Observation with Ashra-1

Holger Motz

Waseda University

Workshop of the Soshikiteki Wakate Program

ICRR 2013/4/22

The Ashra-1 Mauna Loa Site

High Elevation Detector Unit
Sky Survey - Optical Flash

to MLO

Mauna Kea

to Hilo

Main Station   Sub Station

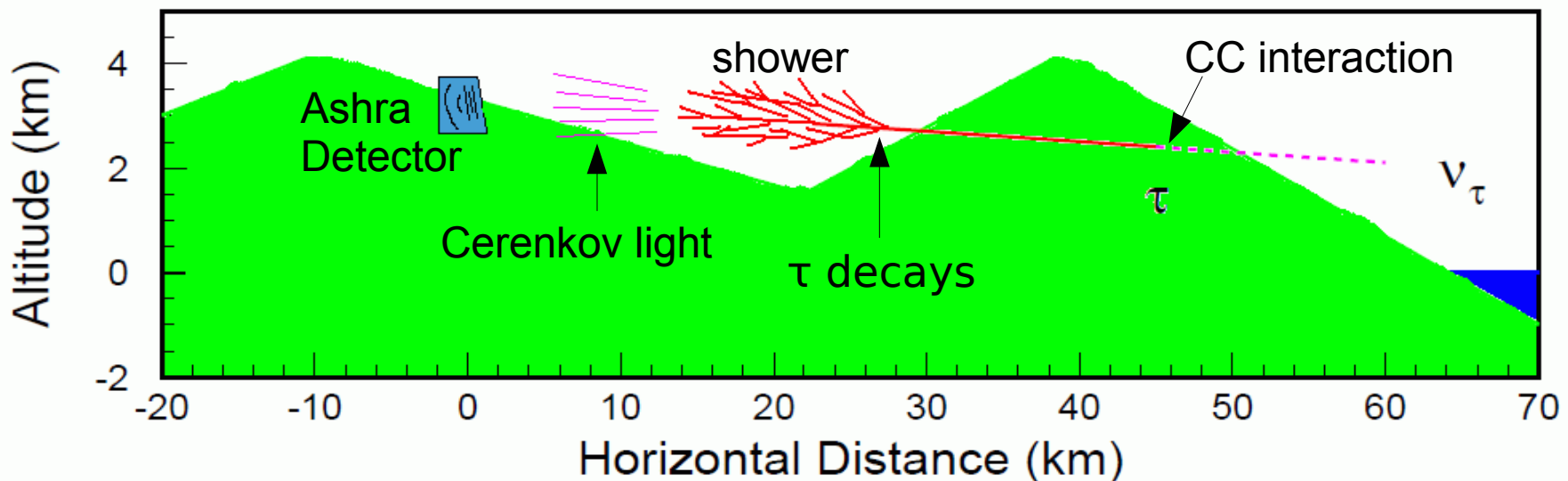Main Station (Mauna Kea side)

Cosmic Ray Study
VHE Neutrino Search

Low Elevation Detector Unit
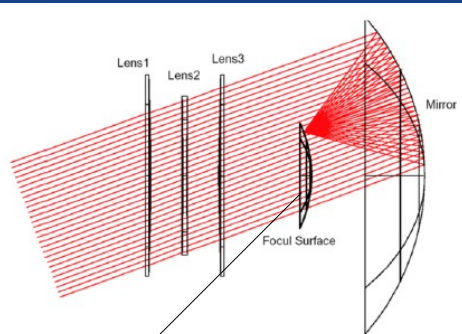with Cerenkov light trigger

Trigger Hut

Earth Skimming Tau-Neutrino Detection

- Background free (cosmic rays blocked by mountain)

- Mountain provides huge target mass

- Clear identification of tau-neutrinos

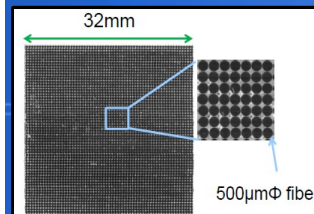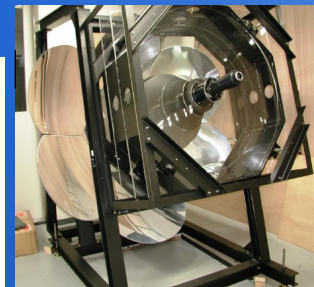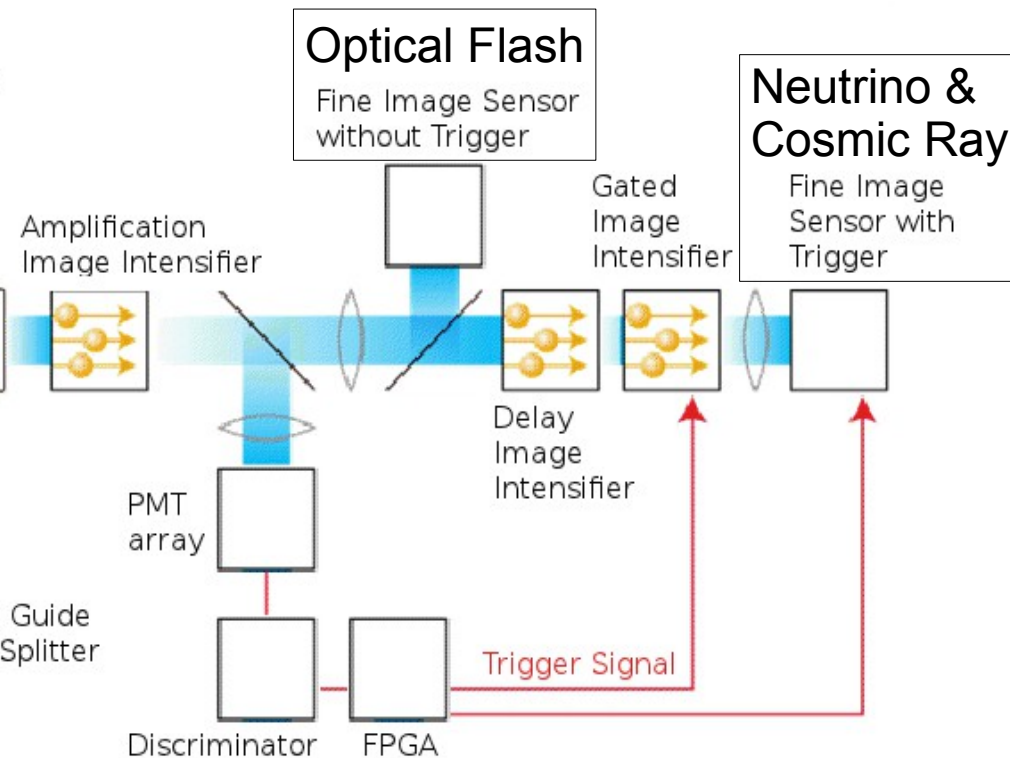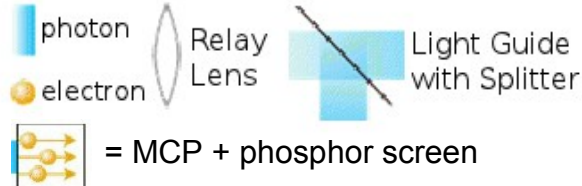- Up to highest energies where whole Earth opaque
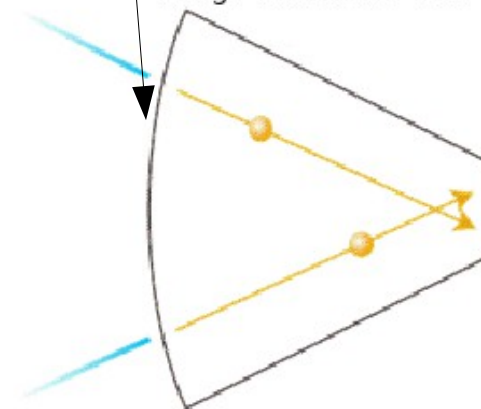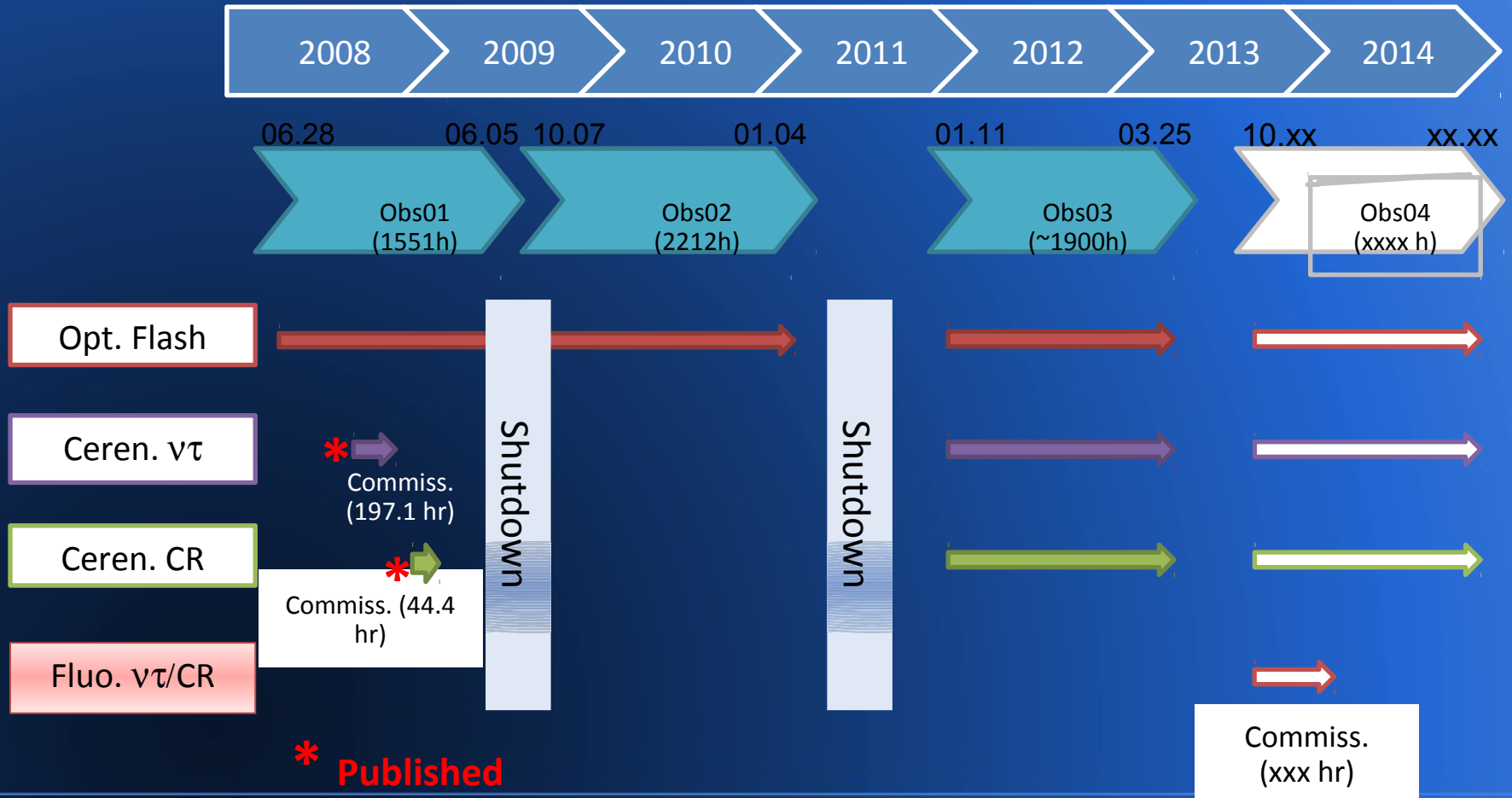
Detector Unit Layout and Image Pipeline

- Modified Baker-Nunn-Camera Optics
- 20" Photoelectric Lens Imaging Tube (largest image intensifier worldwide)
  => 42 deg FOV and 1.2 arc-minute resolution

Observation History and Future

GRB Neutrino Limit

- GRB behind Mauna Kea occurred 2008 during commissioning phase

- Unique τ-neutrino limit

ApJ, 736 (2011) L12

GRB081209A

Optical Flash Search

GRB081203A Optical Observations
GCN#8632
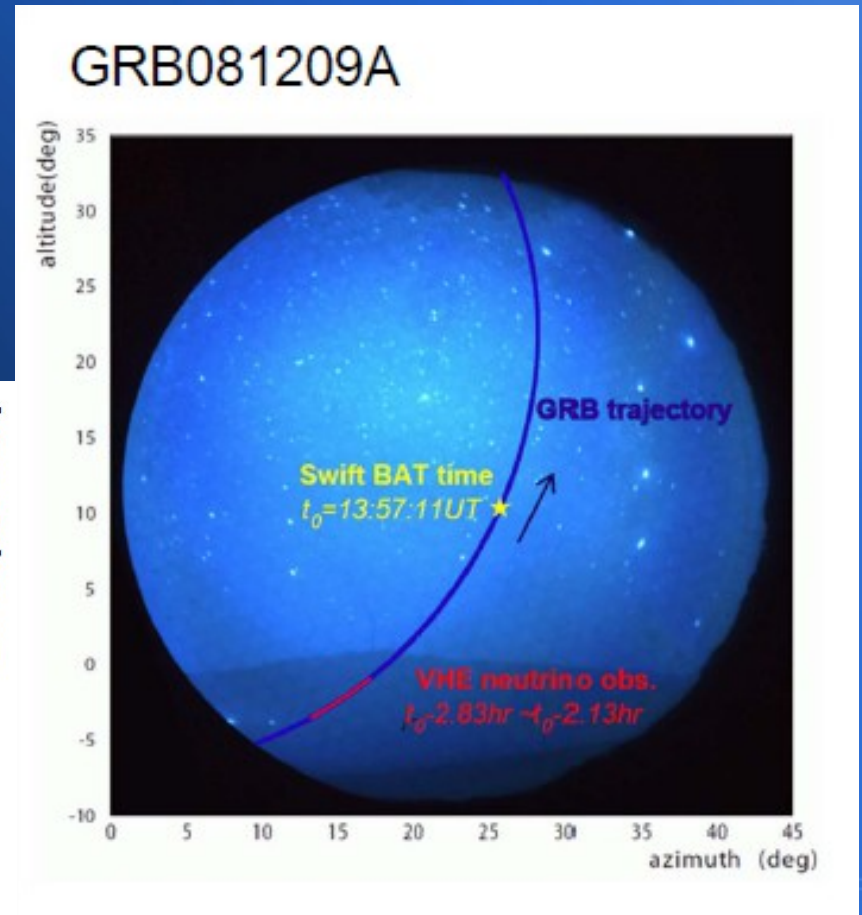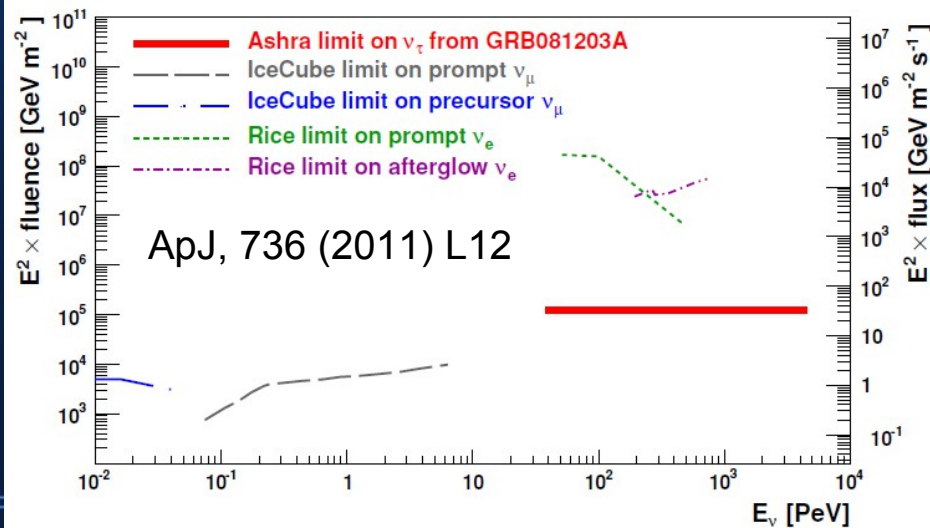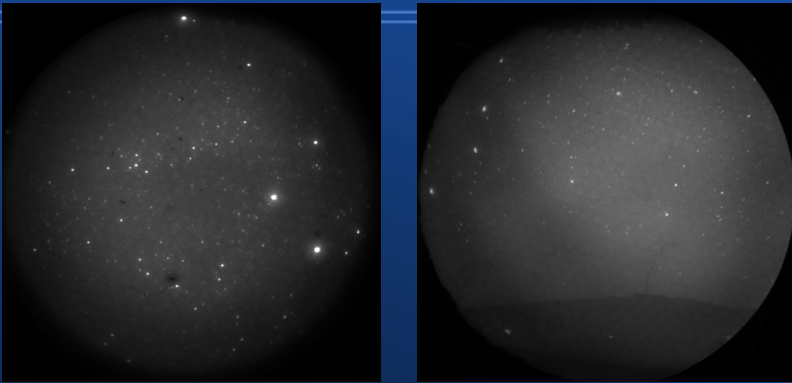
- Non triggered images from High & Low Elevation DUs every few seconds

- Looking for appearing light sources (minus cars, aircraft, but also studying meteoroids)

- Unique limits before trigger from 10 GRBs in FOV of Ashra-1
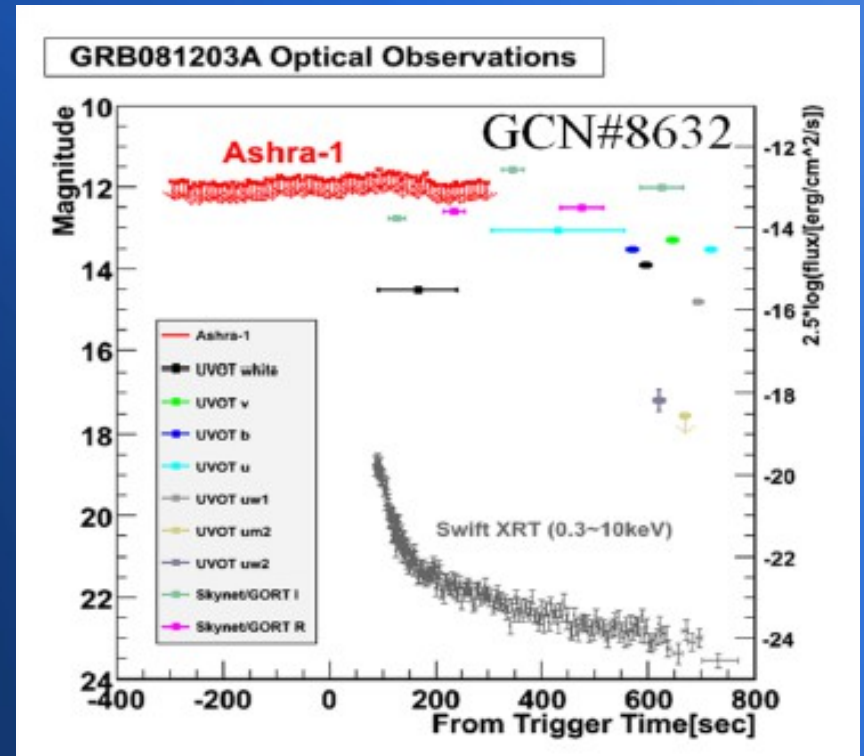
Cosmic Ray Studies

- Important to verify detector sensitivity

- Measure energy spectrum (hint on composition)

- Test MC by event comparison
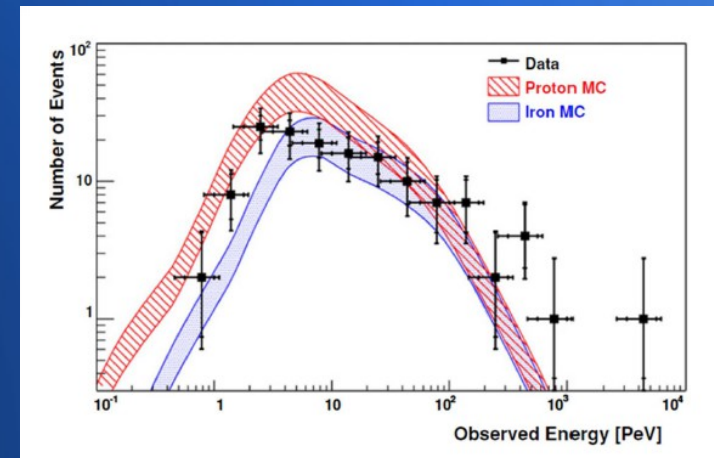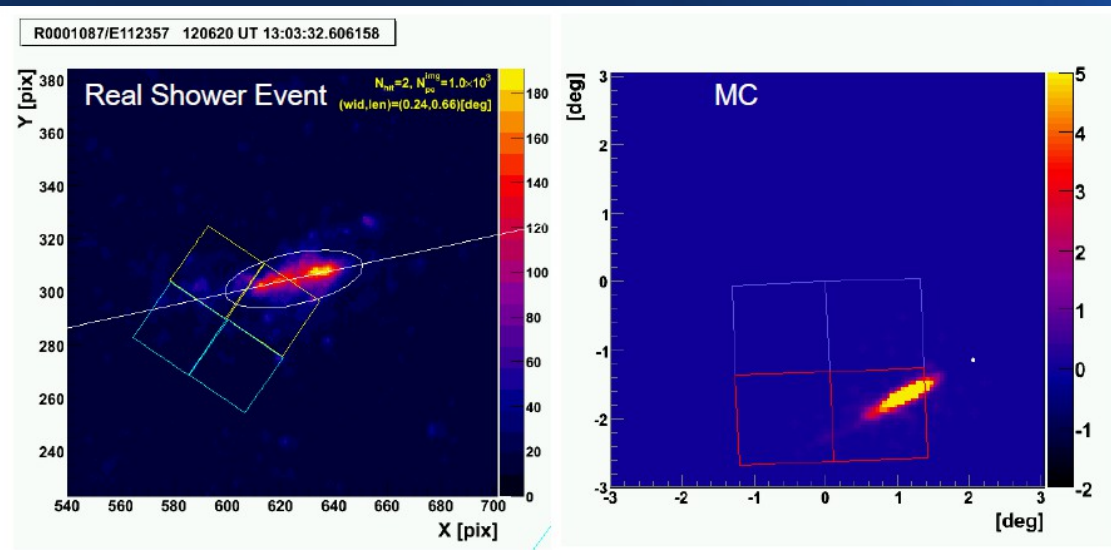
CR energy spectrum from commissioning observation

Observation Schedule

- Background from moonlight => schedule determined by moon phases (and dusk / dawn of course)

- Nightly shift of 1h to 10h length

- ~20% of time observation possible

- Daily Schedule and Duties:

  - prepare detector and start observation

  - manage trigger thresholds

  - take action in case of car, rain, army activity etc.

  - keep eye on data-taking, copy data at end of shift

Observation Statistics

	season	observable time (h)	good conditions (h)	observed (h)	good conditions (%)	observation efficiency (%)
low elevation	43(March)	145.83	139.13	139.1	95.41%	99.98%
(Cherenkov nu)	42(February)	151.12	136.77	136.72	90.50%	99.96%
					96.52%	100.00%
					97.71%	99.83%
					97.14%	99.90%
					99.39%	96.95%
					97.14%	97.74%
					98.46%	99.62%
					99.48%	97.64%
					99.90%	99.70%
	33 (May)	136.08	131.57	125.50	96.50%	95.90%
	32 (March)	133.22	124.08	123.76	93.10%	99.70%
	31 (February)	157.52	153.49	89.34	97.40%	58.20%
	30 (January)	159.34	158.65	155.10	99.60%	97.80%
	total/average	2006.49	1948.12	1862.95	97.09%	95.63%
high elevation	43(March)	145.83	139.75	139.75	95.83%	100.00%
(Optical Flash)	42(February)	151.12	137.22	137.22	90.80%	100.00%
	41(January)	151.37	146.49	135.37	96.78%	92.41%
	40(December)	152.95	150.15	150.15	98.17%	100.00%
	39 (November)	147.52	146.57	144.40	99.36%	98.52%
	38 (October)	143.68	142.47	140.56	99.16%	98.66%
	37 (September)	135.23	132.68	131.39	98.11%	99.03%
	36 (August)	133.07	130.57	130.57	98.12%	100.00%
	35 (July)	130.88	130.88	128.38	100.00%	98.09%
	34 (June)	128.68	128.68	128.68	100.00%	100.00%
	33 (May)	136.08	131.52	127.90	96.60%	97.20%
	32 (March)	133.22	125.24	125.24	94.00%	100.00%
	31 (February)	157.52	153.49	95.96	97.40%	62.50%
	30 (January)	159.34	158.89	158.83	99.70%	100.00%
	total/average	2006.49	1954.60	1874.40	97.41%	95.90%

2006.49 hours possible from light conditions
1862.95 hours of data taken with LE DU
1874.40 hours of data taken with HE DU
> 97% good condition fraction

no:
- moon
- daylight
- rain
- army activity
- passing cars
- power cut
- hardware failure
- operator error

Observation Statistics

	season	observable time (h)	good conditions (h)	observed (h)	good conditions (%)	observation efficiency (%)
low elevation	43(March)	145.83	139.13	139.1	95.41%	99.98%
(Cherenkov nu)	42(February)	151.12	136.77	136.72	90.50%	99.96%
					96.52%	100.00%
					97.71%	99.83%
					97.14%	99.90%
					99.39%	96.95%
					97.14%	97.74%
					98.46%	99.62%
					99.48%	97.64%
					99.90%	99.70%
					96.50%	95.90%
	32 (March)	133.22	124.08	123.76	93.10%	99.70%
	31 (February)	157.52	153.49	89.34	97.40%	58.20%
	30 (January)	159.34	158.65	155.10	99.60%	97.80%
	total/average	2006.49	1948.12	1862.95	97.09%	95.63%
high elevation	43(March)	145.83	139.75	139.75	95.83%	100.00%
(Optical Flash)	42(February)	151.12	137.22	137.22	90.80%	100.00%
	41(January)	151.37	146.49	135.37	96.78%	92.41%
	40(December)	152.95	150.15	150.15	98.17%	100.00%
	39 (November)	147.52	146.57	144.40	99.36%	98.52%
	38 (October)	143.68	142.47	140.56	99.16%	98.66%
	37 (September)	135.23	132.68	131.39	98.11%	99.03%
	36 (August)	133.07	130.57	130.57	98.12%	100.00%
	35 (July)	130.88	130.88	128.38	100.00%	98.09%
	34 (June)	128.68	128.68	128.68	100.00%	100.00%
	33 (May)	136.08	131.52	127.90	96.60%	97.20%
	32 (March)	133.22	125.24	125.24	94.00%	100.00%
	31 (February)	157.52	153.49	95.96	97.40%	62.50%
	30 (January)	159.34	158.89	158.83	99.70%	100.00%
	total/average	2006.49	1954.60	1874.40	97.41%	95.90%

2006.49 hours possible from light conditions
1862.95 hours of data taken with LE DU
1874.40 hours of data taken with HE DU
> 95% observation efficieny

no:
- moon
- daylight
- rain
- army activity
- passing cars
- power cut
- hardware failure
- operator error

Improvements to Observation Procedure

- Partial Automatisation with Run Control Program controlling Front end PCs

- Remote (from control room at site) operation of all devices for setting trigger thresholds etc.

- Remote control of power for trigger system devices by USB-controlled power taps and PCs with WOL

    => less work load
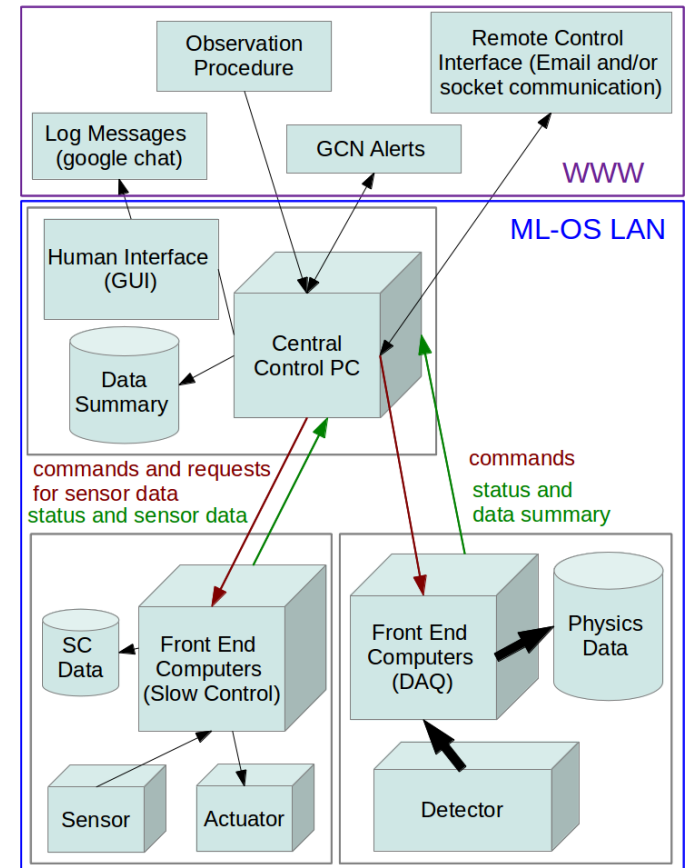
Run Control Interface
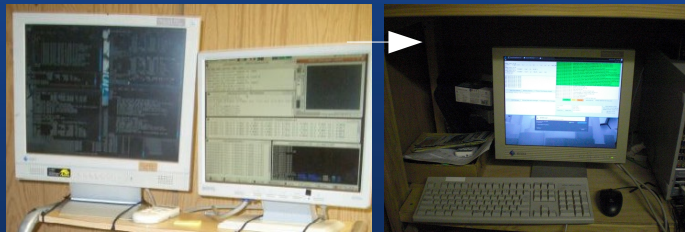
- Replaces / complements terminals for direct control at front end PCs

- creates daily schedule

- guides through preparation and observation

- reports to e-log on google chat

Observation schedule
- time window for each action
- completion logged on google-chat

Overview of today's runs

Front-End PC and Network Monitor

Alert if disk full

FE-PC connected to RC-PC by socket exchange protocol

Lost Connection

PC off / no ping

Data exchange in progress

Sending back Ping but not connected

Control Panel

```
asrmlgw 192.168.1.1 root | disk / free: 1.3G used: 86%
asrmlsv01 192.168.1.2 root | disk / free: 6.0G used: 28%
asrmlsv02 192.168.1.3 root | disk / free: 17G used: 52%
asrmlwm 192.168.1.11 root | disk / free: 4.7G used: 44%
asrscmr01 192.168.1.12 root | disk / free: 907M used: 90%
dqfe11-02 192.168.1.52 root
dqfe11-06 192.168.1.56 sasakig | disk / free: 79G used: 10% | disk /data1 free: 505G used: 72%
cneudaq 192.168.1.57 sasakig | disk / free: 6.9G used: 93% | disk /data1 free: 1.1T used: 41%
cneutrg 192.168.1.58 sskgrp | disk / free: 43G used: 46%
Ashra-COF-ML01 192.168.1.59 maunaloa | disk / free: 30G used: 13%
dqcp11-02 192.168.1.60 maunaloa | disk /data1 free: 1.1T used: 38%
dqfe11-11 192.168.1.61 maunaloa | disk / free: 64G used: 8% | disk /data1 free: 949G used: 46%
sctm11-01 192.168.1.152 root | disk / free: 2.3G used: 73%
scam11-01 192.168.1.154 root | disk / free: 3.7G used: 57%
sctm11-02 192.168.1.155 root | disk / free: 5.2G used: 39%
scvm11-01 192.168.1.156 root | disk / free: 3.3G used: 62%
scvm11-02 192.168.1.157 root | disk / free: 3.1G used: 65%
sccm11-01 192.168.1.159 root | disk / free: 2.3G used: 73%
sccm11-02 192.168.1.160 root
scpm11-02 192.168.1.162 root | disk / free: 5.2G used: 38%
scgm11-01 192.168.1.164 root
scgm11-02 192.168.1.165 root
scth11-01 192.168.1.167 maunaloa | disk / free: 31G used: 11%
```

Rebootall   Reboot   Shutdown   Wake on LAN   Connect   Disconnect   Diskspace (ssh)
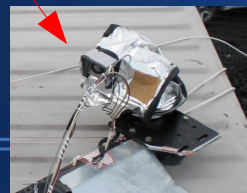
Detector Status Overview

Detector Status Summary

Main04r (LE DU)

Main04r: shutter open | HV on 40.3 kV | LV on | PMT on | DThd: 0.020 V | D70 on | Run 2499 (active)
TR 17.40 Hz | JDis 15.83 Hz | FPGA 2.03 Hz | size 1.5 GB | DR 14.9 MB/s | PGM (mean/var/ptp): 16.3 / 0.7 / 115
Main04rOpfmon: nstar = 170 | bkg = 24241.0 | res = 4.06 | measured 0.1 min ago
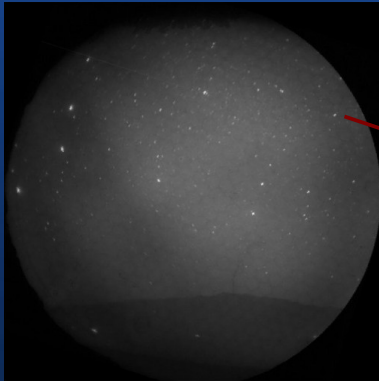
Sub00b (HE DU)

Sub00b: shutter open | HV on 41.3 kV | Run 1482 (active) | size 1.8 GB | DR 8.3 MB/s
Sub00bOpfmon: nstar = 259 | bkg = 13173.0 | res = 4.89 | measured 0.8 min ago
Sub00bLVmon: Curr = 98.28 μA | Δ = -0.01 μA | measured 0.5 min ago
Sub00bLCmon: T(mean) 4.4 C | H(mean) 33.0 | DewP(mean) -10.4 C
T(min) 2.6 C | H(max) 35.7 | DewP(max) -9.5 C | measured 4.0 min ago
Sub00bTHmon: T(mean) 5.1 C | H(mean) 37.5 | DewP(mean) -8.3 C
T(min) 4.3 C | H(max) 37.7 | DewP(max) -7.6 C | measured 2.0 min ago

Common

Weather Monitor: active | T(out) 1.8 C | T(in) 27.4 C | H(out) 27.0 | H(in)   8.0
P 682.9 hPa | WS 3.1 m/s | WD 34.0 deg | measured 1.0 min ago
Rain Monitor: no rain | since 644.8 minutes | measured 1.0 min ago
Cloud Monitor: active | Alt 60.0 | Azi 0.0 | CL 66.2
Vehicle Monitor East: no car (0.0)
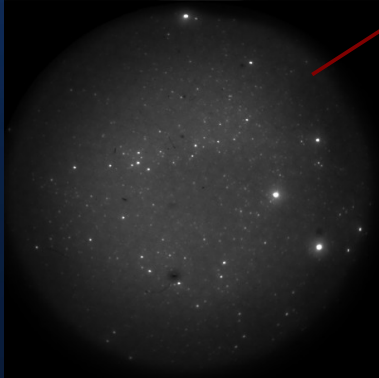Vehicle Monitor West: no car (0.0)

Detector Status Overview

LE OPF

HE OPF

Data Quality Check

: shutter open | HV on 40.3 kV | LV on | PMT on | DThd: 0.020 V | D70 on | Run 2499 (active)

Dis 15.83 Hz | FPGA 2.03 Hz | size 1.5 GB | DR 14.9 MB/s | PGM (mean/var/ptp): 16.3 / 0.7 / 115

Main04rOpfmon: nstar = 170 | bkg = 24241.0 | res = 4.06 | measured 0.1 min ago

Sub00b: shutter open | HV on 41.3 kV | Run 1482 (active) | size 1.8 GB | DR 8.3 MB/s

Sub00bOpfmon: nstar = 259 | bkg = 13173.0 | res = 4.89 | measured 0.8 min ago

Sub00bLVmon: Curr = 98.28 µA | Δ = -0.01 µA | measured 0.5 min ago

Sub00bLCmon: T(mean) 4.4 C | H(mean) 33.0 | DewP(mean) -10.4 C
T(min) 2.6 C | H(max) 35.7 | DewP(max) -9.5 C | measured

Sub00bTHmon: T(mean) 5.1 C | H(mean) 37.5 | DewP(mea
T(min) 4.3 C | H(max) 37.7 | DewP(max) -7.6 C | measured

Weather Monitor: active | T(out) 1.8 C | T(in) 27.4 C | H(out) 27
P 682.9 hPa | WS 3.1 m/s | WD 34.0 deg | measured 1.0

Rain Monitor: no rain | since 644.8 minutes | measured 1.0

Cloud Monitor: active | Alt 60.0 | Azi 0.0 | CL 66.2

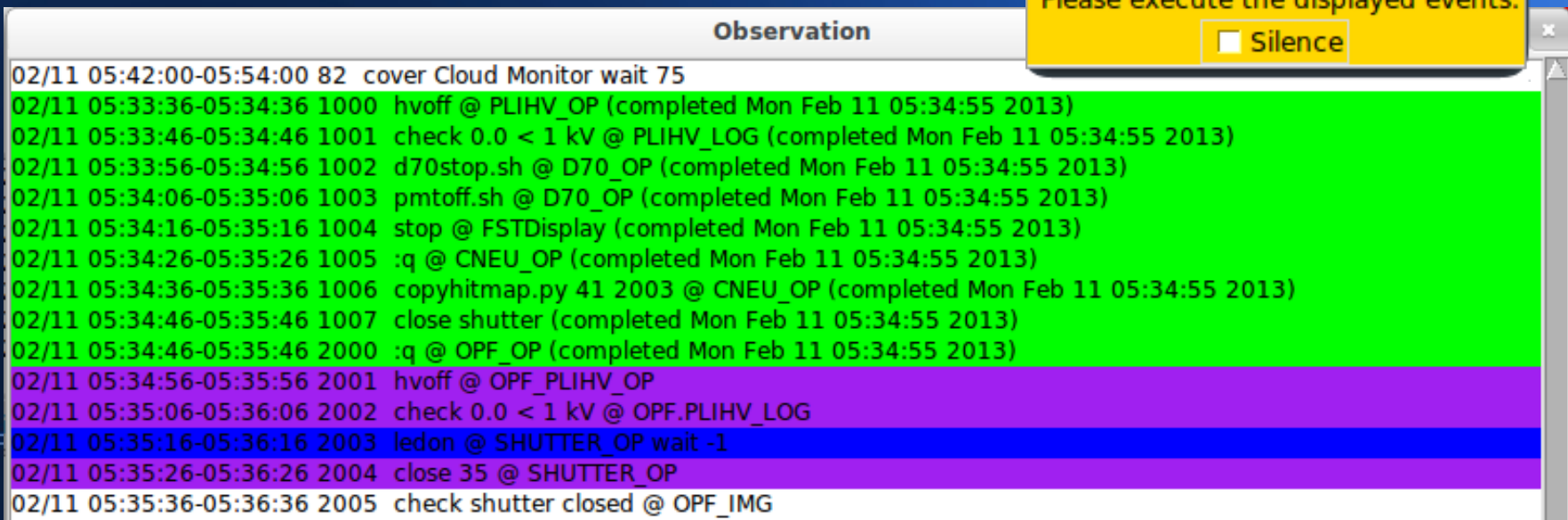Vehicle Monitor East: no car (0.0)

Vehicle Monitor West: no car (0.0)
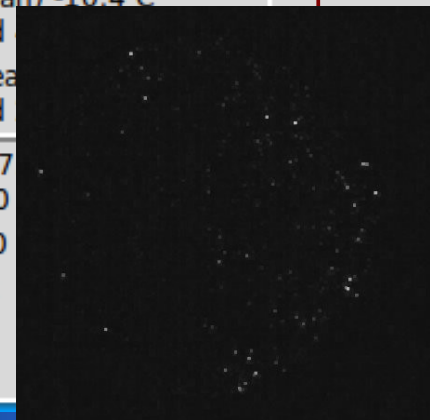
Information collected => situation analysed by RC program

LE Cneu

Alert

- If bad situation detected (e.g. rain starting), an alert notice with sound and actions to be taken are shown to the operator

- Check if decision right in preparation for automatic operation

- Help for inexperienced operator

- Log actions by confirming completion
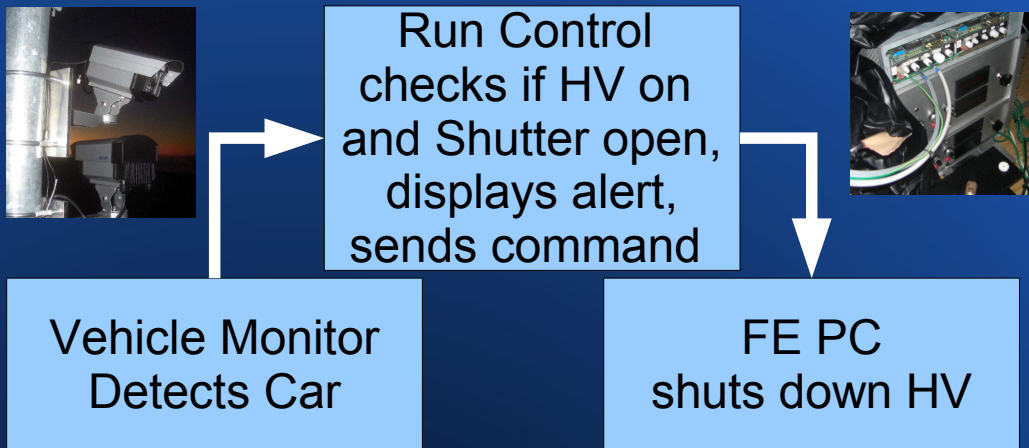

rainalert

Rain has started.
If observation ongoing, stop it!
Please execute the displayed events.
☐ Silence

Observation

```
02/11 05:42:00-05:54:00 82  cover Cloud Monitor wait 75
02/11 05:33:36-05:34:36 1000  hvoff @ PLIHV_OP (completed Mon Feb 11 05:34:55 2013)
02/11 05:33:46-05:34:46 1001  check 0.0 < 1 kV @ PLIHV_LOG (completed Mon Feb 11 05:34:55 2013)
02/11 05:33:56-05:34:56 1002  d70stop.sh @ D70_OP (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:06-05:35:06 1003  pmtoff.sh @ D70_OP (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:16-05:35:16 1004  stop @ FSTDisplay (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:26-05:35:26 1005  :q @ CNEU_OP (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:36-05:35:36 1006  copyhitmap.py 41 2003 @ CNEU_OP (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:46-05:35:46 1007  close shutter (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:46-05:35:46 2000  :q @ OPF_OP (completed Mon Feb 11 05:34:55 2013)
02/11 05:34:56-05:35:56 2001  hvoff @ OPF_PLIHV_OP
02/11 05:35:06-05:36:06 2002  check 0.0 < 1 kV @ OPF.PLIHV_LOG
02/11 05:35:16-05:36:16 2003  ledon @ SHUTTER_OP wait -1
02/11 05:35:26-05:36:26 2004  close 35 @ SHUTTER_OP
02/11 05:35:36-05:36:36 2005  check shutter closed @ OPF_IMG
```

Example of Automatic Slow Control: Vehicle Monitor

Run Control checks if HV on and Shutter open, displays alert, sends command

Vehicle Monitor Detects Car

FE PC shuts down HV

- Fast reaction required if car approaches (~ 20s)

- Headlights cause image intensifiers to hang up

- First test of automatic command execution

- Improved algorithm for car detection using mask and focusing on detection of bright objects only => earlier detection and less false alerts due to moving clouds
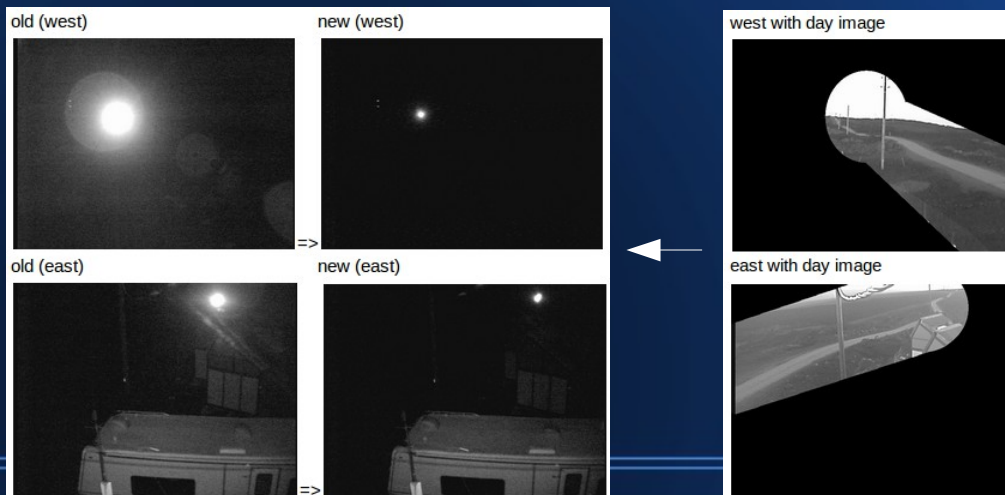
Summary

- Wide physics case

    - Earth skimming tau-neutrino detection

    - Optical Flash

    - Cosmic Ray Studies

- Efficient observation effort to take physics data

    - > 97% good conditions

    - > 95% observation efficency

- Run Control for partially automatic operation

    - creates and displays daily schedule, reports to e-log

    - detector and environment monitored with alert for bad condition

    - direct control of slow control systems