

A new standard in mass spectrometry

Why Monash University implemented the Thermo Scientific™ Orbitrap™ Astral™ Mass Spectrometer—and how it's transforming biomedical research.





Introduction

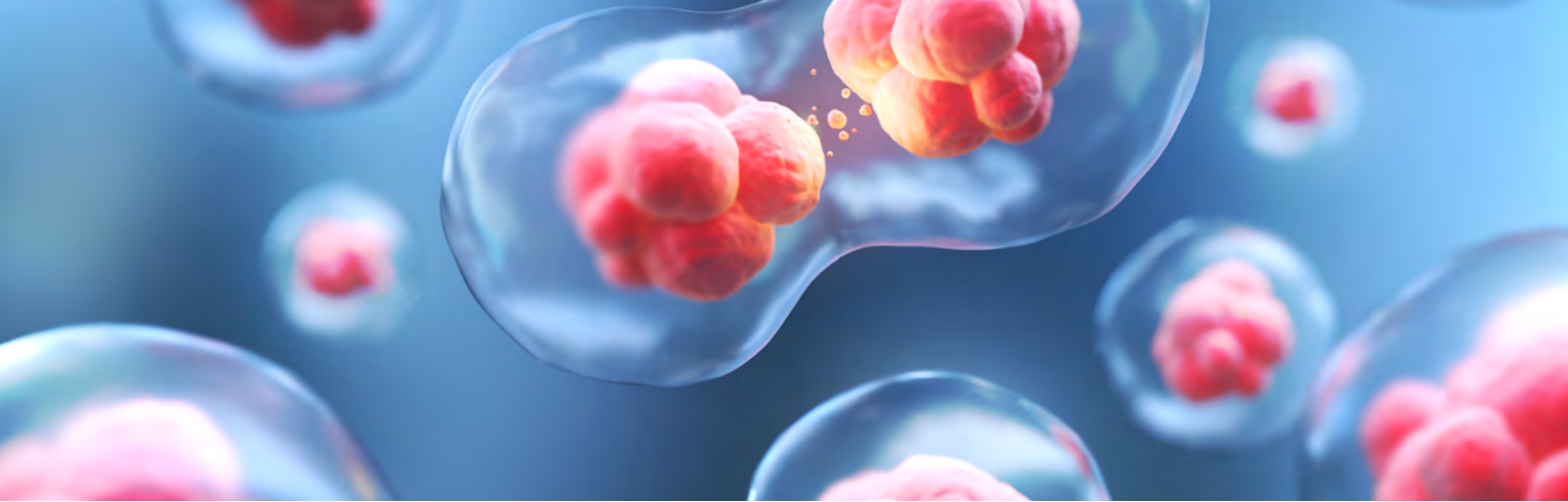
How much difference can a new mass spectrometer make? It's a question Monash University asked itself when deciding whether to procure the Thermo Scientific™ Orbitrap™ Astral™ Mass Spectrometer (MS) for use in its Proteomics & Metabolomics Platform. The university already managed an impressive suite of mass spectrometers, including some of the latest high-performance models, but the Orbitrap Astral MS promised a transformative leap in data precision, protein coverage, and research throughput that Monash's researchers could not overlook.

As Professor Ralf Schittenhelm, Director of the Monash Proteomics & Metabolomics Platform (MPMP), explained it: "For us, pushing the limits in proteomics is not just about speed—it's about the depth of insight. In proteomics, protein coverage can make or break research outcomes. We needed a solution that would allow us to reach unprecedented protein identifications consistently."

This white paper explores Monash's journey with the Orbitrap Astral MS, providing insight into the transformative power of high-throughput, high-sensitivity mass spectrometry for academic research.

Key topics include:

- The challenges and opportunities Monash faced in proteomics—and the capabilities needed to address them
- An overview of the Orbitrap Astral MS's features and Monash's rationale for its acquisition
- The real-world productivity and research gains the Orbitrap Astral MS makes possible
- Perspectives from Monash's research team on the impact the Orbitrap Astral MS had on their work
- The process of integrating the Orbitrap Astral MS into existing infrastructure and workflows



When expertise meets innovation

Professor Darren Creek and Dr. Ghizal Siddiqui lead MPMP's Drug Target Identification Node with a shared commitment to advancing global health. Prof. Creek—a PhD in pharmaceuticals—focuses on drug discovery and understanding anti-malarial drug mechanisms, drawing on 15 years of experience in metabolomics and proteomics. Dr. Siddiqui—a PhD in proteomics with a background in parasitology—dedicates her research to malaria biology.

In 2023, Prof. Creek was awarded funding from the Medical Research Future Fund (MRFF) to establish a Drug Target Identification Platform. This platform, the first of its kind in Australia, relies on advanced proteomics approaches to support drug discovery in Australian universities and industry.

Cutting edge research of the kind spearheaded by Prof. Creek relies on—or is at least significantly assisted by—cutting-edge tools.

Recognising this, Monash University integrated the Thermo Scientific Orbitrap Astral Mass Spectrometer into its operations, addressing the inherent limitations of traditional proteomics and unlocking new possibilities. Prof. Creek points to two pivotal factors driving this acquisition: “Coverage and throughput were the two key drivers. Proteomics often fell short compared to transcriptomics in the sheer scope of data it could deliver. The Orbitrap Astral MS offered us a way to push past these barriers.”



Prof. Darren Creek (right) and Dr. Ghizal Siddiqui (left)

Breakthrough throughput

Previously, Monash's researchers faced bottlenecks in their studies, particularly those requiring extensive sampling across multiple conditions, such as varying drug concentrations and time points. The slow gradients of earlier instruments stretched timelines over months. The Orbitrap Astral MS, with its ability to process significantly more samples in less time, revolutionised their approach. “We no longer face bottlenecks that extend our timelines by four or five months,” says Prof. Creek. “The Orbitrap Astral MS

gives us the capacity to push through far more studies.”

Dr. Siddiqui echoes this sentiment, highlighting the instrument's transformative effect on throughput: “Previously, we faced significant limitations in the number of samples we could process within a given timeframe. The Orbitrap Astral MS has allowed us to scale up our operations dramatically, enabling us to complete more experiments in less time. This shift not only saves valuable resources but also

broadens the scope of research we can conduct simultaneously.”



Improved experiment design

The Orbitrap Astral MS's enhanced throughput has ripple effects beyond speed. Prof. Creek explains how it has allowed for more robust and thorough experimental designs: "Before, we had to slim down experiments, asking whether every extra condition or control was truly necessary due to time and sample constraints. Now, we can afford to be much more thorough, exploring additional variables while maintaining reproducibility."

This capacity for detailed experimentation is crucial for studies in drug mechanism analysis and biomarker discovery, where precision and depth are non-negotiable.



Now, we can afford to be much more thorough, exploring additional variables while maintaining reproducibility.



Prof. Darren Creek

Director of the Drug Target Identification Node -
Monash Proteomics & Metabolomics Platform



Unprecedented depth

The Orbitrap Astral MS's ability to detect low-abundance proteins has proven invaluable. In drug target identification experiments, Dr. Siddiqui notes that the instrument consistently uncovers proteins that earlier technologies would have missed entirely. "These low-abundance proteins are often key to understanding drug mechanisms," she says.

The Orbitrap Astral MS also excels in identifying protein modifications. Dr. Siddiqui describes its groundbreaking impact: "We can now analyse purified samples in a single run, identifying modifications like phosphorylation and acetylation without additional enrichment steps. This saves both time and resources while providing insights into protein functionality that were previously out of reach."

Thermo Scientific Orbitrap Astral Mass Spectrometer—in brief

The Orbitrap Astral Mass Spectrometer represents a transformative leap in mass spectrometry technology, blending innovation with over two decades of development. It integrates a quadrupole mass filter for precise precursor selection, a Thermo Scientific™ Orbitrap™ Mass Analyzer for high-resolution, high dynamic range HRAM full MS acquisition, and the novel Thermo Scientific™ Astral™ Mass Analyzer for high-speed HRAM MS/MS acquisition at rates of up to 200 Hz. Together, these analyzers form a unified, parallelized architecture that maximises instrument utilisation, sampling efficiency, sensitivity, and quantitative performance.



Unparalleled throughput

Capable of processing up to 180 samples per day, the Orbitrap Astral MS enables researchers to tackle high-throughput projects without compromising on data integrity. Its rapid eight-minute run-to-run time is four times faster than traditional systems.



Enhanced sensitivity

With a single-ion detection capability, the Orbitrap Astral MS achieves unprecedented depth in proteome coverage. This is a game-changer for applications like single-cell proteomics and biomarker discovery.



High resolution and dynamic range

By combining 80,000 FWHM resolution with a high dynamic range (HDR) detector, the Astral Mass Analyzer enables accurate and precise measurement across a broad spectrum of protein abundances, ensuring reliable identification and quantification of both low- and high-abundance proteins.

With near-lossless ion transmission enabled by the Astral Mass Analyzer, the Orbitrap Astral MS delivers highly efficient ion detection, minimizing dispersion and enhancing analytical reliability. This results in a powerful balance of speed, depth, and coverage, enabling researchers to process large datasets with confidence. As Prof. Darren Creek explains: “The Orbitrap Astral MS balances throughput, depth, and coverage in a way that no other instrument has before, helping researchers push the boundaries of what’s possible in proteomics and beyond.”



Improved productivity, greater cost efficiency

Beyond its scientific capabilities, the Orbitrap Astral MS brings tangible productivity and cost benefits. It has significantly reduced the time spent on re-runs and secondary analyses, enabling researchers to move forward with their projects more efficiently.

According to Professor Ralf Schittenhelm, Director of the Monash Proteomics & Metabolomics Platform: “The Orbitrap

Astral MS’s efficiency has significantly lowered the time we spend on sample re-runs and secondary analyses, allowing our researchers to move forward with their projects more quickly and confidently.”

Moreover, the Platform has achieved unprecedented proteome coverage, identifying over 10,000 proteins in human samples. Prof. Schittenhelm

underscores the significance: “Identifying low-abundance biomarkers, which were previously below our detection threshold, is now possible. This opens new avenues for critical biomarker research, which play a vital role in disease mechanisms.”

“In short, the Orbitrap Astral MS provides Monash with greater productivity and greater insight in our proteomics research at the same time as it improves our cost efficiency.”

Ease of integration

The ambitious decision to acquire the Orbitrap Astral MS was influenced by Monash’s goal of setting a national standard in academic proteomics research. As Prof. Schittenhelm puts it: “The need for greater sensitivity and higher throughput in proteomics means institutions like ours must invest in the most advanced equipment available. The Orbitrap Astral MS’s capabilities immediately stood out, promising us that extra coverage we were missing.”

Within the Proteomics & Metabolomics Platform, a long-standing relationship with Thermo Fisher Scientific helped streamline this decision, as the lab already operated within a Thermo Fisher Scientific-centric infrastructure.

The lab’s pre-existing Thermo Fisher Scientific infrastructure allowed for rapid integration, as Prof. Schittenhelm notes: “Being a Thermo Fisher Scientific-centric platform allowed us to integrate the Orbitrap Astral MS with ease—it was nearly plug-and-play.”

The Orbitrap Astral MS’s compatibility with existing quality control workflows further enabled a seamless implementation, positioning Monash Proteomics & Metabolomics Platform to take full advantage of its advanced analytical capabilities.

Additionally, the integration streamlined workflows, as the team could employ similar protocols and quality control checks across all instruments. “The ability to rely on consistent QC standards across instruments is a major advantage for a busy research facility like ours,” adds Dr. Siddiqui.

The decision-making process also factored in Thermo Fisher Scientific’s reputation for innovation and reliable support. Having previously collaborated on equipment improvements, Monash knew they could count on Thermo Fisher Scientific’s team for ongoing technical support, ensuring high uptime and seamless troubleshooting—a vital factor when operating in fast-paced, high-demand research environments.





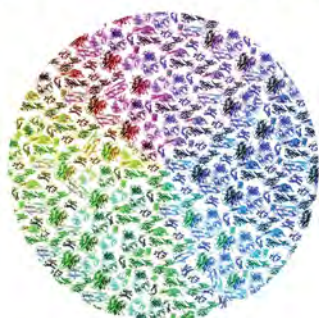
Agile and adaptable

Dr. Siddiqui explains that Orbitrap Astral MS's ability to adjust for various data acquisition strategies enables Monash's team to switch seamlessly between high-throughput and high-sensitivity analyses. This adaptability allows the lab to handle complex workflows, such as targeted proteomics, quantitative data-dependent acquisition (DDA), and high-resolution narrow-window data-independent acquisition (nDIA). "We can move from a traditional DDA experiment to TMT multiplexing with no loss in data fidelity," notes Dr. Siddiqui, "meaning we're prepared to address the wide-ranging needs of our collaborators."

This adaptability makes Orbitrap Astral MS a powerful tool for academic labs that need flexibility across both routine and advanced experiments. "The flexibility of switching strategies while maintaining data quality has been instrumental in handling the diverse needs of our research partners," says Prof. Schittenhelm.

The Orbitrap Astral MS's advanced features allow Monash's lab to support full-service workflows, from experimental design to data analysis, ensuring researchers can gain deep, reliable insights across a range of applications.

Analyze one sample in only 8 minutes



8,135
protein groups

1 sample



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The flexibility of switching strategies while maintaining data quality has been instrumental in handling the diverse needs of our research partners.

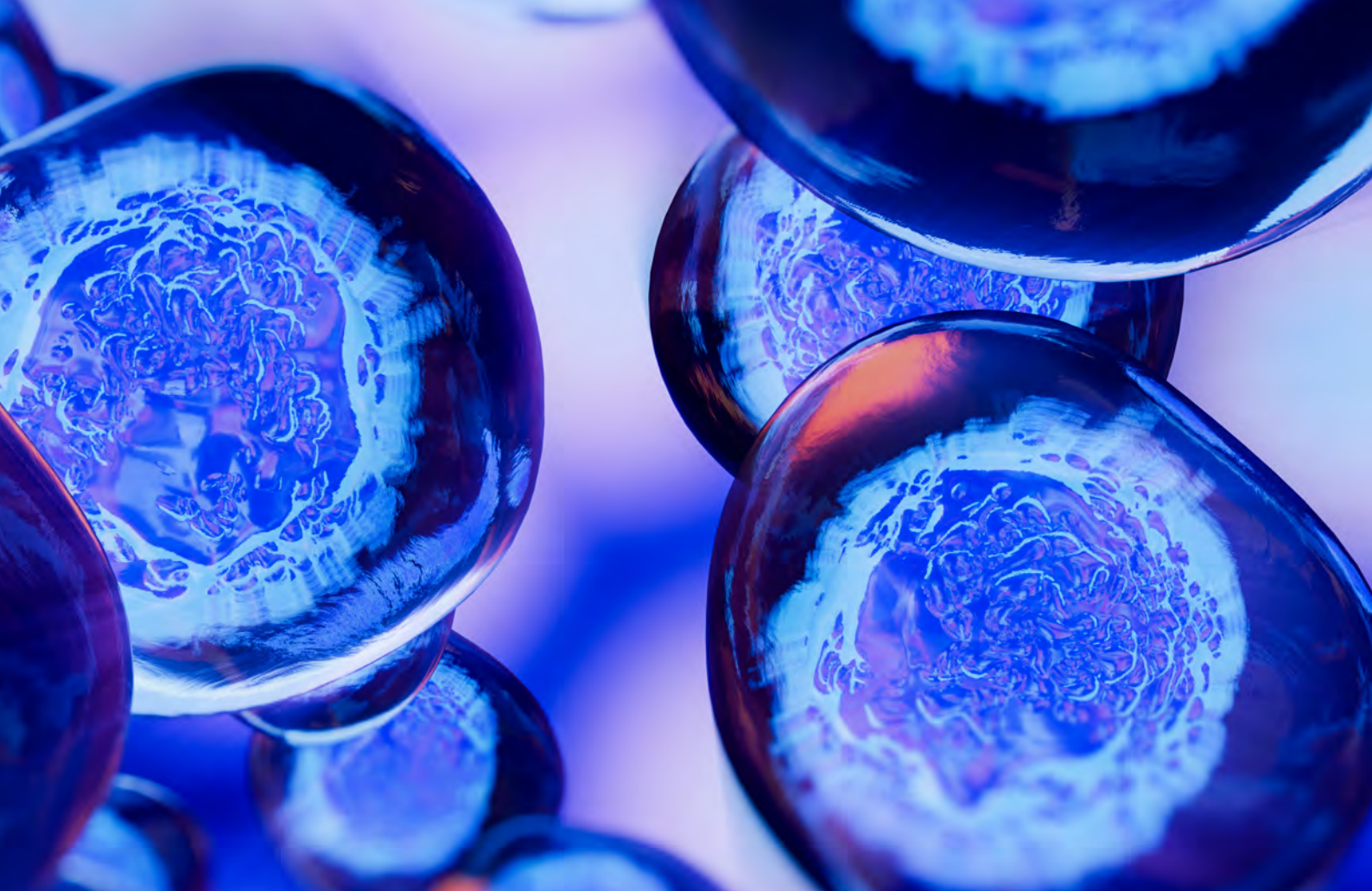
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Prof. Ralf Schittenhelm

Director of Monash Proteomics & Metabolomics Platform





A bright future

Beyond the immediate gains in throughput and depth, the Orbitrap Astral MS will prove critical for Monash's future research objectives. "The reliability of the instrument has exceeded our expectations," says Prof. Schittenhelm. "High throughput can often compromise data quality, but the Orbitrap Astral MS maintains both, ensuring that we deliver reproducible, high-confidence data—improving the quality of our research and ensuring we hit our objectives."

Dr. Siddiqui sees potential for the Orbitrap Astral MS to support new research directions in single-cell proteomics and native MS applications, further expanding the lab's capabilities. Prof. Creek echoes this sentiment, saying, "We're only beginning to explore the full potential of the Orbitrap Astral MS. It's not only fulfilling current needs but also future proofing our lab."

Monash's leadership in Australian proteomics has attracted new collaborations, with research teams eager to access the Orbitrap Astral MS's powerful capabilities. "In the year

since we installed the Orbitrap Astral MS, we've expanded our partnerships in both academia and industry," says Dr. Siddiqui. "The Orbitrap Astral MS has become a magnet for researchers looking for comprehensive, reliable data that supports their work across a variety of complex fields, from drug discovery to clinical biomarker identification."



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Dr. Ghizal Siddiqui

Monash Proteomics & Metabolomics Platform



Key outcomes from Monash University's Orbitrap Astral MS integration



Increased sensitivity and low-abundance detection

Capable of processing up to 180 samples per day, the Orbitrap Astral MS enables researchers to tackle high-throughput projects without compromising on data integrity. Its rapid eight-minute run-to-run time is four times faster than traditional systems.



High quantitative accuracy

A coefficient of variation (CV) below 10% across 9,000 proteins ensures reliable, reproducible results, strengthening Monash's reputation as a trusted research partner.



Effortless integration

The Thermo Fisher Scientific-centric setup facilitated smooth adoption and maximised uptime with minimal workflow disruption.



Significant increase in throughput

The Orbitrap Astral MS has enabled Monash's lab to dramatically expand its sample processing capacity, paving the way for more complex and large-scale studies.



10,000+ proteins identified per analysis

Enhanced proteome coverage from previous limits of 6,000-8,000 proteins, offering deeper insights into protein interactions.



Conclusion

The Orbitrap Astral Mass Spectrometer has redefined Monash University's Proteomics & Metabolomics Platform, positioning it at the forefront of proteomics research in Australia. With the Orbitrap Astral MS's superior throughput, sensitivity, and data reproducibility, Monash's team has been able to push the boundaries of their research, deepening their insight into protein interactions, disease biomarkers, and drug mechanisms. It's no surprise, then, that the Monash team has been so satisfied with the Orbitrap Astral MS that they have procured a second one.

Monash's experience with the Orbitrap Astral MS demonstrates how cutting-edge technology can overcome traditional barriers in academic proteomics, opening the door to new possibilities in drug discovery, biomarker research, and more.

For academic labs seeking to expand their proteomics capacity, the Orbitrap Astral Mass Spectrometer represents a transformative investment.

For more information on how the Orbitrap Astral MS can benefit your research, contact Thermo Fisher Scientific today.

References:

¹ Monash University. "MRFF backs Australia's first drug target identification platform." News release, 2023. Available at: <https://www.monash.edu/pharm/about/news/news-listing/2023/mrff-backs-australias-first-drug-target-identification-platform>.

 Learn more at thermofisher.com/orbitrapastral

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