

## Dr Stephane Melanson

Buckley Systems would like to congratulate Stephane Melanson on obtaining his PhD using Buckley Systems' & D-Pace's co-owned ISTF to explore negative ion extraction. Stephane then worked on extracting  $C^-$  with the TRIUMF licensed filament-powered ion source, using methane and acetylene gases. An RF powered ion source was developed based on designs from TRIUMF and the University of Jyväskylä. After managing to extract a  $H^+$  beam current of 8 mA from the RF ion source, Stephane's final research involved the extraction of  $C_2^-$  with the RF powered ion source, experimenting to find the maximum possible beam current with a minimal glitch rate. A peak  $C_2^-$  current of 0.27 mA was achieved but with a high glitch rate. To achieve a rate of <20 glitches per hour, the beam current had to be reduced to 50  $\mu A$ . The results have provided valuable insights and has opened up both new research and commercial possibilities.

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## NIBS 2020 & 2022

The COVID-19 pandemic forced the postponement of the 7th International Symposium on Negative Ion Beams and Sources (NIBS 2020) that was to be held in Auckland New Zealand. Instead, the 2020 symposium became an online event hosted by the Budker Institute.

The D-Pace sponsored NIBS award for outstanding recent contributions to the fields of physics, theory, technology and/or applications of sources, low energy beam transport, or diagnostics of negative ions was presented to Dr. Mieko Kashiwagi, Dr. Atsushi Kojima, Dr. Junichi Hiratsuka and Mr. Masahiro Ichikawa from the National Institutes for Quantum and Radiological Science and Technology (QST) for the work "The Development of long-pulse high-intensity negative ion beam accelerations for Fusion reactors".

The Auckland based NIBS conference has been rescheduled for 2022.



A "Group photo" of the NIBS 2020 online attendees.

## Upcoming 2020/21 Conferences and Events

Buckley Systems and D-Pace have currently shelved all travel plans for any remaining 2020 conferences and events. With the current Covid-19 pandemic and limited world travel, it is not anticipated that any travel to conferences will take place in 2021 but this will be reviewed early next year. In the meantime, we are more than happy to meet customers via phone or video conference to discuss any current or future projects.

## COVID-19

While the Covid-19 pandemic is sweeping the world, New Zealand's isolation has meant that the country has been able to control the community spread of the virus with very little disruption to our business.

We are confident that our practices and protocols will allow our staff to continue work safely in the event of another community outbreak.

Most of our suppliers have been relatively unaffected and we are working hard to ensure our supply chains are intact.

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BUCKLEY  
SYSTEMS  
Ingenious at work

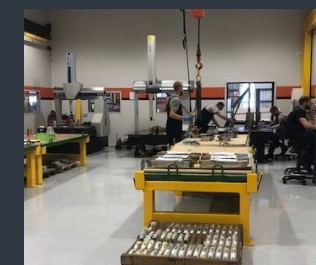
# Buckley Systems Technical Bulletin

## New quality control facility opened

Increased workload and a doubling of our quality assurance staff over recent years, meant that our existing QC area had become too small to operate efficiently. The department was also impinging on our testing facility which had recently installed new coil testing equipment.

To solve the space problem, a new 300 m<sup>2</sup> dedicated quality control facility has been constructed at our #8 Bowden Road premises.

Fully insulated, temperature controlled and with a stabilised, resin coated floor, the new room houses precision measuring equipment including two gantry style coordinate measuring (CMM) machines. A large access door enables large components to be easily delivered and a gantry crane can be used to place heavy objects onto the inspection benches. The move has created more space for the testing department and increases our potential throughput



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## Arron Sands appointed as new CEO for Buckley Systems

We are delighted to announce that Arron Sands has accepted the role of CEO at Buckley Systems. Arron succeeds Bill Dodge who has stepped aside from the role due to the current difficulties in travelling between his base at Buckley Systems International in Rowley, Massachusetts, USA and Buckley Systems in Auckland, New Zealand. Bill will remain at Buckley Systems as Vice-president of Global Sales while Arron steps up from his previous role of COO as part of the succession plan for the business implemented by the Board of Directors, including President, Bill Buckley.

Arron has extensive practical engineering

knowledge and spent eighteen years running his own fabrication business. He is looking forward to building on the firm foundations Bill has laid down and is focussed on the future direction of the business. Major projects ahead include implementing a new enterprise resource planning software package and looking at driving both quality and efficiency through active, constant improvement initiatives.

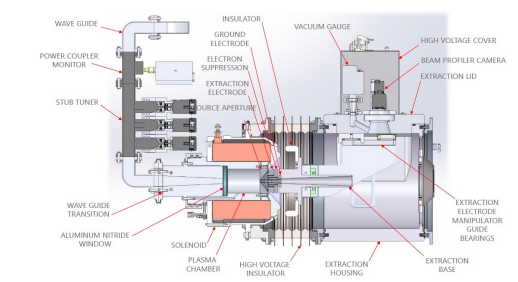
Buckley Systems would like to thank Bill Dodge for his three and a half years' service as CEO and look forward to him being able to focus more on building strong customer relationships.

## D-Pace licenses ECR ion source

Buckley Systems' partner D-Pace has obtained the license to manufacture, develop and market a 30 mA @ 50 KeV  $H^+$  ECR ion source. This expands D-Pace's market penetration to positive ions, where previously D-Pace specialized in the production of negative ions.

The well proven source, used in the proton accelerator of Neutron Therapeutics' BNCT machine, is powered by 2.4 GHz microwaves and currently provides over 30 mA of  $H^+$  at 50 KeV. The license agreement includes access to the Neutron Therapeutics ion source test stand based in Danvers, Massachusetts where D-Pace engineers and physicists intend

to test and develop it for other 1+ and 2+ charge states. Dr Morgan Dehnel, D-Pace founder and Buckley Systems' CSIO, is excited about the potential of the source and keen to hear from anyone requiring a reliable CW proton source.



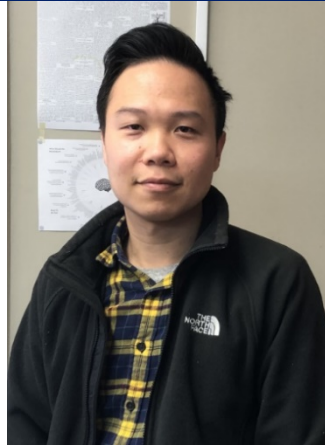
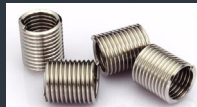


## Tangless thread inserts

Thread inserts are typically used on soft materials such as aluminium or carbon to help strengthen the thread, allowing greater torque to be applied to a fastener without risk of the thread stripping. The traditional wire thread inserts use a tang to drive the insert to the correct depth. Once in place, the tang is snapped off and removed. While this is fine for a one-off job or repairing a damaged thread, they have many disadvantages for a production environment.

- Snapping off the tang takes time
- The insert or product can be damaged while snapping off the tang
- The tang may not snap off cleanly
- Tangs must be removed and accounted for to prevent possible foreign object damage
- If a tang is not snapped off, it can cause the fastener to bind in the thread
- If wound in too far, the insert cannot be repositioned
- Tanged inserts cannot be removed without destroying them and possibly damaging the product

Tangless inserts overcome many of the problems associated with the traditional tanged insert. By driving the insert using a tiny notch at the base of the coil, no tang is required. This is faster, more accurate and eliminates the problems of snapping, removing and accounting for tangs. By using an extraction tool, inserts can also be repositioned or removed without damage. Buckley Systems has invested in the technology and is recommending the use of tangless inserts in place of tanged inserts wherever possible. For more information on tangless inserts, contact our design team.



## Vincent Kuo

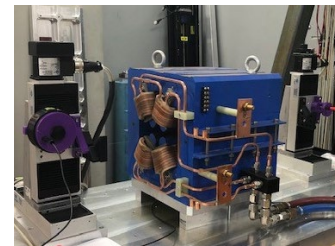
### Physicist

Buckley Systems would like to welcome Vincent Kuo to our physics department. Originally from Taiwan, Vincent attended National Chiao Tung University in Hsinchu Province, renowned for its pioneering work in computer science and semiconductor research. There he studied electro-physics with his MSc thesis based on researching the alignment of liquid crystals. After gaining his degree in 2007, he started work at Taiwan's National Synchrotron Radiation Research Centre

(NSRRC), working on the Taiwan Photon Source (TPS) project. Part of his work involved visiting Buckley Systems premises in New Zealand to help measure the parameters and performance of the 600 plus, 3<sup>rd</sup> generation synchrotron magnets that Buckley Systems manufactured for the TPS.

Starting at Buckley Systems in 2020, Vincent's experience in the performance measurement of high-precision light source magnets is a valued addition to our

physics team. He is currently working on developing a stretched-wire field measuring instrument that can be used for measuring magnetic fields inside small aperture magnets.



Stretched-wire field measuring instrument undergoing trials.

## Technology topics

### ISTF news

PhD student, Anand George, is using the Buckley Systems / D-Pace ion source test facility (ISTF) for his PhD work with the University of Auckland, under Dr Neil Broderick, and Dr .Morgan Dehnel. The key focus is the development of a high current RF-powered ion source for H<sup>-</sup> & D<sup>-</sup>, thus eliminating a consumable filament for long-term operation.

PhD student Nicholas Savard is progressing with his research into producing He<sup>+</sup> and He<sup>2+</sup> from a penning ion source. A redesign of the initial source has eliminated arcing up to 15 kV but has uncovered other issues that he is currently working to resolve.

### Powder-coating line

As part of our commitment to offering an end-to-end service, we

have invested in an electrostatic powder-coating line. Powder-coating is commonly used to provide an additional insulation layer on wire-wound magnet cores. It also provides a smooth, surface that does not damage the enamel coating on the wire during winding. The attraction of the charged powder to the steel surface means that an even coating can be achieved even in narrow slots where it is difficult to spray paint. The most common powder we use is an extremely tough, epoxy-based powder that has excellent insulation properties and is resistant to most solvents or chemical attack.

### Second robot for welding department

Following the successful implementation of our first welding

robot, a second robot has now been purchased and installed. The smaller, Fanuc 200iD has been equipped with a custom-made torch clamp system to enable fast changeover between jobs. It has currently been set up with a TIG torch and automated wire feeder to weld the ends of aluminium chambers. With careful jiggling and fine-tuning of the welding process, the robot has improved both throughput and the cosmetic finish of the product. The articulated arm can now perform the fusion welds inside the chambers, an operation that was previously a time-consuming and difficult manual process.



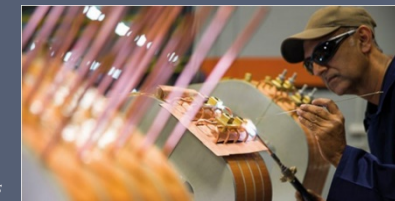
## The advantage of in-house manufacture

Since the founding of Buckley Systems over 35 years' ago, there has been a constant focus in keeping manufacture in-house. While many other companies rely on outsourcing to others to supply components, our founder, Bill Buckley has had a vision to become a one-stop company that provides everything from physics and engineering design through to dispatch, needing only raw materials and off-the-shelf components to produce a finished product. While it may go against the philosophy of many business analysts, Bill could see that the specialised nature of the business required precise engineering tolerances that could only be achieved by carefully managing each step of the process. With the company dedicated to manufacturing precision magnets, vacuum components and ancillary equipment for the implantation, medical and science sectors, investment decisions are made

around resources that meet the specific requirements of the industry, not general manufacture. The result has seen Buckley Systems boasting one of the largest specialist engineering workshops in the industry including 34 CNC machines plus laser cutting and EDM wire cutting equipment. Our coil winding workshops can wind wire, copper strip and hollow core conductor coils from a few grams up to several tons. Specialised vacuum chambers, resin batching equipment and curing ovens are used for reliable coil infusion. The plating bay handles nickel, copper and silver plating plus conversion coatings for steel and aluminium while painting and powder-coating have their own dedicated departments. Even the packing department makes custom wooden crates for the magnets to ensure they arrive in perfect condition. Extensive, custom made machinery, tooling and handling equipment has been designed by

Bill over the years to meet the challenges of what is often pioneering work. Having complete control of the manufacturing process also has huge advantages for product development and prototyping as instant feedback is available to the design teams and any production issues can be easily workshopped and sorted. The setup also allows easy upscaling of production with many of the production machines fitted with changeable pallets meaning that subsequent jobs can be set up while the machine is running. By splitting shift times and pre-loading pallets, up to 24-hour production can be achieved if required. Our QC and testing departments also have specialised equipment to handle the requirements of our customers' quality requirements. While we do use outsourcing for some regularly manufactured parts, we retain the capability to manufacture them in-house if required.

In-house brazing of copper terminations



## Innovative Mazak Pallettech machining centre installed

The latest addition to the Buckley Systems' machining capability is a Mazak i700 Variaxis VMC with a PALLETECH multi-pallet changer. The machine represents the latest generation of 5 axis CNC machinery coupled with a twelve-pallet racking system. Having multiple pallets means that the machine can be configured with frequently used jigs and fixtures permanently mounted to eliminate set up time or it can be loaded with multiple, identical products to be run "lights out" over night shifts or weekends. Five axes of movement (X, Y, Z, 360° rotation and tilt function) vastly reduces repositioning processes and allows complex profiles to be machined easily. The i700 is also fitted with the Mazak Smooth X conversational type controller, which eliminates many of the time-consuming setup steps required by conventional controllers. This machine will increase our manufacturing capability by the equivalent of approximately three conventional CNC machines and keeps us at the forefront of manufacturing technology.



Mazak i700 shown here with PALLETECH stacking rack.