



# **TORRENT Readiness Review**

August 20, 2010

# Agenda

	<u>Time</u>		<u>Section</u>	<u>Presenter</u>
1	9:00AM	30 min	Intro	Mark
2	9:30AM	60 min	PSM/LCB/MEZ	Peter
	10:30AM	30min	<i>Break N/Lunch South</i>	All
3	11:00AM	30 min	AFE/Flex/Connectors	Mark
4	11:30AM	30 min	TSM	Mark
	12:00PM	30 min	<i>Lunch North/Break S</i>	All
5	12:30PM	45 min	Mechanical	Joe
6	1:15PM	45 min	Software	Nick
7	2:00PM	30 min	Mfg & Test	Ron
	2:30PM	30 min	Overall Q & A	All
	3:00PM	60 min	Panel Session	Panel
	4:00PM	15 min	Panel debrief	Torrent team & Panel

# Charge to Review Panel

The NOAO TORRENT team will hold a Readiness Review on August 20, 2010. The team will be presenting an overview and reporting on the current status for the hardware, firmware, and software systems. They will also present the mechanical drawings for the packaging and results from lab tests of the complete controllers. Finally, they will discuss plans for bulk manufacture and testing of the controllers.

The goal of the review is to get the Panel's advice on one general question: is the complete TORRENT system ready to go into bulk production? This is much like a final acceptance test review in that the inquiry is expected to be at a high level and focus on results of tests of the assembled systems. It is not meant to address details of design, component choice, or interfaces, as those issues have been reviewed and settled long before now.

Here are some specific questions to help guide your discussions:

- Is the TORRENT system ready to go into bulk production?
- Do the test results presented show successful operation?
- Are there other tests that should be conducted?
- Are there any risk areas that have not been identified in the testing or adequately addressed in the plans for production?
- Are there any areas in which the production plans appear incomplete?
- Are there adequate resources identified to carry out the manufacturing plans?

Given the nature of the review and in recognition of the fact that the panelists have plenty of other work to do, the Panel is not asked to produce a formal written report. We do ask for the benefit of the team that the Panel provide a verbal report, supplemented if possible with an outline or Powerpoint slides, that gives a record of your findings and recommendations in as much detail as possible within the time available.

# Rules for Questions

## **Question to the Panel:**

- Lots of material to cover
- Allowing questions during presentations is up to the panel:
  - Panel only during presentation with everyone at end, as time permits?
  - Or anyone anytime?

# What the review covers

- Overview
  - Quick look at the system
- Hardware
  - All the boards
- Mechanical
  - Making the enclosure
- Software
  - Configuration and automatic system generation
  - Compatibility with older systems
- Manufacturing & test
  - Inventory control
  - Product flow

# Section 1 - Overview of Torrent

We are reviewing a CCD version of the controller, which has:

- 8 channels of video inputs
- 32 clocks
- 16 low voltage biases
- 16 high voltage biases
- Back side bias supply for Deep Depletion devices
- Supports either N or P type devices
- Uses the MONSOON software and PAN hardware without modification

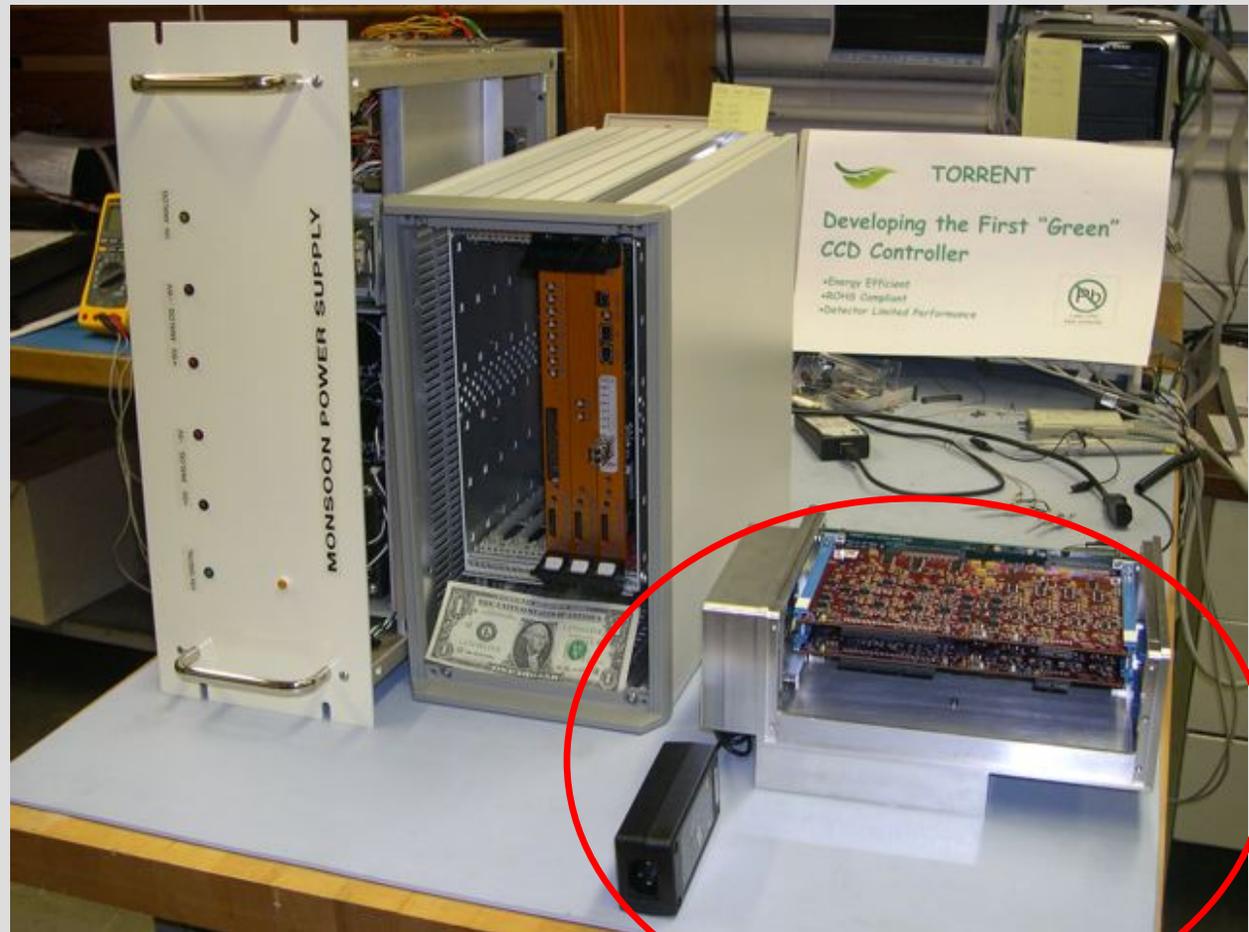
# What is Torrent?

- Like MONSOON, Torrent is not an acronym
- A smaller more purposed MONSOON
- Aimed towards:
  - Replacing old controllers at Kitt Peak & CTIO
  - New instruments that don't need the capabilities of its big brother 'Orange'
  - Helping with commonality of controllers
    - At both sites: KPNO & CTIO
    - Replacing varying controllers and architectures

# How big is it?

*Much smaller*  
than Big Brother  
‘Orange’  
MONSOON!

(Equivalent 8  
channel systems)



August 20, 2010

Torrent Readiness Review

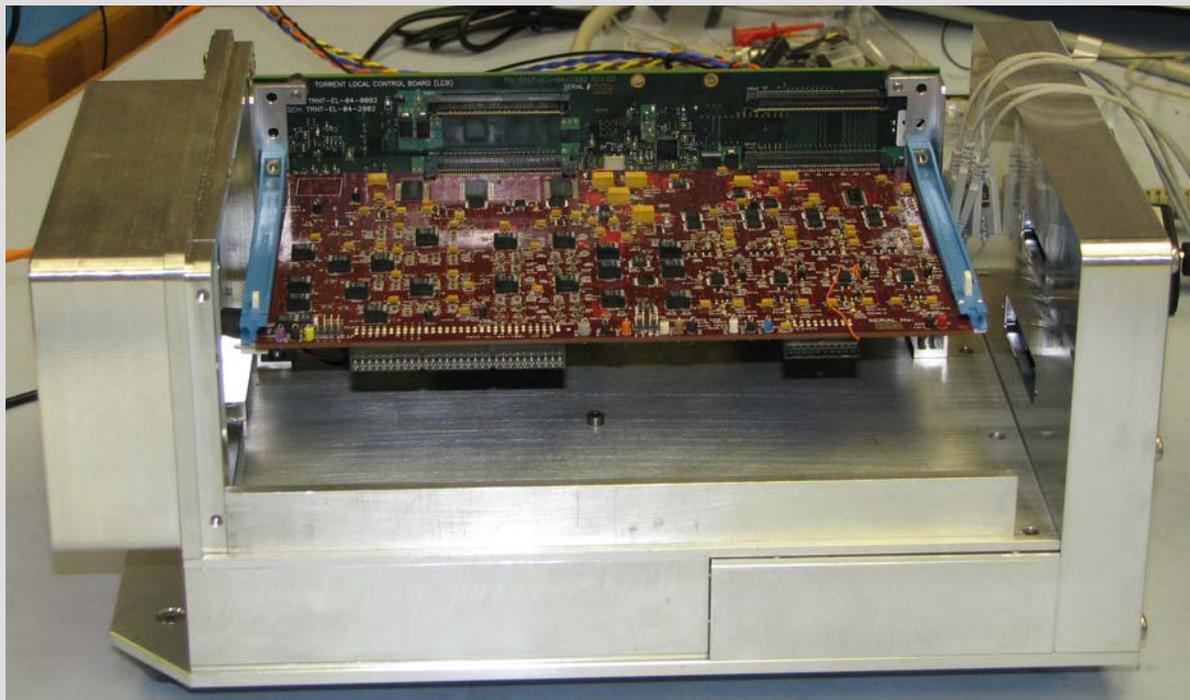
Photo credit: D. Sprayberry

# OK – really, how big?

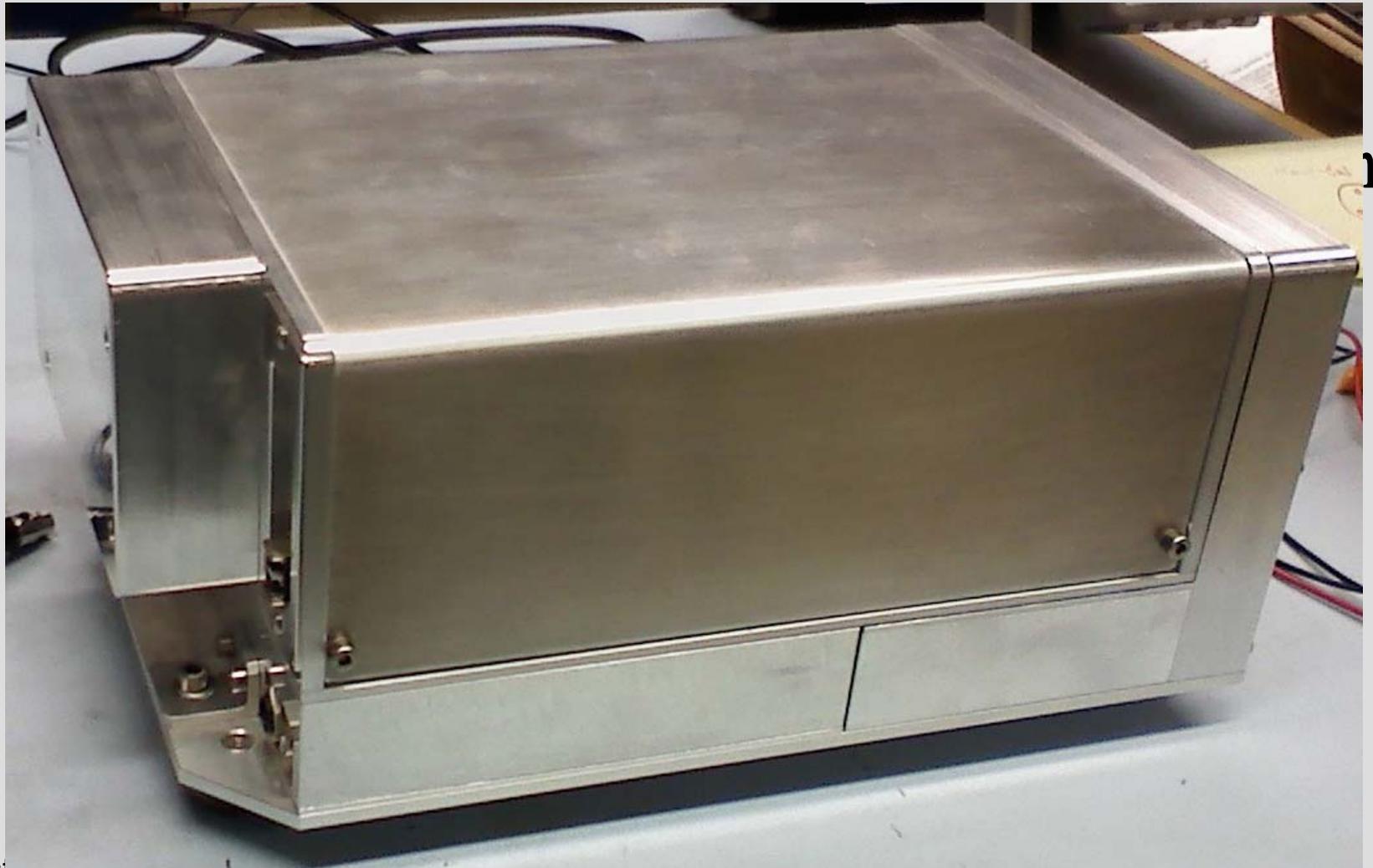
SAE: 7  $\frac{5}{8}$ " W x 5  $\frac{7}{8}$ " H x 13  $\frac{1}{4}$ " D, 11.8 lbs

Metric: 195mm W x 150mm H x 335mm D, 5.36kg

(Or 19.5cm W x 15cm H x 33.5cm D , 5.36kg)



# Torrent Hardware - Names



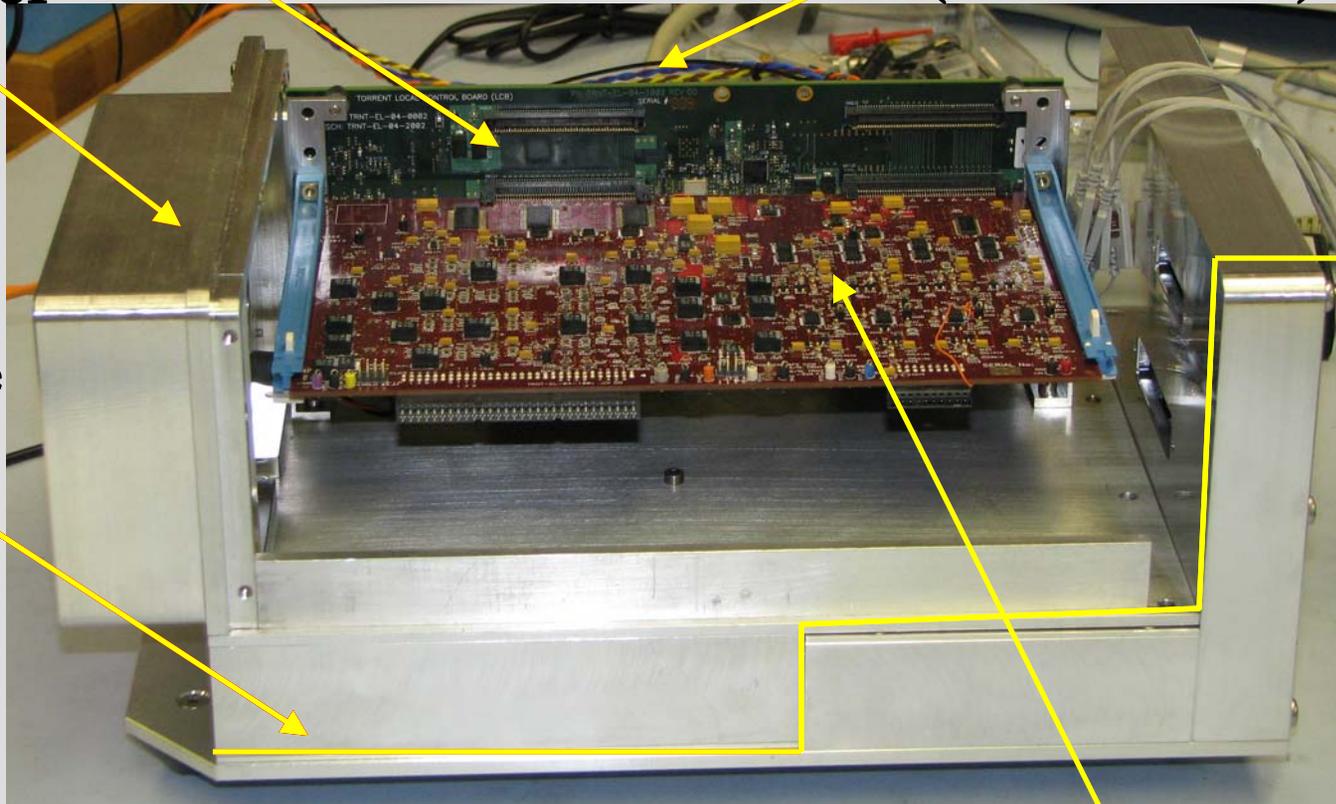
# Torrent Hardware Parts

Local Control Board (LCB) Mezzanine board (MEZ)

(behind LCB)

Blower

Power  
Supply  
Module  
(PSM)



Analog Front End (AFE)

August 20, 2010

Torrent Readiness Review

11

# Other interesting facts

- Torrent is a *Green* controller (Rohs compliant)
  - Power dissipation targeted at <30W
- Integrated closed loop dewar heater
  - Uses either diode or RTD feedback
- Integrated optically isolated shutter output
- Integrated switching power supply
  - Requires only a small external 24VDC power supply
- Boards are fabricated at outside vendors
  - Allows use of automated assembly for improved yield
  - Allows use of BGA technology and soldered back contacts
- Chassis will be nickel plated
  - Coating is electrically conductive & has beneficial EMI properties

# Summary of recommendations from the Feb 08 design review

- 1 – The MONSOON PM needs to plan refined estimates for time and resources with areas that could use more resources to accelerate the schedule. He would then bring this to a meeting with David, Buell & Alistair.
  - *Ongoing though the players change.*
- 2 – Resource contribution from other groups are needed to speed up the project. Specifically mentioned was Mechanical Engineering support.
  - *Contribution from other groups has been low. ME support has been supplied and utilized.*
- 3 – The group should start the design of power supplies first and make a prototype for verification. This is a possible opportunity for outsourcing.
  - *Agreed and done.*

## Summary of recommendations from the Feb 08 design review

4 – Agreement that we should start with the CCD version.

– *Agreed and done.*

5 – The group should use the conventional CDS front end that exists on the present MONSOON.

– *Agreed and done.*

6 – Need to sell the project - if KPNO does not buy into it, CTIO would not.

– *Ongoing, through design into current instruments.*

7 – Resolve size issue & interface specification for existing systems we are targeting.

– *Done.*

# Summary of high importance concerns from the Feb 08 design review

- 1 - The power supply is a high risk area
  - *This was sent out for contract design/fab and is operational.*
- 2 - Resource issues
  - *We have been resource limited as predicted.*
- 3 - There should be use cases, hopefully with the assistance of the mountain groups to help 'sell' the project.
  - *Use cases have been done for new instruments: KOSMOS and MOSAIC1.1 Upgrade.*
  - *At NOAO North, we have been using mountain tech help on the MOSAIC1.1 upgrade to help gain familiarity with MONSOON and Torrent.*
  - *At NOAO North & South there have been training courses .*
- 4 - Look at a typical 4 amp 4kx4k to see if there are sufficient resources to run the chip.
  - *Done – there are with the present design.*
- 5 - How do we plan to spare and maintain the systems for different configurations?
  - *We will have only one configuration for CCD and one for IR (in the future) allowing spares to be at the unit controller level.*

# Summary of high importance concerns from the Feb 08 design review

- 6 - Access to signals for debug and development, including test point mux.
    - *Done for Clocks, Biases, computer selectable; CDS signals on a header.*
  - 7 - Supplies for some chips in the design are outside specified range.
    - *Corrected.*
  - 8 - On multiple Torrents, we need to be able to disable the slave clocks.
    - *Done.*
  - 9 - Delete the flash memory.
    - *Done.*
  - 10 - The present cds design has not been tested on a low output CCD (1uV/e).
    - *Done with Orange on the 1.5M Echelle, though not as low noise as we would like due to time constraints.*
  - 11 - How the heater is dealt with on power up needs to be finalized.
    - *Heater disabled on power up and enabled through software.*
- Later from Tim Abbot: Obsolescence
- *Dealt with through use of modern components and research into lifetime.*

# Summary of present progress

- Systems are operational in Tucson and La Serena labs
- Analog Front End (AFE) board is at rev. 1
- Mezzanine board is at rev. 1
- PSM is at rev. 1 to include  $V_{BB}$  (on order)
- All other boards at proto level with ECOs
- Autoconfig software is in test
- Testing, calibration and EEPROM writing has been demonstrated
- In Tucson, we have operated an E2V chip in a test dewar with a Torrent

# What is needed before manufacture?

All boards will go through a design check for ECOs and red flags (a file we keep on problems)

- LCB
  - ECOs and minor improvements: Low risk
- CBB Flex
  - Make smaller and more flexible by splitting into two sections:  
Low risk
- Verification of new PSM
  - Relayout and addition of Back side Bias: Low risk - VBB design prototyped, rest just relayout of PSM
- TSM Utility
  - Modify to support Back side Bias: Low risk

# Configuration Management

- We have been working on setting up the documentation and flow charts for Torrent
  - Still working on complete tracking from parts ordering through deployment
  - Have parts already in place
- We have flowcharts to take the ‘order’ and be able to understand what we need to provide
  - Have product flow diagrams for controller configuration
  - Requires knowing the CCD type
  - If a dewar already exists, pinout would be provided by customer for TSM development

# Configuration Management

- Draft of abbreviated plan 75% complete
- Typical block diagrams in place
- Most of plan draft is in document control
- A sample change request form was developed
- A proposed change analysis block diagram is in progress
- Draft requires edit and additions, hardware and software management

# Torrent Product Support

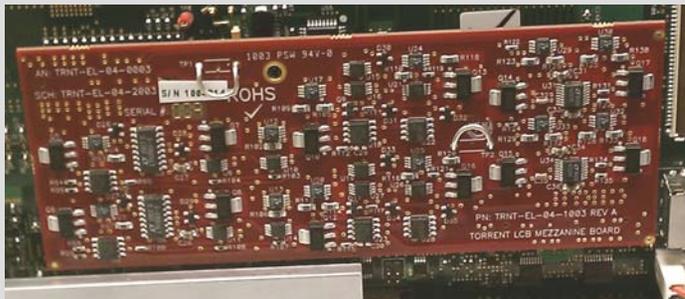
- Need to decide on the paradigm with two possibilities:
  1. Rely on Tucson for all test & calibration which would include repair of all systems
  2. La Serena and Tucson both have the same capabilities
    - Requires purchase of more test equipment and software
- Right now only Tucson will have the capabilities for the automated testing and calibration
  - We are developing the testing now
  - We will be receiving and testing all production boards from manufacturers
- This leaves us with only one ‘repair depot’
  - Each site would need a spare controller
  - When there is a failure, mountain techs replace controller and notify Tucson to send another unit (same for KPNO & CTIO mountain ops)
  - Simultaneously ship the bad controller to Tucson for repair
  - The hardware & software could then be duplicated when resources are available, allowing us to have duplicate facilities at both sites

# Overview of the Presentations

<u>Section</u>	<u>Subject</u>	<u>Presenter</u>
2	PSM/LCB/MEZ	Peter
3	AFE/Flex/Connectors	Mark
4	TSM	Mark
5	Mechanical	Joe
6	Software	Nick
7	Mfg & Test	Ron

# Section 2 - Peter Moore

- Power Supply Module (PSM)
- Local Control Board (LCB)
- Mezzanine Board (MEZ)



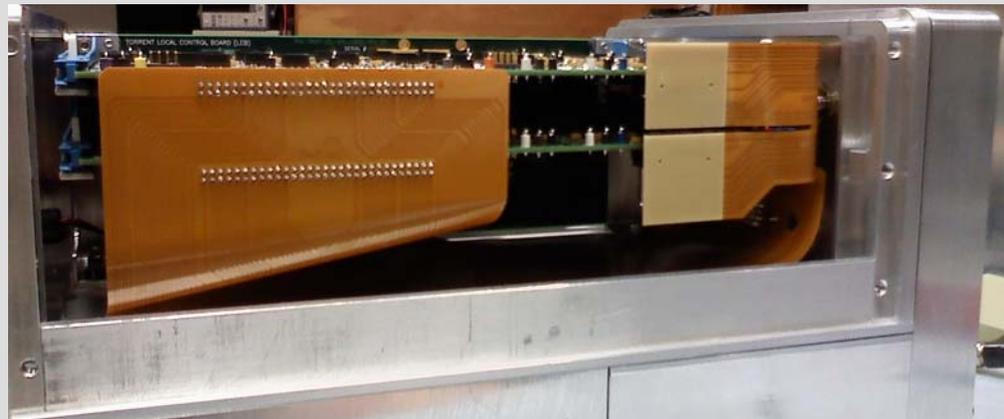
August 20, 2010

Torrent Readiness Review

23

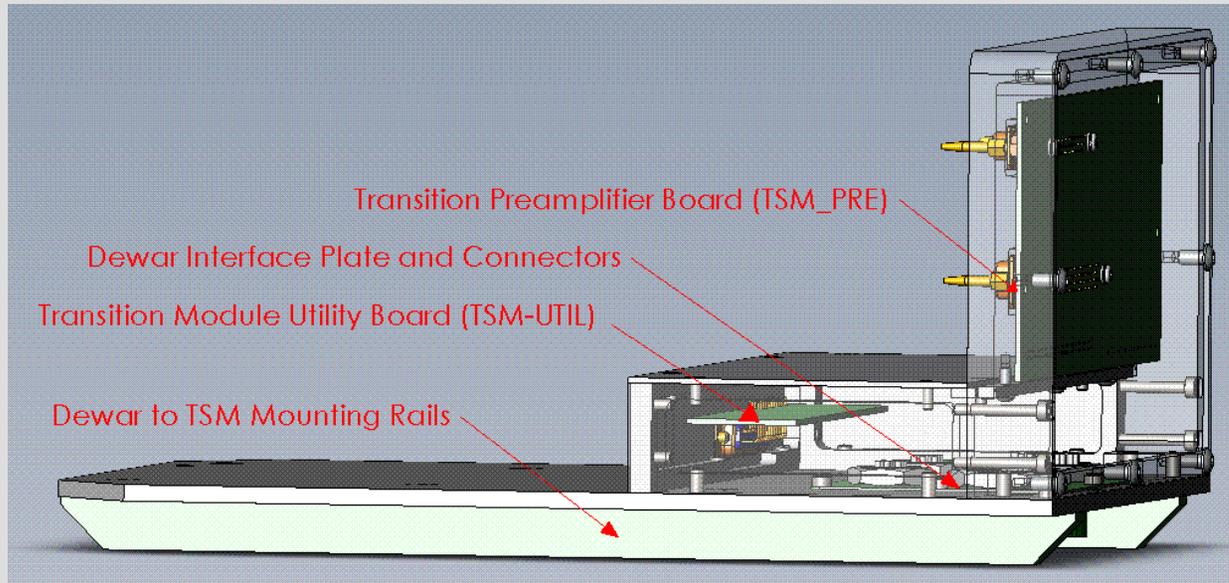
# Section 3 - Mark Hunt

- Analog Front End (AFE)
- Flex Cables



# Section 4 - Mark Hunten

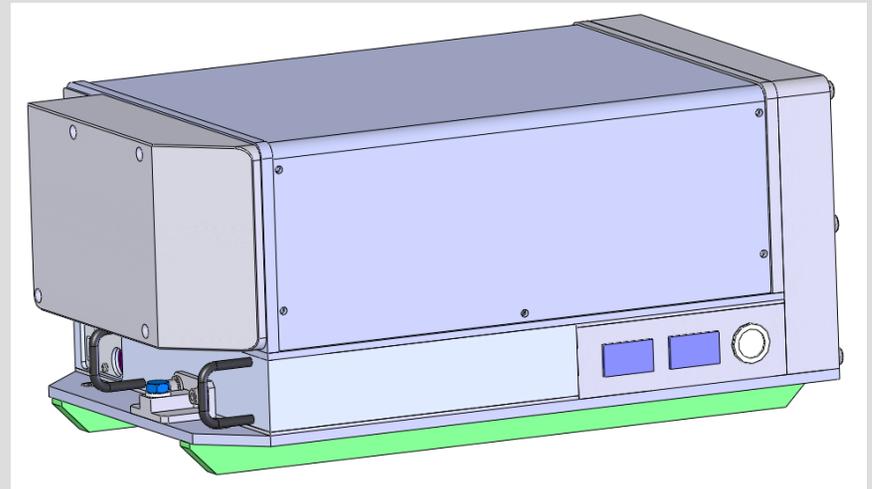
- Transition Module (TSM)
  - Preamp
  - Utility Board



# Section 5 – Joe DeVries

## Mechanical

- Dewar Interface
- Connectors
- Transition Module Assembly
- Power Supply Module (PSM)  
Chassis
- Blower Housing
- Detector Head Electronics
  - Manufacture
  - Detail / Assembly drawings
  - Materials / plating
  - Machined part quotes
  - Identification



# Section 6 - Nick Buchholz

## Software Topics

- Introduction - Where are we now?
- Software Goals
- Software Process Flow
- Achieving the Goals
- Providing Automation Tools
  - Assimilate
  - SysConfig Tools
  - borg and mborg Tools
- Runtime Failure Mode analysis

# Section 7- Ron George

## Manufacturing Overview

- Hardware receiving
- Mechanical hardware kits
- Electronics hardware
- Hardware assembly
- Test Overview
  - Test concept
  - Test software design
  - Test fixture design

# Torrent Manufacturing Plan

- Plan is ordering 15 – 18 systems for instruments, spares, lab and development systems
- Estimating a system cost of less than \$15,000
  - Making large quantities of boards drives costs per board down
- Resources will be supplied through the present group of people
  - 1 ED (Dee Stover) 80 - 100% through mid-Oct, tapering off through November, done by December 2010
  - 3 EE @ 50 – 70% through the end of '10,
  - 3 EE @ 70 – 80% for test and system verification in CY11
  - 1 – 2 EE @ 50 % for instruments through CY11
    - 2 x KOSMOS x 2 dewars
    - MOSAIC1.1 Torrent conversion
  - SE (Nick B /Phil D) 50 – 75% for support and new functions
  - 1.5 – 2 ET for board inspection, test and system assembly after board receipt continuing through mid CY11
  - Mountain Technician support will help by familiarization

# Bulk Manufacture Schedule

- For purposes of this review, the schedule starts the manufacturing cycle September 1, 2010.
- This give us systems to test & assemble December 2010
- Delivery of the first system on a dewar is March 2011
  - KOSMOS first dewar is a NOAO North dewar with an E2V 2k x 4k CCD
- These purchases and this effort are provided for in the FY11 budget, which begins on Oct 1, 2010.

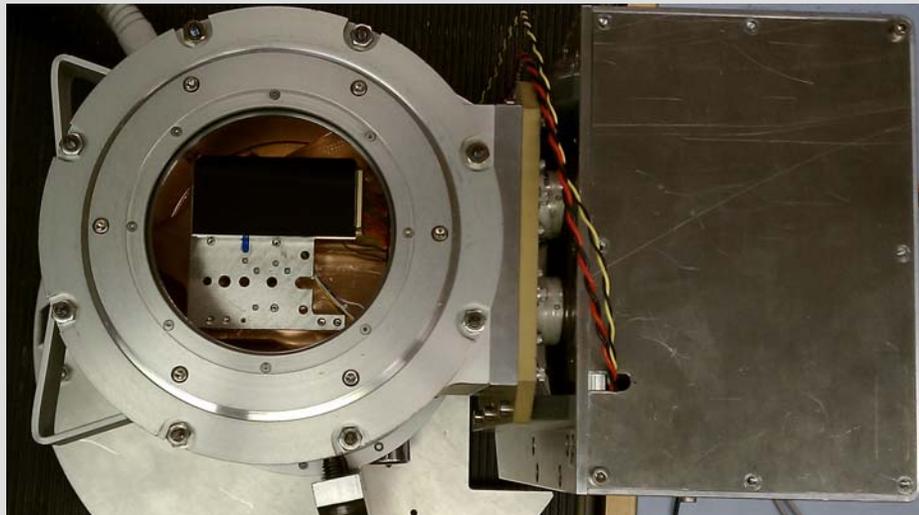
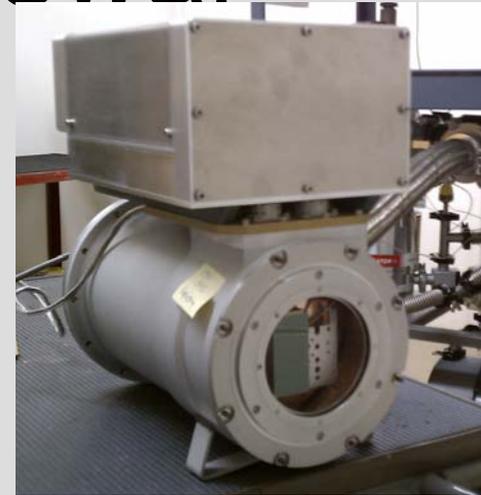
Task Name	Duration	Start	Aug '10		Sep '10				Oct '10				Nov '10				Dec '10				Jan '11				Fe							
			1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30			
<b>Make ProductionSystems</b>	110 days	Wed 9/1/10	[Gantt bar from Sep 1 to Feb 1]																													
AFE	33 days	Wed 9/1/10	[Gantt bar from Sep 1 to Oct 4]																													
LCB	44 days	Thu 9/9/10	[Gantt bar from Sep 9 to Oct 23]																													
PSM	34 days	Thu 10/7/10	[Gantt bar from Oct 7 to Nov 11]																													
TSM PRE	27 days	Mon 10/18/10	[Gantt bar from Oct 18 to Nov 14]																													
TSM UTL	29 days	Thu 10/28/10	[Gantt bar from Oct 28 to Dec 26]																													
Flex Cables and connectors	54 days	Fri 9/3/10	[Gantt bar from Sep 3 to Oct 27]																													
Mechanical Fab	40 days	Fri 9/3/10	[Gantt bar from Sep 3 to Oct 13]																													
System Integration & Test	60 days	Wed 11/10/10	[Gantt bar from Nov 10 to Jan 10]																													

# A few lab results

- We have recently put the controller on our test Dewar and started debug & test.
- The results are on the next few slides
- Interested analyzers can have the fits files (at 68MB each!)

# Torrent mounted on the NOAO Test Dewar

Torrent mounted on  
our MOSAIC test  
dewar with the E2V  
CCD44-82 2k x 4k  
Engineering grade  
CCD installed.



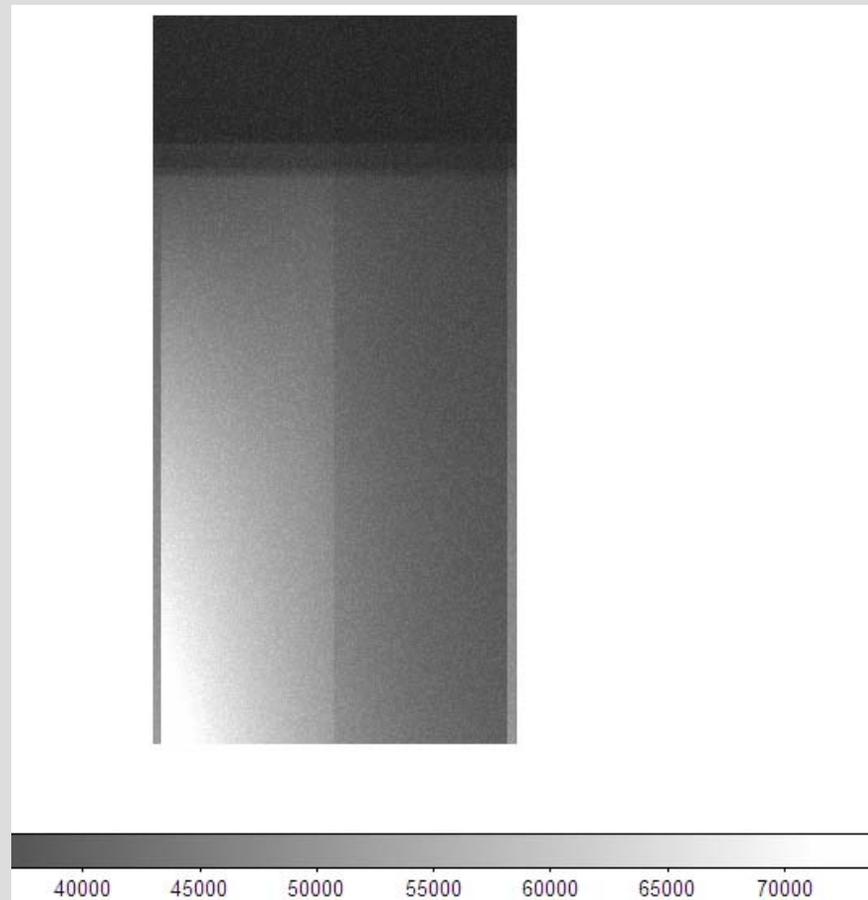
August 20, 2010

Torrent Readiness Review

32

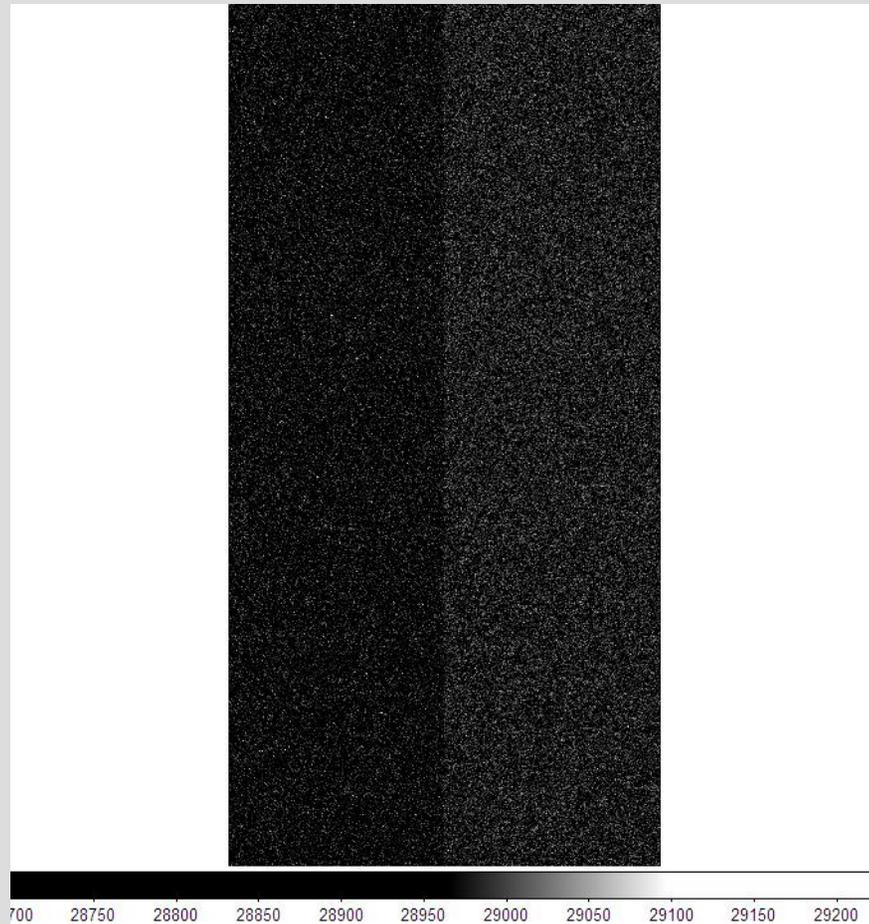
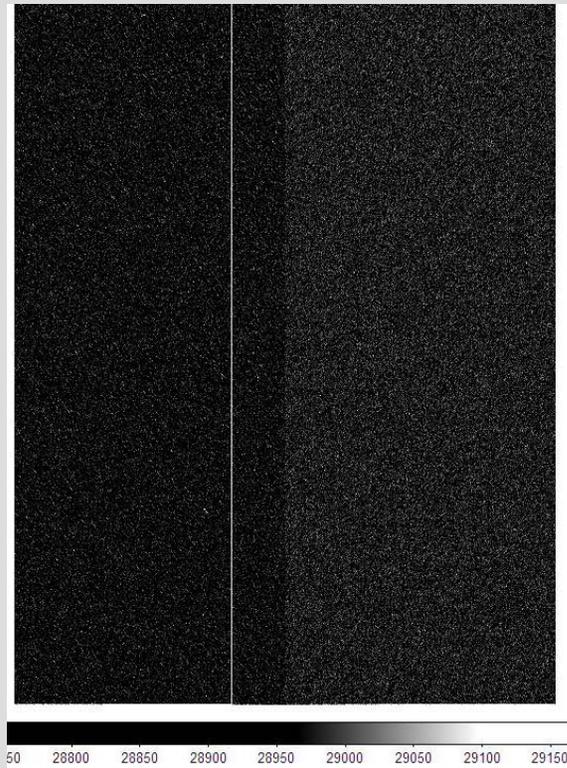
# First light image from E2V CCD

- Picture was taken Wed. evening with no shutter



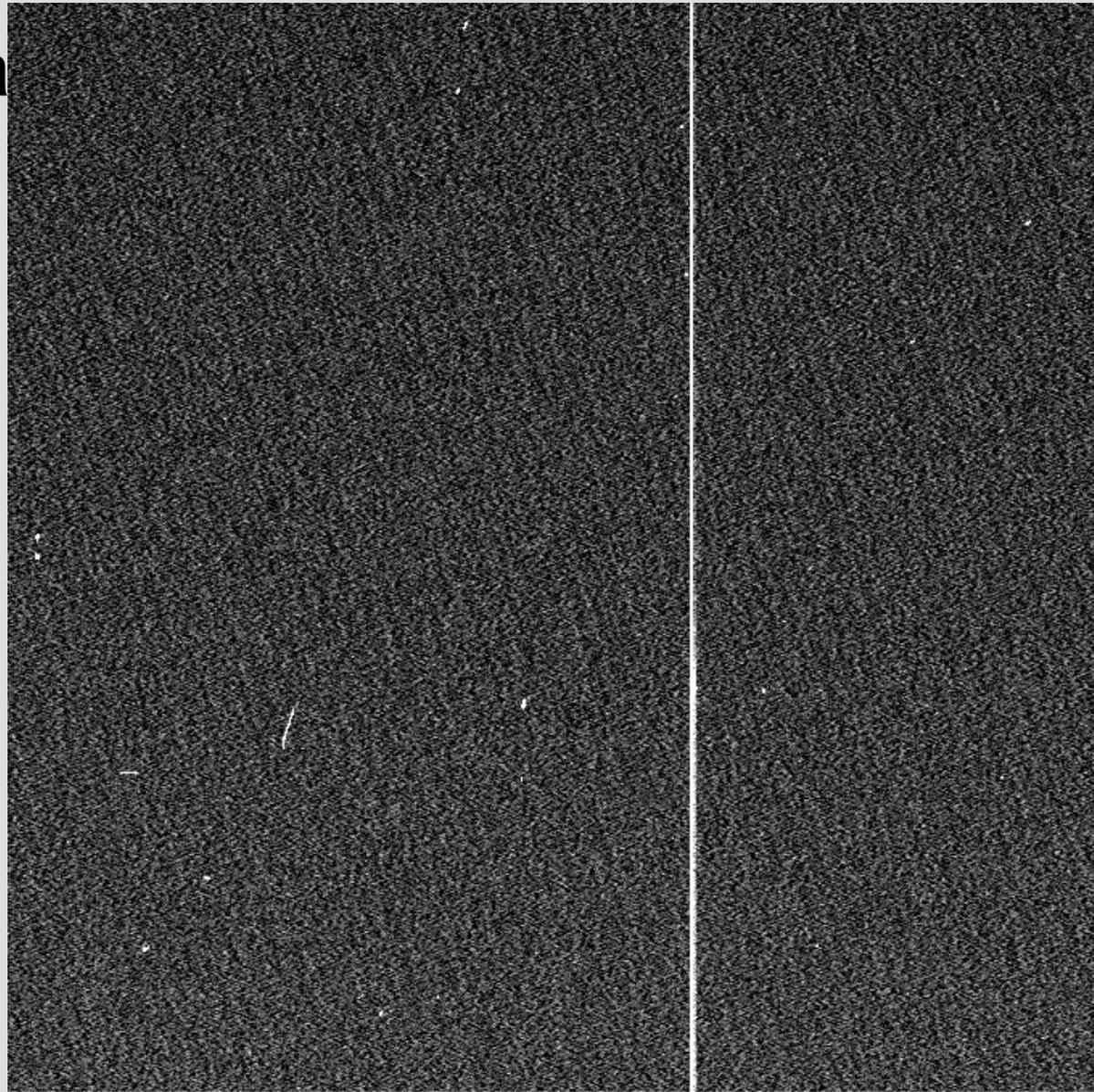
# Zero image from E2V CCD

Closeup shows  
engineering chip  
defect



Da

Closeup  
shows  
engineering  
chip defect  
and cosmic  
rays



29200

August 20, 2010

28900 28950 29000 29050 29100 29150 29200



# The Torrent Team

Mark Huntten, Project Manager

- Peter Moore, Senior Engineer
- Nick Buchholz, Senior Software Engineer
- Ron George, Engineer
- Dave Sawyer, Senior Engineer
- Dee Stover, Designer & PCB Layout wizard
- Roy Olson, Technical Writer
- Phil Daly , Senior Software Engineer
- Joe DeVries, Mechanical Engineer
- The Technicians: Jack Carlson, Ken Don, Kathy Zelaya

# Torrent Controller

- End of Overview
- Questions/Comments from Panel?
- Next up is: Section 2: PSM, LCB and MEZ