G. EQUIPMENT DEVELOPMENT

The year saw several milestones in equipment development. Gammasphere finished its first successful campaign in March 2000 and was shipped back to Berkeley to restart operation at the 88" cyclotron on schedule in July. During the move several upgrades were implemented in the Gammasphere electronics, in addition to the necessary bi-annual maintenance. After Gammasphere was removed, a large array of barium fluoride detectors, the ORNL/MSU/Texas A&M array, was installed and commissioned on the Gammasphere platform at the FMA and was operating within eight weeks of Gammasphere's departure. The Canadian Penning trap came on line and made first "on-line" mass measurements. Particular emphasis was placed on developing the "gas catcher" technique, which enhances the efficiency of loading the trap, but also has become an integral component in the RIA accelerator design. For "in-flight" production of radioactive beams, a new solenoid was procured which should greatly enhance both the beam quality and quantity in future. This was a timely move, as the original solenoid malfunctioned, so an upgrade was needed. A long-planned upgrade of the FMA was started in initiating a procurement of a "split-electrode", which should greatly expand the scope of the device. To broaden the scope of the "proton-emitter" program at the FMA, a series of test experiments was begun to try to observe short-lived (10's to 100's ns) proton emitters. The first position-sensitive planar gamma-ray detector was delivered which will allow new polarization physics now and permit developments of designs for the next generation of gamma-ray array, which will have a "tracking capability".

g.1. Gammasphere Operations (M. P. Carpenter, C. J. Lister, R. V. F. Janssens, F. Kondev, T. Lauritsen, D. Seweryniak, and I. Wiedenhöver)

On March 14, 2000, Gammasphere completed its cycle of operations at ATLAS marking two years and two months of experimental activity. In that time, 100 experiments were performed. Many of the nuclei studied in these investigations lie at or near the proton drip line as clearly illustrated in Fig. I-82. Approximately 1/2 of the Gammasphere experiments used the Argonne Fragment Mass Analyzer to provide mass identification of residues. Nearly all of the experiments performed utilized one or more of the 19 auxiliary detectors available for use in tandem with Gammasphere.

The operation of Gammasphere proceeded smoothly while the device was at ATLAS. For nearly all experiments, Gammasphere ran with its full compliments of Ge detectors (101 maximum). Table 1 summarizes the beam on target hours for Gammasphere while operating at Argonne. A total of 9864 hours of beam time was available for experimental research. This represents 72% of the total ATLAS beam time delivered to the experimental areas for the period January 15, 1998 to March 15, 2000. In addition, 1224 experimental hours were utilized for Gammasphere experiments with radioactive sources bringing the total time of Gammasphere operations at ATLAS to 11088 hours.

Table 1. Beam on target hours for ATLAS and Gammasphere for the period January 15, 1998 to March 15, 2000.

Year	ATLAS Hours	GS Hours	% of Beam time
FY1998[1]	4597	3011	65%
FY1999	6046	4719	78%
FY2000[2]	3096	2134	69%
Total	13739	9864	72%

[1]ATLAS ran a total of 5749 hours in FY98, including the period GS was not available for experiments.
[2]For the period Oct. 1, 1999 to March 15, 2000.

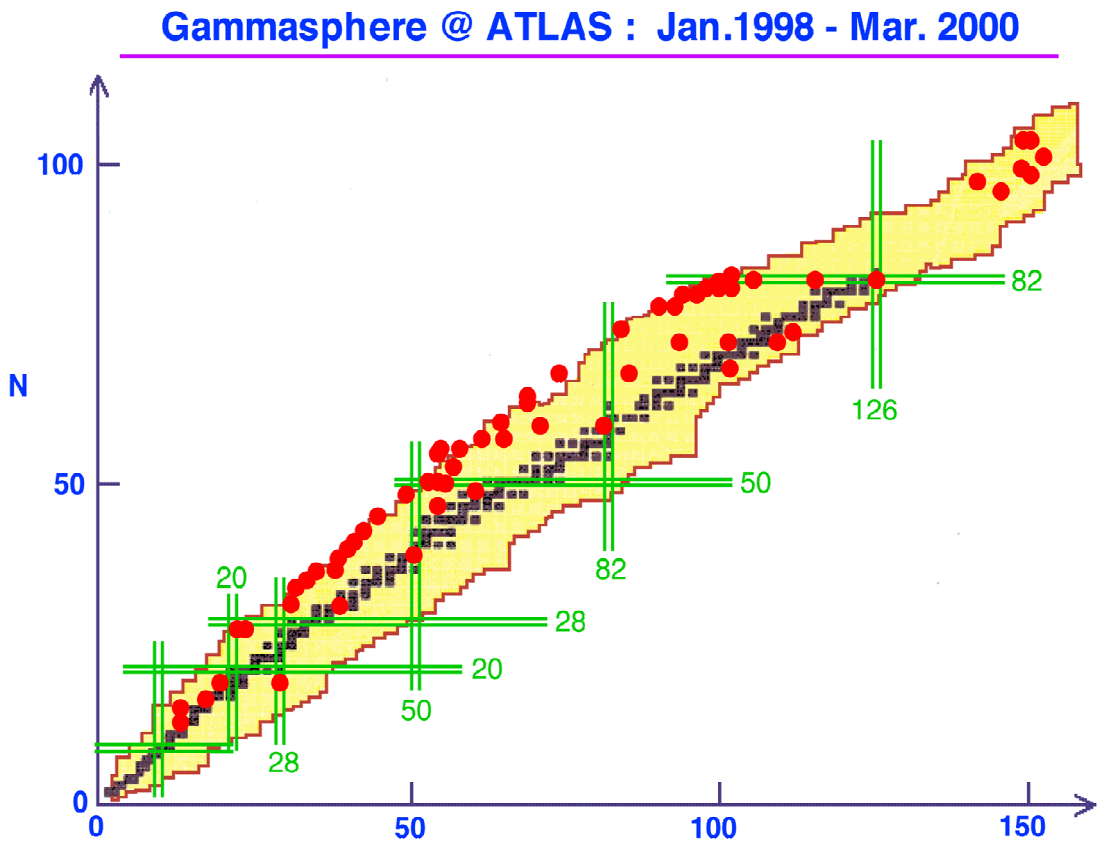

Fig. I-82. Known chart of the nuclides. Black squares represent stable nuclei. Red circles represent nuclei that have been measured with Gammasphere at ATLAS between January, 1998 and March, 2000.

g.2. Move of Gammasphere to LBNL

(M. P. Carpenter, C. J. Lister, R. V. F. Janssens, F. Kondev,T. Lauritsen, D. Seweryniak, I. Wiedenhöver, A. O. Macchiavelli,* and M. Cromaz*)

On March 14, 2000 at 8:00 AM, Gammasphere completed its cycle at ATLAS marking two years and two months of experimental activity. The dismantling of Gammasphere in preparation of the move to the 88-inch Cyclotron at Lawrence Berkeley National Laboratory began the following day. Based on the last move, a goal was set to have Gammasphere ready for operations at LBNL in four months.

With regards to the move, Argonne took responsibility for (i) dismantling Gammasphere, (ii) packing and shipping all equipment to LBNL, and (iii) annealing all Ge detectors. In addition, repairs were made to both BGO and Ge detectors before shipment to LBNL. The most time-consuming portion of these responsibilities was the annealing of the Ge detectors. With 10 pump-and-bake stations available, the annealing of all Ge detectors took six weeks. Four separate shipments of Gammasphere equipment was sent to LBNL by truck. All equipment was delivered to LBNL by May 31st. Gammasphere began experiments at the 88-inch cyclotron in mid-July as planned. A summary of major milestones for the move can be found in Table 1.

Table 1. Milestones for move of Gammasphere from ANL to LBNL*.

Date	Milestones
Mar. 14	Last Gammasphere experiment at ATLAS ends.
Mar. 15	First detectors removed from the array.
Mar. 20	All detectors removed from south hemisphere.
Mar. 24	All detectors removed from north hemisphere.
Mar. 24	Annealing of Ge detectors begin.
Apr. 3	First shipment of equipment to LBNL leaves Argonne.
Apr. 7	South-side support structure removed from target area.
Apr. 11	North-side support structure moved from target area.
Apr. 14	Truck transporting support structure leaves ANL for LBNL.
Apr. 24	Support structure installed in Cave 4C at the 88-inch Cyclotron.
May 2	Annealing of all Ge detectors finishes.
May 8	Second shipment of equipment to LBNL leaves Argonne.
May 31	Third and final shipment of equipment arrives at LBNL.
July 7	101 Ge detectors mounted and working in cave 4C at LBNL.

*Lawrence Berkeley National Laboratory

g.3. Response of Gammasphere to High Energy Gamma Rays (D. Jenkins, C. J. Lister, and A. O. Macchiavelli*)

Gammasphere is frequently employed as a 4π colorimeter, using both the germanium and BGO detectors to measure the gamma-ray flux from reactions. When the flux consists of many low energy (< 4 MeV) photons, the device's response is well understood, as it has been measured using radioactive sources. However, for the exceptional case where the flux pattern is harder, consisting of one, or a few photons of high energy (> 10 MeV) the response of the detector is less well determined. As Gammasphere is increasingly used to study light nuclei, where high energy radiation is more common, a more extensive calibration is important. One application where these issues are critical is the study of light ion radiative capture ($^{12}C + {}^{12}C$ for example) where the capture mechanism always involves at least one gamma ray of energy > 10 MeV.

We performed a test calibration experiment using the $^{10}B(p,p')$ and $^{10}B(p,\gamma)$ reaction to produce high energy gamma rays. The cross section for these processes is well known, so both relative and absolute efficiency responses can be determined. Both the germanium and BGO data were written to tape for analysis, allowing both germanium and "module" efficiencies to be mapped. The module "add-back" energy spectrum can also be studied. Selecting events in which most of the energy is deposited in germanium (usually when the germanium is hit first) can result in a module spectrum which has both reasonable energy resolution (~5%) and good efficiency for high energy gamma-rays. For the highest energies, above 15 MeV, the response of Gammasphere is severely reduced by electronic cutoffs, both in the germanium electronics, where the transistor reset preamps saturate on a single pulse, and in the BGO, when operated at normal tube voltages.

Analysis is in progress and will lead to a technical publication.

*Lawrence Berkeley National Laboratory

g.4. Development of HpGeDSSD Planar Detectors for the Gamma-Ray Box (GARBO) (C. J. Lister, T. A. Sienko, F. G. Kondev, D. Seweryniak, T. Lauritsen, M. P. Carpenter, R. V. F. Janssens, T. L. Khoo D. G. Jenkins, S. M. Fischer,*and B. Phlips†)

The research and development of "next generation" γ-ray detectors which may lead to more sensitive gamma-ray experiments in the future continued. The new detectors need to have all the characteristics of current gamma ray detectors, but in addition have position sensitivity, polarization sensitivity, excellent countrate capability, and very good timing characteristics in order to replace the excellent "Gammasphere", GASP, and "Euroball" arrays of the current generation. At ANL we are pursuing planar germanium wafer technologies which may offer all the required characteristics.

We have worked in collaboration with Perkin-Elmer (formerly Ortec) to develop the worlds largest planar detector. The crystal is 90 mm × 90 mm × 20 mm. On each side it has sixteen 5-mm strips, making a 256-pixel array. We performed "inbeam" and source tests to evaluate its characteristics and the detector was returned to Tennessee for further refinement. Many encouraging measurements were made, including good position sensitivity and uniformity of response. Figure I-83 shows the response measured when moving a collimated source across the detector. The main shortcoming of the detector was high noise on the "cold-FET, Boron implanted" side which should have LEPS-like resolution, below 1 keV at 122 keV. Inbeam, the $^{24}Mg(^{136}Xe,4n)^{156}Dy$ reaction was used to produce nuclei recoiling into vacuum at v/c > 0.075. This presents a very stringent test of the position sensitivity, as excellent Doppler correction is crucial to observe γ-rays from such a swift-moving source.

The detector was returned to Ortec for re-etching and rebuilding in order to remove some mechanical shortcomings. A new round of tests will start in May and "inbeam" experiments are anticipated in June. Design work started on a new-streamlined cryostat. Working from the existing mechanical drawings, we are

developing a more compact geometry for a detector which could form an element of a large array.

Procurement of a second detector has begun. With two detectors many interesting technology projects can be pursued, including imaging of extended sources and making a Compton camera for locating radioactive "hotspots". This project will be pursued in collaboration with the ANL Technology Division. For nuclear structure research, many interesting issues involving position sensitivity and tracking, and especially for polarization sensitivity, will be explored.

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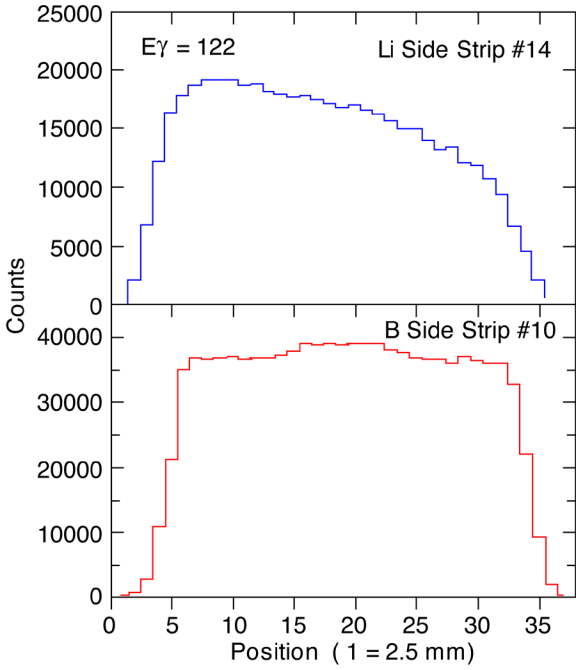

Fig. I-83. A scan along the middle of central Li and B strips using ^{57}Co 122-keV γ rays to measure efficiency. The fall-off on the Li side was remedied on the second prototype counter.

g.5. Delay-Line Shaping Amplifiers for a Double-Sided Silicon Strip Detector

(C. N. Davids, P. Wilt, and D. Seweryniak)

The double-sided silicon strip detector (DSSD) is used as an implantation detector behind the focal plane of the FMA. It consists of a silicon wafer 16 × 16 mm^2 × 0.06 mm deep, with 48 strips per side, each side orthogonal to the other. In typical operation a heavy nuclear reaction residue having an energy of 30-150 MeV has its mass/charge (M/Q) measured at the focal plane, and is subsequently implanted into one of the quasi-pixels of the detector. Here a subsequent particle (proton or alpha) decay of energy 0.5-12 MeV can be time- and position-correlated with the M/Q of the parent nuclide. At ANL each strip is instrumented with a charge-sensitive preamplifier and 2 Gaussian shaping amplifiers with shaping time 0.5 μs[1]. The full-scale range of the 2 amplifiers are set to 20 MeV for measuring the decay particle energy and 200 MeV for measuring the implant energy.

The decay amplifiers are overloaded by the signal from the implant, and do not recover until approximately 5-10 μs or even longer after the implant, depending on the degree of overload. Normally this is not a problem for proton emitters whose half-lives are > 1 ms or so, but for short-lived emitters, the energy measurement is disturbed by the fact that the proton signal is riding on the tail of the implant pulse. What is seen is an energy shift which increases with decreasing time between decay and implant event.

We tested the response of a commercial delay-line shaping amplifier (Ortec Model 460, delay time 0.5 μs) with respect to overload recovery, and found that recovery from overload is significantly improved over the 0.5 μs Gaussian shaping amplifiers. The height of a proton signal occurring as little as 1.5 μs after the end of an implant signal can be easily measured with good resolution (< 50 keV).

We constructed a prototype delay-line shaping amplifier using a lumped-constant delay chip, and its performance equals or exceeds that of the model 460. After optimizing performance and miniaturization, about 80 channels will be constructed, in packaging along the lines of the shaping amplifiers in Ref. 1.

[1] S. L. Thomas *et al*., Nucl. Instrum. Methods **A288**, 212 (1990).

g.6. PICA Data-Acquisition Development (B. Nardi, K. Teh, and A. H. Wuosmaa)

A new set of data-acquisition hardware for readout of experiments at ATLAS is being developed. The system, called PICA, is conceived as a replacement for the MSU VME front-end data-acquisition systems currently in use at ATLAS. The PICA system is built around an intelligent CAMAC crate controller module containing an embedded Intel x86 microprocessor running the RealTime Linux (RTLinux) operating system. Within the CAMAC controller, a CAMAC logic sequencer communicates directly with the x86 processor via the embedded processor's PCI bus. Data from the PICA controller in each CAMAC crate in an experiment are sent via a private Ethernet link to a separate event builder that consolidates the data for each event, fills them into event buffers, which are then sent via Ethernet to data-consumer processes. Prototype versions of the CAMAC logic sequencer and PCI communication hardware were built and tested. The procurement of hardware for production systems is under way, and it is planned to deploy the first production modules in mid-2002.

g.7. Nuclear Target Development (J. P. Greene and G. E. Thomas)

The Physics Division operates a target development laboratory that produces targets and foils of various thicknesses and on various substrates, depending on the requirements, for experiments performed at the ATLAS and Dynamitron accelerators. The targets are prepared from both naturally occurring materials and mass separated stable isotopes that are supplied either in pure, elemental form or as stable compounds. Targets are made not only for the Physics Division but also for other divisions at the Laboratory and occasionally for other laboratories and universities.

In the past year, numerous targets were fabricated either as self-supporting foils, on various substrates, or as "sandwich" targets. Targets produced include Al, Au, ^{11}B, Be, ^{12,13}C, ^{44}Ca, Cd, Cr, ^{63}Cu, ^{170}Er, ^{54}Fe, formvar, ^{76}Ge, Havar, HfO_2, kapton, L-Valine ^{24,25}Mg, ^{92,98,100}Mo, mylar, ^{58,60,64}Ni, ^{208}Pb, PbO, ^{108}Pd, polypropylene, ^{29}Si, $^{29,30}SiO_2$, ^{149,150}Sm, ^{122,124}Sn, Ta, TaN, ^{130}Te, Th, ^{46}Ti, U, V, W, ^{176}Yb, ^{64}Zn and ^{96}Zr. Many of these target foils were fabricated via mechanical rolling using our small rolling mill.

Gammasphere finished its stay at ATLAS in March with the majority of this research effort accomplished using targets and sources fabricated by the Physics Division Target Laboratory. Over 1000 targets were prepared in the target laboratory during the two-year experimental program carried out at ATLAS. Target requests are now being requested for experiments beginning at Lawrence Berkeley National Laboratory.

The Argonne/MSU/ORNL BaF_2 array was assembled in the place of Gammasphere. The majority of the experiments required a rotating target wheel so as to increase target lifetimes and allow for higher beam currents. The Gammasphere style target wheel is now in routine use within the LEPPEX array target chamber. The target laboratory fabricated approximately 70 targets (mainly target wheels) for the LEPPEX research effort during this time period.

Experiments were undertaken to explore the realities of heavy element searches. Intense beams, by necessity, must be employed, requiring new demands upon target performance. Target wheels of lead and bismuth as

well as high melting point lead compounds were prepared for these initial tests. Beam intensities up to 80 pnA were put on target. At these intensities the lead did not exhibit any appreciable lifetime. An online target monitoring system needs to be developed. Calculations were performed in an effort to model the target behavior. The next step is to return to the large FMA target wheel. Gas cooling of the targets is also likely, which in turn will place high demands upon whatever window materials eventually will be employed to confine the gas.

Outside of target development, support is being provided for the production of thin films and foils for use in various detector systems developed for experiments at ATLAS. Several variations of metallized plastic foils were prepared for use in the channel plate detector at the FMA. A variety of windows employed in CPT experiments at the SPS in Area II were produced. These included windows of Ti, Ni, Kapton and Havar. Also developed for the SPS II focal plane was an energy degrader system consisting of a ladder of various thickness, large area, aluminum foils, some of which were prepared by mechanical rolling. One area of considerable importance is the ability to manufacture and measure the thickness of large area foils of various kinds. For example, the preparation of metallized formvar films for the channel plate detector at the FMA. To accomplish this, we constructed a new alpha particle energy loss counting system with a chamber large enough to accommodate these large foils.

As part of ATLAS support, the target lab routinely produces carbon stripper foils of 2 $\mu g/cm^2$ for use in the Tandem as well as other thicknesses for additional stripping throughout the accelerator. Over 1100 carbon stripper and gold foils of various types were prepared for ATLAS during this past year. There continues to be an increase in the preparation of various dilutions of isotopic source material into a form and shape suitable for introduction into PIIECR and SNICS sources for the production of enriched beams at ATLAS. These included CaO, ^{54}Fe, FeS, LiF, Mn, ^{58,60}Ni, ^{124}Sn, ^{86}Sr, Ti, $^{44}TiO_2$ and Zn. The continuing procurement of stable and enriched material for ATLAS consumption and maintenance of isotope inventories for enriched beam production is being provided by the target laboratory staff.

The target development laboratory includes state-of-the-art equipment used for thin-film fabrication. The available techniques consist of multiple resistive heating, focused ion beam sputtering, glow-discharge plasma deposition, electron beam and electron bombardment evaporation, electrodeposition and mechanical rolling. The evaporators are maintained under high vacuum and each vessel contains a quartz-crystal film-thickness monitor with deposition rate indicators. Also included are movable shutters, quartz-lamp substrate heaters and thermocouple temperature sensors, allowing for complete process monitoring during target deposition.

Other auxiliary equipment used for target development includes electrodeposition equipment, a small rolling mill, an alpha particle counting chamber, inert atmosphere glove box, laminar flow clean bench, pellet press, a reduction furnace, and a variety of precision balances. A turbo-pumped target storage facility is in operation for maintaining, under high vacuum, those targets that readily oxidize in air. This system utilizes computer-controlled circuitry to prevent targets from exposure to atmosphere during power interruptions. A second storage system, employing a bank of vacuum desiccators and connected to a mechanically pumped manifold, is available for use by individual experimenters. Similar systems are in operation at ATLAS just inside the entrance to Target Area II. A new additional set-up, consisting of two large glass desiccators evacuated using a small turbo-pump system, is in operation for long-term material storage. This allows a separation of material storage from target storage, hence eliminating repeated exposure when transferring and retrieving targets.

A low-level radioactive source and target preparation laboratory exists at a separate location within the Division that is dedicated to the production of these sources and targets. Available preparation techniques include multiple resistive heating, employing a diffusion-pumped vacuum evaporator. A second, smaller evaporator system was constructed for close proximity evaporations of higher activity materials, to be used as targets as well as radioactive sources. The small size of this system allows for installation within a hood. Preparation of actinide targets, Am, Cm and Pu by electrodeposition is done for Coulomb excitation studies at ATLAS. Production also continues for natural and depleted uranium and natural thorium foils by mechanical rolling, the latter for a Solar Neutron Detector for the University of Chicago.

Another area of increased research effort is toward development of radioactive beams for the RIA proposal and involves neutron producing targets which in turn induce fission in uranium or a uranium compound production target. Toward this end, direct

measurements of the thermal conductivity of uranium carbide were made using the method of heating by electron bombardment and measuring the surface temperature of thin UC_2 disks by optical pyrometry. The uranium carbide sample disks are first prepared by the reduction of uranium oxide using carbon in a resistively heated source in the Radioactive Target Laboratory. Next, the samples are heated by a 10-kV electron beam provided by a mortar source in a vacuum evaporator in the target lab and the temperature measured as a function of beam current using a two-color pyrometer. This work is still in progress.

Support of the efforts involving a high-pressure He gas stopper cell as a means to capture and ionize reaction products being pursued by the CPT researchers at SPS II required foils and gas cell window technologies previously developed for gas cell production of secondary beams at ATLAS. Calculations are being carried out to investigate the range straggling of high energy heavy ions in a He gas cell following Pb and Be absorbers for applications related to RIA.

g.8. Progress at the Canadian Penning Trap Mass Spectrometer

(G. Savard, J. A. Caggiano, A. Heinz, J. Schwartz, D. Seweryniak, G. Sprouse,* J. A. Clark,† R. C. Barber,† C. Boudreau,‡ F. Buchinger,‡ J. E. Crawford,‡ H. Fukutani,† S. Gulick,‡ J. C. Hardy,§ J. K. P. Lee,‡ R. B. Moore,‡ K. S. Sharma,† J. Vaz,† and J. C. Wang†)

The Canadian Penning Trap (CPT) mass spectrometer is designed to make precise mass measurements on nuclides with half-lives longer than 50 ms. The radioactive nuclides are produced through fusion evaporation reactions using heavy-ion beams from the Argonne Tandem Linac Accelerator System (ATLAS). Once created, the nuclides of interest are separated from the beam in an Enge magnetic spectrometer operated in the gas-filled mode. They are then stopped in a gas catcher filled with 150 Torr of helium, extracted and subsequently guided to a radio-frequency quadrupole ion trap where they are accumulated before being transferred to a high-precision Penning trap. Activities at the CPT spectrometer this year focussed on increasing the transfer efficiency of ions from the target to the Penning trap, decreasing the number of contaminants and performing first on-line mass measurements on short-lived isotopes.

Efficiency improvements started with the target region where a recently installed rotating target, coupled to the rotating window assembly, allowed extended operation at high beam current. A single target now routinely lasts the full duration of a run (typically 4 days) at 0.5 μA beam current from ATLAS.

Detailed ion optical calculations show that, for most reactions, the cone of recoil products entering the gas-filled magnet is significantly increased by scattering in the gas. As a result there is significant loss in activity on the spectrometer poles. As a temporary measure we decided to run the spectrometer without gas for these reactions as more recoil products are collected at the focal plane. A permanent solution was identified that will require the addition of a magnetic triplet at the entrance of the spectrograph. Ion optical design is completed and installation of the triplet should take place during the summer of 2001. This will result in an acceptance gain of a factor of roughly 3 at the cost of a loss of resolution which is not detrimental when operating in the gas-filled mode.

The mini beam stop at zero degrees that was installed last year was also replaced by a series of four beam stops of various diameter located at the entrance of the spectrograph. They can be precisely positioned and are tuned by minimizing the total charge created in the gas cell system (most of the charge comes from stray beam, not from radioactive ions).

Within the past year the gas cell diameter was also increased to roughly 8 cm internally to allow more of the reaction products to enter the cell. The vacuum chamber hosting the gas cell and gas cooler was modified to accept this new cell and allow easier mechanical alignment of the full system. A new window frame for this larger diameter cell was also designed. It is an all metal assembly, sealing the window with an indium seal, and supporting the window with a thin gold plated tungsten wire grid. A new extraction cone was also installed with an increased plate granularity and an improved insulator design. Higher DC and RF fields can be used in this gas cell resulting in better confinement of the ions. The various parameters of the cell are now being optimized

to determine the best operating parameters for various conditions of illumination by fast ions.

Suppression of stable (and unstable) contaminants is an important issue for on-line measurements. The steady improvements of the cleanliness of the gas cooler system continued with additional purification steps added in the helium gas feed system, replacement of the small roots blower in section 2 by a high-throughput turbo pump from Alcatel, and addition of an oil-free booster system in front of the 2000 m^3/hr roots blower in section 1.

The cooler itself saw few modifications. It is occasionally operated in "mass selective mode" to reduce the number of contaminants transferred to the radio-frequency quadrupole ion trap (Paul trap). However, because of finite mass resolution, many masses must be transferred to not reduce at the same time the intensity of the desired mass. A more selective method was therefore implemented to further reduce the contaminants. A 1" square deflection plate system was installed just prior to the last 90 degree bend in the transfer line, located below the Paul trap. By placing the deflection plates as far as possible from the ejection of ions from the cooler we can separate the different masses due to their TOF arrival at the plates and let just a narrow mass range go through with a proper deflection pulse. We successfully limited the masses transferred through to the Paul trap to approximately 3 amu with the central mass unaffected and the two neighboring masses reduced by over an order of magnitude in intensity. The remaining contaminants must be eliminated at the Penning trap.

The ions approaching the Paul trap are first decelerated before entering the trap through a small aperture in the bottom endcap. This deceleration electrode is however now maintained at a potential providing a better quadrupole potential inside the Paul trap between beam bunches and is only lowered briefly when a new bunch of ions is ready to be captured. Thus ions previously captured and cooled by the helium buffer gas are kept in a fairly uniform quadrupole potential and do not 'leak' out due to the influence of the deceleration voltage on the quadrupole potential where they had before.

The Penning trap has also seen an added pulsed deceleration voltage but for a different reason. Resonances obtained from the excitation of ions in the trap are extremely sensitive to field imperfections and it was found that the deceleration filed penetrated enough to perturb the resonance when the ions had large oscillation amplitudes inside the trap. The deceleration electrode is therefore now held at about 150 volts below the Penning trap potential to allow ions to enter the trap, but once they are captured, the electrode is raised to a voltage consistent with providing an extended uniform quadrupole potential.

Contaminants present in the Penning trap can be removed by applying a dipole excitation at large amplitudes at the reduced cyclotron frequency of the contaminant. However, with a great number of contaminants, it is nearly impossible to identify every single one individually and than remove it. A method was established to 'sweep' through a set of frequencies and remove all contaminants in a given mass range. Combining the strong single mass cleaning procedure for the strong contaminants with the 'sweep' procedure to remove the weaker channels allows sufficient purification to identify and perform mass measurement on the remaining selected radioactive isotope.

These new procedures were applied in on-line runs this year and resulted in mass measurements on the short-lived neutron isotope ^{120}Cs produced by a ^{60}Ni beam on a natural Cu target. More recently, preliminary measurements on ^{68}Ge and ^{68}As produced by bombardment of a ^{12}C target with a ^{58}Ni beam were also obtained. These measurements will be continued in the coming year and extended to neighbouring isotopes along the rp-process path.

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*On sabbatical leave from Stony Brook University, †University of Manitoba, Winnipeg, Manitoba, ‡McGill University, Montreal, Quebec, §Texas A&M University