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NEWSLETTER

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News about Chalk River's Tandem Accelerator Superconducting Cyclotron facility for users and potential users

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Solar cells successful as fission detectors

A recent experimental study at TASCC has successfully used low-cost solar cells as detectors for fission fragments. Insensitivity to light ions makes the cells especially attractive detectors for heavy-ion-induced fusion-fission reactions, in which light ions are produced in very large numbers. In addition the cells can easily be assembled into a compact spherical detector array inside the 8π spectrometer.

This successful use of solar cells in the study of the relatively light nucleus, vanadium-47, a difficult case, implies that they will have general applicability to the study of fission over a wide mass range.

Database conversion to VISTA tests out OK

The TASCC computer-control group has successfully verified control-highway operation, including NMR control, under the new VISTA Vsystem. A prime goal of the one-day test was to determine if the database conversion to Vsystem from the present PDP–11-based control system had been fully successful. It had. In general, system response for users is acceptable, even at this early stage of testing

TASCC control personnel will describe the recent conversion of the TASCC control-computer system to VISTA at the first workshop and users-group meeting for Vsystem users, to be held at Brookhaven in September.

Facility report

An efficient mode of beam production was achieved during a one-day experiment this month in which many small changes of beam energy on target were accommodated within a short time period. Energy changes every 100 keV between 9 and 6.2 MeV were made in less than a minute per change. This included setting the Tandem terminal voltage and beamline optics each time.

A brief outage of site electrical power in the first week of July caused an interruption of beam during a three-day projectile-fragmentation experiment. About two hours of beam time were lost. Brief storms in the area usually cause several short beam interruptions during the summer months.

Beams produced for experiments during July were:

Ion	*Energy (MeV)*
^{6}Li	35
^{7}Li	175
^{10}B	37
^{12}C	98
^{14}N	350
^{15}N	6.2 - 9
^{23}Na	89, 150
^{35}Cl	150, 200, 1050
^{37}Cl	155
^{40}Ca	120

Employment equity action plan targets women

AECL Research has provided employment equity targets for its Physical Sciences unit, to which TASCC belongs, for the next 18 months. The plan calls specifically for the hiring of more females: at least three professional, five technical and two clerical.

Visible minority representation on staff already closely matches that of the population.

Studies provide new insight into deflector behaviour

Very recent TASCC studies of the phenomena involved in operating the cyclotron electrostatic deflector have revealed the apparent role of gas produced at electrodes, insulators and electrode holders. The quantity of gas evolved can be sufficient to produce an avalanche discharge by which the voltage gradient breaks down. Deflector performance sets the practical limit for cyclotron extraction of most high-energy beams.

Bill Diamond, responsible for cyclotron deflector development at TASCC for the past four years, recently measured the quantity of gas evolved from copper electrodes in a dedicated high-voltage test-stand, shown in the diagram. More than 10^{-3} torr-litre of evolved gas was measured over a 20 second interval as the voltage increased from 50 to 55 kV across a 1-mm gap. This volume of gas is sufficient to trigger an avalanche discharge between the two electrodes if the voltage is increased rapidly. (A spark is also often observed during rapid voltage increases in other experiments.)

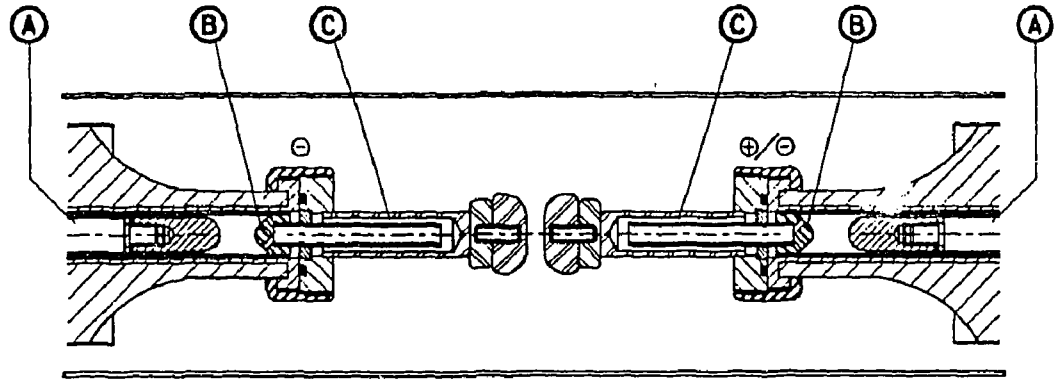
Following the spark discharge there is continuous field emission of electrons from the cathode, whereupon the current increases exponentially with electric field. Finally, at currents of 200 - 400 μA, continuous sparking limits any further increases in field.

Diamond also noted that differences in electrode surface treatments produce differences in gas evolution and electric field that can be maintained before the transition to field emission occurs.

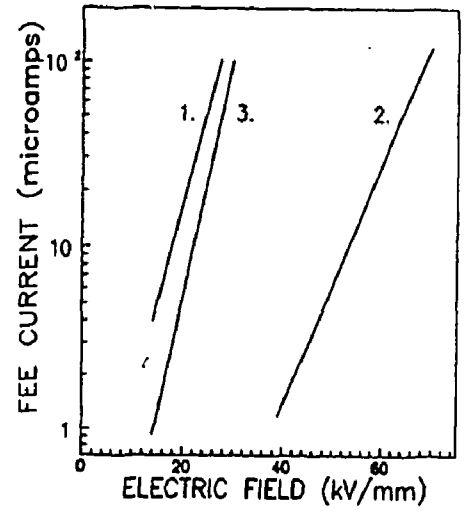
The graph here shows the field-emitted electron current for three sets of electrodes having a 2 mm gap: (#1) as-machined, (#2) heat-treated and electropolished, and (#3) heat-treated only.

Data for sample #1 are fairly typical of other results for copper electrodes at the same gap. Data for sample #2 represent a significant improvement in vacuum high-voltage insulation. A second set of tests with a sample treated in the same manner as #2 show the same results within 15 percent. Data for sample #3, with heat-treatment alone, do not show any improvement.

Ongoing experience gained from the test-stand indicates that treatments that increase the threshold at which field emission occurs also increase the operating voltage of the deflector in the cyclotron with magnetic field and r.f. applied.



High voltage is fed via cables (A) that have the ground shield removed. A thin tube passes through holes in fittings (B) to provide cooling water to both the anode and cathode mounts. Water is returned coaxially on the outside of the tube. The water column between (A) and (B) provides a surge resistance in each circuit. One insulator and electrode (C) is moveable so the electrode gap can be set externally.



Field-emitted electron current (FEE) for three sets of electrodes with a 2 mm gap: (#1) as-machined (#2) heat-treated and electropolished, and (#3) heat-treated only.

July experiments

Experiment	Exploratory study of fusion, fission and giant-dipole resonance behaviour in vanadium-47 with the 8π spectrometer, the miniball equipped with detectors sensitive to fission fragments, and two counter telescopes. Coincidence data were collected for subsequent analysis.
Researchers	A. Galindo-Uribarri, D.C. Radford, G. Savard and D. Bowman *(TASCC);* R. Roy, B. Djerroud and R. Laforest *(Université Laval)*; J. Jonkman and J.L. Rodriguez *(McMaster U.)*; S. Pilotte *(U. of Ottawa)*
Beams	150 and 200 MeV ^{35}Cl; 89 and 150 MeV ^{23}Na
Duration	3 days

Experiment	Continuation of systematic study of projectile breakup. This experiment studied the breakup of a high-energy chlorine beam.
Researchers	D. Bowman, E. Hagberg and D. Horn *(TASCC);* R. Roy, B. Djerroud and R. Laforest *(Université Laval)*
Beams	30 MeV/u ^{35}Cl; 98 MeV ^{12}C for calibrations
Duration	3 days

Experiment	Training for cyclotron specialists and operations crews on beam injection, acceleration and centering. Neither beam was extracted at this time.
Researchers	Beam Commissioning Team and TASCC operations personnel
Beams	25 MeV/u ^{7}Li; 25 MeV/u ^{14}N
Duration	5 days

Experiment	Measurement of depth profiles of hydrogen in zirconium and its alloys with the resonance reaction ^{15}N (p,α γ(4.43))^{12}C. A BGO detector was used to detect the 4.43 MeV γ-ray.
Researchers	J.S. Forster and J.W. McKay *(TASCC);* D. Khatamian *(System Chemistry and Corrosion Branch, CRL)*
Beam	9 to 6.2 MeV ^{15}N in 100 keV steps
Duration	1 day

Experiment	Attempt to confirm that a recently identified band characterized by strong ΔJ=1 transitions is in praseodymium-131. Measurements of DSAM lifetimes with both backed and unbacked targets were made with the 8π spectrometer and miniball. The assignment to praseodymium-131 was confirmed.
Researchers	A. Galindo-Uribarri and D. Ward *(TASCC);* S.M. Mullins and G. Hackman *(McMaster U.);* S. Pilotte *(U. of Ottawa)*
Beam	155 MeV ^{37}Cl
Duration	5 days

Experiment	Study of the effect of electric-field gradient on metastable negative calcium ions. Calcium ions were accelerated to various energies in the vicinity of 120 MeV and their transmission in the Tandem compared to that of titanium ions at similar energies.
Researchers	A.E. Litherland, M.-J. Nadeau and X. Zhao *(ISOTRACE Laboratory, U. of Toronto)*; H.R. Andrews, V.T. Koslowsky and Y. Imahori *(TASCC)*
Beam	120 MeV ^{40}Ca
Duration	2 days

Experiment	DSAM measurements of lifetimes of levels in vanadium-47 and several neighbouring nuclei. Results from this experiment should allow completion of a Ph.D. thesis by a collaborating student.
Researchers	J. Rodriguez, J. Cameron. and L. Yao *(McMaster U.)*; V.P. Janzen, A. Galindo-Uribarri and D.C. Radford *(TASCC)*
Beam	37 MeV ^{10}B
Duration	3 days

Experiment	Study of the decay of vanadium-44 in the ISOL spectrometer. A tentative assignment of beta-delayed gamma rays to vanadium-44 was confirmed. In addition, the He-jet setup was used to acquire γ–γ coincidence data on this decay scheme.
Researchers	E. Hagberg, V.T. Koslowsky, G. Savard, J.C. Hardy and J. Albrecht *(TASCC)*
Beam	35 MeV ^{6}Li
Duration	2 days

Next month . . . . .

- RCE studies of silicon ions channeled in gold
- Study of intruder bands in indium isotopes
- Measurement of lifetimes in indium-109
- AMS measurements of chlorine-36 content in various samples
- Assessment of forward elastic recoil technique for materials analysis
- Development of heavy-ion cyclotron beams

Facility operating record

Elapsed Time (Year-to-date)	5111 h
Beam Available	
Tandem Only	2867.6
Tandem + Cyclotron	688.3
Beam Development	699.1
Planned Shutdown	532.5
Forced Shutdown	323.5

Editor: Larrie Thomson
Tandem Accelerator Superconducting Cyclotron Facility
AECL Research, Chalk River Laboratories
Mail Station 49A Chalk River,
Ontario, Canada K0J 1J0
Phone (613) 584-3311, extension 4131.
FAX 613-584-1800
Bitnet TASCC@CRL.AECL.CA

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AECL Research EACL Recherche