# IceTop DOM User's Guide

Revision 1.1

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# 1. Introduction

This guide is a brief introduction to the operation of the IceTop DOMs installed in Tank 09 and Tank 10 in the 2003-04 pole season. At the time of this writing, the TestDAQ software was not available for deployment on Rev2.0 DOMs. This document, however, will cover basic hardware bringup and shutdown, as well as how to take waveforms using the DOMs. As more functional DAQ software can be deployed, this document can be updated.

# 2. Hardware Bringup

The IceTop hardware deployed in 2003-04 consists of four DOMs, connected via two DOR PCI cards in a DomHub PC ("icetop-dh"), an Agilent 6645A power supply connected through the DOR cards to power the DOMs, and a custom GPS clock distribution box connected from the SPASE TrueTime GPS system to the DOR cards (and to the SPASE DAQ hardware).

## 2.1 Power Supply

The power supply for IceTop is an Agilent DC power supply located on the leftmost rack in SPASE. The power supply will power on to the correct settings:

> 60V DC output
> 1.5A current limitation
> voltage output **on**

They are, however, listed here in case they need to be reset. The documentation for the power supply, including how to change the power-on settings, is located in a labeled, padded envelope on the bookshelf in SPASE.

## 2.2 DomHub

The DomHub PC is a black Dell tower PC labeled as "icetop-dh" on a rack in SPASE. It's currently running RedHat 8.0.

Power on the DomHub and login, via ssh, as the "icecube" user – if you're in SPASE, you can log in from the "icetop-daq" PC, which has a monitor (you can use "ssh –X" to ensure X-forwarding, if you like). Next, start the domservers that create network sockets to the DOMs:

```
% domserv_start
```

The DomHub is now ready.

### 2.3 GPS Clock Distribution Box

There's no on/off switch or configuration to the brown GPS clock distribution box – when power is applied, it's running.  However, the SPASE TrueTime GPS unit must be running as well!

### 2.4 DOMs

Please see Kael's *DOM User Guide* (in `/home/icecube/doc/` on icetop-dh) for more info on how to operate a DOM, but here are the basics for getting them up and running: simply execute the command:

```
% on all
```

If you are watching the power supply, you will see the current increase from zero as the DOMs power on.  You should also see the following output from the command (which takes about five seconds to complete):

```
Driver $Revision: 1.132 $
/proc/driver/domhub/card0 -- 009g
/proc/driver/domhub/card1 -- 009g
0 0 A: communicating
0 0 B: NOT communicating
0 1 A: communicating
0 1 B: NOT communicating
1 0 A: communicating
1 0 B: NOT communicating
1 1 A: communicating
1 1 B: NOT communicating
```

Note in particular that all the "A" DOMs are communicating.  There are no "B" DOMs, so don't pay any attention to those messages.  The "A" DOMs are described by two numbers; the DOR card they are on (0 or 1) followed by the wire pair they are on (0 or 1).  A diagram showing the physical position of the four DOMs is at the end of this document.

You are now ready to communicate with the DOMs, run acquisition or other scripts, etc.

You can also power on single DOMs if you wish, by using their card/pair numbers as arguments to "on" – the following command powers on only the DOM on card 0, pair 1:

```
% on 0 1
```

# 3. Hardware Shutdown

The hardware shutdown procedure is straightforward, and should be completed in the order given below.

### 3.1 DOMs

Log into "icetop-dh" as the "icecube" user via ssh, stop any acquisition scripts you may be running, and execute the following command to power off all the DOMs:

```
%off all
```

If you are physically watching the power supply, you should see the current indicator drop to zero.

### 3.2 Power Supply

Just turn off the main power swich to the power supply.

### 3.3 GPS Clock Distribution Box

There is no power switch on the clock distribution box, but you can remove the power connector on the front right side if necessary to power it off.  Note that this will affect the SPASE DAQ as well, since it will no longer be receiving GPS data – you may want to shut the SPASE system down before the IceTop system, in this case.

Unless you are preparing for a power outage, you should probably leave the GPS box on.

### 3.4 DomHub

There is currently no monitor hooked up to the DomHub, so to power it off, ssh in and become root, then execute the shutdown command:

```
% su
# /sbin/shutdown —h now
```

The DomHub will now power off.  You will need to be physically present when you want to power it back on (with the power switch on the front).

The IceTop hardware is now all powered off.

## 4. Data Acquisition Scripts

Currently all data acquisition for IceTop DOMs uses Kael's Python library in combination with scripts that I have written.  The scripts are located in

`/home/icecube/DOM/src/icetop/`. So far, scripts exist to take waveforms, measure trigger rates for various discriminator levels, and a few other test functions.

**IMPORTANT!!!!** Versions of the scripts exist that do not use the high voltage – only these should be used until the tanks are dark-adapted. The different flavors of scripts are in these directories:

**High voltage:**      `/home/icecube/DOM/src/icetop/HV/`
**No high voltage:**   `/home/icecube/DOM/src/icetop/no_HV/`


## 4.1 acq.py

The main data acquisition script is "acq.py". It will take a number of waveforms from one DOM (multiple instances can be run concurrently), and store the data, along with UTC timestamps, as an ASCII file in `/home/icecube/data/`.

Usage is as follows:

```
usage :: acq.py [ options ] <card> <pair>
    -v <voltage>   Set high voltage (default 1500V)
    -n <events>    Number of events to capture per cycle
                   (default 100)
    -c <cycles>    Number of cycles
                   (groups of events per file, default 100)
    -s             Use SPE trigger (default)
    -p             Use CPU trigger
    -t <level>     Set SPE discriminator level
                   (default 510)
    -f <mask>      Format mask indicating which ATWD and
                   channels to capture
                       Examples (these can be ORed!):
                           0x001 = ATWDA Channel 0 only
                           0x007 = ATWDA Channel 0-2 (default)
                           Ox010 = ATWDB Channel 0 only
                           Ox070 = ATWDB Channel 0-2
                           0x100 = FADC
    -h             Print this message
```

The script will take data continuously, creating a new file every 10000 events by default, until stopped with CTRL-C.

## 4.2 rate.py

This simple script ramps the discriminator level on a DOM and measures the resulting trigger rate.  The rate given by the script is in kHz, while the discriminator level is in DAC units.  The conversion to mV is given in Kael's *DOM User's Guide*.

Usage is as follows:

```
usage :: rate.py [ options ] <card> <pair>
  -v <voltage>    Set high voltage (default 1500V)
  -l <level>      SPE discriminator low level (default 500)
  -h <level>      SPE discriminator high level (default 600)
  -s <step>       Discriminator step value (default 5)
```

# 6. Troubleshooting

If you are getting "connection refused" errors from the Python scripts or from telnet, make sure that you have executed `domserv_start`.  If the DOMs are still not responsive (perhaps you are getting timeout errors from the scripts), try power-cycling the DOMs with "`off all`" and "`on all`".  Or just power-cycle the one DOM that's acting up.

If the DOMs are not communicative after powering them on (the `on` command shows all DOMs not communicating), try reloading the Linux DOR device driver:

```
% su
# /etc/init.d/dhrc restart
```

If this still doesn't work, you may need to power-cycle the DomHub PC itself:

```
% su
# shutdown –r now
```

If things still aren't working, you may need to contact technical support (me).

# 6. DOM JTAG Programming Ports

The four IceTop DOMs have been equipped with a second penetrator which allows direct access to their JTAG programming port.   If the flash filesystem on any DOM is ever corrupted so severely that it will not boot, it must be erased and reprogrammed through this port, which is accessible through orange-capped PVC pipes located between Tank09 and Tank10.  Each pipe contains two DB25 connectors (labeled on the shell as to which DOM they belong).

The required hardware is a Windows laptop with a parallel printer port, and a DB25 extension cable (the latter is located in the lower left drawer of the SPASE-DAQ desk in SPASE).

The necessary Quartus drivers and software are located in `/home/icecube/quartus/` on icetop-dh, along with instructions (in .pdf files) on how to install the drivers. The binaries `exc_flash_programmer` and `jtagconfig` also must be unzipped from quartussoft.zip and installed on the laptop.
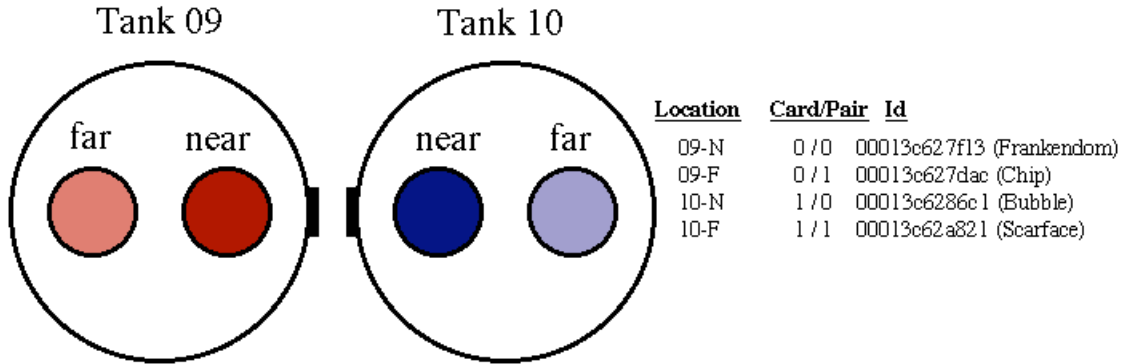
At this point, I would recommend contacting me for further instructions, but in a pinch, you can consult my web page:

http://amanda.wisc.edu/jkelley/talks/upload.html

which describes how to upload a release.hex.0 and release.hex.1 software into the flash filesystem using the Quartus software.

# Appendix A: DOM Orientation

This diagram shows the locations of the DOMs in Tank 09 and Tank 10, their card and pair numbers, and the DOM Id numbers for each.



| Location | Card/Pair | Id |
|---|---|---|
| 09-N | 0 / 0 | 00013c627f13 (Frankendom) |
| 09-F | 0 / 1 | 00013c627dac (Chip) |
| 10-N | 1 / 0 | 00013c6286c1 (Bubble) |
| 10-F | 1 / 1 | 00013c62a821 (Scarface) |

Near/far defined in relation to terminal box

to SPASE

# Appendix B: Local Coincidence Connections

Unfortunately, local coincidence is not supported in the Rev2.0 firmware that is loaded on the DOMs. However, the hardware connections are present just in case this is developed in the future. The following diagram shows the topology of the current LC connections between the four DOMs.



Near/far defined in relation to terminal box