilon \frac{\exp[-\kappa r]}{r}$$



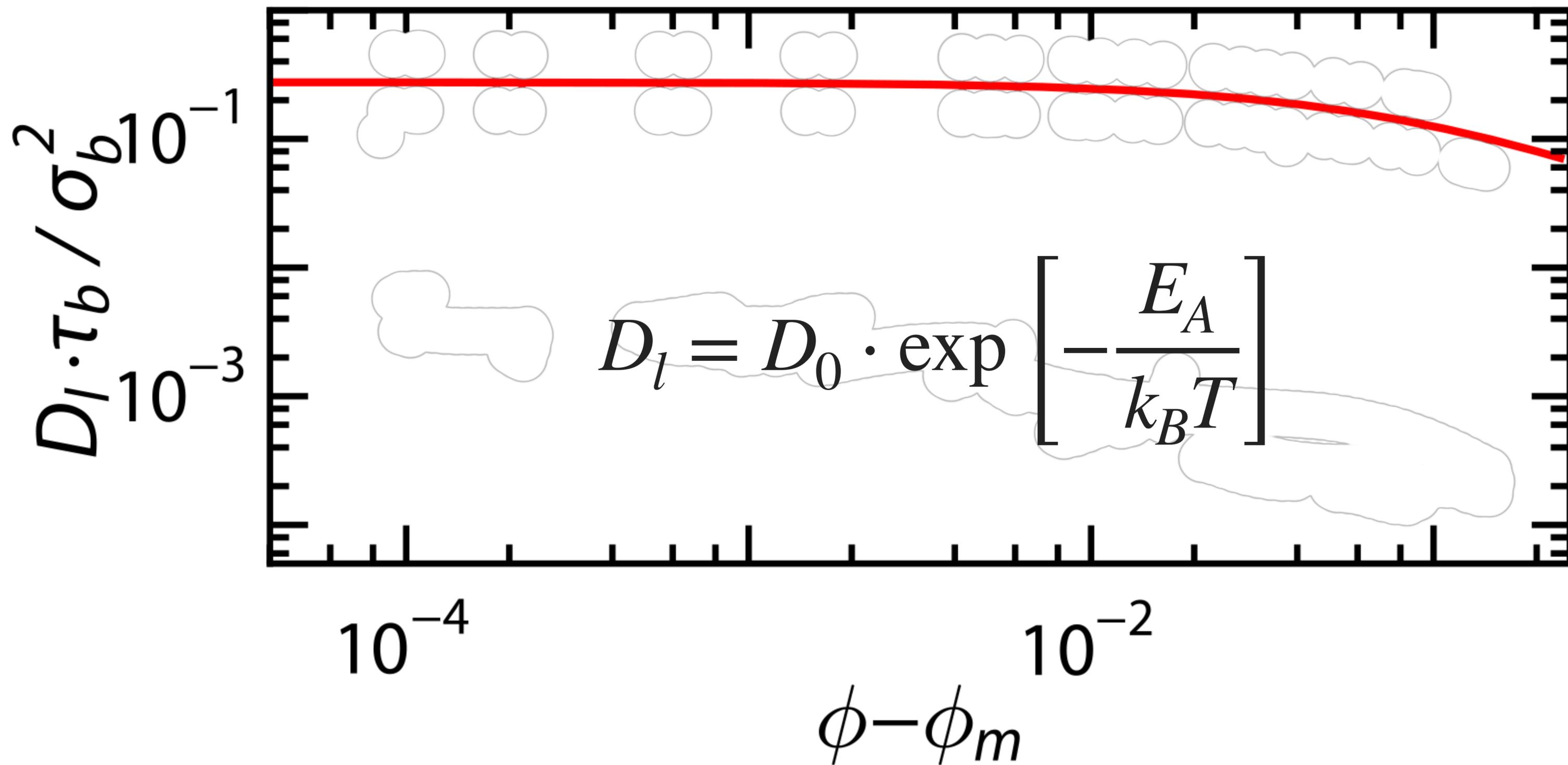
**HOOMD**  
— **blue**

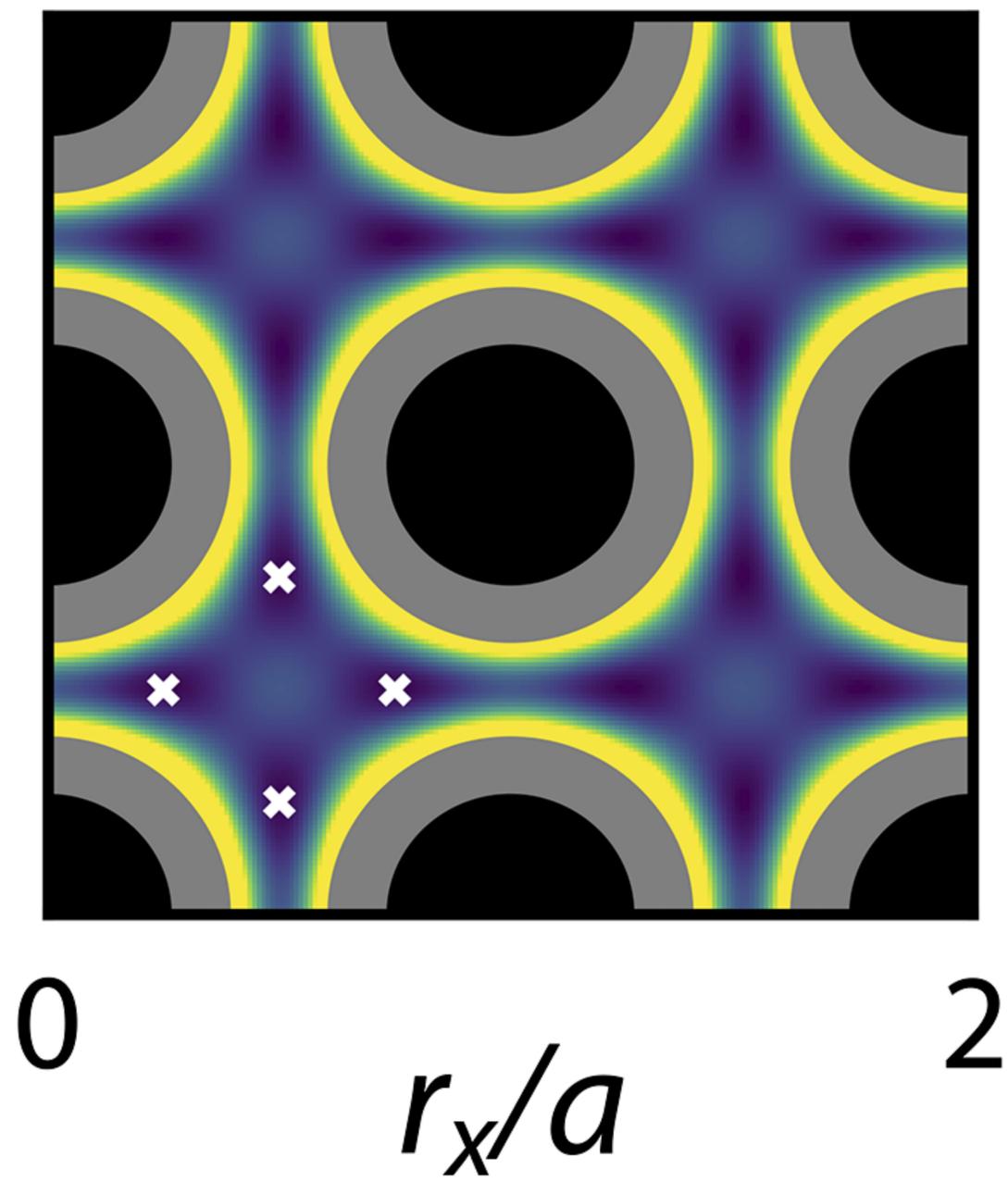
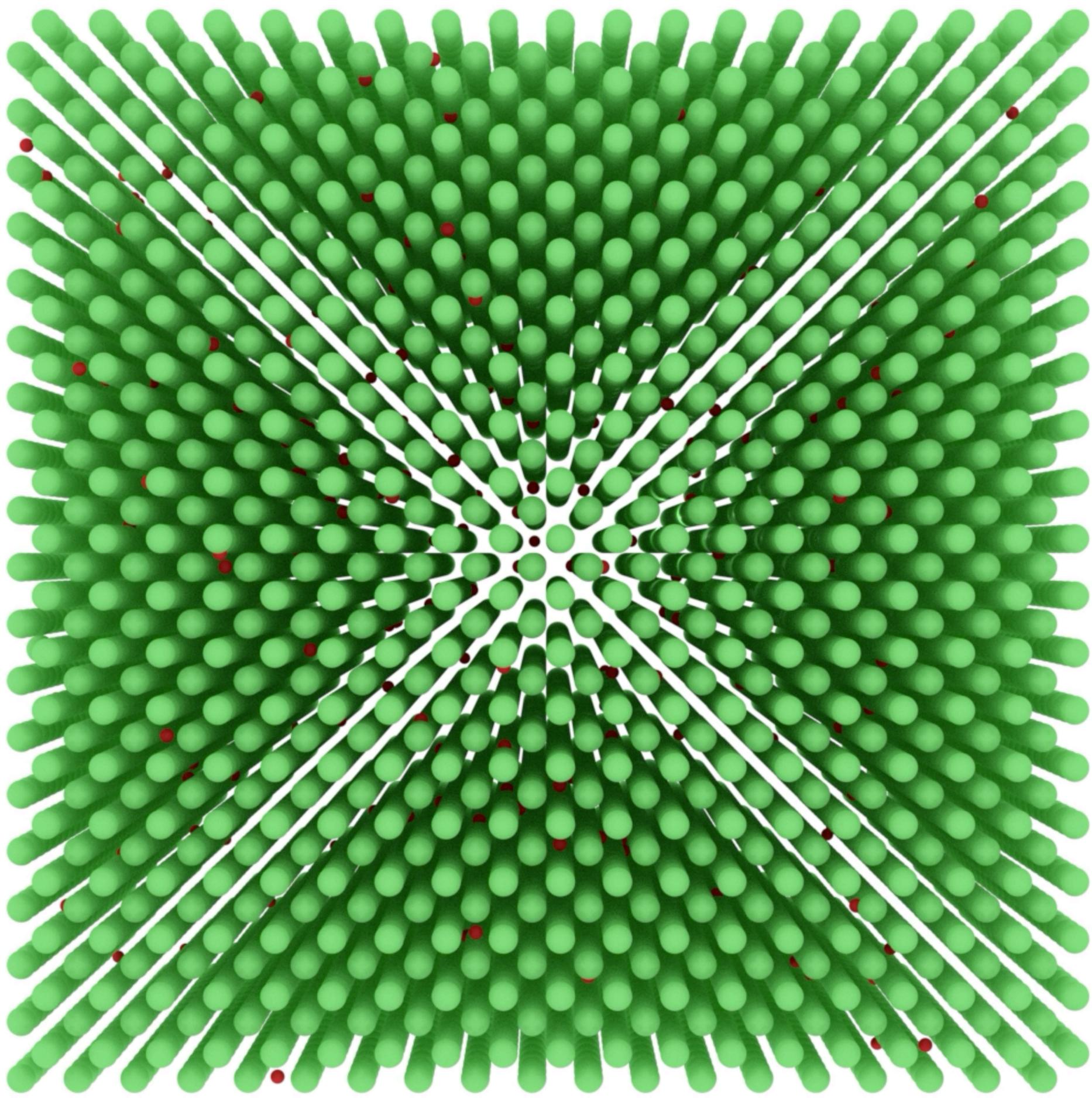


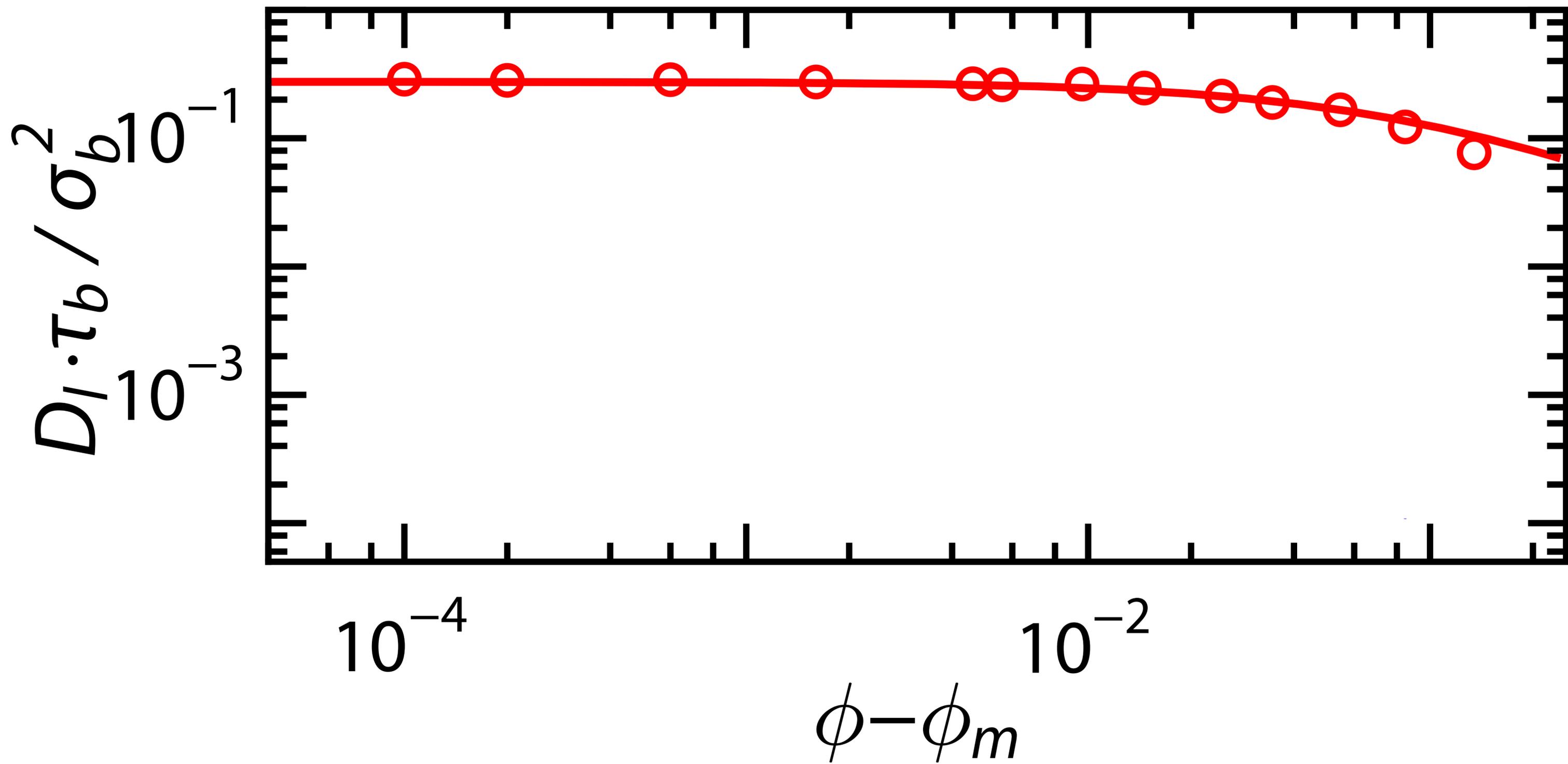
“Direct Observation of Entropic Stabilization of bcc Crystals Near Melting”

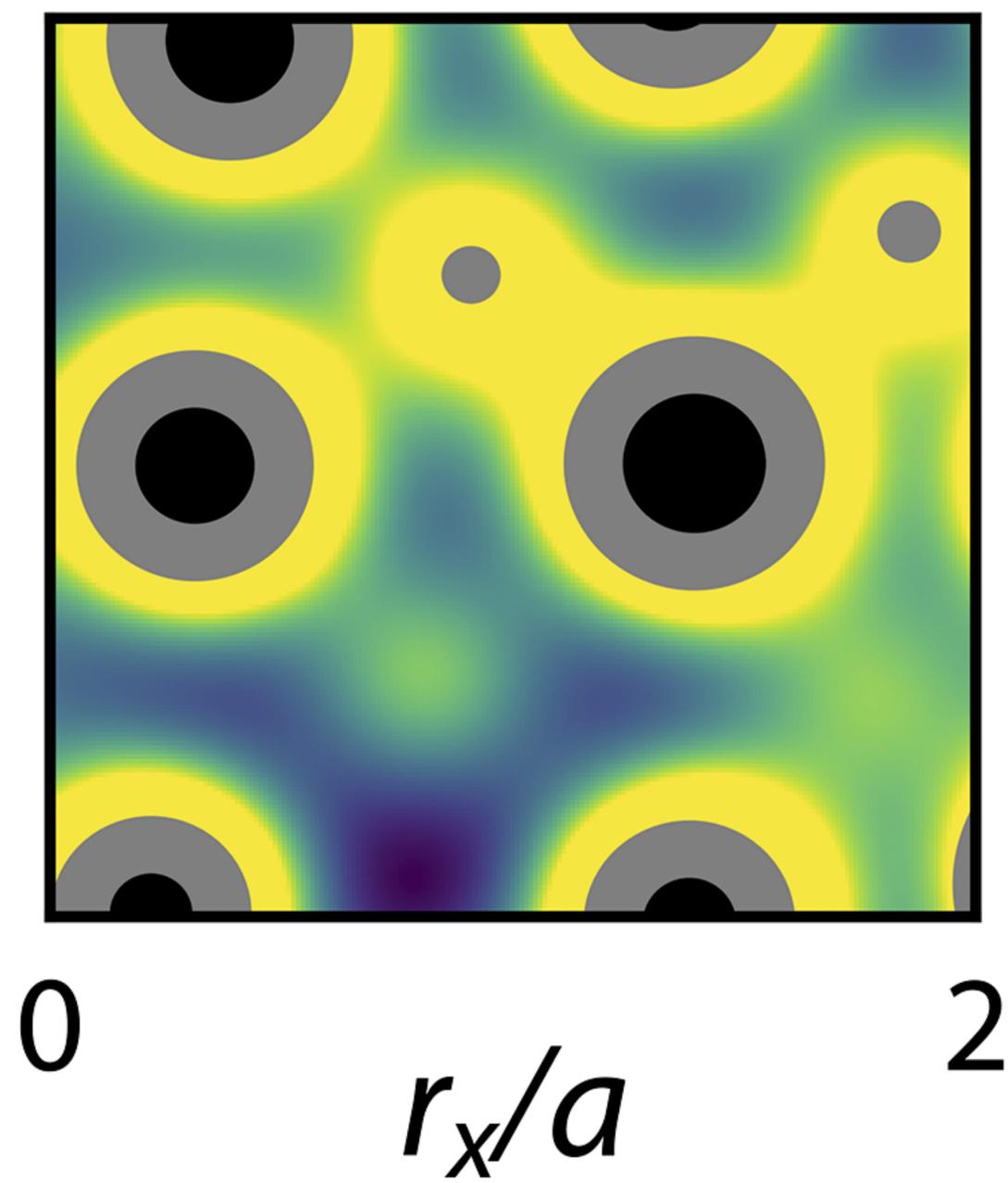
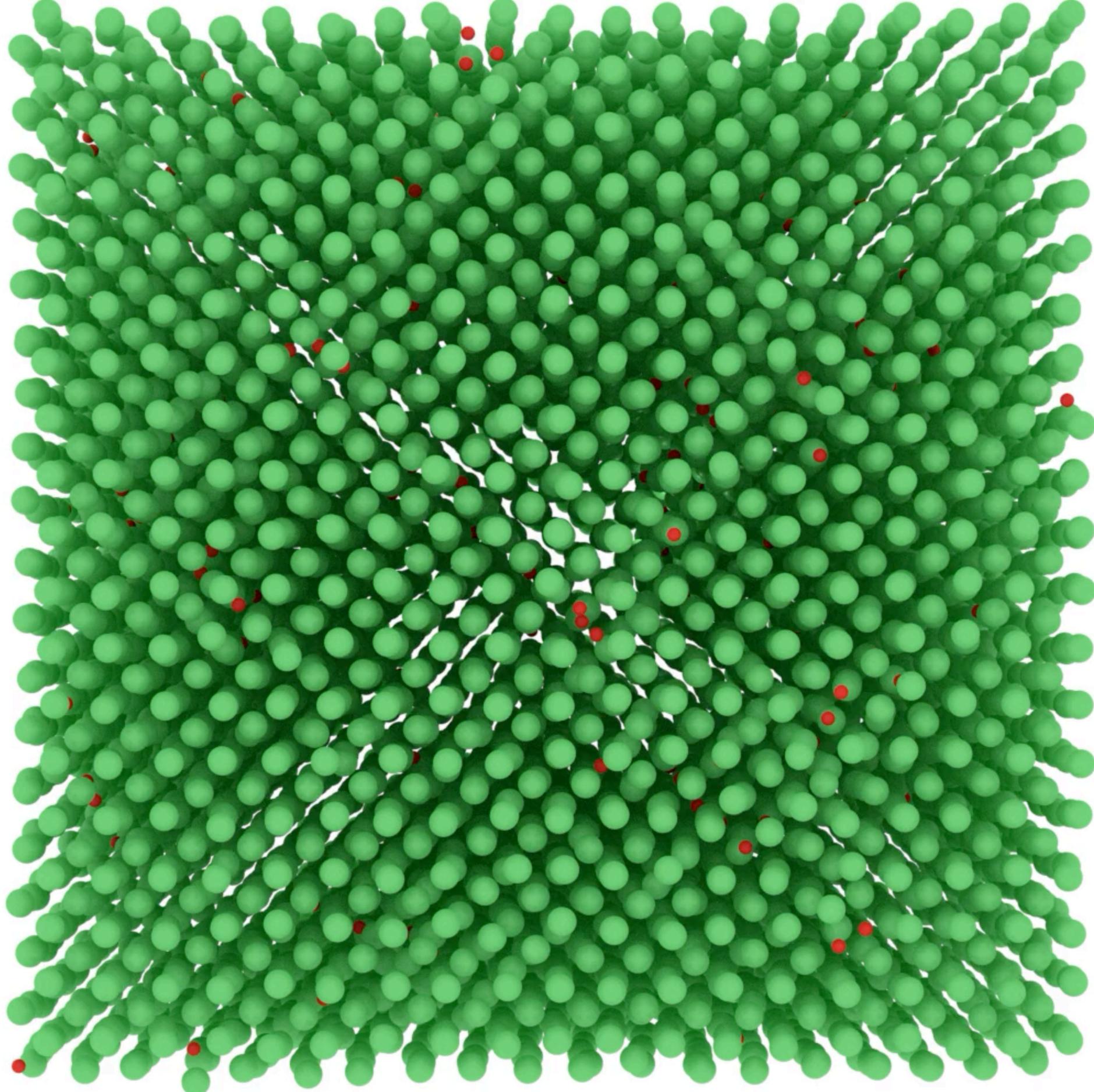
Joris Sprakel, Alessio Zaccone, Frans Spaepen, Peter Schall, and David A. Weitz

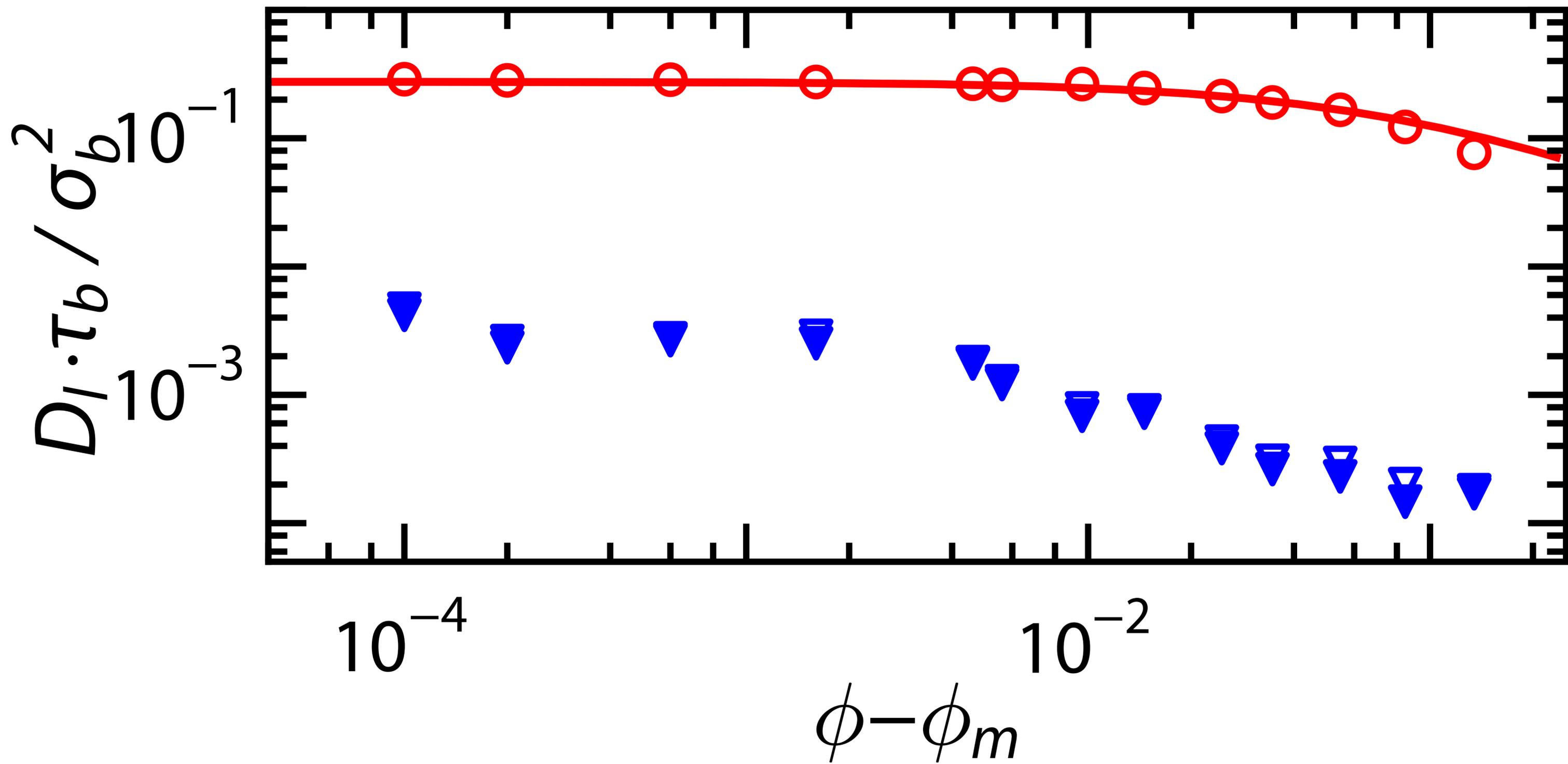
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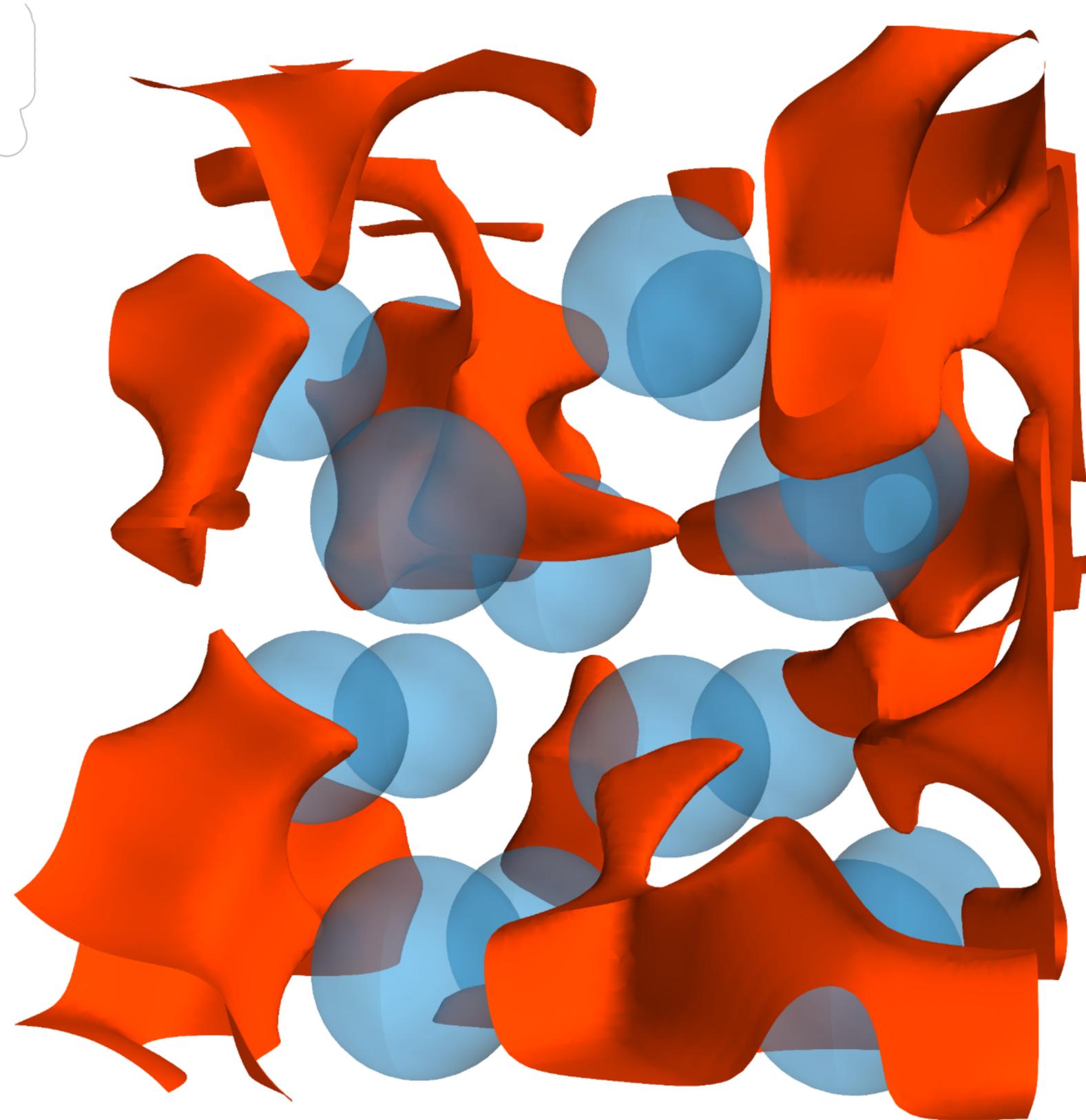
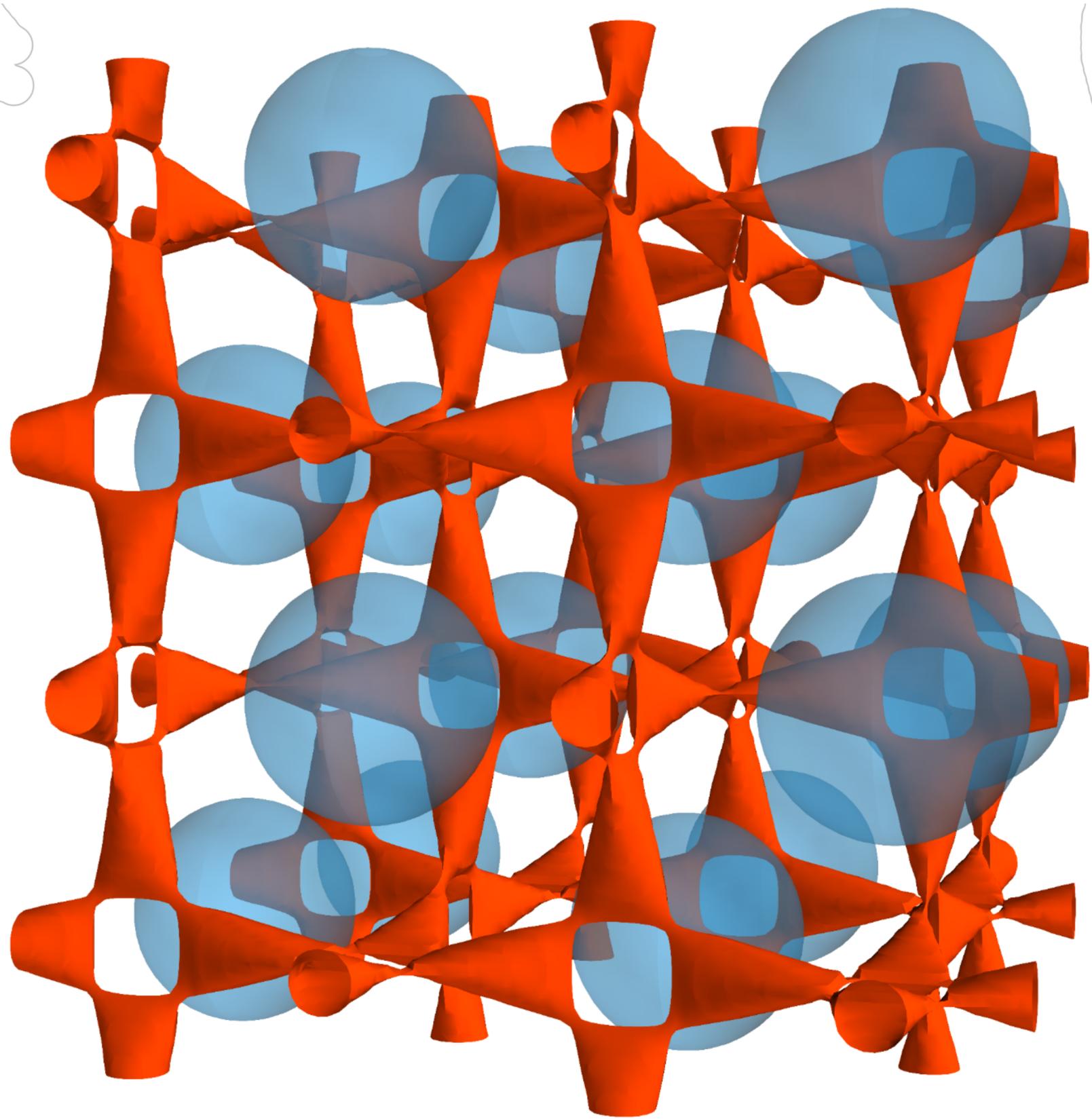












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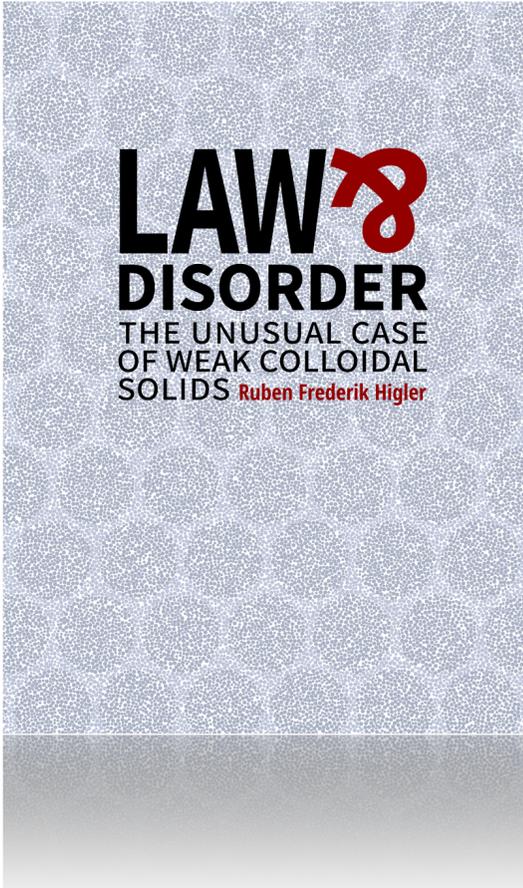
Justin Tauber\*, Ruben Higler\* & Joris Sprakel

Proc. Nat. Acad. Sci., **113**, 13660-13665 - Published 29 November 2016

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Ruben Higler & Joris Sprakel

Scientific Reports, **7**, 12634 - Published 3 October 2017



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PhD Thesis - 2018

