

Precise Robust Inertial Guidance for Munitions: Nav. Grade IMU (PRIGM:NGIMU) [Other: Navigation]

Background

- The Department of Defense desires a higher performing Inertial Measurement Unit (IMU) for future guided munitions, but with no increase in cost, size, weight, and power (C-SWAP)
- PRIGM is focused on building a Navigation Grade IMU using the common IMU form factor and bringing 100x performance improvement over what is currently available.

Key IMU Performance Goals for PRIGM:NGIMU					
Accel Velocity Random Walk	Accel Bias	Accel Scale Factor	Gyro Angle Random Walk	Gyro Bias	Gyro Scale Factor
15 $\mu\text{g}/\sqrt{\text{Hz}}$	17 μg	25 ppm	0.0035 $^\circ/\sqrt{\text{hr}}$	0.05 $^\circ/\text{hr}$	60 ppm

Projected Performance for Various DoD Missions		
Mission	Duration	Key Performance Parameter
Gun Launched	80 s	2 m CEP
Air Launched	3 min	10 m CEP
JDAM	60 s	10 m CEP
Ground Vehicle	1 hr	0.4 m CEP
Azimuth	60 s	2 mrad 1- σ
UAV	1 hr	0.8 nm CEP
UUV	2 hr	25 m CEP

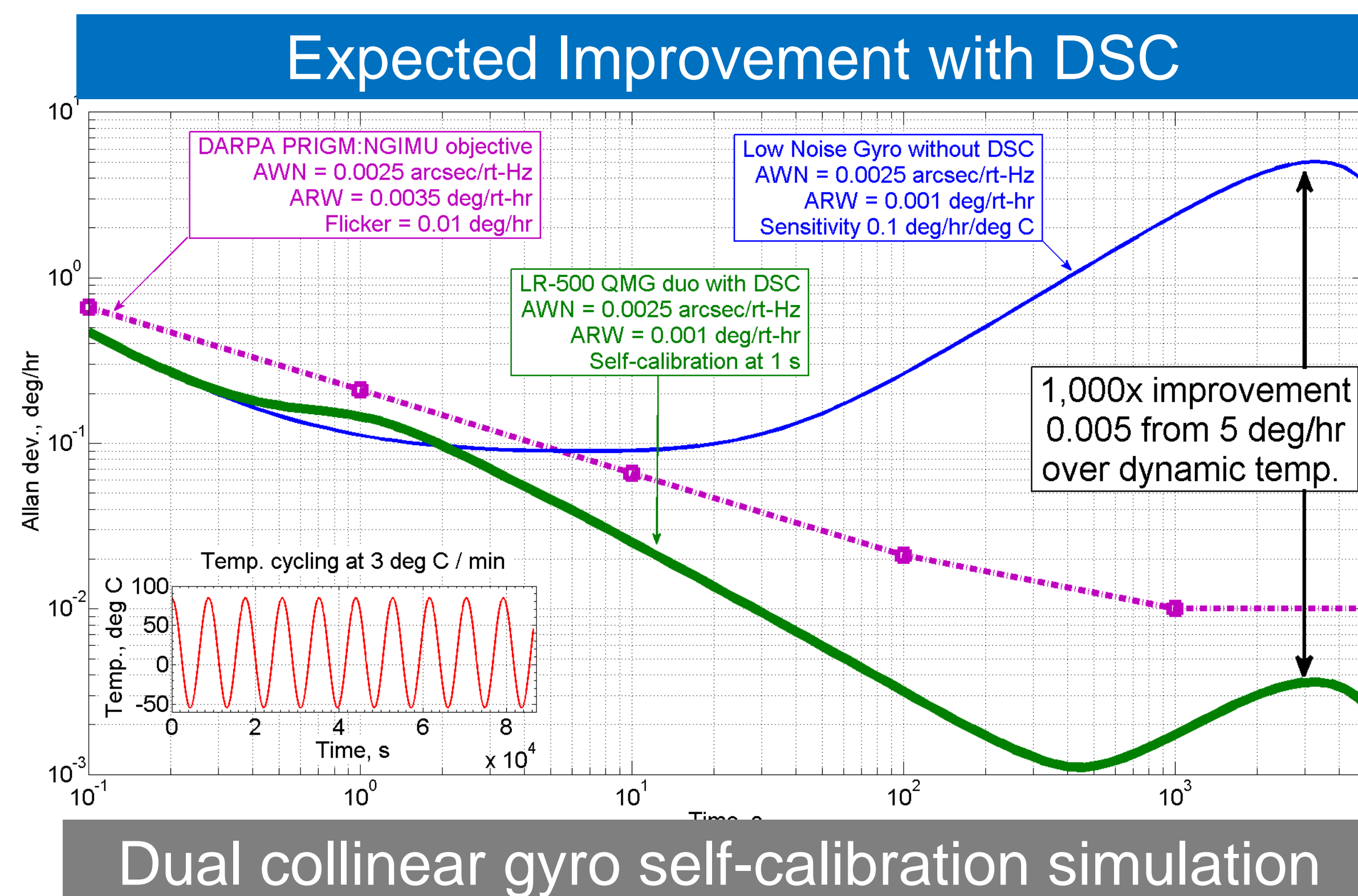
CEP = Circular Error Probability



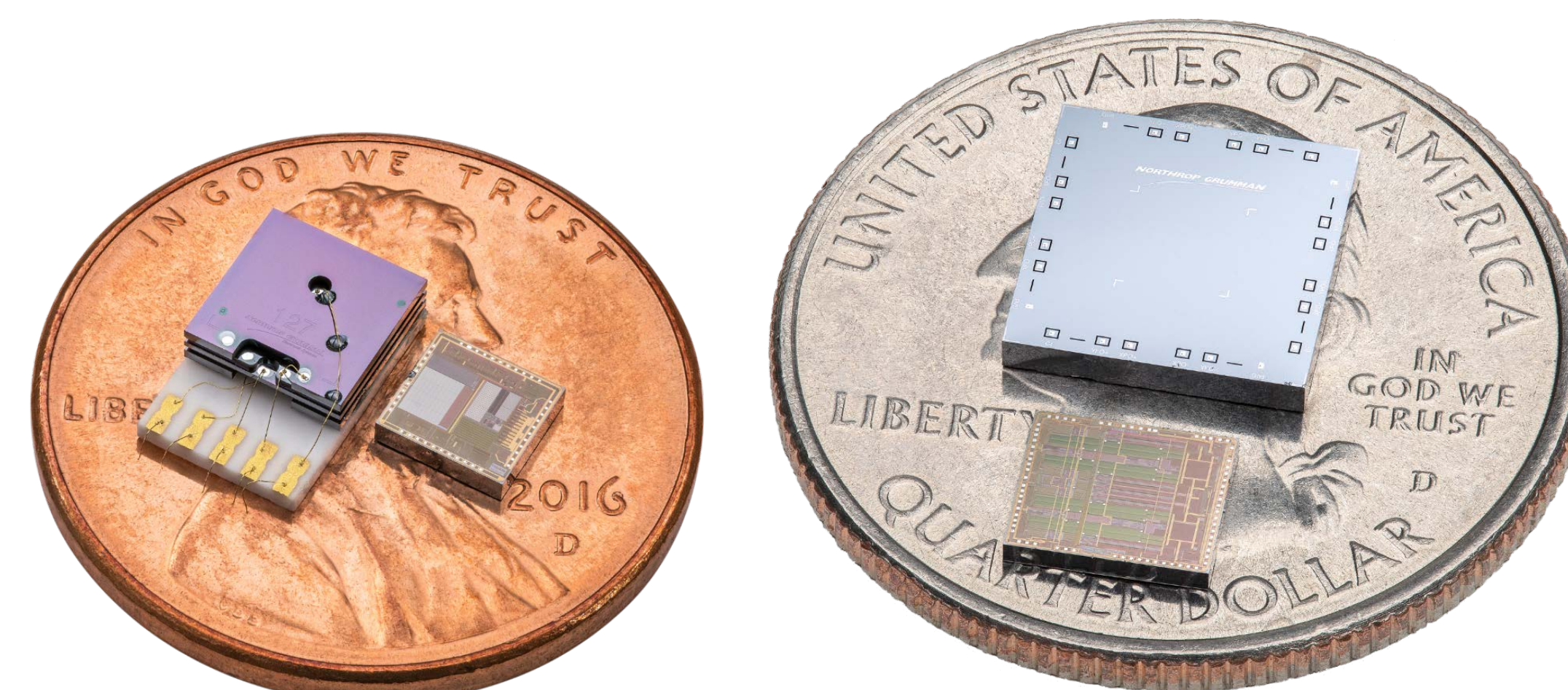
Northrop Grumman Phase 2 IMU Package

Approach

- DARPA is funding Northrop Grumman to develop an IMU using our production Silicon Accelerometer (SiAc) along with the new Quad Mass Gyroscope (QMG) incorporating Dynamic Self-Calibration (DSC).
- DSC enhances MEMS gyro performance by making errors observable and removable during dynamic operation.
- This allows for an IMU that can meet the performance goals set forth by the program in a footprint compatible with currently used IMUs.



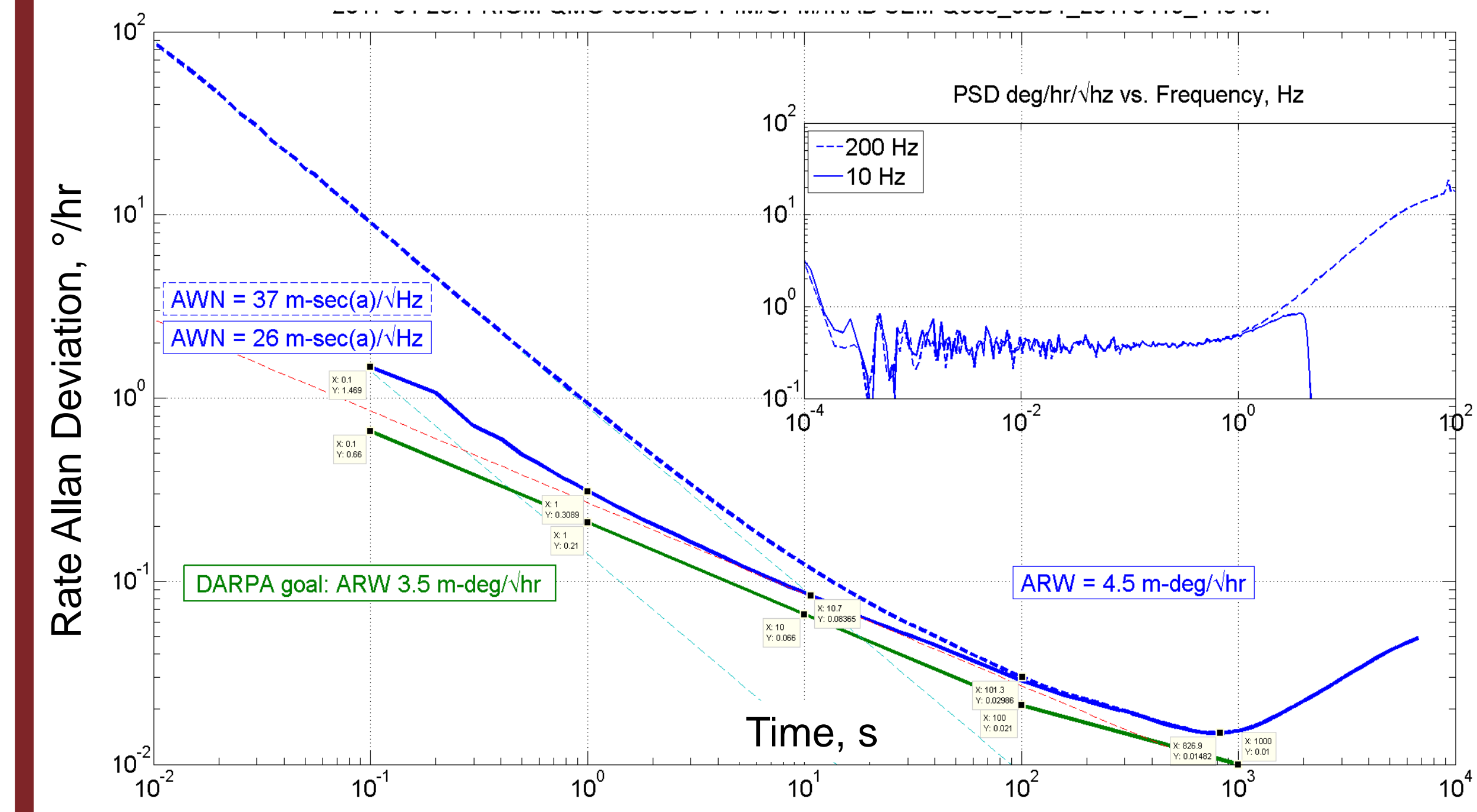
Dual collinear gyro self-calibration simulation



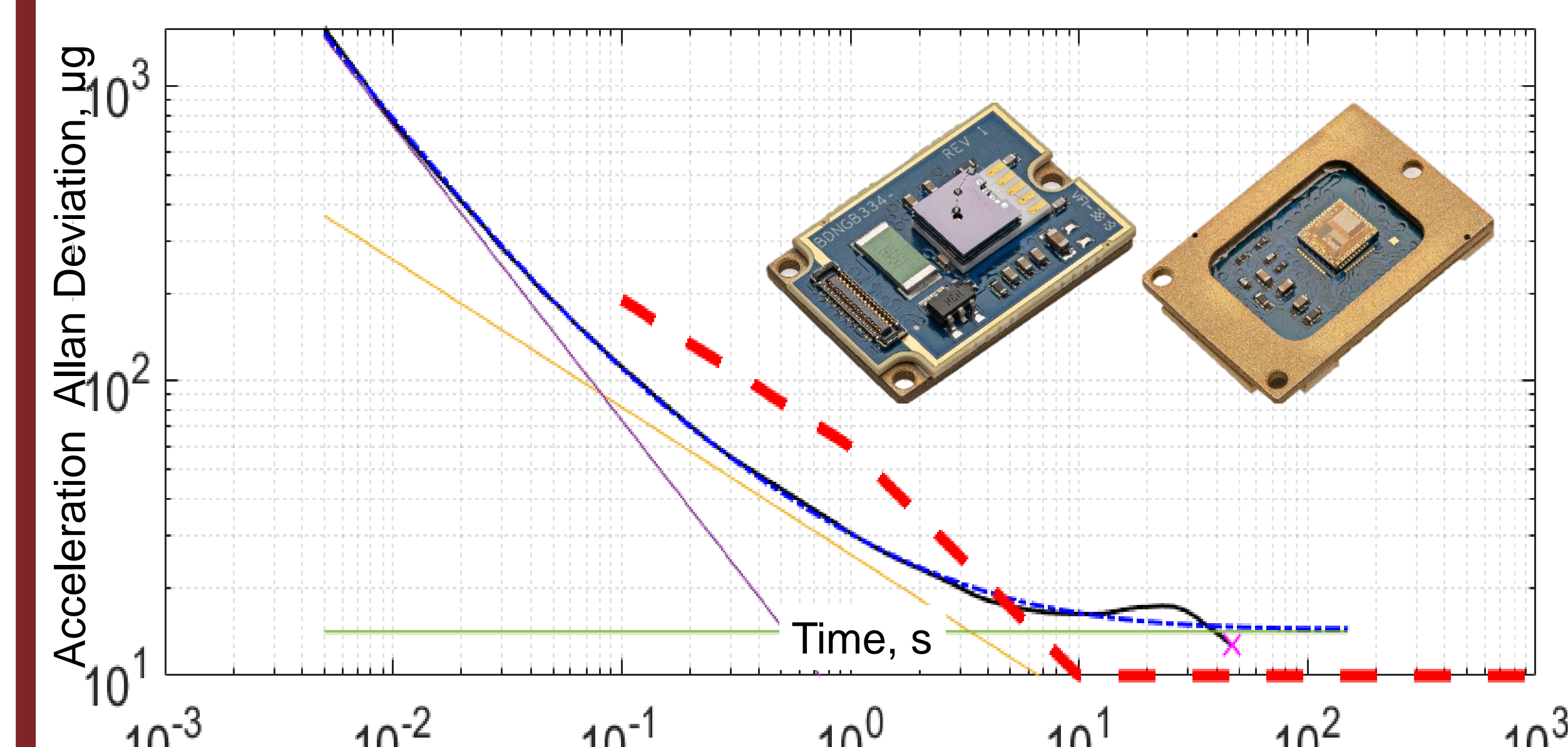
SiAc with ASIC and QMG with ASIC

Results and Impact

- Transitioned instrument interface electronics to high performance ASICs, reducing power consumption.
- Transitioned QMG to 8 inch Wafer Level Vacuum Package (WLVP) foundry process which allows for more compact packaging and lower cost.
- Along with demonstrating sensors performance with lab electronics and first ever QMG self-cal, the initial Phase 2 gyro (top graph) and accel (bottom graph) performance data are near the final Phase 3 goals.



QMG in-run performance test data



SiAc in-run performance test data