



California Science Center  
**CALIFORNIA STATE SCIENCE FAIR**  
**2001 PROJECT SUMMARY**

<b>Your Name</b> (List all student names if multiple authors.) <b>Csaba M. Petre</b>	<b>Science Fair Use Only</b>  <b>S1410</b>
<b>Project Title</b> (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9) <b>Teaching an Old Dog New Tricks: Using Mechanical Resonators to Demonstrate Quantum Computer Operations</b>	<b>Division</b> <b>_ Junior (6-8) <u>X</u> Senior (9-12)</b>
<b>Preferred Category</b> (See page 5 for descriptions.) <b>14 - Physics &amp; Astronomy</b>	
<b>Abstract</b> (Include Objective, Methods, Results, Conclusion. See samples on page 14.) Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.  <b>OBJECTIVE:</b> The purpose of this project is to demonstrate that a simple resonant mechanical device, a system of coupled dual mode mechanical resonators, can be used to exhibit some fast and efficient quantum computer operations.  <b>METHODS:</b> I explored quantum computer designs, quantum bits, quantum gates, Grover's quantum search algorithm, and reversible logic gates. I reached the conclusion that for most quantum operations, only the wave property of quantum bits is needed, without the actual matter portion. I designed and built a quantum bit and a simple two quantum-bit memory register using Lego Technic and masses and springs to demonstrate basic quantum computer operations.  <b>RESULTS:</b> The mechanical resonator based quantum bit and the two-quantum bit memory register worked as planned. I was able to demonstrate the basic concept of a quantum computer using these two devices.  <b>CONCLUSION:</b> From my research, I found that it is possible to demonstrate quantum computer operations on wave-based macroscopic devices such as mechanical resonators. This allows quantum algorithms, which are much more efficient than any classical algorithm, to be implemented for use in many different fields in the near future. To prove this conclusion, a coupled system of two dual-mode mechanical resonators were constructed. This system demonstrated quantum computer operations such as quantum memory storage.	
<b>Summary Statement</b> (In one sentence, state what your project is about.) The purpose of my project was to determine if some quantum computer operations can be performed by using mechanical resonators.	
<b>Help Received in Doing Project</b> (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4. Dr. Peter Petre helped with design issues.	