TOPTICA EAGLEYARD

APPLICATION INSIGHTS

Showing valuable customer insights into applications that use a TOPTICA EAGLEYARD laser diode component

Customer: Max Planck Institute
Product: *mini*ECL 671 nm

About the Max Planck Institute of Quantum Optics:

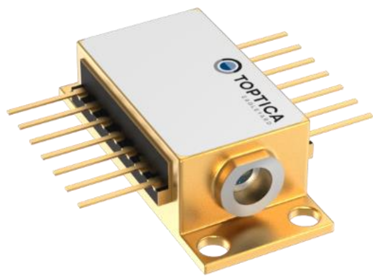
The Max Planck Society is world's leading research organizations, renowned for its groundbreaking contributions to scientific advancement. Comprising over 80 institutes across Germany and beyond, it fosters pioneering discoveries in physics, chemistry, biology, and related fields. With 31 Nobel laureates and more than 15,000 annual publications in leading scientific journals, the Society exerts a profound and enduring influence across multiple disciplines.

MAX-PLANCK-GESELLSCHAFT

One of its most prestigious institutes is the **Max Planck Institute of Quantum Optics (MPQ)**, located in Garching, Germany. MPQ is at the forefront of quantum research, exploring the interaction between light and matter at the smallest scales. Scientists at MPQ have made significant advances in quantum computing, ultracold atoms, and precision laser spectroscopy. Their work not only deepens our fundamental understanding of physics but also paves the way for revolutionary technologies, including secure quantum communication and ultra-precise atomic clocks.
With its strong interdisciplinary approach and collaborations worldwide, MPQ continues to push the boundaries of what is possible in quantum science.

About the laser diode:

The *mini*ECL is a miniaturized external cavity laser with a narrow linewidth of 100 kHz that is available at 671 nm, 770 nm, 780 nm, 852 nm and 895 nm. The hermetically sealed butterfly package with 14 pins is not only very robust but also integrates thermal management and beam collimation making it very convenient to operate. The narrow linewidth of the *mini*ECL enables usage especially for spectroscopy, QT, metrology, atomic clocks and life science. Moreover, wavelengths between 650 – 1100 nm are customizable upon request, opening more freedom across the spectrum. In addition, the 780 nm *mini*ECL was recently launched with a fiber-pigtail that offers a convenient ‘plug and play’ option.



In which product does the Max Planck Institute use EAGLEYARD's laser diode? For which application is your product used for?

Max Planck Institute: "EAGLEYARD's laser diodes are widely used in laboratories across the Max Planck Institute of Quantum Optics for cooling, trapping, imaging, and manipulating atoms. For many years, we have developed in-house designs for ECDLs, employing either Littrow or linear configurations and utilizing these laser diodes.

The new *mini*ECL line of products features 671 nm laser diodes that are employed in the "Lithium Quantum Gas Microscope" laboratory. While not dedicated to a single experiment or project, these diodes are integral to the lab's continuous daily operations."

Can you give some insights on how your product works and what role EAGLEYARD's laser plays?

Max Planck Institute: Our experiment (a quantum simulator) operates 24/7. It involves dozens of different lasers and hundreds of other components working in sync to trap individual fermionic lithium atoms in optical lattices. Within this setup, we perform quantum simulations (measurements) and image the resulting states. Each individual run takes approximately 20 seconds, and we repeat them many times, adjusting the physics parameters as needed.

The 671 nm lasers and amplifiers are essential components for keeping the machine continuously operational. In our experiment, *mini*ECL lasers from EAGLEYARD are currently used as seeds in two critical stages: the initial laser cooling of lithium atoms (Zeeman laser) and the final fluorescence imaging of individual atoms in optical lattices.

For the initial Zeeman stage, we couldn't fully utilize our amplifiers because the existing solutions do not provide sufficient seeding power, often resulting in underseeding. The *mini*ECL lasers partly or largely address this issue. For fluorescence imaging, we value their excellent frequency lock stability. While our previous solution performed well over the long term, the *mini*ECL laser has not fallen out of frequency lock since its integration into our existing infrastructure several months ago. That level of stability is exceptional.

If you have used a different laser diode component before using the one from EAGLEYARD in your product, what was your motivation to switch?

Max Planck Institute: "There is limited variety in 671 nm single-mode and single-frequency laser sources, and their power output is often constrained. When we noticed a new product on the market, we decided to test it. After the *mini*ECL outperformed the alternatives, we were impressed with the results and chose to transition more of our lasers to this solution."

Can you share insights on the decision-making process towards EAGLEYARD's laser diode component?

Max Planck Institute: "We are very familiar with the market for single-mode and single-frequency 671 nm sources. When we noticed that the specified output power of the *mini***ECL** is 30–40% higher than the next best option and that its beam profile is significantly more Gaussian—facilitating easier and more efficient fiber coupling—we were eager to try it. Working with lithium atoms, we never have an excess of 671 nm power, and both lasers and amplifiers at this wavelength tend to degrade relatively quickly compared to other wavelengths. Hopefully the *mini***ECL** line will perform well in terms of longevity.

How did you experience the collaboration with EAGLEYARD from the first request until the whole order was built into your product?

Max Planck Institute: "The information was clear, communication prompt and there were no issues."

What is the advantage of using the selected EAGLEYARD laser diode component compared to alternatives/prior solutions?

Max Planck Institute:

1. "More Gaussian Beam Profile at 671 nm: This enables more efficient fiber coupling compared to alternatives, improving overall system performance.
2. Higher Output Power: Combined with efficient fiber coupling, this facilitates more effective seeding of amplifiers, addressing power limitations in critical stages.
3. Smaller Footprint: The compact design allows for easier integration into existing setups, saving valuable space."

We thank the Max Planck Institute and Petar Bojovic for these great insights!