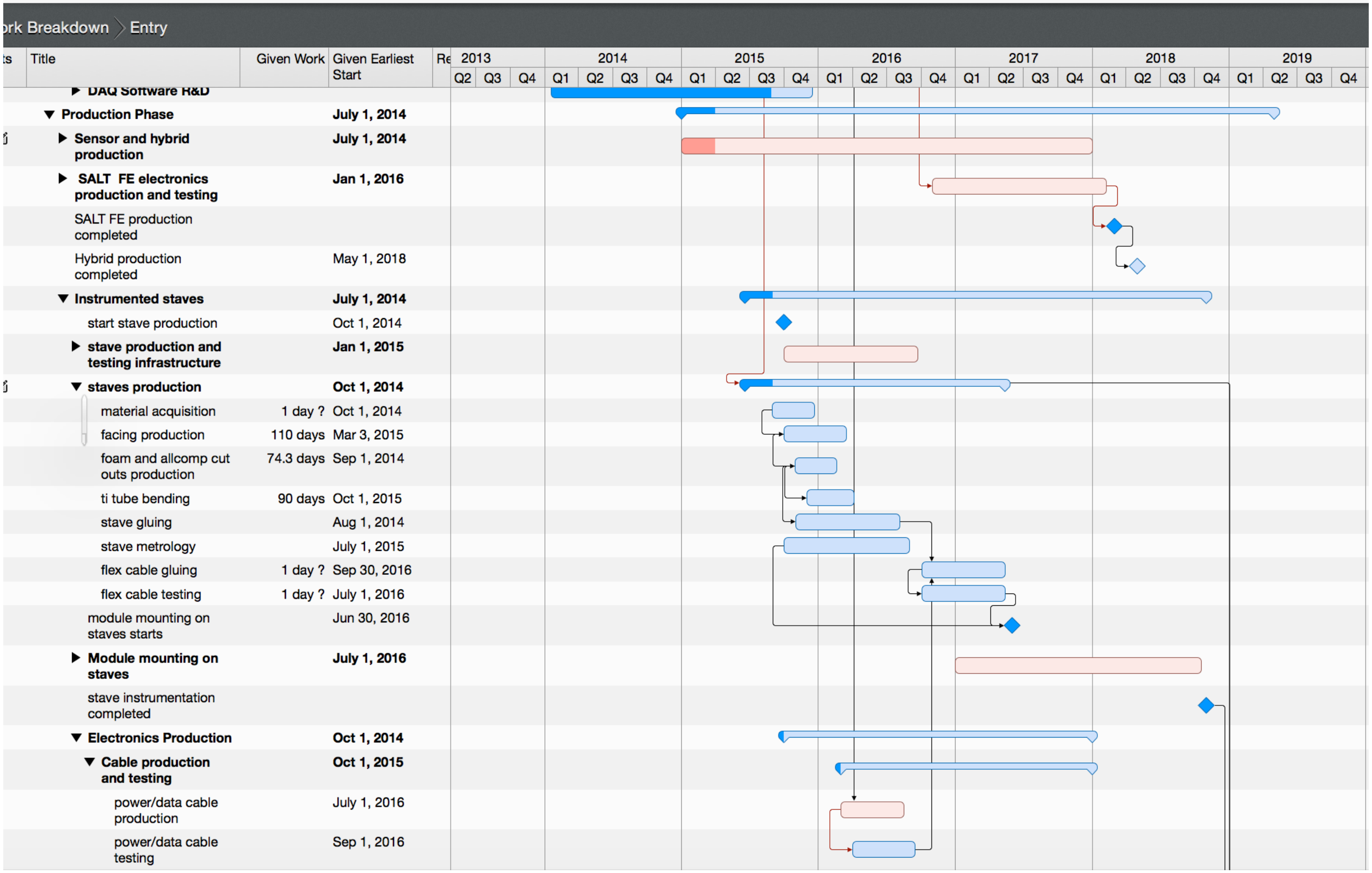
# Man/Women-Power Considerations for Construction

.

Sheldon Stone, Syracuse University

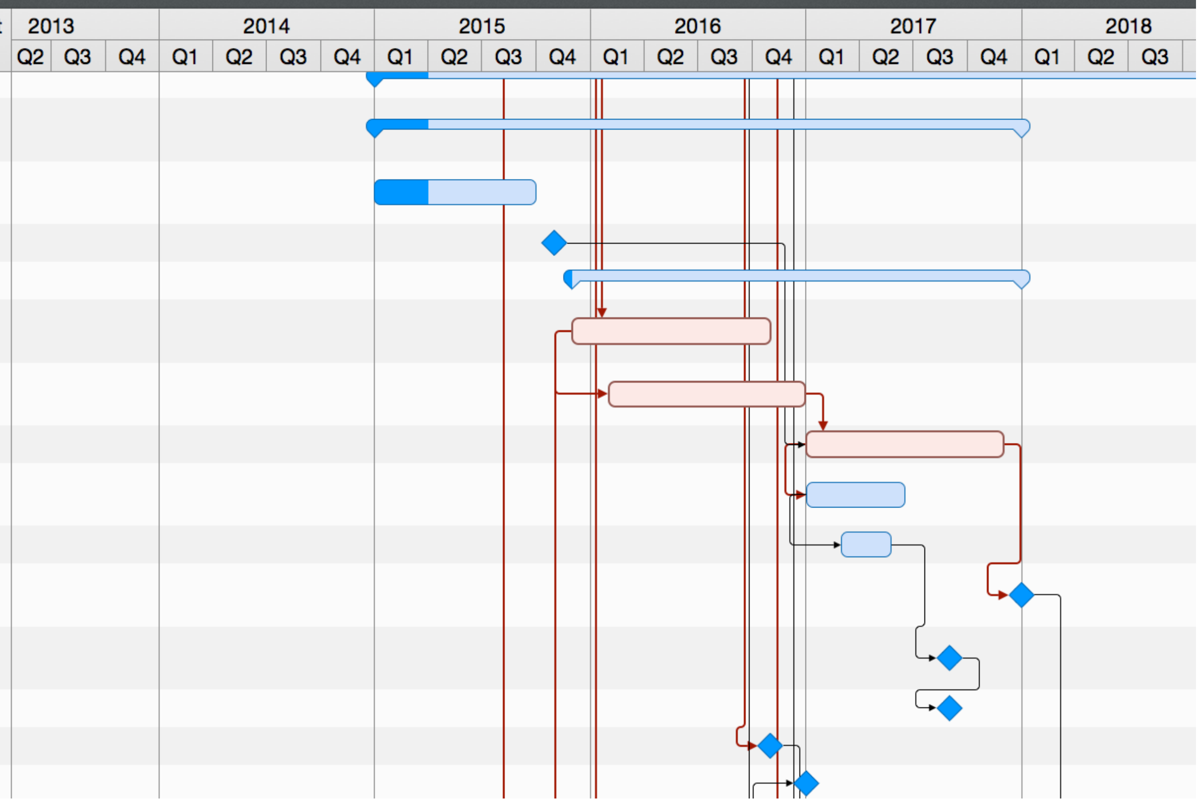
# Critical path items



# Sensor production is in the critical path

Work Breakdown > Entry

| # | Traits | Title | Given Work | Given Earliest Start |
|---|---|---|---|---|
| 84 | | **▼ Production Phase** | | **July 1, 2014** |
| 85 | | **▼ Sensor and hybrid production** | | **July 1, 2014** |
| 86 | | **▶ sensor infrastructure development** | | **May 1, 2014** |
| 90 | | sensor production starts | | |
| 91 | | **▼ sensor production** | | **April 1, 2015** |
| 92 | | sensor a preproduction | | Oct 15, 2015 |
| 93 | | sensor a preproduction testing | | Feb 15, 2017 |
| 94 | | sensor a production | 12 months | |
| 95 | | sensor b,c,d production | 1 day ? | Nov 30, 2016 |
| 96 | | sensor b,c,d testing | 2 months | July 1, 2015 |
| 97 | | sensor a production completed | | July 1, 2016 |
| 98 | | sensor b,c,d production completed | | July 1, 2017 |
| 99 | | sensor production ends | | |
| 100 | | Salt production starts | | Feb 1, 2016 |
| 101 | | Hybrid production starts | | Jan 1, 2016 |



# RISKS

# Schedule Risk

- Critical situation is already upon us due to delays
  - Data flex - >~6 months behind schedule
  - Hybrid - Need a preliminary design drawing immediately, especially giving Salt position to start Stave construction
  - Salt - hopefully on track now, can expect working chip by end of July, but needs to be tested & refined

# Materials risk

- Silicon sensors
  - Design protoype was done using a sole source, Hamamatsu. (Could not be avoided as Micron did not give a realistic price for prototypes)
- Other parts
  - Procurement of cables also a potential problem even if protoypes work
  - Other parts need to be ordered expeditiously (Ti tubes, CBF…)
  - Electronic components

# Electronic risk

- Salt takes more than estimated power (6mW/channel)- Pepi cannot supply enough power
- Noise level is too high as determined in slice test
- Mitigation strategy causes time delay & more cost, needs redesign of either Pepi, Salt, or both

# Electronics box risk

- ❑Can box be assembled and fit all the components?
- ❑Will grounding scheme work, or will noise be too much? Should be able to test this as we install staves.

# Testing risks

- Incur more schedule delays because testing systems are not yet ready
- Is the Salt testing system ready? If not when will it be ready? (this is on the critical path). I am talking here not only of tests on the next chip version, but also the production version
- This is still under our control, lets not let the testing systems setups slip (cables, hybrids, electronics, fully populated staves).

# Shipping risk

- Obvious hazards in trans-Atlantic transport
  - Mitigation: early construction and testing of transport device. (Design is already done)

# Financial risk

- Running over budget on any component is a problem here
- As there is no contingency any item over run needs to be replaced by cost saving elsewhere
- This problem is made worse by the accumulated project delays

# Manpower risks

- Is there adequate manpower to get everything done in the remaining time? This is for each group to answer.
- Mitigate by starting stave construction now

# Construction tasks

- Work at all institutions: Chip testing, electronics testing, at CERN: detector box,  testing finished modules after shipment, mounting in box….
- Electronics production (Maryland)
- Machining (Cincinnati)
- Data flex & hybrid production (Milano)

# Available person power

| WBS# | Subsystem | Contact Person | Physicists | Software pros | CERN | AGH | Cinn | Maryland | Milan | Syr | Zurich | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Upstream Tracker | Marina Artuso | | | | | | | | | | |
| | | | | | | | | | | | | |
| **1** | **Sensor and hybrids** | **M. Rudoff, M. Citterio** | **7** | | | | | | | | | |
| **1.01** | Sensor | | 4 | | | | | | | 4 | | 4 |
| **1.02** | Front-end hybrid | | 3 | | | | | | 3 | | | 3 |
| **2** | **SALT ASIC** | **M. Idzik, K.Swientek** | **6** | | | | | | | | | |
| **2.01** | Asic production | M.Idzik | 6 | | | 4 | | | | | | 4 |
| **2.02** | Testing | O. Steinkamp | | | | | | | | | 2 | |
| **3** | **Electronics** | **T. O'Bannon J. Wang** | **7** | | | | | | | | | |
| **3.01** | Flex cables | | 3 | | | | 1 | | 1 | 1 | | 3 |
| **3.02** | PEPI electronics | | 4 | | | | | 4 | | | | 4 |
| **4** | **DAQ/Electronics infrastructure** | **C. Beteta** | **6** | **2** | | | | | | | | |
| **4.01** | Tell40/sol40 boards/crates | C. Beteta, J. Wang | 4 | 2 | | | | | | 1 | 1 | 2 |
| **4.02** | HV/LV/cabling | C. Beteta | 2 | | | | | | | | 2 | 2 |
| **5** | **Mechanics and Cooling** | **R. Mountain, S. Coelli** | **11** | | | | | | | | | |
| **5.01** | Cooling plants | S. Coelli | 2 | | 1 | | | | 1 | | | 2 |
| **5.02** | Staves and hybridization | R. Mountain | 9 | | | | | | | 9 | | 9 |
| **6** | **Integration with LHCb** | **B.Schmidt, N. Neri** | **1** | | | | | | | | | |
| **6.01** | Frame and detector box | | 1 | | 3 | | | | | | | 3 |
| **7** | **Integration and testing** | **S. Blusk, T. Skwarnicki** | **4** | | | | | | | | | |
| 7.01 | Module and stave wirebonding | | 2 | | | | | | | 2 | | 2 |
| 7.02 | Test infrastructure | | 2 | | | | | | | 2 | | 2 |
| | | | | | | | | | | | | |
| **8** | **Project management** | **M. Artuso** | | | | | | | | | | |
| **8.1** | sensor and hybrids | M. Artuso, M. Citterio | | | | | | | | | | |
| **8.2** | salt asic | M. Idzik | | | | | | | | | | |
| **8.3** | Electronics | T.O'Bannon, J. Wang | | | | | | | | | | |
| **8.4** | Mechanics and cooling | R. Mountain, N. Neri | | | | | | | | | | |
| **8.5** | Electronics Infrastructure | C. Beteta | | | | | | | | | | |
| **8.6** | Integration in LHCb | B.Schmidt ,O. Steinkamp | | | | | | | | | | |
| **8.7** | Integration and testing | S. Blusk and T. Skwarnicki | | | | | | | | | | |
| | **TOTAL** | | **42** | **2** | **3** | 4 | 1 | 4 | 5 | 19 | 5 | |

# STAVE CONSTRUCTION

# Syracuse tasks

- Construct bare staves (metrology)
- Test & glue on dataflex cables (metrology)
- Test hybrids
- Construct modules & test them (metrology)

# Syracuse tasks II

- Glue modules to staves (metrology)
- Wire bond modules
- Test modules & full staves electrically
- Package and ship to CERN

# Manpower situation

- Generally we need to use the people we have
- Syracuse
  - 5 faculty @ ½: 2.5 fte contingency only
  - 5 grad students: 2.5 fte
  - 2 Res. Prof. & 2 postdocs: 2 fte (other UT tasks, procurements, oversight….)
  - 10 undergraduates @ 20%: 2 fte,
  - 1/2 tech: 1/2 fte
  - Total time: 7*40=280 hr/week, yearly total 13,000 hours (46 weeks)
  - Contingency = 100 hr/week, 4,600 hours

# Construction Time Estimates

| Item | Manpower time |
|---|---|
| bare staves | 1360 hours |
| Test and glue data flex (320) (metrology) | 960hours |
| Test hybrids (use test bonds) | 1000 hours |
| Unpack Si inspect and test | 2000 hours |
| Construct modules & Test | 1400 hours |
| Glue modules to staves | 600 hours |

# Construction Time Estimates II

| Item | Manpower time |
|---|---|
| Wire bond modules to flex | 2300 hours |
| Measure Si positions | 320 hours |
| Cool down stave and test | 320 hours |
| Test full stave electrically | 160 hours |
| Vibration free stave transport system | 1000 hours |
| Package for shipment to CERN | 200 hours |
| TOTAL | 11600 hours |

# Bare stave tasks

- Bend tubes – 2 hr
- Braise tubes & test – 1 hr (testing)
- Cut Carbon fiber faces – 30 min
- Mount 1st side facings to vacuum jig & mount on granite table – 20 min
- Glue end blocks to facing – 1 hr
- Glue on foams – 4.5 hr
- Cut trough for cooling tube (shop)

# Bare stave tasks II

- Epoxy in tube - 1 hr
- Glue carbon foam over tube and opposite side facing - 1 hr
- Trim facings - 30 min
- Glue in ultem inserts -1 hr
- Metrology & other tests including cool down -2 hr
- Move to storage - 10 min
- Ancillary (little things) – 1 hr
- Total: 14 hours
- Times 80 staves= 10 hr

# Summary

- Sufficient manpower to do the project at Syracuse
- Spatial needs within the clean room are an issue
- Propose starting bare stave construction now in order to use available manpower and finishing this task before others. Otherwise we have unused manpower