

Participating Site Inspection Tours

Cooling and Heating Asset Management Program



7:30 a.m.	Arrival and Badging	LLNL Westgate Badge Office
8:30 a.m.	Welcome & Overview of LLNL	Carol Meyers, Ph.D. <i>Associate Program Director, Nuclear Weapons Evaluation & Planning, Weapons Infrastructure, WCI, LLNL</i>
9:00 a.m.	Overview of CHAMP Pre-Bid Site Visits	Barb Quivey <i>Deputy Program Director, Facilities & Infrastructure, Office of Laboratory Infrastructure, LLNL, and Program Manager, Cooling and Heating Asset Management Program, LLNL</i>
9:15 a.m.	CHAMP Program Overview	Barb Quivey <i>Deputy Program Director, Facilities & Infrastructure, Office of Laboratory Infrastructure, LLNL, and Program Manager, Cooling and Heating Asset Management Program, LLNL</i>
9:45 a.m.	Contract Overview	Tracey Lewis <i>Division Manager, Supply Chain Management, LLNL</i> Roosevelt Pascal <i>Contract Analyst, Supply Chain Management, LLNL</i>
10:15 a.m.	B170 CHAMP Project Overview <i>Bldg. 170 Rm. 1091</i>	Tom Deighton <i>Project Manager, LLNL</i>
10:30 a.m.	Q&A	All Participants
11:00 a.m.	LLNL Project Inspection	All Participants
12:00 p.m.	Lunch Break	



Lawrence Livermore National Laboratory

Laboratory Overview

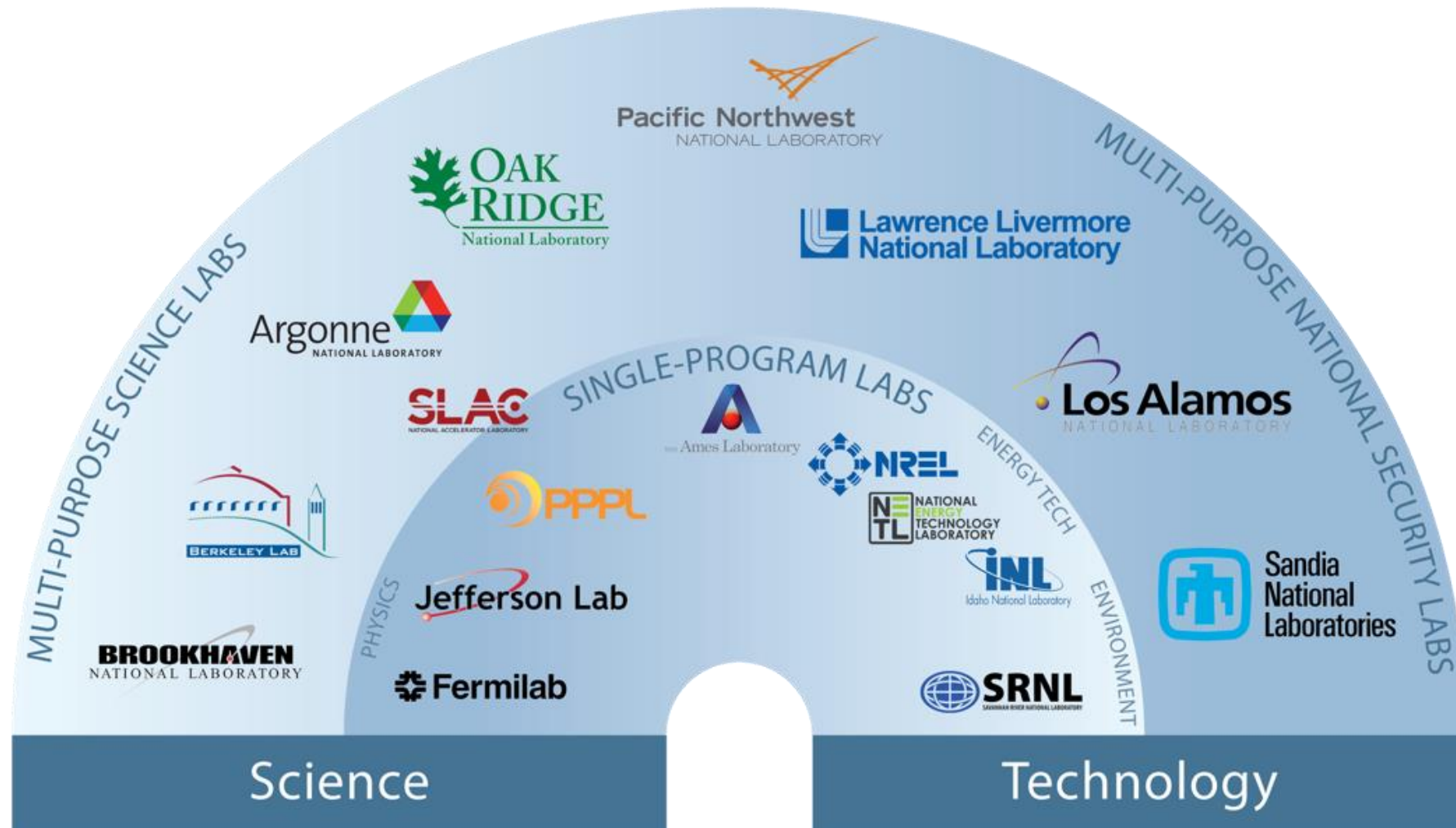
Carol Meyers

Associate Program Director for Nuclear Weapons Enterprise Evaluation and Planning
Weapons Infrastructure Program, Lawrence Livermore National Laboratory

October 2022



LLNL is one of 17 Department of Energy national laboratories



- LLNL established in 1952
- ~ 8,200 LLNS employees
- 1 square mile and 521 facilities
- Annual budget: ~ \$2.8B
- Operated by LLNS, LLC
(University of California and Bechtel, BWXT, Amentum)



Experimental Test Site
(11 miles² near Tracy, CA)

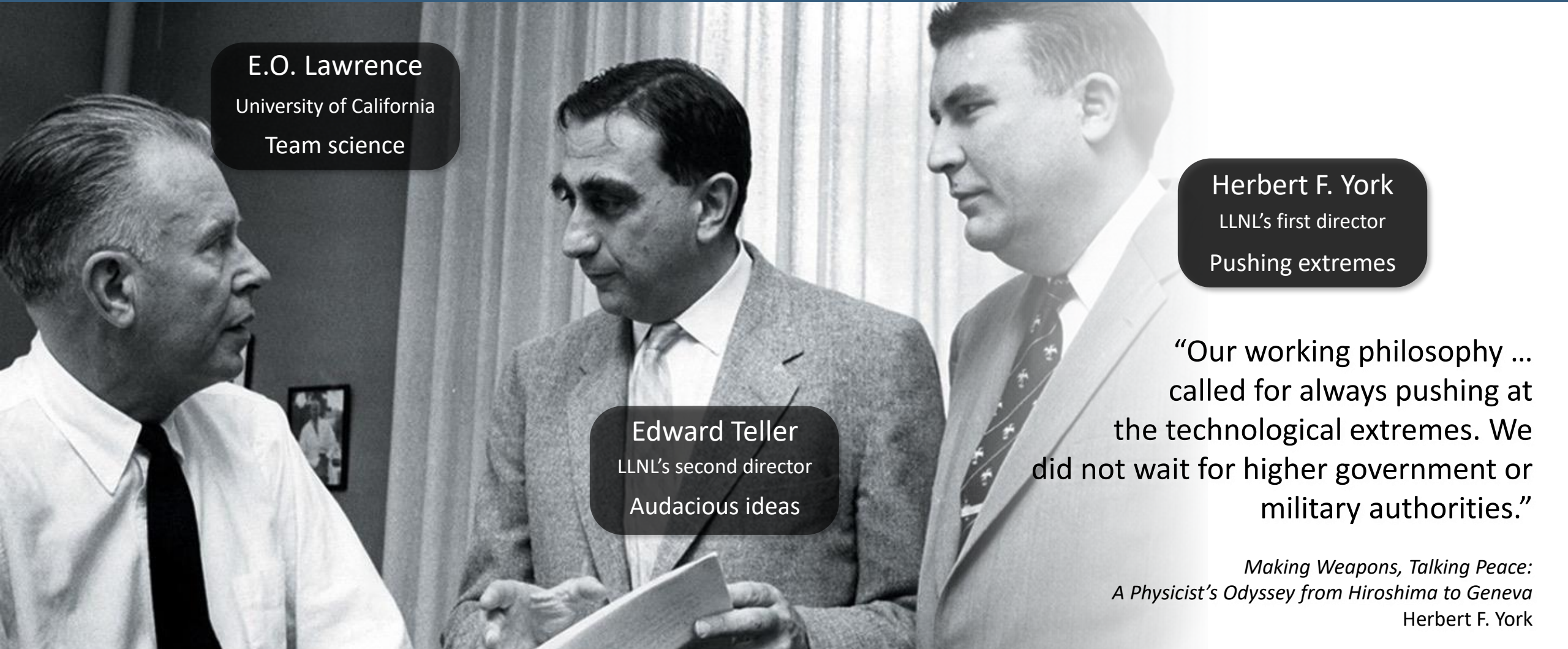
LLNL is part of the National Nuclear Security Administration nuclear weapons complex

DOE National Laboratories / Nevada Site

Production Complex



Our heritage: team science, audacious ideas, and pushing the extremes



E.O. Lawrence
University of California
Team science

Edward Teller
LLNL's second director
Audacious ideas

Herbert F. York
LLNL's first director
Pushing extremes

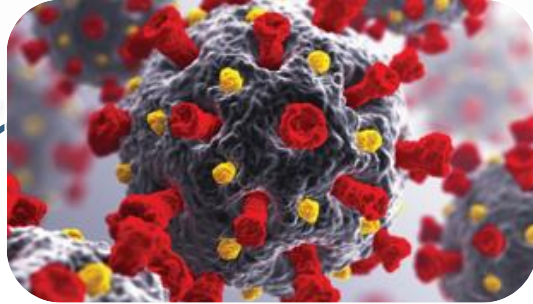
“Our working philosophy ... called for always pushing at the technological extremes. We did not wait for higher government or military authorities.”

*Making Weapons, Talking Peace:
A Physicist's Odyssey from Hiroshima to Geneva*
Herbert F. York

Our Mission: to strengthen national security through world-class science, technology, and engineering



Nuclear
Deterrence



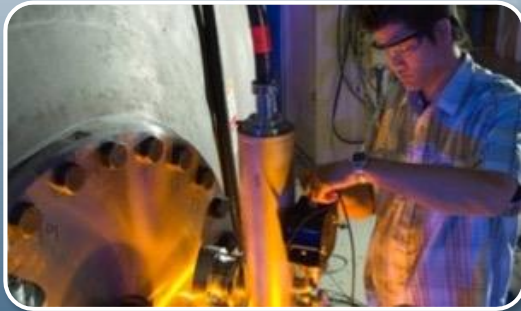
Threat Preparedness and
Response



Climate and Energy
Resilience



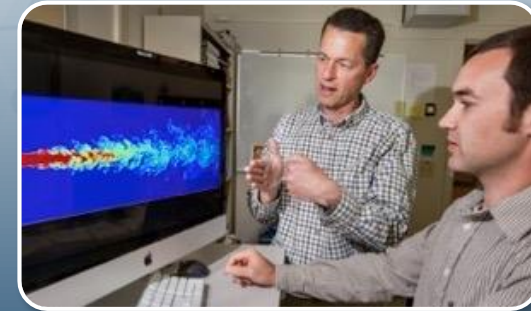
Integrated Deterrence
and Competition



Science



Engineering



Computing

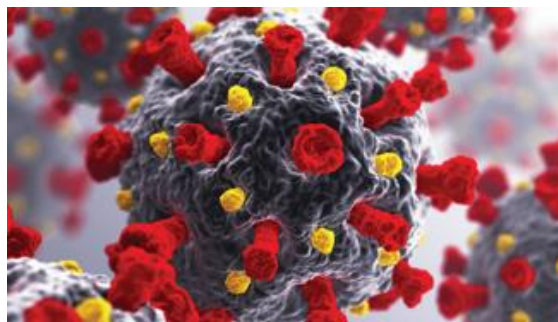
Our mission: to strengthen national security through world-class science, technology, and engineering

Nuclear Deterrence



- Annual Assessment
- Stockpile modernization
- Advanced science and technologies
- NNSA enterprise agility and resilience

Threat Preparedness and Response



- Pandemic response tools / biosecurity
- Nuclear counter proliferation and counterterrorism
- Forensic science
- All-source intelligence

Climate and Energy Resilience



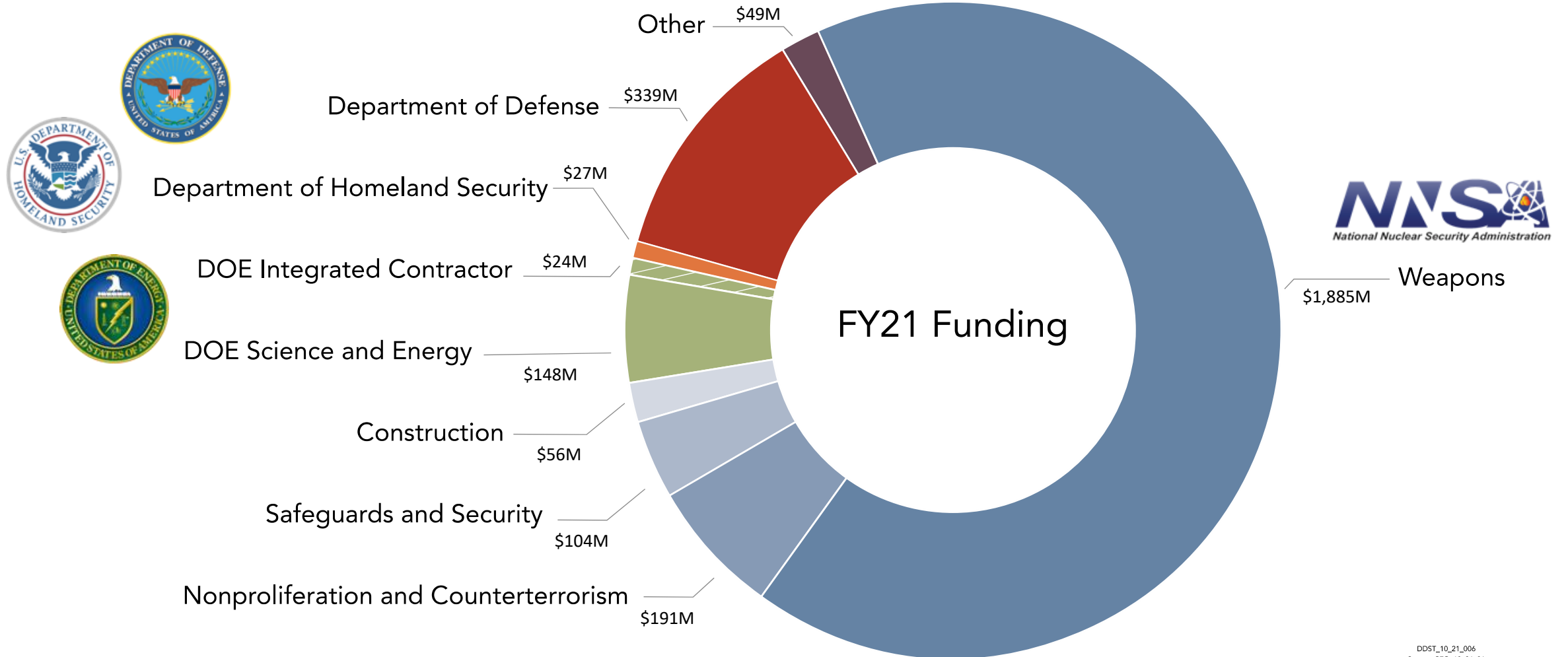
- High-fidelity climate impact assessments
- Reliable, secure, low-carbon energy
- Infrastructure sustainability
- Advanced materials and manufacturing

Integrated Deterrence and Competition



- Emerging technologies R&D and assessments
- Strategic defense and conventional strike
- Space / cyber security
- Cognitive simulation / artificial intelligence

LLNL's ~\$2.8B budget reflects our national security focus



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Source: CFO_10_26_21

Key Facilities

National Ignition Facility



Livermore Computing Complex B453



Site 300



Jupiter Laser Facility



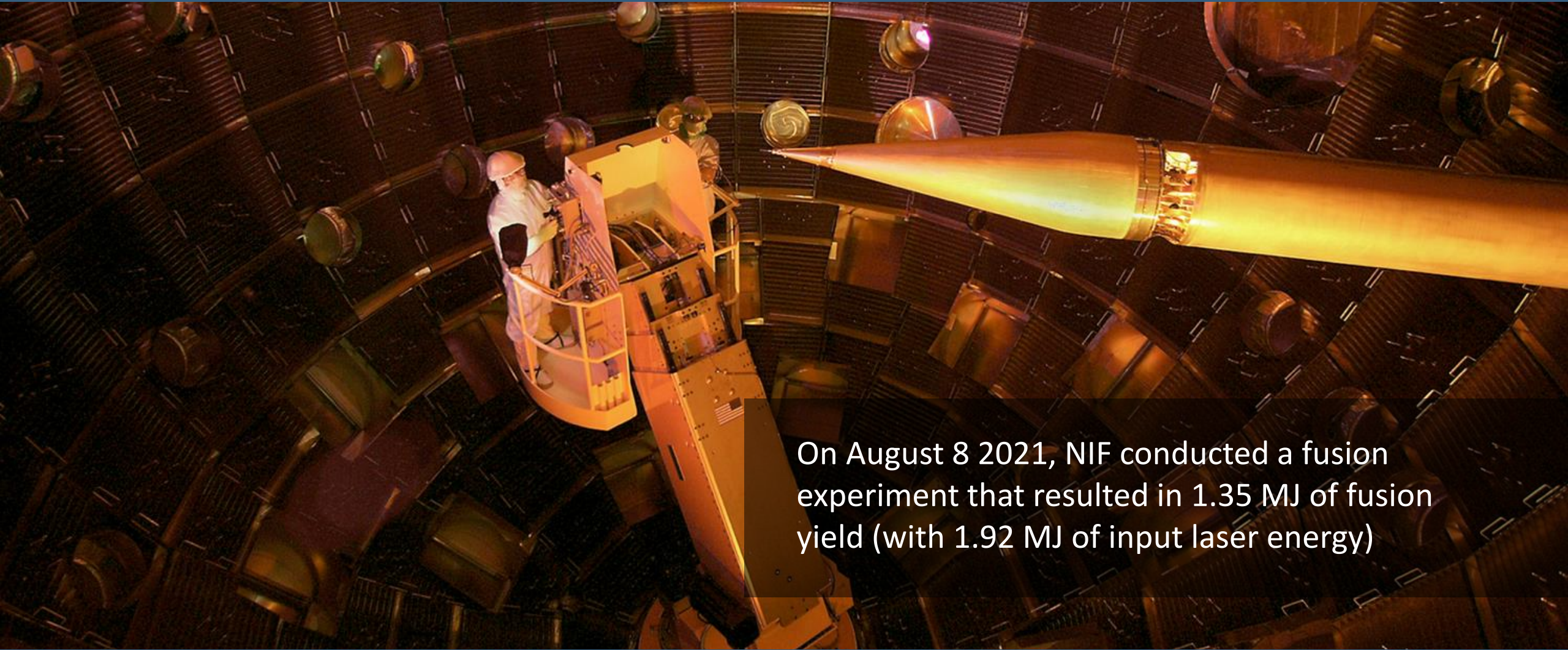
Advanced Manufacturing Laboratory



High Explosives Applications Facility



The National Ignition Facility (NIF) is the largest and most energetic laser facility ever built



On August 8 2021, NIF conducted a fusion experiment that resulted in 1.35 MJ of fusion yield (with 1.92 MJ of input laser energy)

LLNL is home to four of the world's most powerful supercomputers



Sierra 94.6 petaFLOPs



Lassen 18.2 petaFLOPs



Ruby 3.7 petaFLOPs



Magma 3.24 petaFLOPs

A total of

187 petaFLOPs

at Livermore Computing

TOP 500
The List.

FLOP = floating operations per second

Our approach is rooted in challenging predictions with experiments



High-performance computing

Sierra

#3 on Top 500 List	95 petaflops sustained	125 petaflops peak
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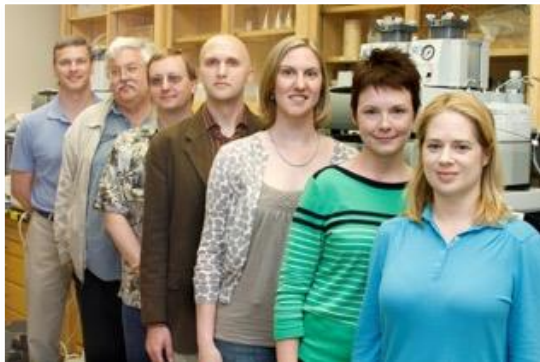


Advanced experimental capabilities

National Ignition Facility

192 laser beams	500 terawatts power output	2.15 MJ to target
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Frontier research and collaboration underlies our ability to deliver cutting-edge solutions

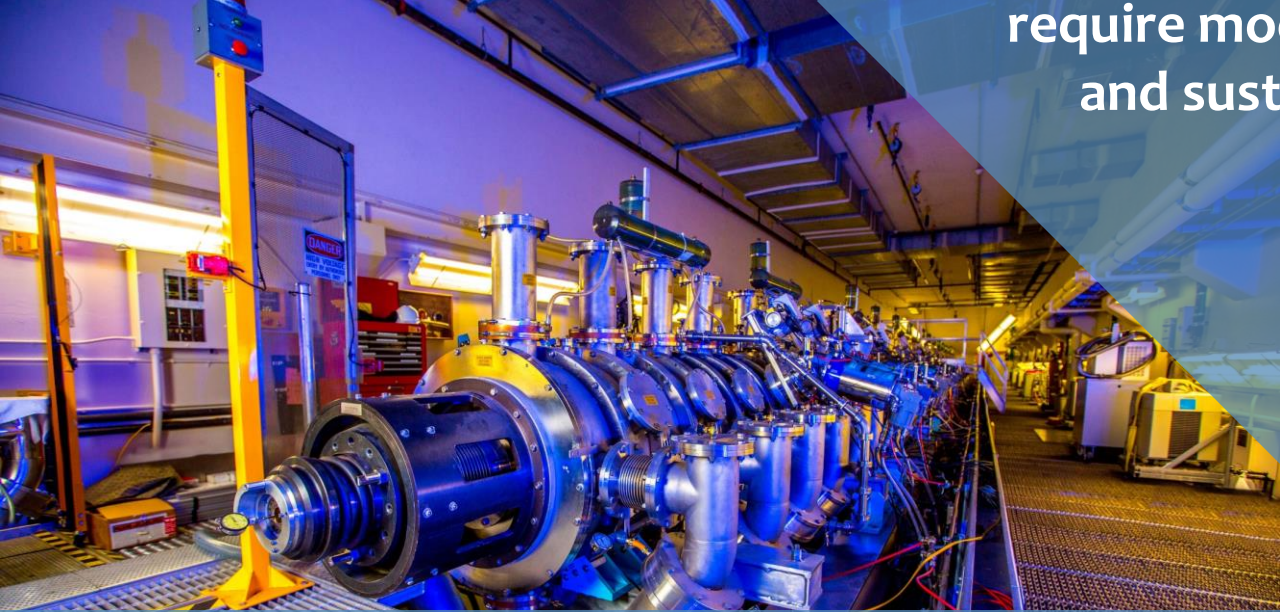


<div style="font-size: 2em; font-weight: bold;">116</div> <div style="font-size: 4em; font-weight: bold; margin: 10px 0;">Lv</div> <div style="font-size: 1.5em; font-weight: bold;">Livermorium</div>																<table border="1" style="width: 100%; text-align: center; font-size: 0.8em;"> <tr> <td>1</td><td colspan="16"></td><td>2</td> </tr> <tr> <td>H</td><td colspan="16"></td><td>He</td> </tr> <tr> <td>Hydrogen 1.008</td><td colspan="16"></td><td>Helium 4.002602</td> </tr> <tr> <td>3</td><td>4</td><td colspan="14"></td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td> </tr> <tr> <td>Li</td><td>Be</td><td colspan="14"></td><td>B</td><td>C</td><td>N</td><td>O</td><td>F</td><td>Ne</td> </tr> <tr> <td>Lithium 6.94</td><td>Beryllium 9.012182</td><td colspan="14"></td><td>Boron 10.81</td><td>Carbon 12.01</td><td>Nitrogen 14.007</td><td>Oxygen 15.999</td><td>Fluorine 18.99840323</td><td>Neon 20.1797</td> </tr> <tr> <td>11</td><td>12</td><td colspan="14"></td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td> </tr> <tr> <td>Na</td><td>Mg</td><td colspan="14"></td><td>Al</td><td>Si</td><td>P</td><td>S</td><td>Cl</td><td>Ar</td> </tr> <tr> <td>Sodium 22.98976928</td><td>Magnesium 24.305</td><td colspan="14"></td><td>Aluminum 26.9815385</td><td>Silicon 28.0855</td><td>Phosphorus 30.973761998</td><td>Sulfur 32.06</td><td>Chlorine 35.45</td><td>Argon 39.948</td> </tr> <tr> <td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td> </tr> <tr> <td>K</td><td>Ca</td><td>Sc</td><td>Ti</td><td>V</td><td>Cr</td><td>Mn</td><td>Fe</td><td>Co</td><td>Ni</td><td>Cu</td><td>Zn</td><td>Ga</td><td>Ge</td><td>As</td><td>Se</td><td>Br</td><td>Kr</td> </tr> <tr> <td>Potassium 39.0983</td><td>Calcium 40.078</td><td>Scandium 44.955909</td><td>Titanium 47.867</td><td>Vanadium 50.9415</td><td>Chromium 51.9961</td><td>Manganese 54.938044</td><td>Iron 55.845</td><td>Cobalt 58.933194</td><td>Nickel 58.6934</td><td>Copper 63.546</td><td>Zinc 65.38</td><td>Gallium 69.723</td><td>Germanium 72.630</td><td>Arsenic 74.921595</td><td>Selenium 78.9718</td><td>Bromine 79.904</td><td>Krypton 83.798</td> </tr> <tr> <td>37</td><td>38</td><td>39</td><td>40</td><td>41</td><td>42</td><td>43</td><td>44</td><td>45</td><td>46</td><td>47</td><td>48</td><td>49</td><td>50</td><td>51</td><td>52</td><td>53</td><td>54</td> </tr> <tr> <td>Rb</td><td>Sr</td><td>Y</td><td>Zr</td><td>Nb</td><td>Mo</td><td>Tc</td><td>Ru</td><td>Rh</td><td>Pd</td><td>Ag</td><td>Cd</td><td>In</td><td>Sn</td><td>Sb</td><td>Te</td><td>I</td><td>Xe</td> </tr> <tr> <td>Rubidium 85.4678</td><td>Strontium 87.62</td><td>Yttrium 88.90584</td><td>Zirconium 91.224</td><td>Niobium 92.90637</td><td>Molybdenum 95.94</td><td>Technetium 98</td><td>Ruthenium 98.9062</td><td>Rhodium 101.072</td><td>Palladium 106.42</td><td>Silver 107.8682</td><td>Cadmium 112.411</td><td>Indium 114.818</td><td>Tin 118.710</td><td>Antimony 121.757</td><td>Tellurium 127.603</td><td>Iodine 126.90447</td><td>Xenon 131.29</td> </tr> <tr> <td>55</td><td>56</td><td colspan="2">57 - 71</td><td>72</td><td>73</td><td>74</td><td>75</td><td>76</td><td>77</td><td>78</td><td>79</td><td>80</td><td>81</td><td>82</td><td>83</td><td>84</td><td>85</td><td>86</td> </tr> <tr> <td>Cs</td><td>Ba</td><td colspan="2">Lanthanoids</td><td>Hf</td><td>Ta</td><td>W</td><td>Re</td><td>Os</td><td>Ir</td><td>Pt</td><td>Au</td><td>Hg</td><td>Tl</td><td>Pb</td><td>Bi</td><td>Po</td><td>At</td><td>Rn</td> </tr> <tr> <td>Cesium 132.90545196</td><td>Barium 137.327</td><td colspan="2"></td><td>Hafnium 178.49</td><td>Tantalum 180.94788</td><td>Tungsten 183.84</td><td>Rhenium 186.207</td><td>Osmium 190.23</td><td>Iridium 192.222</td><td>Platinum 195.084</td><td>Gold 196.966569</td><td>Mercury 200.592</td><td>Thallium 204.38</td><td>Lead 207.2</td><td>Bismuth 208.9804</td><td>Polonium 209</td><td>Astatine 210</td><td>Radon 222</td> </tr> <tr> <td>87</td><td>88</td><td colspan="2">89 - 103</td><td>104</td><td>105</td><td>106</td><td>107</td><td>108</td><td>109</td><td>110</td><td>111</td><td>112</td><td>113</td><td>114</td><td>115</td><td>116</td><td>117</td><td>118</td> </tr> <tr> <td>Fr</td><td>Ra</td><td colspan="2">Actinoids</td><td>Rf</td><td>Db</td><td>Sg</td><td>Bh</td><td>Hs</td><td>Mt</td><td>Ds</td><td>Rg</td><td>Cn</td><td>Nh</td><td>Fl</td><td>Mc</td><td>Lv</td><td>Ts</td><td>Og</td> </tr> <tr> <td>Francium 223</td><td>Radium 226</td><td colspan="2"></td><td>Rutherfordium 261</td><td>Dubnium 268</td><td>Seaborgium 269</td><td>Bohrium 270</td><td>Hassium 277</td><td>Moscovium 288</td><td>Darmstadtium 289</td><td>Roentgenium 290</td><td>Copernicium 285</td><td>Nihonium 286</td><td>Flerovium 289</td><td>Moscovium 289</td><td>Livermorium 293</td><td>Tennessine 294</td><td>Oganesson 294</td> </tr> <tr> <td>57</td><td>58</td><td>59</td><td>60</td><td>61</td><td>62</td><td>63</td><td>64</td><td>65</td><td>66</td><td>67</td><td>68</td><td>69</td><td>70</td><td>71</td><td colspan="4"></td> </tr> <tr> <td>La</td><td>Ce</td><td>Pr</td><td>Nd</td><td>Pm</td><td>Sm</td><td>Eu</td><td>Gd</td><td>Tb</td><td>Dy</td><td>Ho</td><td>Er</td><td>Tm</td><td>Yb</td><td>Lu</td><td colspan="4"></td> </tr> <tr> <td>Lanthanum 138.9047</td><td>Cerium 140.12</td><td>Praseodymium 140.90766</td><td>Neodymium 144.242</td><td>Promethium 145</td><td>Samarium 150.36</td><td>Europium 151.964</td><td>Gadolinium 157.25</td><td>Terbium 158.92535</td><td>Dysprosium 162.50</td><td>Holmium 164.93033</td><td>Erbium 167.259</td><td>Thulium 168.93402</td><td>Ytterbium 173.045</td><td>Lutetium 174.967</td><td colspan="4"></td> </tr> <tr> <td>89</td><td>90</td><td>91</td><td>92</td><td>93</td><td>94</td><td>95</td><td>96</td><td>97</td><td>98</td><td>99</td><td>100</td><td>101</td><td>102</td><td>103</td><td colspan="4"></td> </tr> <tr> <td>Ac</td><td>Th</td><td>Pa</td><td>U</td><td>Np</td><td>Pu</td><td>Am</td><td>Cm</td><td>Bk</td><td>Cf</td><td>Es</td><td>Fm</td><td>Md</td><td>No</td><td>Lr</td><td colspan="4"></td> </tr> <tr> <td>Actinium 227</td><td>Thorium 232.0377</td><td>Protactinium 231.03688</td><td>Uranium 238.02891</td><td>Neptunium 237</td><td>Plutonium 244</td><td>Americium 243</td><td>Curium 247</td><td>Berkelium 247</td><td>Californium 251</td><td>Einsteinium 252</td><td>Fermium 257</td><td>Mendelevium 258</td><td>Nobelium 259</td><td>Lawrencium 260</td><td colspan="4"></td> </tr> </table>																		1																	2	H																	He	Hydrogen 1.008																	Helium 4.002602	3	4															5	6	7	8	9	10	Li	Be															B	C	N	O	F	Ne	Lithium 6.94	Beryllium 9.012182															Boron 10.81	Carbon 12.01	Nitrogen 14.007	Oxygen 15.999	Fluorine 18.99840323	Neon 20.1797	11	12															13	14	15	16	17	18	Na	Mg															Al	Si	P	S	Cl	Ar	Sodium 22.98976928	Magnesium 24.305															Aluminum 26.9815385	Silicon 28.0855	Phosphorus 30.973761998	Sulfur 32.06	Chlorine 35.45	Argon 39.948	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	Potassium 39.0983	Calcium 40.078	Scandium 44.955909	Titanium 47.867	Vanadium 50.9415	Chromium 51.9961	Manganese 54.938044	Iron 55.845	Cobalt 58.933194	Nickel 58.6934	Copper 63.546	Zinc 65.38	Gallium 69.723	Germanium 72.630	Arsenic 74.921595	Selenium 78.9718	Bromine 79.904	Krypton 83.798	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	Rubidium 85.4678	Strontium 87.62	Yttrium 88.90584	Zirconium 91.224	Niobium 92.90637	Molybdenum 95.94	Technetium 98	Ruthenium 98.9062	Rhodium 101.072	Palladium 106.42	Silver 107.8682	Cadmium 112.411	Indium 114.818	Tin 118.710	Antimony 121.757	Tellurium 127.603	Iodine 126.90447	Xenon 131.29	55	56	57 - 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Rubidium 85.4678	Strontium 87.62	Yttrium 88.90584	Zirconium 91.224	Niobium 92.90637	Molybdenum 95.94	Technetium 98	Ruthenium 98.9062	Rhodium 101.072	Palladium 106.42	Silver 107.8682	Cadmium 112.411	Indium 114.818	Tin 118.710	Antimony 121.757	Tellurium 127.603	Iodine 126.90447	Xenon 131.29																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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Cs	Ba	Lanthanoids		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Cesium 132.90545196	Barium 137.327			Hafnium 178.49	Tantalum 180.94788	Tungsten 183.84	Rhenium 186.207	Osmium 190.23	Iridium 192.222	Platinum 195.084	Gold 196.966569	Mercury 200.592	Thallium 204.38	Lead 207.2	Bismuth 208.9804	Polonium 209	Astatine 210	Radon 222																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
87	88	89 - 103		104	105	106	107	108	109	110	111	112	113	114	115	116	117	118																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Fr	Ra	Actinoids		Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Francium 223	Radium 226			Rutherfordium 261	Dubnium 268	Seaborgium 269	Bohrium 270	Hassium 277	Moscovium 288	Darmstadtium 289	Roentgenium 290	Copernicium 285	Nihonium 286	Flerovium 289	Moscovium 289	Livermorium 293	Tennessine 294	Oganesson 294																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Lanthanum 138.9047	Cerium 140.12	Praseodymium 140.90766	Neodymium 144.242	Promethium 145	Samarium 150.36	Europium 151.964	Gadolinium 157.25	Terbium 158.92535	Dysprosium 162.50	Holmium 164.93033	Erbium 167.259	Thulium 168.93402	Ytterbium 173.045	Lutetium 174.967																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Actinium 227	Thorium 232.0377	Protactinium 231.03688	Uranium 238.02891	Neptunium 237	Plutonium 244	Americium 243	Curium 247	Berkelium 247	Californium 251	Einsteinium 252	Fermium 257	Mendelevium 258	Nobelium 259	Lawrencium 260																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

The Dubna-LLNL collaboration has discovered 6 new elements since 1989



**NNSA Flagship S&T facilities
require modernization
and sustainment**



FXR/CFF Risk Reduction Project

High Explosives Applications Facility (HEAF)
Deferred Maintenance and Sustainment

Enhanced Minor Construction & Commercial Practices (EMC2) Pilot
Emergency Operations Center (EOC)

NA-50 Recap with NA-10 Equipment Programs
B225 Polymer Enclave



Recent investments are
transforming Lab
infrastructure and
enabling mission
delivery



STAR Construction and Streamlining
B224 AME and B642 LVOC

NA-50 Asset Management Programs
B170 Roof and HVAC for NARAC

The Laboratory provides critical reachback capabilities to the nation and beyond

National Atmospheric Release Advisory Center



Forensic Science Center



Counterproliferation Analysis & Planning System



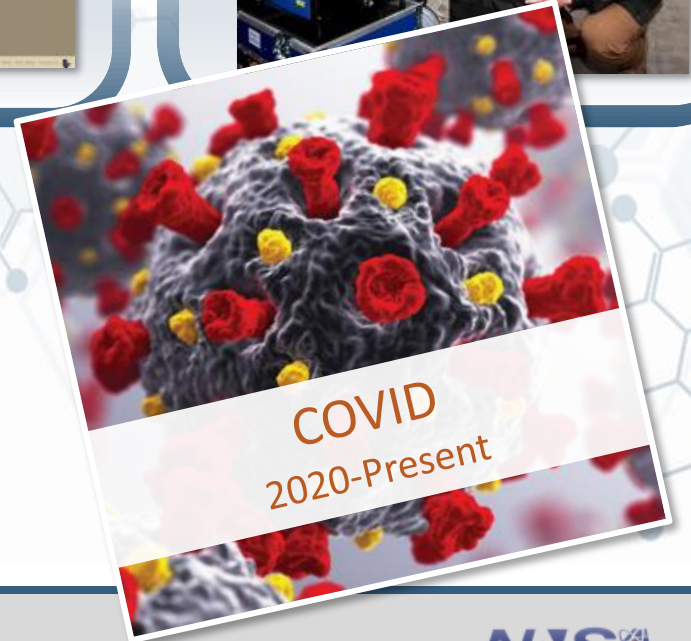
Render Safe Operations



Support of Analyses of DPRK Tests 2006-Present



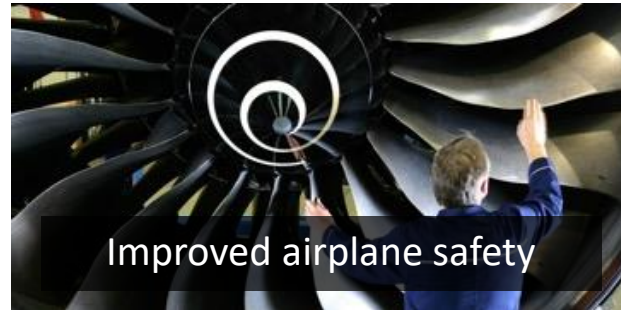
OPCW Support 2013 – Present



COVID 2020-Present

LLNL technologies: a multi-billion-dollar impact on the economy

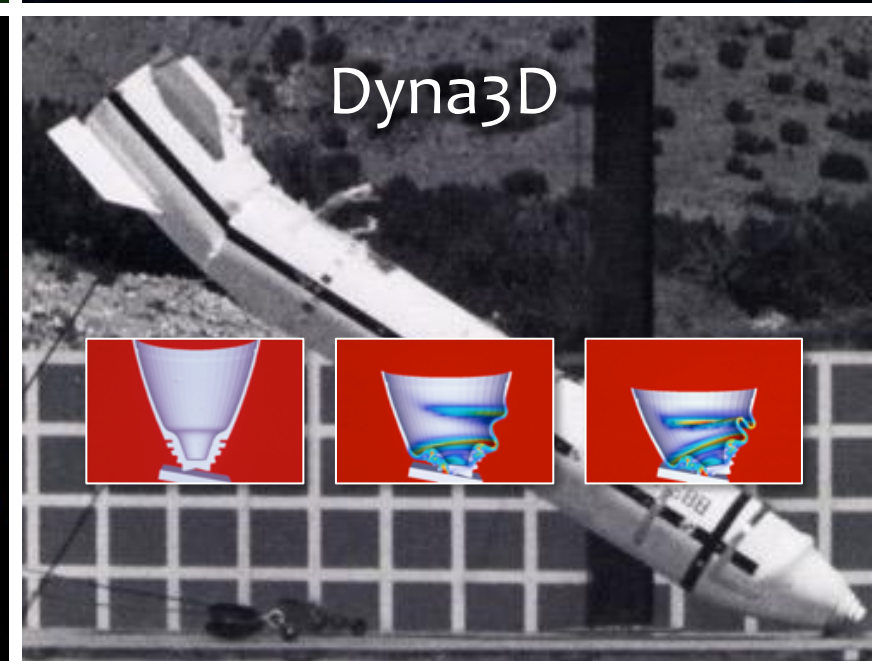
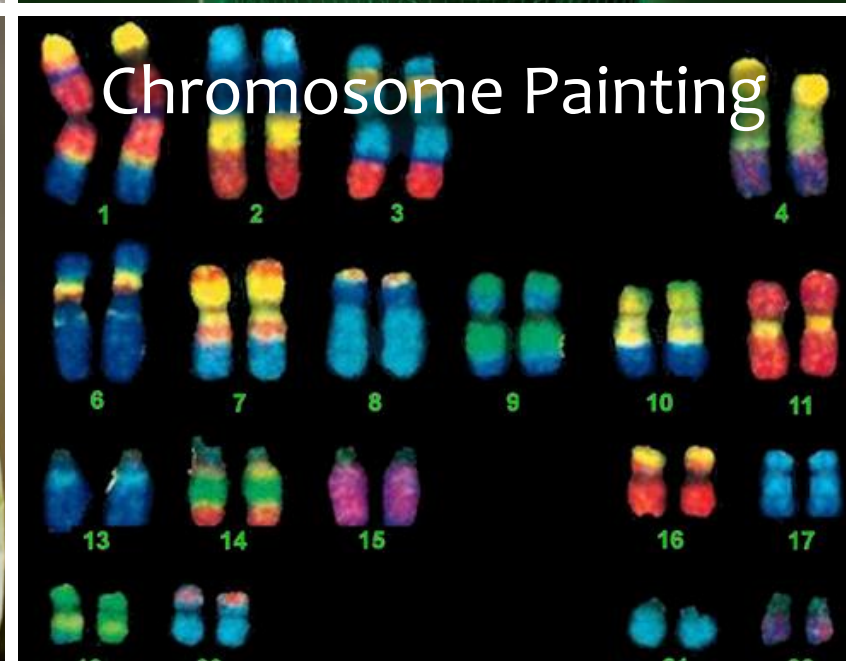
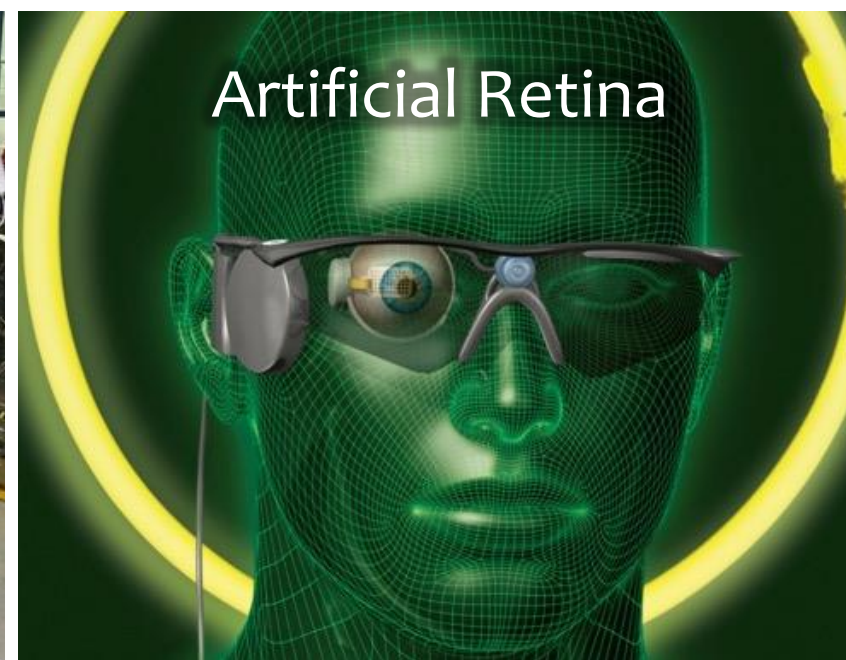
Over **\$1B** worth of products based on LLNL technology were sold in the past 5 years

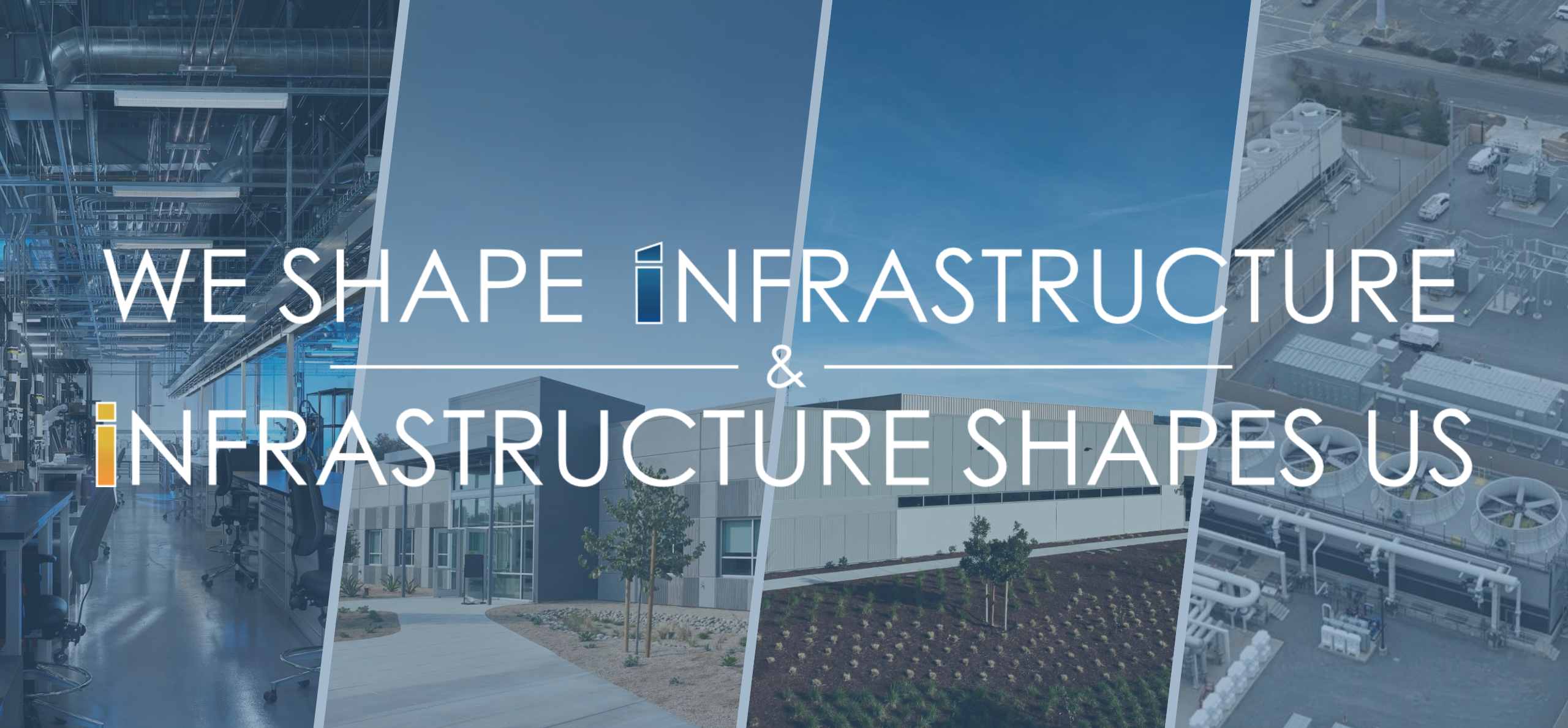


Licensing and royalty income topped **\$4.6M** in 2020

cādence
Rambus

Two public companies started by LLNL scientists have a total market value of over **\$21B**





WE SHAPE **i**NFRASTRUCTURE
— & —
iNFRASTRUCTURE SHAPES US



Lawrence Livermore
National Laboratory

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Science and Technology on a Mission





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