AUSTRALIAN NATIONAL UNIVERSITY

DEPARTMENT OF NUCLEAR PHYSICS

14UD TANK OPENING REPORT NO. 23

November 25th to 28th, 1980

(4 days open; 1 re-entry)

REFERENCES: Earlier Tank Opening Reports are referenced by the notation 12/4 etc., meaning Report No. 12, page 4.

OMISSION: Having been shyly asked by a faithful reader why we had gone to the immense trouble of changing the terminal spinnings we looked through Report No. 21. In spite of all the details of enthusiasm, setbacks and turmoil, we found no indication of purpose at all. It was like this:

Two years ago we recorded (14/2) that the success of NEC contoured casting covers in reducing sparking had led us to order new terminal spinnings predicted to reduce peak fields by 9%. Because of the magnitude of the operation, and machine downtime, installation was delayed until August 1980 (Report No. 21). First brief comments on performance were made in the last report (22/1, 22/3).

REASON FOR THE TANK OPENING

Primarily to change foils and avoid an opening during the Christmas and New Year period. Also to examine the stabilizing idlers following the measures taken after the failure of the ANU idlers (22/2; two references) observed at the last opening.

PREAMBLE

The tank was last closed on October 8th and the machine ran for 48 days since then. For a few weeks eerie stability returned and then, as time proceeded, began to fade from eerieness to a level which was nevertheless quite acceptable and caused no problem. We suspected that, once again, something on the column had become loose, in spite of our efforts to prevent this.

Now and then the H.E. column current would disappear without apparent reason, and, when least expected, would return merrily as though it had never been away.

On two occasions when users were unable to continue their experiment the machine was conditioned. The conditioning threshold has now risen to 14MV, which is the highest since the tube was opened three months ago to fit the new spinnings.

THE TANK OPENING

Exploratory tour:

The preliminary examination of the column revealed that no rings or stringers were loose and there was nothing else too account for the instabilities which had developed. Stabilizing idler assemblies were inspected and, in all there were 5 shafts on double idler blocks and about 8 singles which were worn in varying degreess, but all sufficiently to require replacement.

The chains werre tacky and there was the usuall amount of oil on the floor of the tank and on H.T. castings around the chain holes.

On the cover of casting 27, the last casting before the H.T. base, we found a patch of discolouration several inches square in a pattern characteristic of corona shadow. At casting 28 some same rings are tied with wire; tthe ends of the wire are twisted into a pigtail which was sticking out horrizontally immediately below the discoloured patch. On the pigtail itself as a faintly yellowish substance and it was clear that corona had been occurring completely across the inside of unit 28, thereby shunting the H.T. column current and giving rise to the effect we had noticed.

Chain oilers

In March 1976 we removed the original NEC oiling pads and installed aerosol devices (2/'1; 2/'2) which have never been really reliable (3/3) though we have observed on various occasions (4/2) that oiling has been effective. At one stage the oilers were removed altogether for overhaul and we relied until the next tank opening on clean chains and a good manual oiling before button-up (10/3). Later (17/'2), we removed the sintered plugs in tthe outputs and tried the resultant oiling which occurred as something between lazy oozing and erratic spitting. This did, nevertheless, deposit the right amount of oil on the pulley rims. Unfortunately the needle valve in the device which adjusts flow proved unreliable, encouraging us to abandon this technique too.

Continued irritation with failures in regard to such a simple, yet critical process haas led us to make a set of completely basic oilers which consist of nothing more than 6" lengths of thick-walled 2" I.D. brass tubing enclosed at each end and filled with oil. At the top a tube, which goes almost to the bottom of the vessel, extends towards the chain pulley, terminating in a length of capillary tube, the end of which points downward over the pulley rim. The vessel can be pressurized with SF6 to a chosen value above ambient. When the actuating button is released the excess pressure of SF6 is vented into the tank and oiling ceases.

The oiling rate is about two and a half drops per second, which turns out to be about 4 ccs/minute. Instead of oiling when the chains are running (with volts off) we now release a few drops onto the stationary pulleys and allow about 15 seconds for the drops to run round the rims. We then give the chains a momentary burst of power so that the pulleys rotate without getting up speed, thereby transferring the oil to the chains before it is thrown off by centrifugal force.

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Stripper foils

When the terminal spinnings were changed six months ago two sets of evaporated foils were loaded; one set was evaporated onto a domed substrate to produce pre-slackened foils. This resulted in about 80% having folds. The expectation that such foils would last significantly longer was not borne out; neither was there a significant reduction in beam transmission due to the greater multiple scattering in the folded areas. Presumably folded areas were too small to cause an observable effect. It was hoped that the shrinkage caused by the beam would unfold the foils, but this did not happen.

In summary, the pre-shrunk foils with folds offer neither benefits nor disadvantages over foils evaporated onto flat substrates.

At this opening we put in a new load of foils similar to those removed, with the difference that only about 20% of the pre-slackened foils have folds. This is probably due to the fact that they were floated off while in a laminar flow cabinet. Unfortunately the degree of slackening from sample to sample is not reproducible; indeed, some ordinary foils appeared as slack as the ones evaporated onto domed substrates.

In addition to these evaporated foils 19 glow discharge foils from Chalk River National Laboratory were put in. These also had folds and were nominally 5 micrograms/cm^2 compared to ours of 2 to 4; also they still had their collodion coating. (The first use of these foils for an oxygen beam resulted in 20% less transmission than for our evaporated foils. Whether this was due to the collodion which had not yet evaporated, or the nominally thicker carbon, is not known. Data on lifetime are not yet available.)

Stabilizing idlers

Spark shields intended to protect stabilizing idlers from spark damage were installed at all positions. These are analagous to the shields installed in pelletron charged M.P's to protect idler pulleys from spark damage. The shields are comprised of a plate which is screwed onto the casting and three petals which enter the casting and pass between the idler pulleys, screening the bearing and support systems. The devices can be fitted easily with the chain in position and are designed so that the petals, which are concave to the chains on a radius of 0.875", can be adjusted to uniform clearance.

Vacuum system

The 10 litre/second ion pump in the terminal was replaced by a 20 litre/second pump. We regretted the necessity of letting the tube up to atmospheric again when conditioning has so much improved since last time; however, it was vented with argon over about an hour while we attended to other matters. Roughing was done extremely slowly and continued for about 20 minutes when the vacsorb was put on.

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Tube and column metering leads

The use of old N.E.C. type 3 corona assembly discs as a protection for metering leads (21/7) has been most effective. At places where the discs faced a flat metal surface, protection has been complete, with no evidence of damage to the wire or double-sided adhesive used to support the discs; however, where the discs were attached to copper tube, the gap was too large and a few adhesive insulators were damaged. All those on copper tubing were removed and the bare leads were allowed to hang free, away from nearby conductors.

MISCELLANEOUS

Twisted charging chain

We reported (22/3) that a new chain which we had stored on a spool was found to have a twist over about half its length. The chain was hung in the tower with the straight half at the bottom in the belief that the weight of the straight half (about 25 lbs) might slowly correct the twist. After four weeks there was no detectable change. The top half of the chain was then anchored and a twist of about half a turn introduced at the bottom in the opposite direction.

A week later the original twist in the top half of the chain had gone, but a new twist was caused in the lower (formerly straight) half. We then anchored the chain at the centre and put in a correcting twist between the bottom and the centre.

After several manipulations we began to find out how much anti-twist to put in, and how long to leave it operating, but there must be enough weight on the defective length if the anti-twist is to work. We have found that correction brought about by anti-twist is likely to revert when the chain is allowed to hang free if much weight is hanging on the corrected length.

A letter received from N.E.C. expressed puzzlement at the twist while they concurred with our diagnosis (22/3) that it was possibly due to the chain remaining spooled for such a long time.

The production of chain links and pellets is carefully controlled by N.E.C. to ensure that a chain twist does not occur because of poor tolerances in the manufacturing process. The twist in our chain was continuous, and not the effect of occasional irregular links.

N.E.C. recommended that a chain should not be used if it has a significant twist, (about 30 degrees) over its full length.

Cleaning

The column was cleaned in the usual way, excepting that special attention was paid to removing all oil from the castings in order that we could observe the overall effectiveness of the new oiling procedure. Likewise the bottom of the tank was thoroughly cleaned of oil. While this was taking place a small grubscrew was found and a great deal of conjecture

arose as to where it might have come from. Most people in the department examined the grubscrew intently and hazarded a variety of interesting but unconvincing suggestions; however, all functions worked normally under test.

After blowing with nitrogen, and tacragging, the usual tests of metering and charging performance were carried out and the 14UD was closed up at 4 p.m. on Friday - a day when so many things can go wrong late in the afternoon and delay the apres-buttonup discussion which we discipline ourselves not to let slip.

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The machine was gassed up next morning and a magnesium run begun. On Sunday the terminal foil counter ceased to work and the pneumatic actuator for the tank cup was found to be leaking SF6 into the tank at the rate of about a bottle a day. The tank cup is used as a failsafe radiation protection, and it also operates to take beam out of the machine when the terminal voltage controller senses volts out of the preselected range. The cup goes in for both pneumatic pressure and solenoid voltage in the "off" condition and this meant that we were unable to survive by closing the SF6 actuator bottle.

In the interests of the experimenters we suffered the inconvenience of changing SF6 bottles until midday on Tuesday when we prepared for the inevitable pump-out. In order to reduce final pumping time, the gas was taken down to 40 psia because the experimenters were content to run at low voltage, and did so until 6 p.m. when pumping resumed.

THE RE-ENTRY

Because of the characteristic co-operation of the gas handling team, who worked through the night, the doors were opened before 8 a.m. on Wednesday. Unless the actuator and foil counter problems were unpredictably difficult we expected to close the doors before lunch.

The new oilers had not been used because there had been no break in running and the hand oiled chains were performing well. Therefore, when we took a ritual look along the column it was with considerable resentment that we found a great deal of oil over the H.E. castings, predominantly where the stabilizing idlers were. There was oil on ceilings and floors of the castings and it lay in pools on the floor of the tank. One of the authors realized, with that acuteness of perception which comes only to the guilty, what had happened.

During the previous weekend, in an effort to free the foil changer by releasing the backpressure of SF6 in the actuator lines, the oilers had been valved off and there was no path by which the volume above the oil could remain in equilibrium with tank pressure; therefore when the tank was pumped down to 40 psia the excess pressure above the oil put the oilers in continual operation until equilibrium; moreover with the chains running and volts on. Then, when the rest of the gas was pumped out, what was left of the oil came out of the reservoirs onto the tank floor.

All the H.E. units were opened and the oil was first mopped up with large kimwipes after which the castings were washed with alcohol. A casting with idlers in was opened but there was surprisingly little oil inside it. Posts near chains had to be cleaned thoroughly and then the bottom of the tank.

The Tank Cup Actuator

The major leak on the actuator had mysteriously disappeared by the time the tank pressure was reduced to 40 psia. The tank opening was persevered with because of the foil changer problem. When the actuator was tested, a small leak was easily located at the piston O-ring. The previous massive failure was probably caused by the tank cup being actuated while the tank was at atmospheric pressure. The regulator on the SF6 bottle was set at 60 psi above normal tank pressure of 80 psia and the high pressure differential caused the O-ring to twist in its groove.

Foil counter

The foil changing mechanism was working correctly and the failure of the counter was soon explained. The foil changing mechanism drives the counter by a small chain on a sprocket wheel which is fixed axially on its shaft by a small grubscrew.....!!! The absence of the grubscrew, together with a too loose chain, had allowed the chain to slip completely from the counter sprocket drive after the tank was closed. Unfortunately these problems have vastly confused our knowledge of which foil numbers now correspond to the C.N.R.L. foils.

Chains

After checking that the amount of oil on the chains was not excessive the charging pulleys, inductors and insulators were cleaned. Chain 3 "bottomed" when run and three pellets were removed. The charging tests for all chains gave copybook results.

Buttonup

The doors were closed at 4.15 p.m., much later than expected because of the time it took to clean up the oil. Even for a re-entry we still held the apres-buttonup discussion.

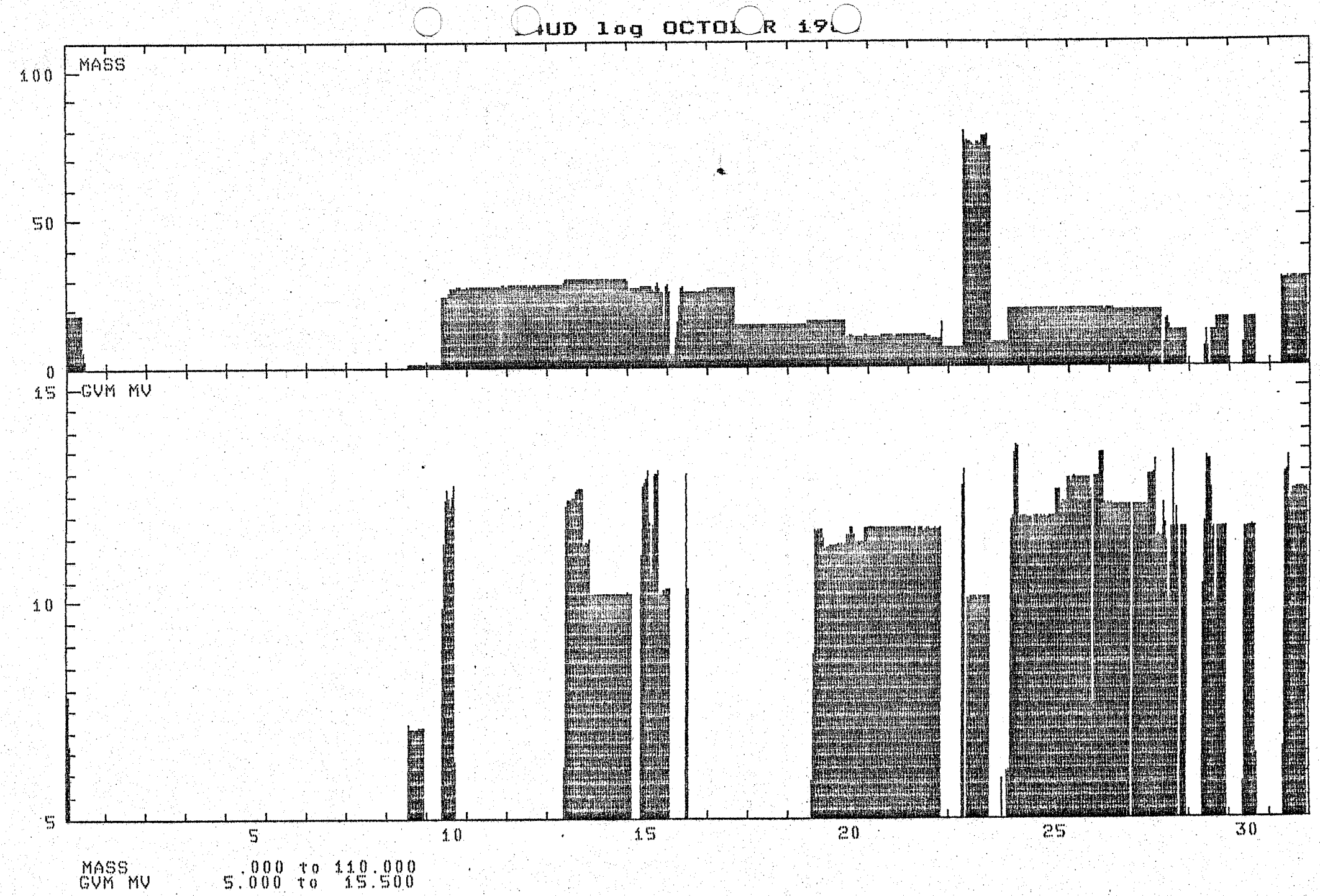
D.C. WEISSER

T.A. BRINKLEY

December 17th, 1980.

We would like to wish everyone on our circulation list a Happy Christmas and a successful New Year with their accelerators.

ERRATUM: The misprints which escape our proof reading are nicely mysterious. In Report No. 22 page 2 the paragraph on STRINGERS stated that 0.040" wires would corona in air, but 0.025" rods did not. This should have read 0.250" rods.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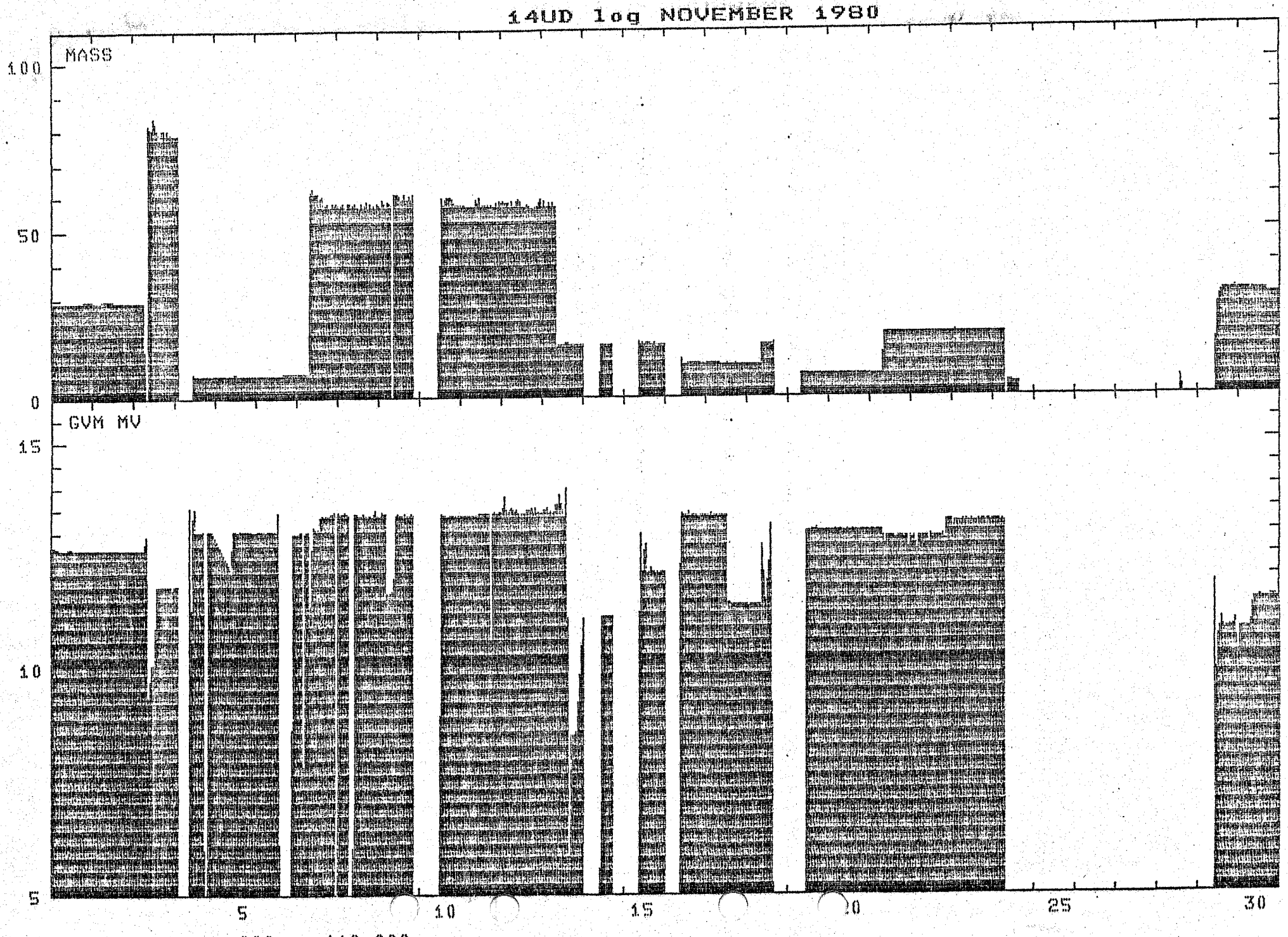
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