AMANDA- Technical Note
August 3, 1997

Brief Report on Stability of 1996 SN Data

Ryan Bay and Ralf Wischnewski

Abstract

We investigated some of the counting rate irregularities observed in the 1996 SN data. A clear correlation with the stoppage of the main muon DAQ is found. This points to the TOT-discriminators being modified at run stoppage, or is an indication of an unexpected behavior of the TDCs and discriminators. We also found an instance of an SN counting rate burst correlated with permanent changes in AMANDA-B and AMANDA-A trigger rates.

The AMANDA-SN/GRB trigger system consists of custom-made CAMAC modules which count the pulses from the main AMANDA DAQ discriminators (TOT discriminators). The SN system sums the pulses over a 0.5 sec time interval, recording a running count. The system is independent of the muon DAQ, and is read out through Jorway-73A CAMAC controller to a PowerMacintosh. For further details concerning the SNMP-GRB system, see [1] as well as collaboration meeting reports since March 1995.

The 1996 AMANDA-B SN data set contains many features which are difficult to classify. This report concentrates on a step feature in which the rate of the entire array abruptly increases by about 40 percent, continues at this higher rate for a few minutes to many hours, then returns to its "normal" rate. During this time the various error checks in the system report no problems. A large portion of the step in the total array rate comes from a few channels, but all channels participate. These steps are inverted in the first 16 CAMAC channels with respect to the rest of the array (i.e., the rates in these channels decrease during the step phase). These steps are not observed in the AMANDA-A rates. **Figure 1** gives an example (day 212, SN file snmp-040_9.hrs). The top plot shows the average of the counting rate for all channels in the array in 0.5 sec intervals (excluding dead channels). The time scale of this SN plot (as well as all other SN plots below) is arbitrarily set to zero at the beginning of an SN analysis run.

The middle plot in fig.1 shows data in ten second intervals from one of the first 16 channels, channel 4, containing a step which is an inversion of that in the array as a whole. The bottom plot, channel 44, is a typical channel. It should be noted that other step-like features exist in the data, but can be distinguished from this phenomenon.

To show the overall stability of the SN data, we display in **fig.2-3** the individual channel counting rates for the same SN run snmp-040_9.hrs for channels 1-10, 11-20 and 71-80 over the full time scale. The drop in rate at $t_{SN} \approx 50000$ secs (see fig1) is clearly seen for chan 1-16, as is the rise for all others. Note that channels 17 and 18 go into overflow (SN counter dynamic range is 8192 Hz). Both channels are next to the laser and are suspicious in many other runs for sudden counting rate increases not observed in other channels.

In order to determine if the steps are a result of a pathology of the SN CAMAC system or something else, we undertook a (somewhat) systematic study to time correlate the steps in the

1996 SN data to the 1996 AMANDA-B muon data. It quickly became obvious that these steps in the SN data correspond to times in which the AMANDA DAQ is switched off. It is not always perfectly clear from the winter-over reports when they stopped the DAQ altogether, and when they simply stopped writing to file, but it seems as though the steps only occur during a full DAQ stop. The steps are always bracketed in time by the cessation of AMANDA-B muon data being written to file, with the step presumably occurring during a full (hardware) DAQ stop.

Figures 4 through **10** show examples of this phenomenon. Another interesting feature is pointed out in **Figure 5** and **6** . In each of the figures the top plot shows the SN data with a time scale in seconds with arbitrary offset, while the middle and bottom plots are AMANDA-B muon data with a time scale of seconds since midnight. The time axes of the two data sets are lined up to within the limit of precision of the SN data (dependent upon known Webb clock performance uncertainties). The middle plot shows event rate for AMANDA-B triggers only (with arbitrary time binning). The bottom plot shows the N_{HIT} distribution for all triggers. Some on-line periods of muon data are missing in the plots because the GPS reads for this period were bad and/or the data is corrupted, and this will be noted in the figure captions which follow.

Figure 4: This plot shows SN file snmp-038_1.hrs (top) along side AMANDA-B muon files ab258_190-96-1 through 3 (run 258, day 190). The step occurs exactly when run 258 is stopped. The winter-over weekly report records a crash on this day.

Figure 5: SN file snmp-039_4.hrs along side AM-B muon files ab260_196-96-27 through 29 and ab261_196-96-0 through 2 (runs 260 and 261, day 196). The step occurs between run 260 and run 261. A fifteen minute crash is recorded in the winter-over report. Notice also the spike around $t_{SN} \approx 91000$ on the SN plot. This spike in the SN data is accompanied by a slight increase in the muon rate, as well as a deficiency in low multiplicities in the Nhit plot. Note that the increase in the muon data rate as well as the low-multiplicity deficit remain after the spike seen in the SN-data.

These missing low multiplicities starting from $t_\mu \approx 83000$ sec are shown in **fig.6**. The N_{HIT} distribution for all AMANDA-B triggers is plotted for 2000 secs before and after the spike (solid and dotted lines, respectively). The deficiency seems to be due to much reduced AMANDA-A or SPASE/GASP trigger rates.

Figure 7: SN file snmp-039_6.hrs along side AM-B muon files ab262_198-96-24 through 26 and ab263_198-96-0 through 3 (runs 262 and 263, day 198). The step occurs between run 262 and 263. A 2:20 long crash is recorded in the weekly report. Note the 2 spikes present in the SN data are also reflected in the muon counting rate.

Figure 8: SN file snmp-039_9.hrs along side AM-B muon files ab264_201-96-26 through 28 and ab265_201-96-0 and 1 (runs 264 and 265, day 201). The spike in the SN data is actually a step (lasting for $\approx$ 5 secs). Run 264 was stopped intentionally according to the report, and presumably the step occurred during a brief full DAQ stop. Some muon data is missing because it was corrupted.

Figure 9: SN file snmp-040_3.hrs along side AM-B muon files ab267_206-96-70 through 72 and ab268_206-96-0 and 1 (runs 267 and 268, day 206). The step occurs between run 267 and 268. The muon data between $t_\mu \approx 81000$ and 84000 is corrupted. A 30 minute crash is recorded in the weekly report.

Figure 10: SN file snmp-040_9.hrs (see fig.1) along side AM-B muon files ab269_212-96-54 through 57 and ab270_213-96-0 through 2 (runs 269 and 270, days 212 and 213). The step again occurs between runs. The muon data between $t_\mu \approx 82500$ and 85500 is missing because of corruption. A crash is mentioned in the weekly report.

To summarize, we have established that the step features in the SN rate considered here are correlated to changes in the DAQ status (probably: full DAQ stop).

These investigations have been made assuming that the discriminators are free-running, i.e., they are not controlled in any way by the muon DAQ (neither the threshold nor the operation mode). If this assumption proves to be wrong it would be the most natural explanation of the observed correlation. This point is currently under investigation. If the TOT-discriminators are in fact free-running, a possible explanation for this effect is that the inputs to the TDCs change state during a DAQ stoppage, and are in turn able to affect the discriminators. Even more unlikely is that the ADC inputs change upon stop and are somehow able to affect the discriminators through the SWAMPs. Suggestions are welcome.

We also found an instance of a short-term SN counting rate burst correlated with a permanent AMANDA-B trigger rate increase and decrease in triggers from AMANDA-A (or SPACE/GASP ?).

We wish to add that winter-over reports containing more detail about the actions taken during muon data runs would be helpful.

[1] S.Hundertmark et.al., Upgrade of AMANDA-B towards AMANDA-II, Proposal to DESY-PRC, PRC-97/05, 1997

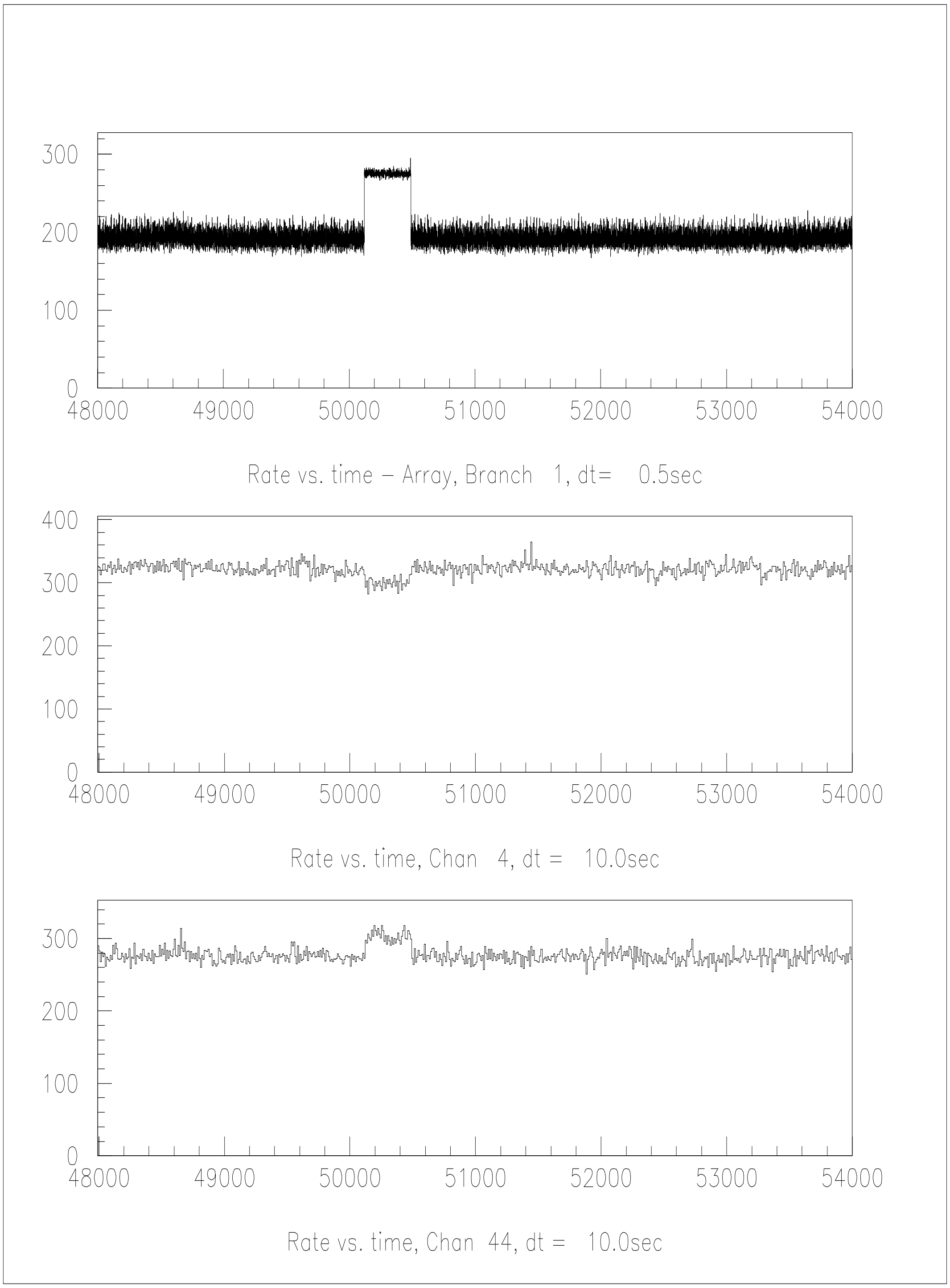

Figure 1: SN-counting rate (in Hz) as a function of time for SN analysis run snmp-040_9.hrs (zoomed for $t_{SN} = 48000 - 54000$ secs). **Top:** average rate for all channels, **Middle:** channel 4, **Bottom:** channel 44. Individual rates are averaged over 10 sec intervals, the array rate is for 0.5 sec intervals.

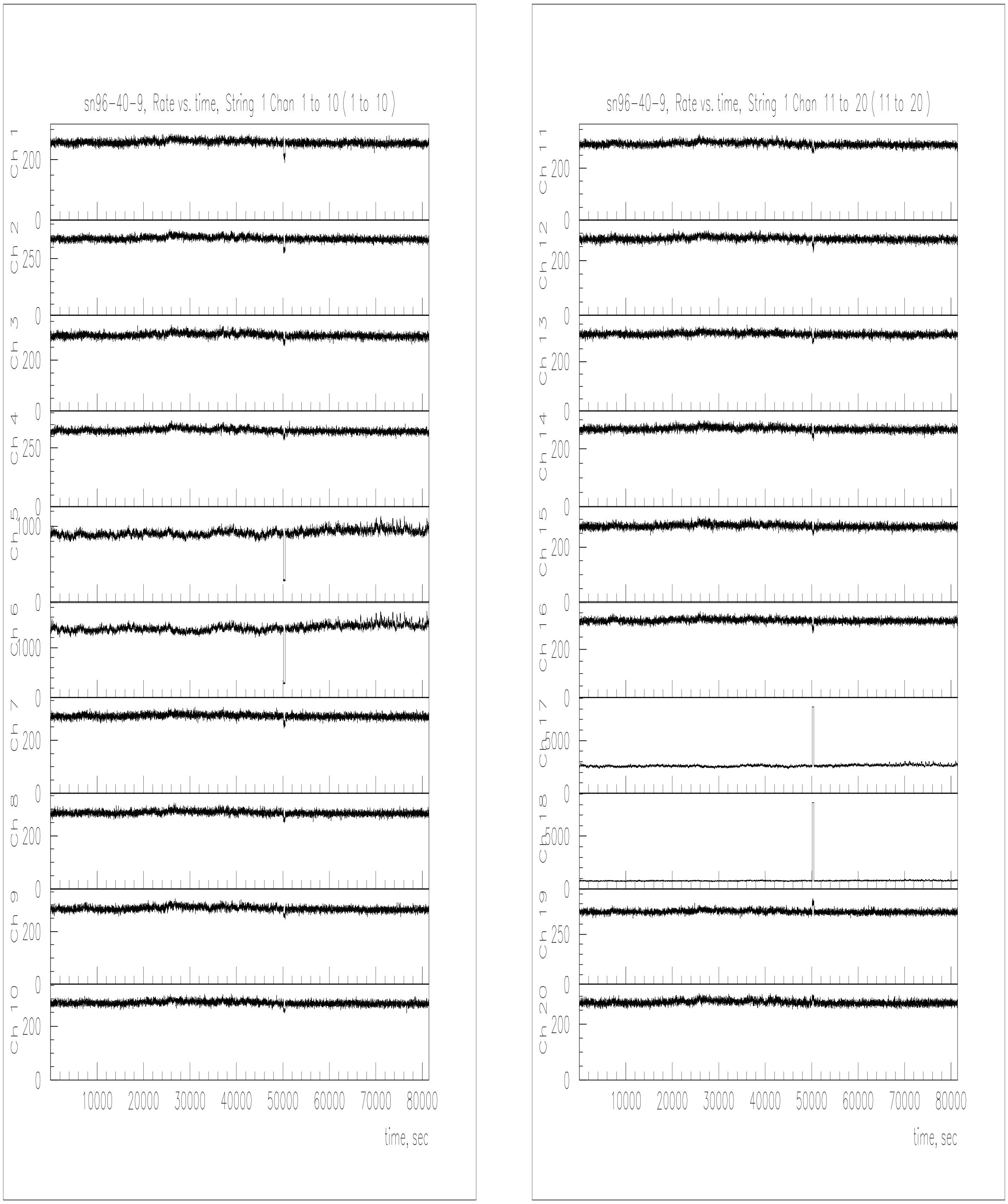

Figure 2: SN-counting rate for individual channels (in Hz) as function of time for the full SN analysis run snmp-040_9.hrs for channels 1-10 (left) and channels 11-20 (right). Rates are averaged over 10 sec intervals.

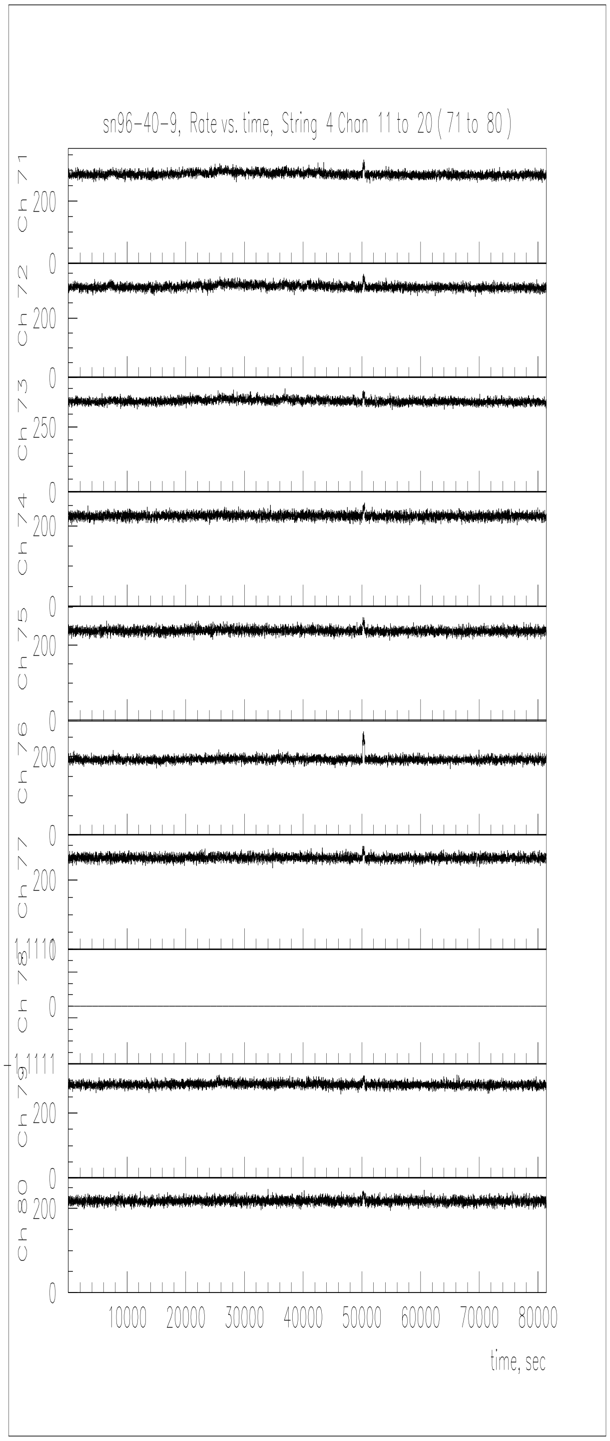

Figure 3: Same as for fig.2 for channels 71-80.

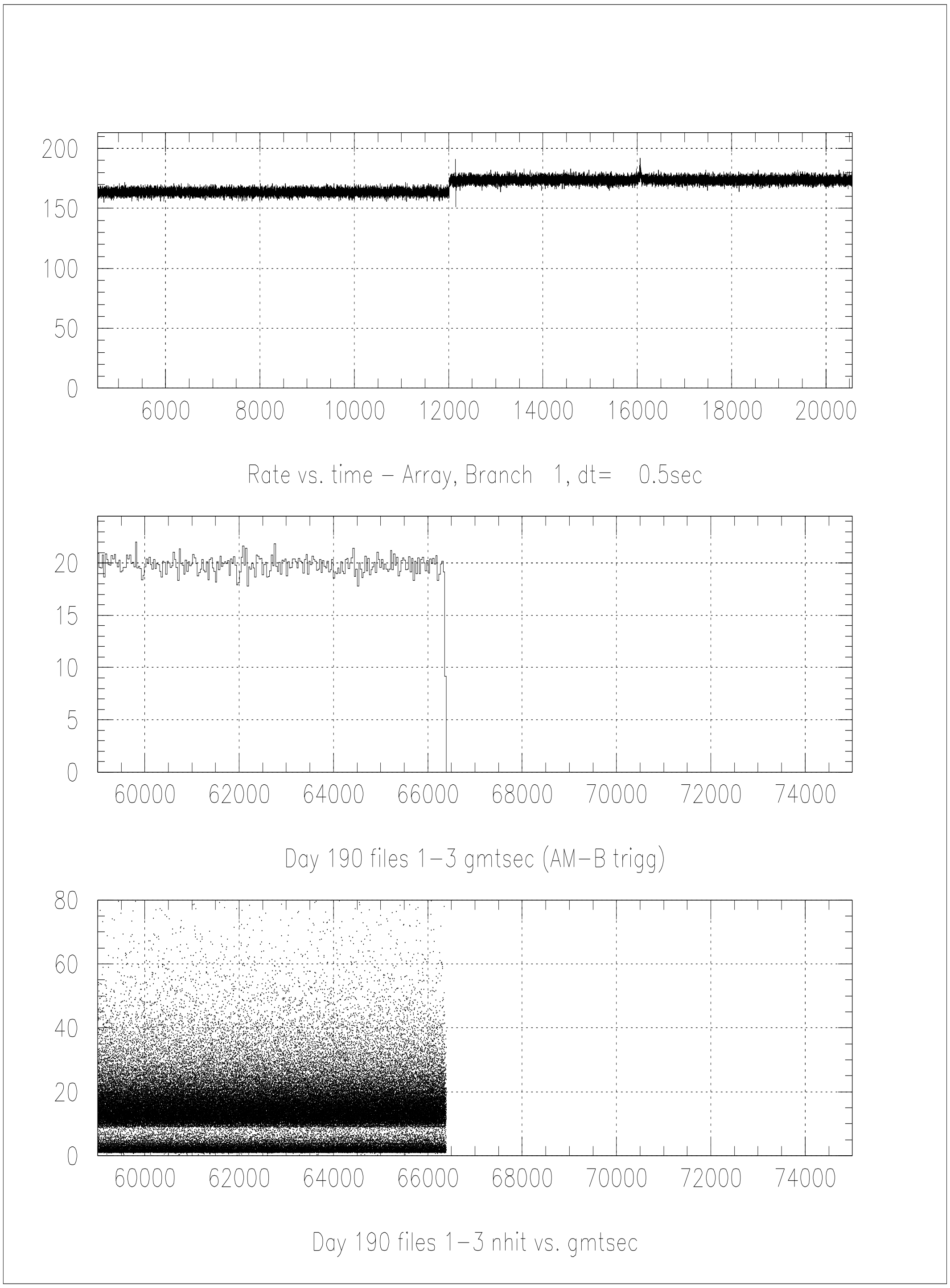

Figure 4: **Top:** SN counting rate (in Hz) as function of time (in secs), for SN file snmp-038_1.hrs. **Middle:** Muon trigger rate (AMANDA-B trigger only, in Hz) as function of time (in secs, see text) for run ab258_190-96 (files 1-3, day 190). **Bottom:** N_{HIT} versus time (in secs) for all AMANDA-B events for the same run period.

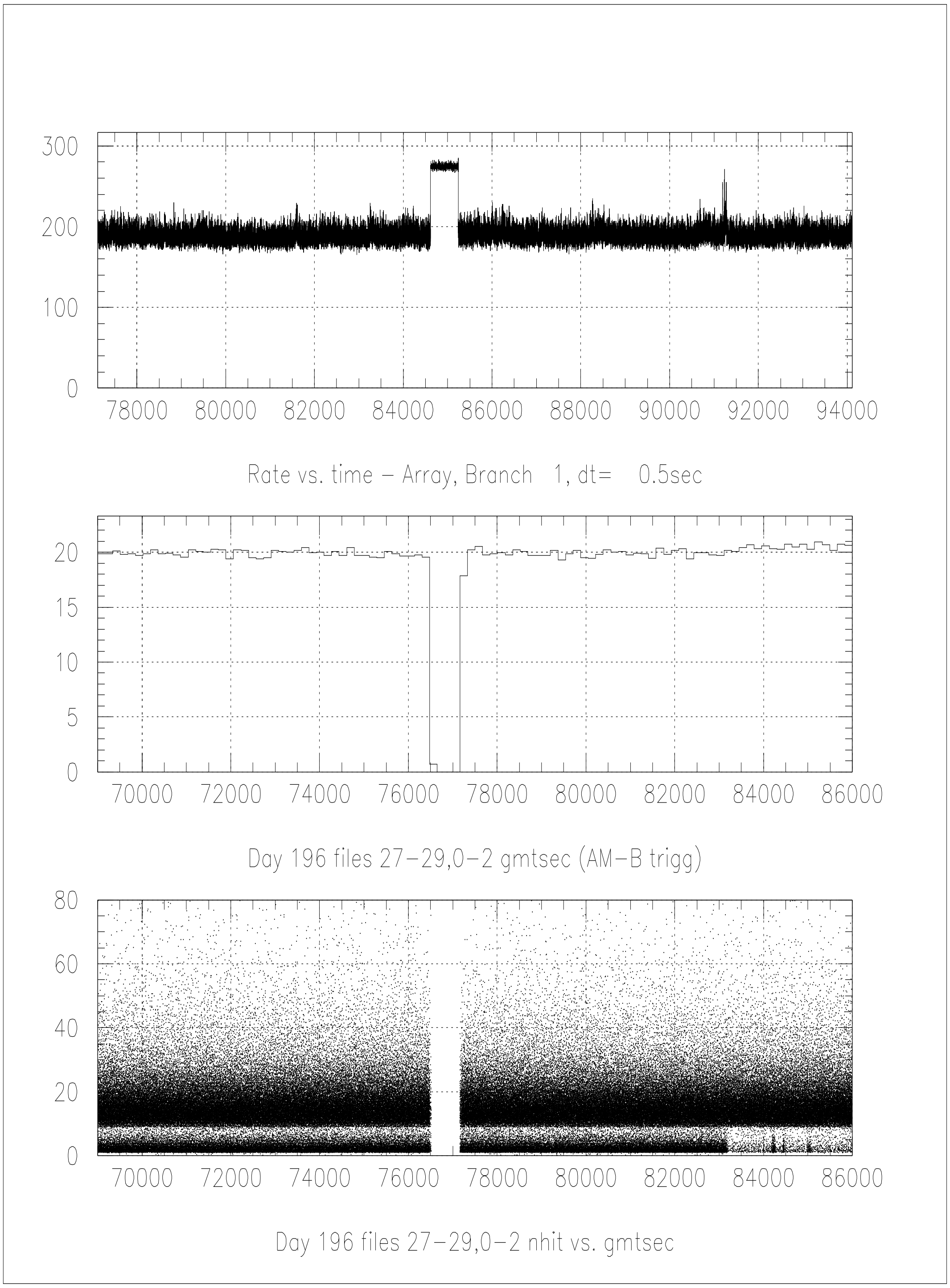

Figure 5: **Top:** SN counting rate (in Hz) as function of time (in secs), averaged over all operating channels for SN file snmp-039_4.hrs. **Middle:** Muon trigger rate (AMANDA-B trigger only, in Hz) as function of time (in secs, see text) for run ab260_196-96 (files 27-29, day 196) and run ab261_196-96 (files 0-2). **Bottom:** N_{HIT} versus time (in secs) for all AMANDA-B events for the same run period.

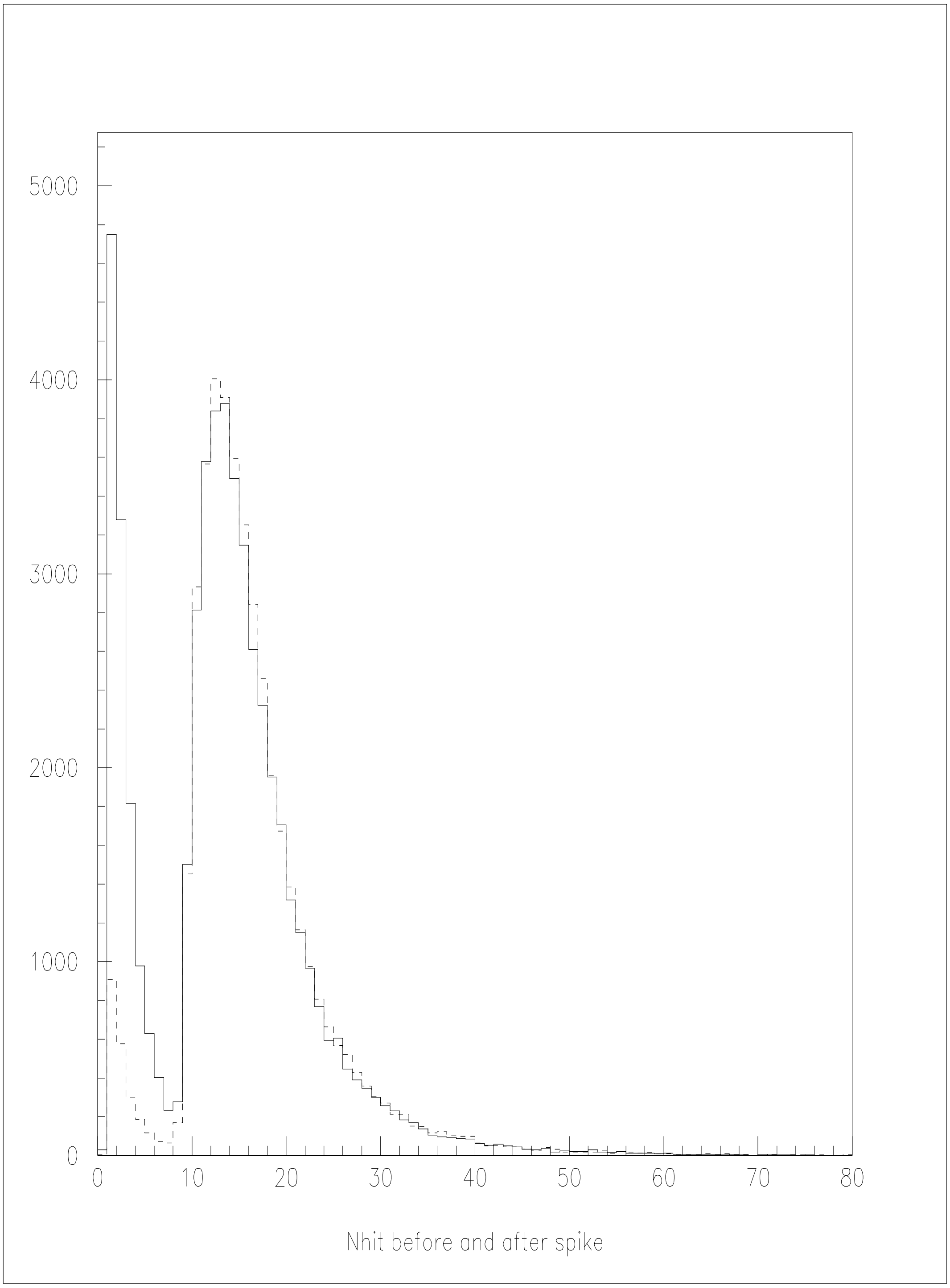

Figure 6: N_{HIT} distribution before (solid) and after (dashed) the spike seen in fig.5, taken for time intervals of same length.

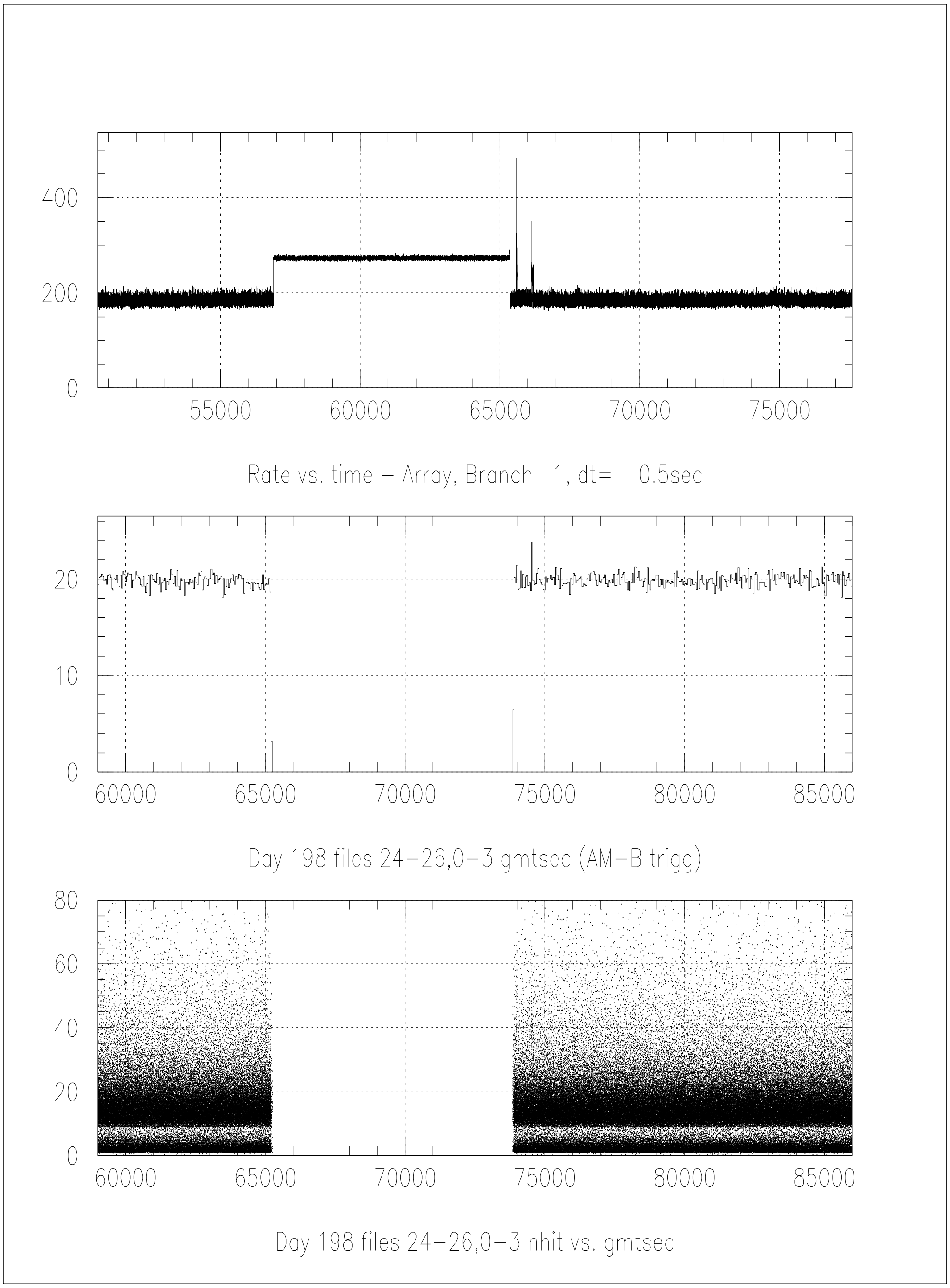

Figure 7: **Top:** SN counting rate (in Hz) as function of time (in secs), for SN file snmp-039_6.hrs. **Middle:** Muon trigger rate (AMANDA-B trigger only, in Hz) as function of time (in secs, see text) for run ab262_198-96 (files 24-26, day 198) and run ab263_198-96 (files 0-3). **Bottom:** N_{HIT} versus time (in secs) for all AMANDA-B events for the same run period.

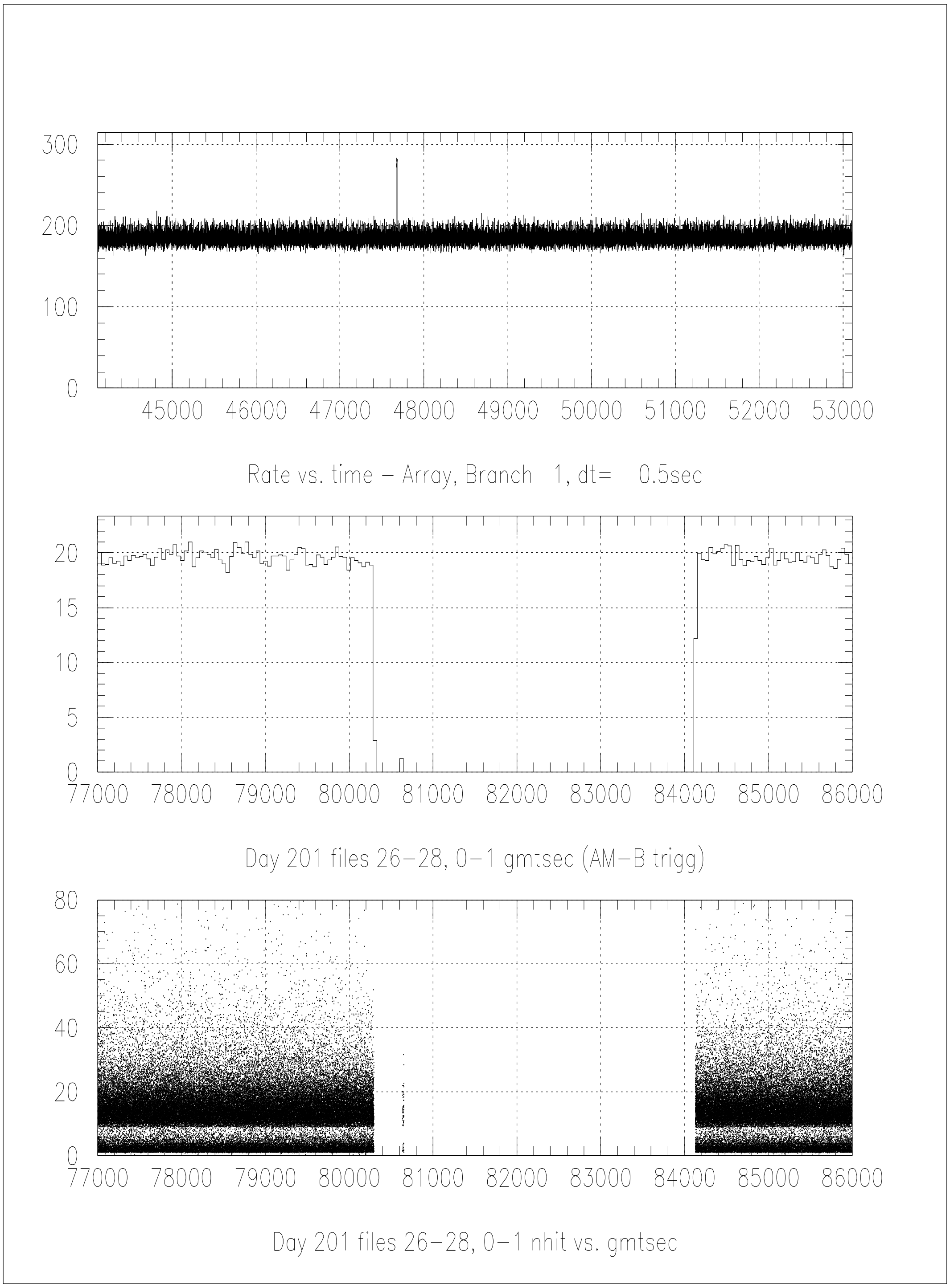

Figure 8: **Top:** SN counting rate (in Hz) as function of time (in secs), for SN file snmp-039_9.hrs. **Middle:** Muon trigger rate (AMANDA-B trigger only, in Hz) as function of time (in secs, see text) for run ab264_201-96 (files 26-28, day 201) and run ab265_201-96 (files 0-1). **Bottom:** N_{HIT} versus time (in secs) for all AMANDA-B events for the same run period.

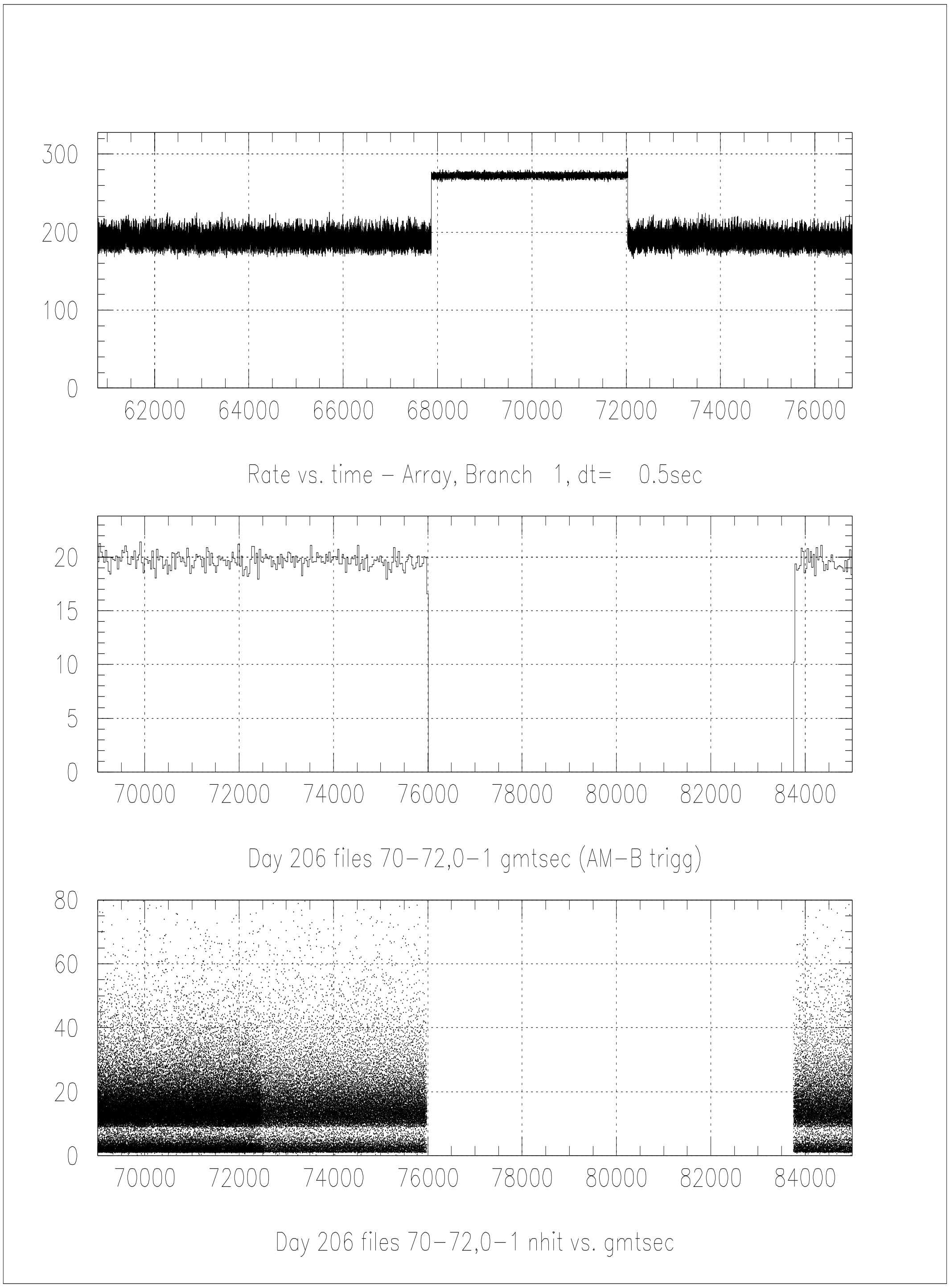

Figure 9: **Top:** SN counting rate (in Hz) as function of time (in secs), for SN file snmp-040_3.hrs. **Middle:** Muon trigger rate (AMANDA-B trigger only, in Hz) as function of time (in secs, see text) for run ab267_206-96 (files 70-72, day 206) and run ab268_206-96 (files 0-1). **Bottom:** N_{HIT} versus time (in secs) for all AMANDA-B events for the same run period.

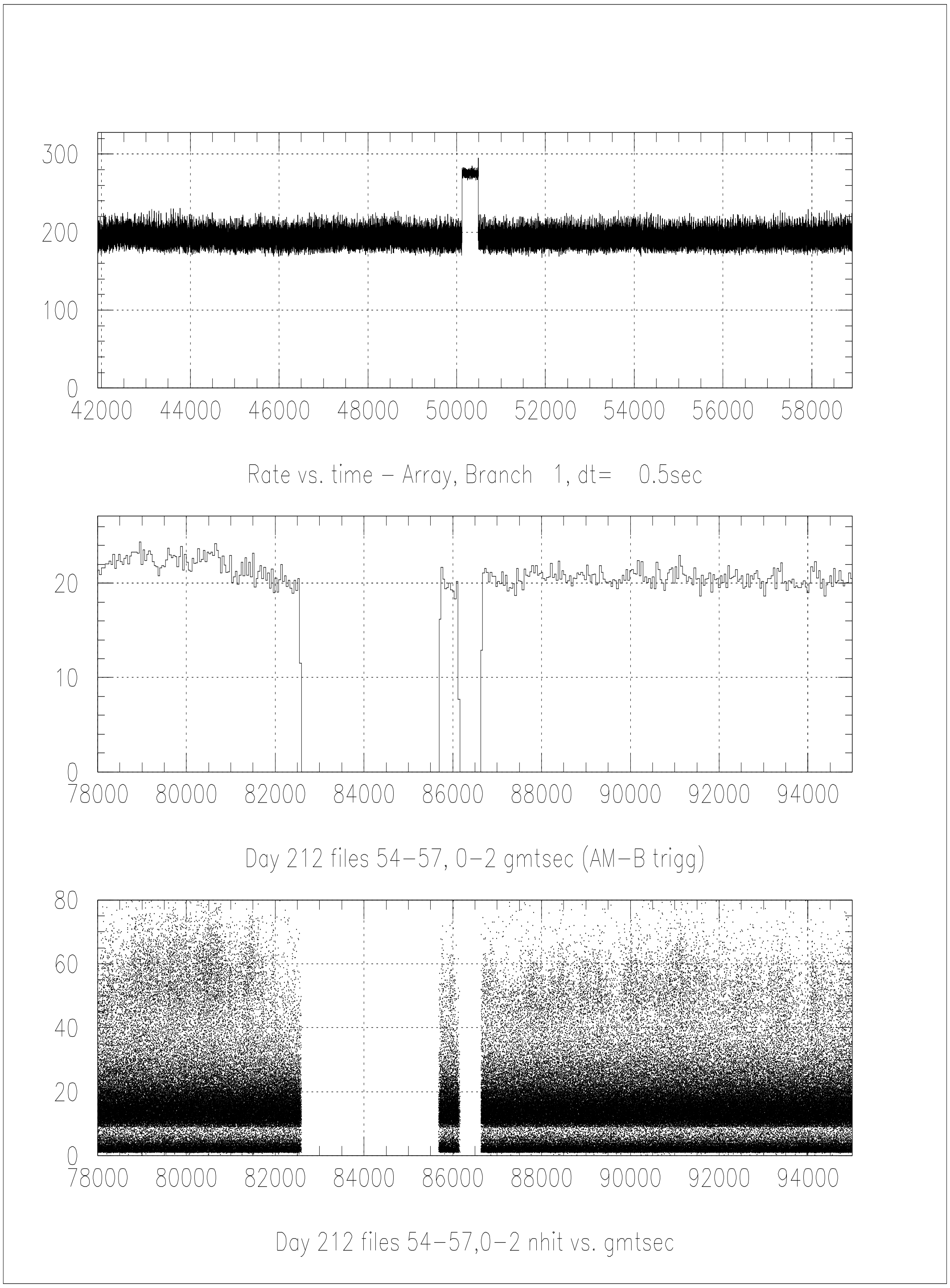

Figure 10: **Top:** SN counting rate (in Hz) as function of time (in secs), for SN file snmp-040_9.hrs. **Middle:** Muon trigger rate (AMANDA-B trigger only, in Hz) as function of time (in secs, see text) for run ab269_212-96 (files 54-57, day 212) and run ab270_213-96 (files 0-2). **Bottom:** N_{HIT} versus time (in secs) for all AMANDA-B events for the same run period.