

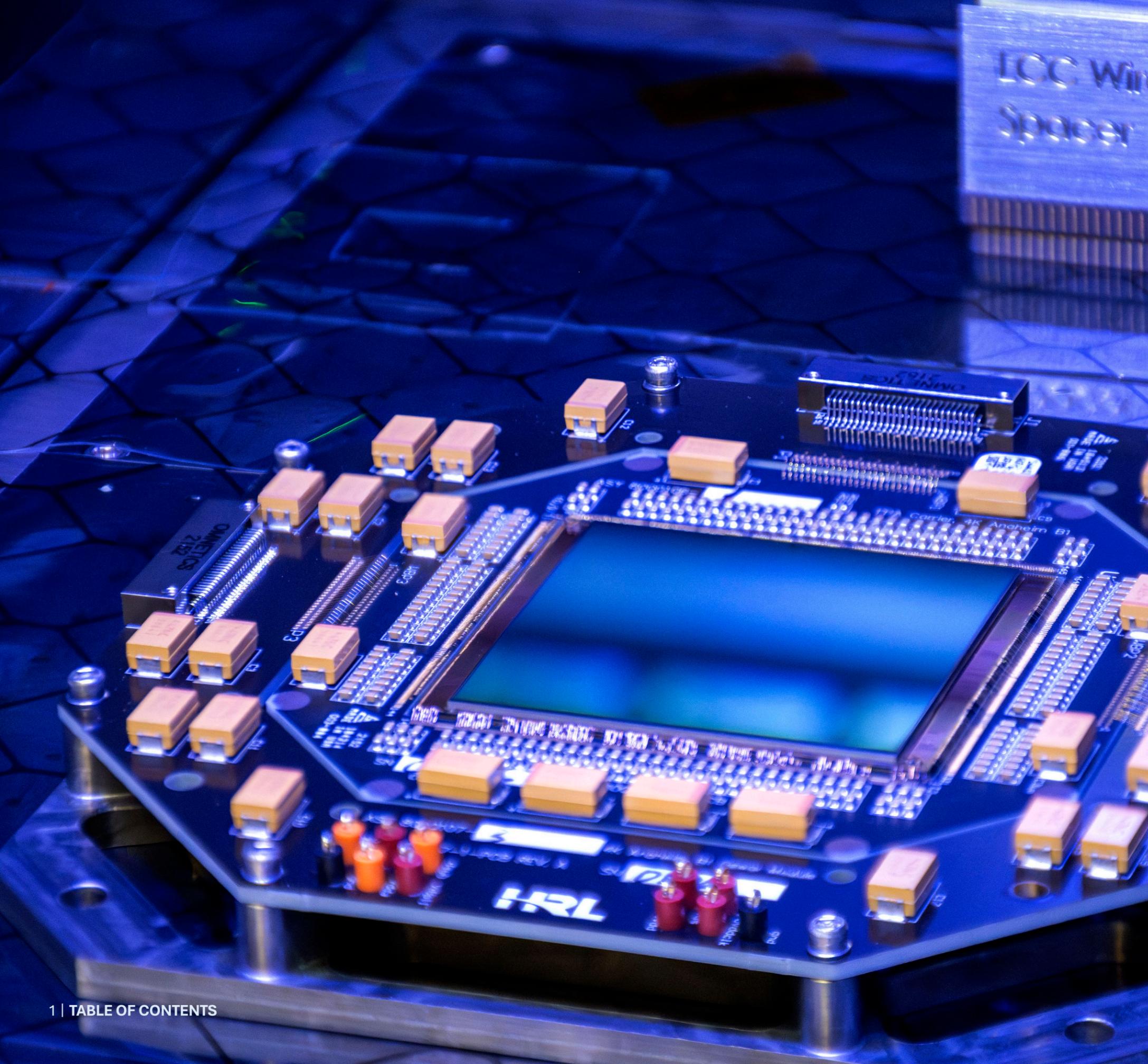


# Innovation and Development Report

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**HRL** | LABORATORIES

2025



## Contents

Who we are	03
CEO message	04
Materials and Microsystems	05
Sensors and Electronics	07
Vision Systems	09
Microfabrication Technology	11
Intelligent Systems	13
Gallium Nitride	14
MEMS IMU	15
Quantum	16
Executive leadership	17
Our people	18

# Who we are

**Vision:** Innovate ground-breaking advancements that solve tomorrow's challenges.

## Mission

**Deliver transformative technologies** in the automotive, aerospace and defense industries through pioneering work in physical science and engineering.

## Values:

- Acting with integrity
- Innovative
- Customer-centric and agile
- Accountable
- Collaborative and communicative
- Respectful

## About us

**HRL Laboratories pioneers** the next frontiers of physical and information science. Delivering transformative technologies in automotive, aerospace and defense, HRL advances the critical missions of its customers to help them **remove limitations and create competitive advantage**. HRL then transitions the work back to customers – ready for real-world application.

**For more than 70 years**, HRL's rich portfolio of scientific discoveries and engineering innovations continues to build on each other — often in unexpected, profound and far-reaching ways. As a private company owned jointly by Boeing and GM, HRL prioritizes purpose over profit, significantly advancing the state of the art.

## CEO message

**2025 was marked by both challenges and meaningful achievements.** The Palisades wildfire at the beginning of the year tested our resilience. We all felt the impact on our company, our employees and even our commutes. I am incredibly proud of how each of our employees rose up to overcome numerous challenges with determination and teamwork.

**Our ability to adapt swiftly** to the new federal government R&D priorities under the new administration showcased our agility. This report highlights extensive accomplishments across key programs and despite the year's pressures, our teams pushed forward on critical advancements.

- We pioneered advancements in new materials
- We integrated our innovations into space systems
- We won large awards related to next-generation radio-frequency systems
- We licensed high-volume, low-cost manufacturing of HRL technology

**And importantly, the strategic direction** we refined early in 2025 aligns seamlessly with three of the six critical technology areas identified by the U.S. Department of Defense<sup>1</sup>:

- Applied Artificial Intelligence
- Quantum and Battlefield Innovation Dominance
- Scaled Hypersonics

This alignment positions us favorably for future contract research and development opportunities.

<sup>1</sup> <https://www.cto.mil/usdre-strat-vision-critical-tech-areas/>

Our internal research and development projects, along with externally funded contracts, drive significant progress in these areas.

**To our valued customers**, our fundamental belief in the future we are creating has never been stronger. Our focus is on delivering the results you need to meet your future goals.

**To our dedicated employees**, your hard work and continued focus on execution are the foundation of our success going forward. Take pride in what we have accomplished together.

**To prospective employees**, we invite you to join a team that is at the forefront of technological innovation.

In 2025, we continued building for the long-term, even in challenging environments. Thank you for your continued dedication and excellence.

**Rob Vasquez**  
President and CEO, HRL Laboratories



# Materials and Microsystems

*Creating solutions that perform in the toughest environments.*

HRL Laboratories advances critical structural and functional materials and semiconductor devices that enable precision navigation, quantum technologies and extreme-environment performance. With expertise from design through deployment, we deliver scalable, high-performance solutions that transform our customers' missions. Our work leverages digital manufacturing and scalable microfabrication techniques to meet tomorrow's toughest challenges.

## 2025 highlights

-  **6** journal publications
-  **25** patents awarded
-  **61** industry presentations

**The Materials and Microsystems Laboratory (MML) continues to lead innovation** in high-impact materials and microsystems that push the boundaries of quantum systems, thermal management and functional material performance.

In quantum technologies, MML launched **spinQICK, an open-source program focused on scalable testing for semiconductor spin-qubits**. spinQICK provides a shared hardware and software platform for generating, routing and detecting quantum states. This new test capability complements HRL's **Qubits for Computing Foundry** program seeking to provide state-of-the-art quantum devices to the research community. These advances help establish a common foundation the quantum-research community can build on.

To support next-generation, high-power AI data centers, this year the MML team achieved **record-low thermal resistance for advanced graphics processor cooling blocks**, enabling unprecedented cooling performance and energy efficiency. The team **advanced quantum benchmarking methods** to quantify

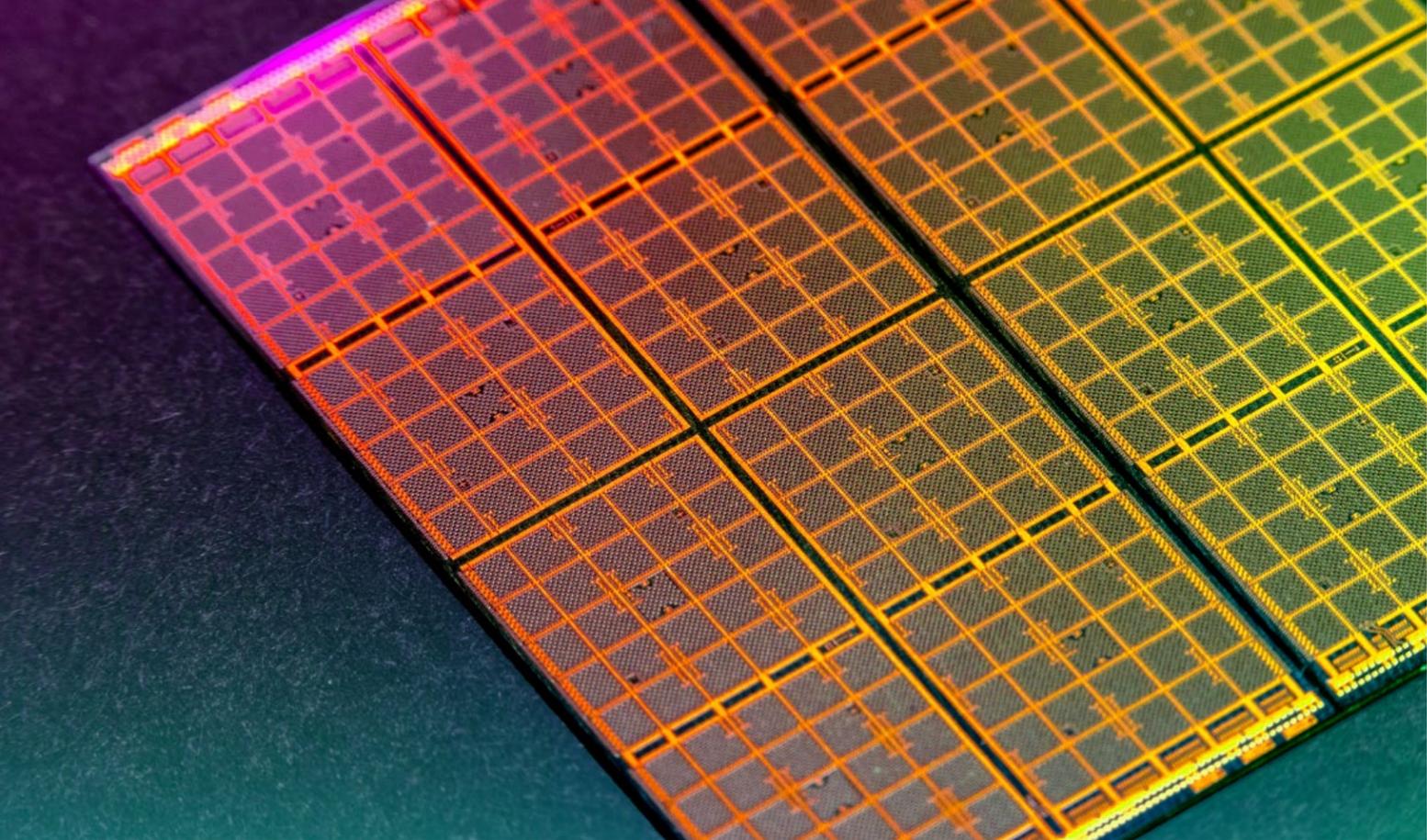
needs and benefits for quantum computing based accelerated material discovery, driving towards key applications in aerospace alloys and corrosion-resistant metals. Finally, a newly architected permanent-magnet design **significantly reduces the need for heavy rare-earth elements** while improving electric-motor efficiency for future vehicles.

**MML also developed pioneering additive manufacturing technologies** under DARPA programs, including integrated sensing to monitor in-mission performance and precision-engineered multi-material control surfaces that meet extreme heat and strength demands. New digital-twin tools for composite manufacturing **now allow real-time property prediction and improved reliability during production**.

With collaborations across industry, academia and government, MML continues to translate materials science and device breakthroughs into practical systems that strengthen national defense, enhance sustainability and **define the next generation of high-performance technologies**.

**HRL thrives where materials science and complex manufacturing meet innovation. We're tackling high-risk, high-reward challenges in integrated microsystems and thermal management, turning ambitious ideas into real-world solutions.**

*Geoff McKnight, VP, MML*



# Sensors and Electronics

*Turning physics into performance.*

HRL Laboratories develops radio frequency, millimeter-wave and electro-optical sensors using state-of-the-art materials and device fabrication processes to deliver agile, mission-ready systems. Our high-performance solutions are highly integrated, architecturally low cost, and optimized for size, weight and power efficiency while leveraging commercial, custom and novel mixed-signal innovations.

## 2025 highlights

 **2** journal publications

 **19** patents awarded

 **6** industry presentations

 **9** projects delivered

HRL is focused on delivering complex technology programs and moving innovative solutions into the hands of our customers. Through strong alignment and steady progress, we advance sensing and electronic capabilities that support ongoing mission performance.

*Seong Kim, VP, SEL*

**The Sensors and Electronics Laboratory (SEL) pushed performance and integration** forward across sensing, RF electronics and mission-ready system development. One of the year's major milestones came from **Boeing's successful integration of HRL's T3L gallium nitride (GaN) low noise amplifiers** into an experimental satellite payload. After completing full verification and environmental testing, the payload is moving toward spacecraft integration, marking **the first use of HRL GaN low noise amplifiers in space.**

SEL also helped secure a **\$16M DARPA award under the Next Generation Microelectronics Manufacturing program**, supporting the creation of a U.S.-based R&D and manufacturing center for 3D heterogeneous microsystems. SEL is playing a central role in demonstrating next-generation phased arrays and infrared focal plane exemplars for leveraging this national capability.

Thermal management advances continued under the **DARPA Minitherms3D program**,

where the team demonstrated a 3D cooling assembly that improves heat removal for high-power millimeter-wave systems.

On the **EQUAL-P program**, SEL strengthened RF receive and transmit performance during testing at the Naval Information Warfare Center, **showing 15 dB better sensitivity and clean over-the-air transmission** in two simultaneous channels. The team also advanced low-cost radar sensing for Boeing by maturing hardware, refining simulation tools and validating low-cost sensor prototypes in multiple test campaigns.

Through the CHIPS Microelectronics Commons consortium, SEL deepened collaborations with university and industry partners, **accelerating "lab-to-fab" transition** for next-generation RF and sensing technologies.

Together, these efforts highlight SEL's growing impact in **delivering the sensing and electronic systems that shape future missions.**

# Vision Systems

*Safety through advanced sight.*

HRL Laboratories pioneers world-class infrared sensor systems for aerospace and defense, enhancing national capabilities through innovative solutions. We collaborate closely with our customers to transform emerging needs into high-performance outcomes. Our business model leverages our focus on advanced research and product delivery, ensuring customer satisfaction and mission success.

## 2025 highlights

 **7** product deliverables

 **6** industry presentations

**The Vision Systems Laboratory (VSL) continues to advance** high performance focal plane systems that **support the nation's most demanding space and defense missions.**

This year the team expanded both production capability and technical depth, strengthening VSL's role as a trusted provider of world-class sensor technology.

VSL's Camarillo production facility reached a **major milestone by doubling throughput since early 2025**, enabling reliable, volume manufacturing of large format devices. That capability fueled significant progress on multiple customer programs, including full engineering builds and **delivering 4kx4k space-grade focal planes for Boeing.**

These devices support Boeing's entry into new satellite markets and **have contributed to significant program awards** to date.

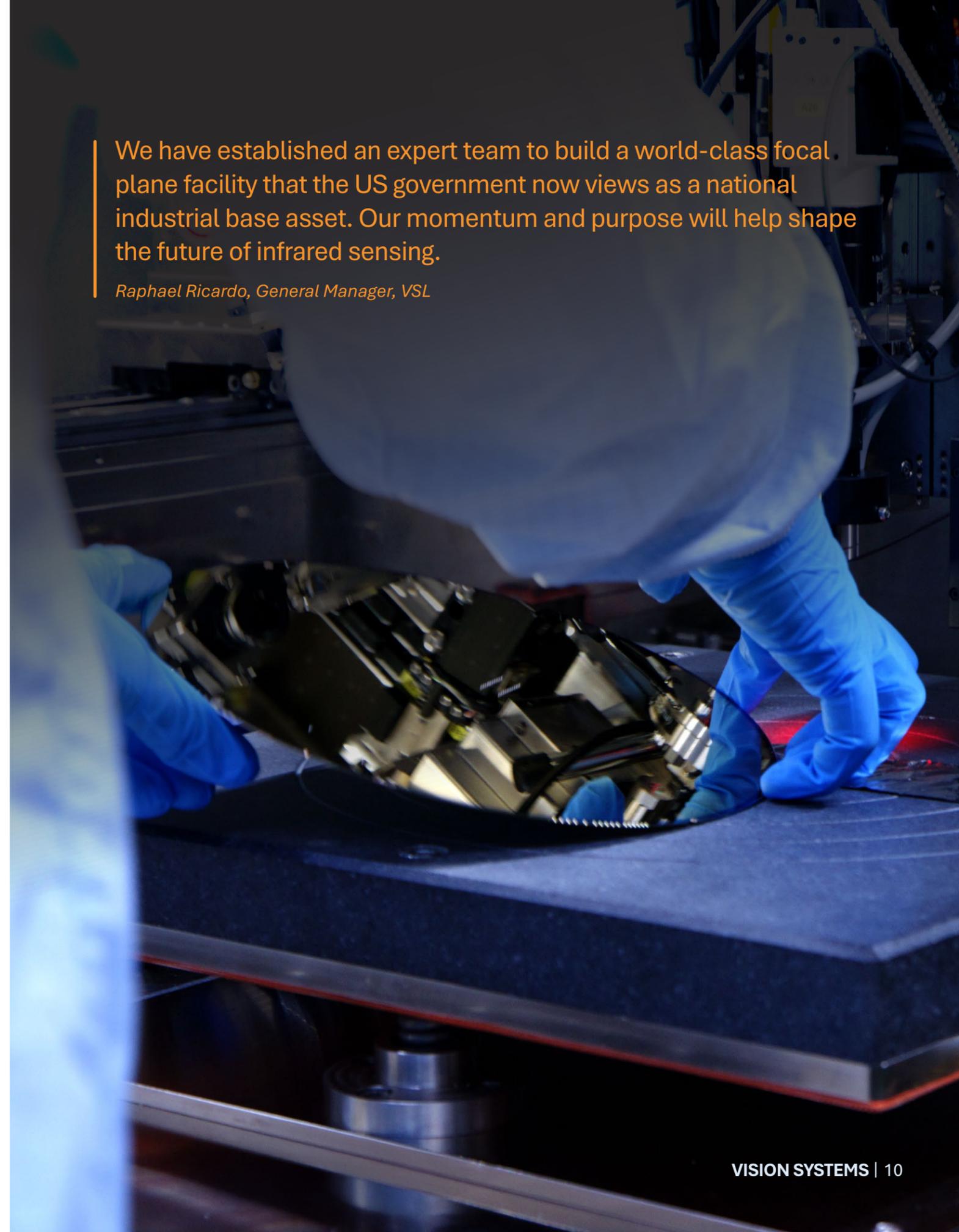
VSL also completed payload integration and ground testing for additional systems that are now in space.

Beyond delivery milestones, VSL continued building the infrastructure required for long-term success. The team adopted advanced enterprise resource planning and product lifecycle management tools, strengthened manufacturing execution processes and **achieved AS9100 recertification for the third straight year.** VSL also made important strides on the **CASTLE program with the Air Force Research Laboratory**, helping reinforce the national industrial base for next-generation infrared systems.

**Through these accomplishments,** VSL is ensuring mission-ready sensor technologies and preparing for new production demands in the year ahead.

We have established an expert team to build a world-class focal plane facility that the US government now views as a national industrial base asset. Our momentum and purpose will help shape the future of infrared sensing.

*Raphael Ricardo, General Manager, VSL*



# Microfabrication Technology

*From record yields to HRL's most complex semiconductor device yet.*

HRL Laboratories offers decades of leadership in semiconductor and microfabrication technologies. With a full cleanroom facility and deep technical expertise, we provide engineering, prototyping and production services. We partner with customers to deliver leading-edge processes and pilot-scale innovations that accelerate technology readiness while maintaining a focus on scalable impact.

## 2025 highlights

- 💡 **2** patents awarded
- 📺 **5** industry presentations
- 🎯 **70+** programs achieving milestones
- 📄 **Cover of *Compound Semiconductor Magazine* presenting HRL's T3L GaN**

**The Microfabrication Technology Laboratory (MTL) continues to deliver** next-generation semiconductor innovations that strengthen HRL's leadership in advanced materials, device performance and fabrication excellence.

In 2025, the team converted a semiconducting ribbon cable process from 100mm to 150mm wafers, improving yields and reducing defects. MTL also produced key infrared focal plane array products, increasing delivery rates while cutting cycle time and boosting manufacturing efficiency. In parallel, **the lab produced the highest fidelity semiconductor device ever manufactured at HRL**, a major milestone supporting the company's quantum technology initiatives.

In support of Boeing, MTL matured T3L GaN MMIC fabrication and qualification lots, **meeting all reliability targets for system insertion**. A technology transfer and IP licensing agreement with MACOM is enabling high-volume, low-cost manufacturing of this GaN technology.

Through the CHIPS Act Microelectronics Commons, MTL deepened collaborations with local universities, driving "lab-to-fab" transition and **accelerating innovation in lithography, RF testing and failure analysis**.

Together, these achievements underscore MTL's role in advancing semiconductor performance and **enabling the technologies that will power the future**.

*Our success this year reflects the dedication of the team. We achieved record productivity and yield while scaling to larger wafers, all while advancing the innovative devices that will power the future of microelectronics.*

*Franklin Monzon, VP, MTL*



# Intelligent Systems

*Smarter systems for a connected world.*

**The Intelligent Systems Center (ISC) continues to advance technologies** that connect people, machines and data in smarter, safer ways.

This year, the team delivered key systems to HRL's owners and government partners, including **human-robot interaction software for GM** and automated **air-to-air refueling software for Boeing and the U.S. Air Force**. We also applied our tools **to help hospitals strengthen cybersecurity** and to support more efficient manufacturing and national security operations.

ISC is expanding how AI is used to support performance and decision making. The team is integrating large language models into business processes and exploring their value in defense and intelligence applications.

Through programs such as DARPA's OP TEMPO, we are using AI to assess and improve human machine performance in real time so operators have systems that understand their needs and respond quickly.

**Collaboration remains core to ISC's work**, with partners across industry and academia to create systems that adapt, learn and scale across domains.

Across our three technology focuses of **human-machine synergy, machine learning for operations, and complex system analytics and agents**, we are applying AI to make it usable and integrating machine learning to improve mission performance for our customers.



# GaN

*Redefining what's possible.*

**Millimeter-wave gallium nitride (GaN) technology continues to raise the bar** for performance in defense, aerospace and advanced commercial systems. HRL's work in GaN is focused on establishing baseline integrated circuit technologies that operate with greater power, reliability and efficiency while demonstrating reproducibility for mission insertion.

In 2025, the team delivered several industry-firsts that advanced this mission. **We demonstrated the first passing reliability tests for sub 100nm gate length GaN devices**, proving the durability of next-generation devices. We also established both baseline and advanced T3L GaN technologies and delivered multiple GaN MMICs for internal and customer demonstrations, showing consistent performance across a wide range of applications.

Our work expanded the foundation for future GaN-based devices by validating interconnect approaches, demonstrating compatibility with 3D die stacking, and preparing T3L GaN for upcoming space qualification and a satellite demonstration with Boeing. **These achievements make it easier for system designers to rely on GaN** for demanding environments where dependable high-power circuits are essential.

Together, these advancements reinforce HRL's position as a leader in GaN innovation and **strengthen the role of GaN as a cornerstone in next-generation microelectronics**.



# MEMS IMU

*Precision in motion.*

The Micro-Electro-Mechanical Systems (MEMS) Inertial Measurement Units (IMU) program **is redefining navigation accuracy, reliability and efficiency** through advanced micro-fabrication and intelligent calibration. By combining custom MEMS device design with novel self-calibration algorithms, **the team is achieving higher performance and tighter system integration** across defense and commercial platforms.

These gyroscopes and inertial sensors support navigation, pointing and stabilization systems for autonomous vehicles, aircraft and guided missile and munition applications. Smaller and lighter than grade-equivalent conventional sensors, **they deliver high precision with lower power and cost.**

**Recent achievements include** the first MEMS IMU flight test in Maryland and prototype units delivered to the U.S Army for system requirement evaluation and to GM for field testing. The team also completed successful demonstrations of vacuum-packed gyros that meet demanding vibration and temperature requirements. In addition, the team designed, fabricated and tested a mixed-signal ASIC for next-generation gyroscopes.

With production readiness on the horizon, **the focus now is on scaling and transition.** By refining manufacturing processes and validation systems, the program is paving the way for our MEMS IMU technology to reach real-world deployment, **bringing precision navigation to the next generation of vehicles and defense systems.**

# Quantum

*The future, entangled.*

**Quantum research at HRL continues to make transformative progress** in computing, communication and sensing. Across each pillar, the team is developing materials, architectures and systems that improve scalability, fidelity and integration.

In quantum computing, **HRL's qubits reached industry-leading fidelities** and manufacturability. Through the Qubits for Computing Foundry, HRL is now providing quantum devices to research labs nationwide, expanding access to scalable quantum hardware and growing the scientific community that relies on it.

Quantum communication efforts reached a breakthrough with the Q4S satellite program with Boeing, which **successfully validated hardware for entangled photon transmission in a future space mission.** This milestone brings global quantum networks closer to reality.

In quantum sensing, the team **advanced next-generation atomic clocks and MEMS-based device structures** that improve precision in navigation and timing. Early prototypes continue to demonstrate promising performance as the technology matures.

**HRL also co-hosted the 2025 Silicon Quantum Electronics Workshop** with UCLA in Los Angeles. More than 250 researchers, students and industry partners attended to share results, build community and explore new opportunities in quantum science.

**Collaborations**, through DARPA-supported programs and close collaboration with government, academic and industry partners, advanced HRL's leadership in quantum materials and device integration. Together, these efforts are laying the foundation for scalable quantum systems and future mission-ready technologies.





L-R: Franklin Monzon, Jim Soash, Jocelyn Hicks-Garner, Jewel Miller, Dave Chow, Robert Pesceone, Genny Findlay, Rob Vasquez, Leslie Momoda, Seong Kim, Raphael Ricardo, Geoff McKnight, Brad Jones

## Executive team

**Rob Vasquez**  
President & CEO

**Jewel Miller**  
General Counsel

**Raphael Ricardo**  
General Manager, VSL

**Leslie Momoda**  
Executive Vice President

**Geoff McKnight**  
Vice President, MML

**Brad Jones**  
Vice President, VSL

**Robert Pesceone**  
Chief Financial Officer

**Seong Kim**  
Vice President, SEL

**Jocelyn Hicks-Garner**  
Vice President, Operations

**Genny Findlay**  
Chief Human Resources Officer

**Franklin Monzon**  
Vice President, MTL

**Dave Chow**  
Chief Scientific Officer

**Jim Soash**  
Vice President, Special Programs

## Board of directors

**R. Vasquez**  
President & CEO

**T. Benson Tolle**  
Boeing

**L. Stancin**  
General Motors

**S. O'Sullivan**  
Board Chair

**C. Toups**  
Boeing

**A. Ganguli**  
General Motors

**D. Meyerriecks**  
Independent Board Director

# Our people

### Our people drive everything we do.

In 2025 we focused on helping them grow, lead, and succeed.

**We broadened our leadership and project management programs** to deepen core capabilities and create more transparent, attainable career paths. These enhanced frameworks elevated the quality and consistency of talent discussions, making development conversations more meaningful across teams.

**We also renewed our company values** to reflect our evolution and future direction.

Integrity, accountability and collaboration continue to define how we show up for each other and for our mission. Together, these values provide a unifying foundation that guides our choices and elevates the employee experience at HRL.

### Culture is more than a set of words.

It shows up in how we work with intention, how we connect with one another and how we take pride in the impact we create. Together, we are shaping a workplace grounded in trust, belonging and purpose, making HRL not just a place to work, but a place where people truly thrive.

## 2025 highlights

 **157** new hires

 **1,130** total staff count



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