

# US Module Production Status

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*for the*  
*US CMS Silicon Tracker Group*

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# Covered in this talk



- US Group Evolution past year and upcoming year
- Status of all production equipment and manpower
- Making US production lines fully robust
  - Steps we have taken
  - What we still need from CMS at large
- Planning for upgrading production capacity further

# Preparing for the mad rush



- Eventually we will get good parts in large quantities
  - Deliveries will not be smooth
  - Meeting the schedule will require
    - Higher than expected peak production rates
    - Extremely robust and stable production lines
    - Well trained personnel
- Current proven capacity in US is 15 modules/day/site
  - Further capacity expansions are possible
    - No further fabrication equipment needed and no expansion in test equipment required
    - Achieve by extending work day (split shifts) and/or adding support personnel to major production tasks
- Rates under study:
  - FNAL: 18/day sustainable and 21/d peak
  - UCSB: 21/d sustainable and 24-27/d peak



# US CMS Tracker Group



- Brown University
  - R. Hooper, G. Landsberg, C. Nguyen, H. Nguyen
- University of California, Riverside (UCR)
  - P. Gattung, G. Hanson, G.Y. Jeng, G. Pasztor
- University of California, Santa Barbara (UCSB)
  - A. Affolder, S. Burke, C. Campagnari, F. Garberson, D. Hale, J. Incandela, P. Kalavase, S. Kyre, J. Lamb, S. Stromberg, R. Taylor, D. White + technicians
- University of Illinois, Chicago (UIC)
  - E. Chabalina, C. Gerber, L. Nigra, T. Ten
- Fermilab (FNAL)
  - M. Demarteau, A. Ronzhin, K. Sogut, L. Spiegel, S. Tkaczyk + technicians
- University of Kansas (KU)
  - P. Baringer, A. Bean, L. Christofek, D. Coppage
- Mexican Consortium:
  - Cinvestav: H. Castilla, R. Perez, A. Sanchez
  - Puebla: E. Medel, H. Salazar
  - San Luis Potosi: A. Morelos
- University of Rochester (UR)
  - R. Demina, R. Eusebi, E. Halkiadakis, A. Hocker, S. Korjenevski, P. Tipton

Manpower no longer a critical concern

**19 joined group this past year (includes 3 UCSB technicians)**

**We are in the process of adding a few more post-docs & students**

**9 left or soon to leave the group (includes KSU and 2 UCSB technicians)**

# Assembly Plates



<b>UCSB Plates</b>	<b># Fabricated (parts made)</b>	<b># Commissioned (ready to be used)</b>	<b>plates used in module production so far</b>
TOB R-phi	7	7	5
TOB Stereo	3	3	1
TEC R5 R-phi	2	2	2
TEC R5 Stereo	2	2	2
TEC R6	5	5	5
TEC R7*	2	0	0
<b>Total</b>	<b>21</b>	<b>19</b>	<b>15</b>

- ***FNAL TOB assembly plates (all used in production already)***
  - ***5 r-phi***
  - ***3 stereo***

***Total of 29 plates in the US***

# US Production Steps/Status



Task	Capacity	Manpower issues	Software Issues?	Hardware Issues
Hybrid Bonding & Thermal Cycle	84/d	Mexico has only one experienced tech.	Recently resolved	No
Module Assembly	>30/d	None	No	No
Module Bonding	>30/d	None	No	No
ARC Testing	>30/d	None	Finalizing	DEPP
LT Testing	200/wk	UCR Repair center	Finalizing	Yes
ARC LED	>30/d	None	No	No
Module Reinforcing	>30/d	None	No	No
Rod Assembly	>4/d	None	No	No
Single rod test	>4/d	2 people to be added	Yes	Yes
Multi-rod burn-in	32/wk	None		Yes

From Tony's talk in the testing meeting

## Set-up in Clean Room



- Recently upgraded to Bruno's current code

- PLL forcing
- Drifting pedestal check
- Added xml file auto-upload

- UCSB, FNAL and Mexico City thermal cycler are commissioned

- Still have a few minor "features"
  - Single channel shorts, etc.

We have all ARCS equipment+spares we need



# DAQ Equipment Status



- 2 fully equipped Vienna boxes
  - 1 slot in UCSB non-functional
- 2 single-rod stands
  - Missing TPO to use MUX
  - FNAL missing rod FEC
    - Can't run 1-rod stand **and** rod thermal cycler
- 2 multi-rod thermal cyclers
  - Both MUXs have been used to test 5 rods tested simultaneously
  - Have enough equipment to fully commission system
    - Only 2 MUX cards + DAQ spares missing

- **To instrument UCR Repair Center & have all critical spare components required in the US we need:**
  - 2 TSC – in production?
  - 5 TPO – in production?
  - 5 rod FEC
    - Picking these up Friday
  - 1 eMUX crate – 1 week away?
  - 5 eMUX boards – “ “
  - 4 oMUX boards – “ “
  - 7 CCU
    - Pick up Friday
  - 10 VUTRI - ?
  - 10 PAACB – half are built, half being assembled now
  - 19 hybrid-to-utri adaptors - ?

From Tony's talk in the testing meeting



## •With current TPOs :

- Cannot run single rod stands
- With 1 failure we lose either:
  - 70% capacity of a Vienna box
  - 1 rod system
- Cannot run more than 16 APVs in UCR stand

•Without the additional MUX, CCU, VUTRI, PAACB, hybrid-to-utri adapter boards

- Can't run UCR LT which is crucial to ops of US Repair center

## •With current TSC complement:

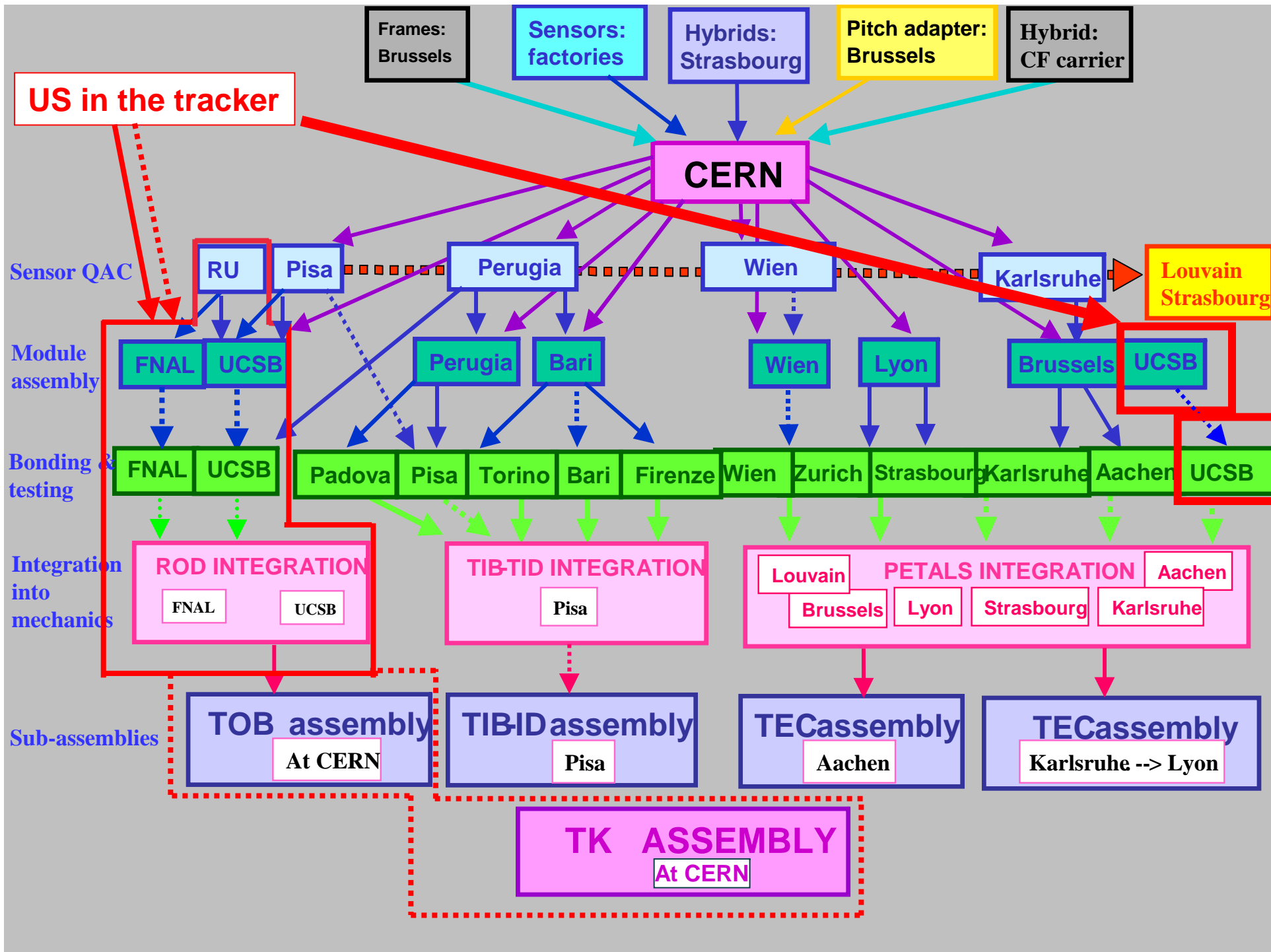
- With 1 failure we lose either:
  - 1 Vienna box
  - 1 single rod stand, or
  - 1 rod thermal cycler

•Without additional hybrid-to-utri adaptors:

- We cannot load Vienna box fast enough to run two cycles at either UCSB or FNAL.
- Would have to go to sample cold testing during production

Component shortages and failures have potential to severely limit production testing capacity which can no longer afford

- Spare sensor and hybrid tools being produced at UCSB for UCSB, FNAL and Brussels.
- Upgraded OGP computer OS and OGP software
  - Automated routine occasionally missed fiducial marks. The new software fixes this problem.
- Setting up back-up gantry computers with spare U600 controllers and expansion cards already installed.
- *Purchased backup components for every piece of production equipment or tooling that, if it were to fail, would cause a significant reduction in production.*





# UCSB TEC Production



- Miscellaneous info
  - 10 more shipping boxes (20 modules each) being made now
  - R7 plates ready for module production by end of August
  - Design for R7 module carrier and wirebond fixture is complete, started making 100 carriers: all complete within the next 2 weeks
  - All wirebond fixtures and 100 module carriers for R5 and R6 complete.
- General capacity issues
  - Could saturate our production capacity with TEC production
    - Actual rate will depend on need and availability of parts as well as TOB production parts availability and schedule
    - Another step higher in production capacity (by extending work day via overlapped shifts):
      - Bonding and Testing capacity adequate
      - LT testing capacity limit is ~100 per week but could eventually be mostly TEC if necessary (TOB burn-in shifted to rods) or sampled

- DB stability
  - For our production rates, we must automate all DB queries.
    - Need to standardize and maintain stable all data structures
  - We rely on data to be accurate and complete from all preceding processing of components and structures.
- Old or un-installable components
  - Prefer to remove them physically from our production sites and to have them properly marked in DB

- No longer have a manpower shortage
- Have studied all possible threats to production stability
  - Purchased or manufactured spares
  - Some test equipment still needed
- Studying further increases in capacity
- Systems status
  - All stages of production have been exercised and are or are near to being finalized except rod testing
    - Multi-rod stands still have substantial work ahead
      - Testing protocols are very preliminary
      - Software has made huge progress but is very fresh and evolving
      - Full coordination of multi-rod daq and chiller systems still to be commissioned