



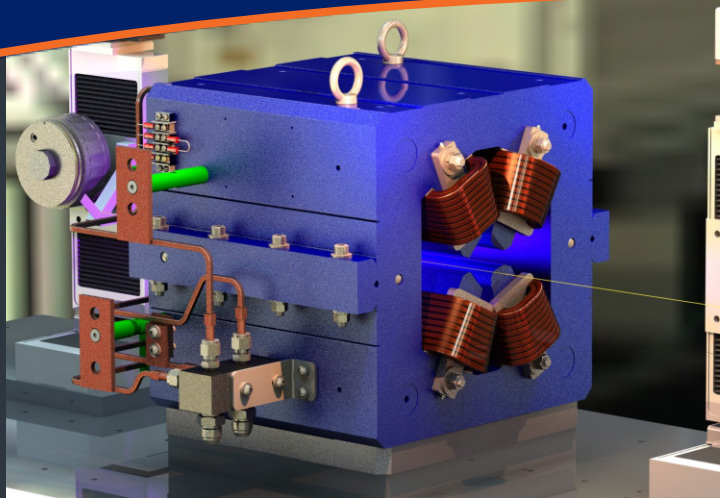
Buckley Systems Technical Bulletin

New building work

To help cope with an increasing workload, Buckley Systems is currently remodelling the machining workshop. The resonator plating line and O-ring finishing departments will be relocated and walls of the old premises removed to incorporate the space into the main workshop. The old roof of the main workshop will be replaced and the new roof will span between two buildings, making more efficient use of the floor area and allowing freer movement of raw materials and finished product. Space will also be created for several new machines that are arriving shortly to help increase capacity and replace older, less efficient machines.

Further up the road at the 3 Bowden Road workshop, the upstairs office space has been refurbished and turned into offices for the Planning, Purchasing, Logistics, IT and Compliance departments. Also included in the renovation is a large training room with an AV and teleconferencing system. Several temporary storage areas have been set up to cope with increased raw material inventory due to higher production and post-Covid, supply chain issues.

Throughout the factory, bathrooms and changing rooms have been remodelled and refurbished to cater for increased staff numbers.



Developments on stretched wire field measurement device

Buckley Systems has begun commissioning a single stretched wire (SSW) magnetic field measurement system. Developed in-house by a team of physicists and testing engineers, led by physicist Vincent Kuo who brings experience in magnetic measurements from his time at the Taiwan Photon Source.

The SSW device is a flexible system that allows measurements of a wide variety of magnets including large to small apertures, different pole types, and a wide range of magnetic lengths. Accuracy and repeatability of harmonic measurements are suitable even for demanding particle accelerator magnets.

SSW measurement uses a thin conductive wire placed through the magnet aperture and tensioned between two sets of precision X-Y stages. Moving the wire through the field under test induces an electrical voltage in the wire, which is measured by means of a high-precision integrator.

Magnetic field inhomogeneity affects particle beam stability, so the aim of a precision magnet is to produce a high-quality field, characterized by low harmonic coefficients. High accuracy measurement of these harmonics is an important part of magnetic measurement for accelerator systems. The SSW allows accurate measurement of field multipoles, as well as integral strength and magnetic axis. These measurements may be referenced back to physical datums on the magnet.

The research team at Buckley Systems has been undertaking extensive testing and trials of a prototype SSW system. This has allowed them to develop several aspects of the system, including:

- A novel wire-tensioning system, using a “frictionless” pneumatic cylinder and precision regulators to achieve controlled, constant tension on the wire. This means the wire sag can be precisely controlled and the sag to be “compensated”, removing sag effect from the measurements. In other words, higher-accuracy magnetic-axis can be measured.

- Custom control software and hardware, providing complex moves of the wire while retaining accurate triggering. This allows measurement of high aspect-ratio and non-circular magnetic apertures.

- Analysis software implementing advanced algorithms for field reconstruction from SSW measurements. This means more repeatable measurements of multipole coefficients in standard apertures, as well as enabling field quality measurements of even very high aspect-ratio apertures.

A range of hardware has been chosen and validated, including: Aerotech stages with 3 μ m positioning accuracy and 0.7 μ m repeatability; a Metrolab integrator with a resolution of 10–8Vs for voltage measurement; and FARO laser tracker for fiducial transfer.

The system has been verified against a synchrotron light source magnet and compared against OPERA 3D simulations.

After final commissioning, the stretched wire system will be incorporated into our testing equipment and offered as a service to customers.

For more information or to access the full report on our stretched wire system, please contact our physics department.

physics@buckleysystems.com.

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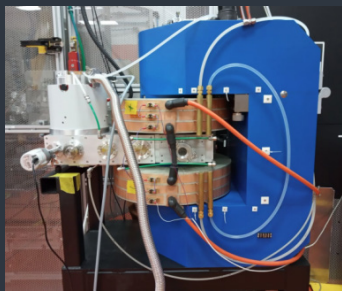
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Penning ion source as alternative to ECR ion sources for theranostics

The recent work done as part of Dr Savard's PhD thesis on penning ion sources, has demonstrated their promise as cheaper and more compact alternative to ECR ion sources for producing alpha (He^{++}) beams for medical cyclotrons.

With further commercial development, penning sources could prove an excellent candidate for making cost-effective cyclotrons to produce important radioisotopes used in therapy and diagnostic such as Astatine-211.

Contact D-Pace for more information.



Penning ion source under test

Laser tracker for magnet alignment

Buckley Systems has invested in a FARO laser alignment device to assist with location and alignment of multiple magnets mounted on a common rail and can also be used for fiducialisation of magnets that are too large to be accommodated on our CMM machines. The laser has been a long desired piece of equipment for our physics departments and will prove invaluable for the measurement of some of the large magnets currently in production. It has already proved its worth by being used to help with the set up, alignment and measurement the stretched wire measuring measuring system described on page one.



Richard has recently joined Buckley Systems, taking up the role of Chief Commercial Officer. Originally from Wellington, New Zealand, Richard's career has had a strong international trade focus across Asia Pacific, North America and Europe, with particular emphasis on Japan.

Fluent in Japanese, Richard developed an early interest in the country through a student exchange program, spending time studying there in his teens before completing degrees in Commerce and Japanese in New Zealand. After university, Richard returned

Richard Wotton

Chief Commercial Officer

to Japan, working in Hiroshima for two years in international relations, before a stint in London, U.K. with a Japanese trading company importing into Europe a wide variety of commodities from tyres to air-conditioners to commercial photographic printers. Richard then returned to Japan, this time working for New Zealand Trade and Enterprise (NZTE) in the New Zealand Embassy, where he was responsible for assisting New Zealand companies to enter into and expand their business in the Japanese market and project management of major New Zealand Government in-market initiatives.

Keen to explore other parts of the world, he took a position with Mitsubishi Corporation's largest subsidiary, an integrated steel trading company with global operations and more than 10,000 employees. Working in corporate and sales

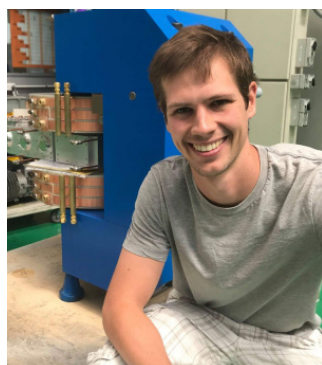
positions in the company's Tokyo headquarters, he also had international assignments to manage project and sales offices in Monterey, Mexico and Detroit, USA, spending several years living in both countries.

After twenty-four years travelling the world and now with a wife and two young children, Richard has returned to New Zealand to settle down while his boys complete their education.

Richard sees his value to Buckley Systems in using his wide corporate and international experience to implement the process changes required to sustain the high growth rate the company is experiencing. While he will be based in New Zealand, Richard will be travelling extensively to help foster relationships with new and existing customers and suppliers.

Technology topics

Nicolas Savard awarded PhD



Nicolas Savard has been awarded a PhD by the University of British Columbia for his thesis "Development and Characterization of a Penning Ion Source using Helium". Dr Savard commenced his research project at Buckley Systems, using the ion source test facility (ISTF) to develop a penning ion source. When the ISTF was relocated to become part of the

DISC facility based at Selkirk College in Canada, Nicolas followed and completed his research there under the academic supervision of Dr. Reiner Kruecken of TRIUMF/UBC and industrial supervision of Dr Morgan Dehnel of D-Pace. It is hoped that his research will lead to the development of a cost-effective, compact ion source to produce alpha beams such as He^{++} for radioisotope production.

Penning source shows promise for argon production

Following Dr Savard's thesis on the production of He^{++} from a penning ion source, further research discovered that the source was also very good at producing different charge states greater than $1+$ for argon. Argon is considered a safe,

proxy particle to typical ions used in the ion implantation industry. The ISTF, based at the DISC facility, does not have the infrastructure to handle certain toxic ions important to the ion implantation industry, so uses non-toxic ions such as Ne which is a proxy for B, and Ar which is a proxy for P, and Kr which is a proxy for As.

MITACS research funding application

D-Pace and TRIUMF have applied for Canadian MITACS funding for a 3-year PostDoc at TRIUMF for the development of an implicit Particle-In-Cell (PIC) computer code for computing the plasma characteristics of D-Pace's TRIUMF licensed, ISV series, H^- ion source. The ultimate aim is to increase current output from 15 mA DC to 30 mA DC.



New laser cutter arrives

Buckley Systems' profile cutting capacity has been greatly increased with the installation of our third laser cutter. The new machine is one of the latest generation, solid-state, fibre-optic lasers, complementing our two, existing CO2 laser source machines.

The concept of using a laser to cut materials has been around since the mid 1960s. The first type of commercially available machines used a CO2 laser source, guided and focussed using mirrors and lenses. This type of laser dominated the market until 2009, when the first fibre optic lasers, capable of metal cutting, were released. Early versions had limited power but they have now reached a high level of development and can

offer some distinct advantages over CO2 lasers especially when cutting thin or reflective materials. The wavelength of laser light from a fibre source, has better absorption in metals up to 4mm thick. The fibre laser beam can also be more precisely focussed to give a greater power density. This means the fibre laser requires less power to cut thin materials and can do it faster and cleaner with less potential to form a burr on the far side of the cut. Fibre optic lasers are also better suited to cutting previously tricky materials such as aluminium and brass.

Buckley Systems pioneered the use of lasers for cutting lamination steel, avoiding the high cost of making and maintaining spe-

cialised press tools. By using lasers, complex pole profiles can be accurately cut and alignment features incorporated into the design to enable accurate stacking and stability during bonding. Projects using laser cut laminations have included work for the Brookhaven (USA), Australian and Taiwanese light sources. Our new laser has a 2 kW output and 3 m x 1.5 m shuttle tables. It has already halved the cutting times of some of our regular jobs.

The long-term plan is to purchase another fibre laser and retire one of our older machines, leaving one CO2 laser for non-metallic work which is less suited to the characteristics of the fibre optic beam.

More machinery on the way

Buckley Systems is constantly investing in machinery to improve both productivity and the quality of our finished products. While shipping delays have meant that some machinery is yet to arrive, we have a lot of exciting new equipment arriving over the next few months.

Router

A CNC router is very similar to a CNC machining centre but is specifically designed for high speed profiling of easy-to-cut materials. Our new machine will be used almost exclusively for cutting aluminium cooling plates for our strip-wound coils. Able to accommodate large 6100 mm x 1800 mm alumin-

ium sheets on twin shuttle tables means we will avoid cutting sheets to fit our machining centres which will also free them up to do the heavier, more complex work they are best suited for.

Deburrer

Also arriving soon is an automated deburring machine. Guillotining, pressing or CNC laser cutting often leaves lamination steel with a tiny burr that needs to be removed before stacking into blocks for pressing and gluing into high precision laminated yokes and poles. The new deburring machine will save tedious manual work and free up staff for more productive

and engaging tasks. While this will be the main use of the machine, many other products will also benefit from automated deburring, improving consistency and productivity.

Strip winding machine

Following the successful implementation of our custom designed, computer controlled, copper strip winding machine, a new one has been ordered to cope with larger coils. The new machine will incorporate the features of the existing machine with some additional improvements for even more efficient material handling.

Magnet upgrades and refurbishment services

Our electromagnets generally have an extremely long service life, some the magnets we have manufactured are still in use after over 30 years of near constant use.

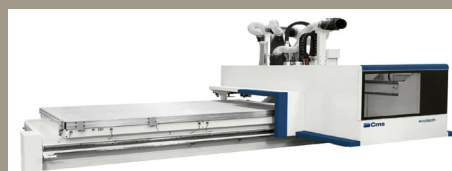
In the event of a mishap or wear and tear, if we have access to the original drawings, we can usually manufacture parts to refurbish any magnet we have made.

To improve or re-purpose early designs, we can also perform upgrades to coils, poles and vacuum chambers. Work we have done has included helping to design supplementary coils that were retrofitted to a magnet, increasing versatility and improving production without the need to replace the entire magnet.

Our physicists and design team can help you get more out of your existing magnets.

To ensure that the new parts mate precisely with the old ones, we strongly recommend that magnets are returned to our workshop for fitting replacement parts. This allows us to guarantee our repair work and test to make sure the magnetic field and any vacuum components are within specification before they are integrated back into a line.

The ability to refurbish products is part of the ongoing service you receive when dealing with Buckley Systems.



CMS Evotech 200 Router - arriving soon



Ultrasonic cleaning

Ultrasonic cleaning is one of the key steps in achieving the microscopic cleanliness levels required for laboratory grade equipment.

Our dedicated cleaning room contains several ultrasonic cleaning tanks in various capacities up to 120 litres (27 gallons). The tanks are filled with high purity de-ionized (DI) water, sourced directly from our own DI water filter and processing system. The water is usually heated to around 60°C (140°F) and used either straight or mixed with surfactants depending on the type of contamination and level of cleanliness required. To help prevent cross contamination, items are thoroughly cleaned and rinsed in DI water, before placing in the tanks. Most of our tanks operate at 40 KHz, which is well proven to be an optimum frequency to thoroughly remove contamination without damaging surfaces.

Ultra-high vacuum ultrasonic cleaning may involve several cleaning steps, finishing off with drying then sealing in a plastic bag or wrapping in aluminium foil, ready for shipping or transporting to the assembly or test area.

Meet Betty Boop

Betty Boop is our name for the straddle crane we use for moving our larger magnets.

Originally used for lifting large powerboats and yachts out of the water, she was refurbished and extensively modified by Bill Buckley to fit inside our factory. She is able to lift and manoeuvre over 30 tons on to the deck of a truck.



Upcoming 2021/22 Conferences and Events

Buckley Systems and/or D-Pace will have a presence at these events. Please contact us if you would like to arrange a meeting with us while we are there.

- **September 25-29 IIT 2022: San Diego, California, USA**

23rd International Conference on Ion Implantation Technology

- **October 2-7 NIBS'22: Padova, Italy**

8th International Symposium on Negative Ions, Beams and Sources

- **October 30-November 2 CAARI/SNEAP 2022: Denton, Texas, USA**

26th Conference on the Application of Accelerators in Research and Industry combined with 53rd Symposium of NorthEastern Accelerator Personnel

Tony Misa accepts new role as USA based Global Operations Support Manager



Tony Misa, our Group Manager – Operations is taking up the newly established role of Global Operations Support Manager, based at Buckley Systems International in Rowley, Massachusetts, USA. Reporting to Bill Dodge, Vice President Global Sales, Tony will be supporting day-to day operations, improving service capabilities, driving supply efficiencies and focussing on people

development. Tony's role will also support sales and customer relations, accompanying Bill Dodge to conferences and sales presentations in North America, Europe and Asia.

With over fourteen years' experience at our New Zealand manufacturing facility, Tony will be bringing his business knowledge of his current role backed with a wealth of practical manufacturing experience.

Establishing personal relationships with key customers, understanding their specific issues and working on solutions that will benefit all parties is where Tony sees himself providing best value. His broad experience allows him to analyse prototype designs from a production point of view, advising on ways to make man-

ufacturing and assembly faster, easier and more precise with the goal of saving time, and improving the consistency of the final product.

He is keen to work with designers, engineers, production and quality staff to ensure our customers are abreast of the latest manufacturing processes in order to maintain their edge in an increasingly competitive market.

Moving to the United States with a young family comes with its own challenges but they are all looking forward to experiencing life in a new continent and establishing new friendships. Tony is excited about the potential of his new role and is looking forward to following the NBA live and getting involved in the growing US rugby scene.

Covid 19 Update

As travel restrictions are eased, we have have being receiving unprecedented demand from our customers to visit our manufacturing facility in New Zealand.

If you are planning to visit, please contact us well in advance to arrange a suitable time and we will keep you in touch with our Covid testing and contact tracing requirements before you arrive.

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