Hybrid preproduction at LBNL

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- **Stuffing** and **bonding**
- Preparation of **assembly tools**
- Test **hardware**
- Test **software**
- **Data base**
- **Test procedures**
- **Work stations/ organization**
- **Irradiation test**

Stuffing and bonding

- keep production in mind, not only preproduction
- have to identify 'best' companies
- don't want to depend too much on a single institution
- working in parallel with different companies could increase initial output (will also mean more trouble shooting)

- LBNL engineering division is very much interested in hybrid technology;
  assembling on-site is highly desirable

Stuffing and bonding (cont'd)

- **Stuffing + die attach**: 2 parties
  - Advanced Assemblies: very good, long collaboration with Carl, Francesco …
  - LBNL engineering: also good, on site, started training

- **Bonding**: 3 parties
  - Amtech, Promex: have done it before, are both interested, got detailed drawings for quote
  - LBNL: have done it before, refurbished old bonder, started using it, training bonding technician since a month (Cherie Brumfield)

- Will start in parallel with all these parties
  - more work, risk of more repairs, higher output rate
  - there is no alternative

- after first experience, will decide on future model

Encapsulation/ Repairs

- **Encapsulation:** LBNL
  - have to encapsulate bonds !
  - need to inspect test hybrid before encapsulation =>
    are preparing to encapsulate at LBNL

- **Repairs**: LBNL

  - for production want to avoid using repaired hybrids; have to minimize need for repairs
  - preproduction is a bit different: have to minimize problems but also need enough hybrids for staves etc.
  - minor fixing will happen at LBNL …
  - are relearning how to remove bad chips from a substrate…

Preparation of tools

remember: 180 hybrids in preprod., ~1200 in production

- **200 hybrid PCBs:**
  - added RTD connector, optimized layout
  - got PCBs, tested them, stuffed them all => DONE

- **200 new hybrid holder boxes:**
  - improved layout: avoid obstruction of bonder, better lid …
  - machining done, need a few more lids, order screw
  - => finish within a few days

- **got full set of new assembly tools …**
- **lab rearrangement essentially done;** was a big job !
- **got bonder fixed**
  - started regaining experience with it

- Layout of travelers and work flow sheets in progress

Test hardware

- have 3 LBNL DAQ systems up and running in parallel
  - 2 have GPIB connection to power supply
  - hardware (power supplies, I/O cards, PATT and scrambler boards) nearly identical   (makes things easier !)
  - have enough spares
- getting ready to bring up PTS
  - have all components
  - need it within ~ 3 weeks

- production of Patt3 boards for UC Davis:
  - bigger job than anticipated
  - optimized layout, fixed some bugs, got most components
  - ready to submit, if OK from Davis
  - should have stuffed boards within 3-4 weeks => in time

Test hardware (cont'd)

- upgraded lab PCs
  - 40 GB hard drives, more RAM, identical I/O (PCI bus)
  - got PTS computer (also use it for data base and htest data)
  - removed old data …
  - NSF mounted, will have backup
- still need to order additional lab microscope
- get shipping boxes etc.

Test software (see John' talk)

- Well advanced, but not yet final
  - **Basic code ready** since a while
  - implemented stand-alone tests (noise, linearity, rise time)
  - got htest on PTS; thanks to Tom and Catalin !
  - got root ntuple platform; thanks to Satyajit; got flat ascii coded
  - are preparing tools to use it at Co-60 and SEU tests
  - **Need to agree on frequency, set of tests, value of cuts** (this is an iterative process)
  - have to finish manual

Data base (see Wajohn's talk)

- contains everything related to hybrids
  - this includes wafer probing data
  - also bus cable data will be stored there
- well advanced, but not yet finished
  - work on data base by UC Davis is a big contribution !
  - finishing data base is a high priority !
- have to get experience with data base
- please check it out and comment
- You may even want to use it !

Test procedures

- **Bare hybrids**
  - visual inspection
  - power trace shorts/opens
  - data base/ travelers
- **Stuffed hybrids** (including SVX4 chips)
  - visual inspection + power checks as above
  - probably at AA for AA hybrids and at LBNL for LBNL engineering hybrids
  - data base/ travelers
- **Bonded hybrids initial tests**
  - visual inspection
  - power open/shorts, power consumption
  - pedestal, charge injection, noise levels, readout errors
  - if necessary repair (not yet well defined)
  - initial tests will take a few minutes only and catch all trivial flaws
  - work bench for initial tests is also used for debugging of bad hybrids
  - data base/travelers

- **Automized testing using htest package**

Test procedures (cont'd)

- Encapsulated hybrids
  - will encapsulate after automized tests for now
  - may encapsulate after sucessful initial tests eventually

  - repeat initial tests
  - repeat automized test using htest

- Burn-in at Davis
- Final OK using PTS/htwish at FNAL
  - it's time to identify the person(s) responsible for it now

Work stations/ Organization

- ▪ 1 bonding machine + 1 person:
  - • eventually _ day could be enough to deliver 8 hybrids/day; this ignores the contributions of companies

- ▪ 1 initial hybrid test work station (bonded hybrids)
  - • initial tests are very fast < 1 hour/day
  - • => use work station for debugging bad hybrids mostly
  - • difficult job => need 2 experienced persons
  - • fast feedback to eliminate production flaws is important

- ▪ 2 work stations for automized hybrid tests (htest)
  - • run 2 hybrids in parallel => 2 DAQ systems, 1 person
  - • should be <2 hours/day at nominal rate (8/ day)

- ▪ Shipping/receiving/database area
  - • Set up quiet and large area, additional cabinets
  - • used for ~2-4 hours per day
  - • 1 person

Organization (cont'd)

- Biggest uncertainty is initial quality of hybrids and time/effort needed for debugging/ trouble shooting
- => have 2 persons with hopefully sufficient time to deal with that

- Going with various vendors risks producing more low quality products initially…
  - this is OK, will pay off during production
  - should have necessary resources for repairs eg. manual gold ball bonder…

Irradiation tests

- **Co-60** total dose (gamma ray) test
  - was scheduled for August 6-7
  - will reschedule due to shift in hybrid delivery
  - irradiate 1 hybrid (not single chip) to about 20 MRad
  - rate is 1.5 Mrad/hour
  - run htest every hour or so
  - online data evaluation using flat ascii/root ntuples …
  - only in case of unexpected behaviour, will consider irradiating a single chip on a PCB
- **SEU test**
  - scheduled for September 4-5 at UC Davis p-cyclotron
  - irradiate 1-2 hybrids, as above
  - booked 16 h, may not need that much
  - have to revisit SEU code

Other issues/questions

- CPT should deliver 180 hybrids (= 30 staves)

- be prepared to get less at FNAL:
  - things will go wrong here and there
  - we will spent 1-3 for irradiation tests

- should we load big analog decoupling cap ?
  (outside of Greg's allowed region for preprod.)

- add resistor chip and bond it for all hybrids ?
  (FNAL will have to break bonds for 4/6 hybrids)

Summary

- preproduction is about to start !

- have worked very hard and should be in good shape
  - I wonder what we overlooked…

- Will have a few exiting and busy months ahead of us !