GRINCH Status

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04/05/2021
Ongoing GRINCH tasks

• Hardware
  – Gain matching
    • Cable checks done, some noise issues resolved, analysis software catching up to CODA3
  – Leak rate measurement
    • Still need a gasket, should have one by next week (more on that later)

• Software
  – Porting all analysis to Hall A analyzer/SBS-offline
    • A VETROC decoder had to be written for this
  – More details will be discussed at the next software meeting
Rack noise problem (now fixed): HV on / HV off

Low threshold noise (10ns, 300mV) remained after grounding the rack.

It was coming from the NINO cards, and eliminated with a threshold adjustment.

Most thresholds are now at 1.4V, 3 NINOs (#5, 11, 25) at 1.5-1.6V

Nothing seen with HV/LV off now!
An interesting observation

Chuck happened to be drilling the BB frame while thresholds were being raised (HV off).

ONE of these cards has its threshold set to 1.5V. The others are at 1.4V...

How much noise is expected to be in the Hall?
The thresholds can be raised back to the original 1.5V if needed, but they should be fixed for gain matching.
A few cables to be repaired

1 TDC ribbon at Weldment (thankfully not in a conduit)

3 BNC cable heads (all at front-end panel)
LED Pulser (at weldment) cabled

2 outputs, BNC cables patched above Hodo crate

Patched again at shower rack

Pulser at Weldment (next to GRINCH crate)

“Center-only” or “all 4 LED” modes available

GRINCH inputs
New VETROC decoder

CODA2 raw data

CODA3 raw data (slightly different header)

Rather than modify the old scripts to process TDC data from CODA3, a VETROC module was written for SBS-offline to use (none existed before).

Once officially added to the Hall A Analyzer, ANYONE with VETROCs can use it.
GRINCH Software

Hall A analyzer: VECTROCMODULE.cxx (VETROC decoder)

SBS-offline: SBSGRINCH.cxx (subdetector class)

SBSGRINCH_ClusterList.cxx (defines GRINCH-specific hits)

Crate/det maps: db_cratemap.dat db_bb.grinch

ANALYSIS
Replays, monitoring, everything else that is currently separate (event display)

Will be collecting better data this week (random noise shown)

We are now here

Replay files ROOT plots

TDC seems to work, still need to integrate ADC into SBS-offline
Gasket material status

• The vendor (Grainger), shipping us the Viton needed to seal the GRINCH door, has been delaying our order since 12/27/2020
  – The cheapest option, but any further delay is unacceptable

• We ordered a sheet of 60A durability silicone from a different vendor (expected this week), while leaving the 75A Viton order in place
  – We will install the first material to arrive
  – If needed, we can get 75A Viton in 2-3 days, at double the price
Viton vs. Other Elastomers

Silicone has the same durability as Viton (ideally \(<5 \times 10^7\) rads).

EPDM has durability up to \(3 \times 10^8\) rads, but must be kept \(<120^\circ\) C (Viton \(<200^\circ\)).

Also, it cracked before.

75A Viton: $2600 - $4300, 60A Silicone: \(~$1000\), EPDM: $134.37

(Original order) 2-3days

Original gasket (cracks) 10
Summary

• NINO thresholds should be set for expected Hall noise and left alone
  – 1.5V+ will likely require gain calibrations to be very efficient

• Despite setbacks in the form of gasket delays and CODA3 translation issues, the GRINCH is still on track, if handled soon
  – The software is being ported to SBS-offline, still needs ADC compatibility (most pressing task)
  – Other needs will be discussed in software meetings
  – Once the gasket finally arrives, leak tests should be ~1week
Backup slides
Effect of raising thresholds

Raising to ~1.4-1.5V reduces lower time over threshold sensitivity by ~5ns
Will hopefully not affect calibrations involving spe’s too much
What 5ns of ToT looks like

ADC[21] vs. TDC_501’s 'Time over Threshold'

<table>
<thead>
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<th>ADCvsToT</th>
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<td>Mean x</td>
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<tr>
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<tr>
<td>RMS x</td>
<td>4.201</td>
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<tr>
<td>RMS y</td>
<td>70.79</td>
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</table>

Cosmic events
fewer available to fit

Need either efficient source (LEDs) or a lot of cosmics

Also need to fix a threshold for consistent HV correlation

spe ~ chan. 180
(with pedestal)
Task: New gasket installation

Cracks appeared in the gasket used to seal the GRINCH door, and needs to be replaced.

New Viton© material was ordered last year, but delayed (twice)

Expected delivery:
12/27/2020
02/17/2021?

Will be cut by JLab (<1 wk)
Door sealed by me (mins.)
Task: Leak Rate Measurement

After installing the new gasket and sealing any leaks, the final leak rate needs to be obtained, for regulating gas flow.

Gas used for leak checks: air + 1% hydrogen

Responsible party: me
Leak check / sealing: 1-2 days
Rate measurement: 1-2 days
Task: PMT Gain Matching

Fit:

\[ Ae^{-\frac{(x-\mu_{sig})^2}{2\sigma_{sig}^2}} + (x - \mu_{ped} - n \sigma_{ped}) e^{-\frac{(x-\mu_{ped})}{\sigma_{ped}}}. \]

Responsible party: me
Time needed: ~1 month

Pulser + LEDs to expedite this
Pre-Hall Timeline

• Leak rate measurement, seal door: ~1 week
  – *Dependency: gasket delivery

• Gain matching: Mar. 1* – Apr. 15*
  – *Dependency: translator rack noise eliminated

• GRINCH ready for Hall transport: < May 1

• Software development, Documentation: Now – May 15
GRINCH Software Needed

- **Offline analysis software**
  - PMT vs. PMT for track/cluster finding
  - All TDC / ADC channels, time over threshold
  - Single event display
  - PMT rate counter
  - TDC multiplicities

- **Online Monitoring**
  - HV / LV monitoring
  - Online PMT rate counter, TDC / ADC
  - Gas pressure monitoring

- **Slow Controls / EPICS**
  - Realtime PMT gain / voltage controls
  - Gas flow

- **Clustering, Integration with other SBS subsystems**

Could really use help with the online software + integration

With beam, we need to verify simulated PMT acceptances, p.e. yield, study blind spots in the mirrors
GRINCH Documentation

- **GRINCH wiki (fairly extensive):**
  [https://hallaweb.jlab.org/wiki/index.php/BigBite_GRINCH](https://hallaweb.jlab.org/wiki/index.php/BigBite_GRINCH)
  - Presentations, background information
  - Cable maps and schematics, technical drawings, spare inventory
  - All past equipment tests, specs, measurements, and studies
  **Needed:** Instructions for running software, shift instructions, any missing safety documentation

- **Approved TEDF GRINCH tasks on halist:**
  - #1595: GRINCH PMT checks and gain matching
  - #1596: GRINCH gas pressure and leak tests

- **Additional safety information:**
  [https://hallaweb.jlab.org/12GeV/SuperBigBite/documents/ERR2017/final/GRINCH_OSP.pdf](https://hallaweb.jlab.org/12GeV/SuperBigBite/documents/ERR2017/final/GRINCH_OSP.pdf)
The cracking is probably from long-term folding/storage. It should be installed and left alone.

**Viton interactions**


**Compatibility**

- Weather Resistance: Excellent
- Ozone Resistance: Outstanding (2wks/150 ppm)
- Oxidation Resistance: Outstanding

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<th>Types of Viton™ for Air, &lt;200°C</th>
<th>Rating</th>
<th>Types of Viton™ for Hydrogen</th>
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**Rating Legend**

- **A**: <10% volume swell. Elastomer may exhibit slight swelling and/or loss of physical properties.
- **B**: 10-30% volume swell. Elastomer affected by chemical exposure (slight visible swelling and/or loss of physical properties).
- **C**: 30-50% volume swell. Elastomer affected by chemical exposure (moderate to severe swelling and/or loss of physical properties. Limited functionality possible but must be determined by testing).
- **D**: >50% volume swell. Elastomer shows extreme volume swell and/or loss of physical properties. Not recommended for service.
- **---**: Insufficient Data.
GRINCH detector class in SBS-offline

DB/db_bb.grinch
(GRINCH cratemap)

```plaintext
#grinch detector map
# crate slot ch_min ch_max
bb.grinch.detmap =
7  4  127  127  -1 #
7  5  127  127  -1 #
7  6  127  127  -1 #
7  7  127  127  -1 #
7  4  0  126  1 #
7  5  0  126  2 #
7  6  0  126  3 #
7  7  0  126  4 #
nbb.grinch.detmap_adc =
7  17  0  31 #
7  18  0  31 #
```

DB/db_cratemap.dat
(SBS cratemap)

```plaintext
==== Crate 7 type vme
# VETROC TDCs for GRINCH - VETROCModule (526) now in Podd
# slot model clear header mask nchan ndata
4  526  1  0x00000000  0x00000000  128  12800
5  526  1  0x00000000  0x00000000  128  12800
6  526  1  0x00000000  0x00000000  128  12800
7  526  1  0x00000000  0x00000000  128  12800
# Caen v792 modules
17  792  1  0x00000000  0xffffffff  32  2048
18  792  1  0x00000000  0xffffffff  32  2048
```
SBSGRINCH variables

```c
// Hits hits
RVarDef var1[] = {
    "nHits", "number of PMT hits", "GetNumHits()"
},
{ "hit.pnum", "Hit PMT num", "fHits.SBSGRINCH_Hit.GetPMTNum()"
},
{ "hit.x", "PMT hit X", "fHits.SBSGRINCH_Hit.GetX()"
},
{ "hit.y", "PMT hit Y", "fHits.SBSGRINCH_Hit.GetY()"
},
{ "hit.row", "PMT hit row", "fHits.SBSGRINCH_Hit.GetRow()"
},
{ "hit.col", "PMT hit column", "fHits.SBSGRINCH_Hit.GetCol()"
},
{ "hit.adc", "PMT hit ADC", "fHits.SBSGRINCH_Hit.GetADC()"
},
{ "hit.tdc_r", "PMT hit TDC rise", "fHits.SBSGRINCH_Hit.GetTDC_r()"
},
{ "hit.tdc_f", "PMT hit TDC fall", "fHits.SBSGRINCH_Hit.GetTDC_f()"
},
{ "hit.tdc_tot", "PMT hit TDC time over threshold", "fHits.SBSGRINCH_Hit.GetTDC_TOT()"
},
{ 0 }
};
DefineVarsFromList( var1, mode, "" ); // (re)define path here...

RVarDef var2[] = {
    "nClus", "number of GRINCH PMT clusters", "GetNumClusters()"
},
{ "clus.size", "GRINCH cluster size", "fClusters.SBSGRINCH_Cluster.GetNHits()"
},
{ "clus.x", "GRINCH cluster X center", "fClusters.SBSGRINCH_Cluster.GetXcenter()"
},
{ "clus.y", "GRINCH cluster Y center", "fClusters.SBSGRINCH_Cluster.GetYcenter()"
},
{ "clus.t_mean", "GRINCH cluster mean lead time", "fClusters.SBSGRINCH_Cluster.GetMeanRisingTime()"
},
{ "clus.t_f_mean", "GRINCH cluster mean trail time", "fClusters.SBSGRINCH_Cluster.GetMeanFallingTime()"
},
{ "clus.adc", "GRINCH cluster total charge", "fClusters.SBSGRINCH_Cluster.GetCharge()"
},
{ 0 }
};
```