



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Aaron S. Goldin	Project Number S0709
Project Title Autonomous Gyroscopic Ocean-Wave-Powered Generator: Invention of a New Energy Conversion Technology	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Harnessing ocean power has been a long-sought goal. Existing wave-powered systems are large, land-based or moored, preventing autonomous applications. My goal was to invent a way to efficiently convert ocean wave power to an adaptive, autonomous, easily controlled system. Specifically, I applied gyroscopic precessional torque to convert periodic kinetic energy of surface waves into continuous torque that drives a rotary electric generator.</p> <p>Methods/Materials A prototype was designed, built and tested. All parts were scavenged from electronic equipment or fabricated from scraps. Many components were retooled and optimized. The effect of the gyro's angular velocity on both generator power output and adaptability to varying wave frequencies was determined. Bench tests recorded output power, gyro angular velocity, generator electrical load and slope frequency. A mathematical model was developed approximating precessional torque as a function of wave frequency and angular momentum of the gyro. A buoy was built, gyro-generator and data recorder installed, and tested at sea.</p> <p>Results Data show a direct relationship between gyro rate and output power at all tested wave frequencies. Greater gyro rates allowed the generator to adapt to lower wave frequencies and greater electrical loads. Greatest power (1.9 watts) was generated at the highest gyro velocity (90 r.p.s.) with the largest load (33 Ohms); zero power with gyro stopped. The prototype powered the gyro while delivering 0.6 watts into the load. Sea tests confirmed that precessional torque significantly increased the generator's power by >8x.</p> <p>Conclusions/Discussion A practical wave energy converter can be built using gyroscopic precessional torque sufficient to run both the gyro and an auxiliary load. It can be electronically controlled to adapt to different wave frequencies. This technology differs from current systems as it is autonomous, compact, avoids corrosion and rough sea damage common when moving parts directly contact seawater, and is scalable to much greater power outputs.</p>	
Summary Statement I invented a new way to mechanically convert ocean wave energy into electricity.	
Help Received My dad assisted me with testing, electrical circuit theory, and use of power tools. I got permission from Marine Physical Lab at Scripps Institution of Oceanography to use its pier for sea tests.	