LNS
LABORATORY FOR
NUCLEAR SCIENCE

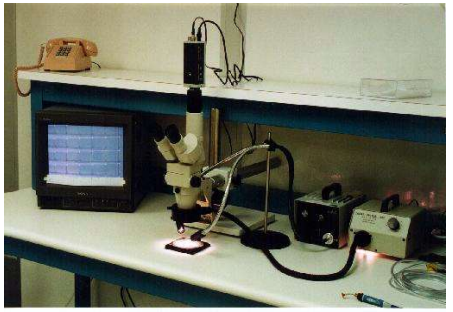
Silicon Capabilities

Gerrit van Nieuwenhuizen
STAR Tracker Meeting
MIT, Nov. 7, 2003

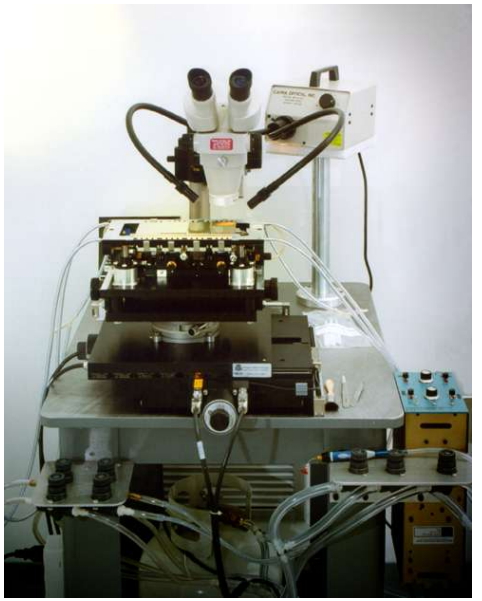
Silicon Lab Infrastructure

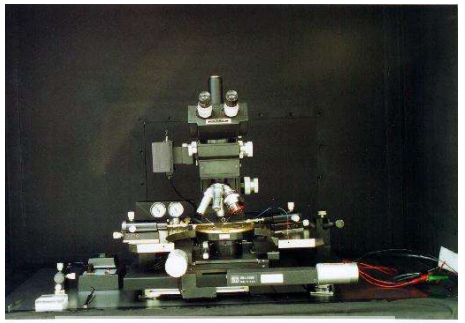
Hughes 2470-V bonder

Inspection stations



Gluing Station





Probe Station

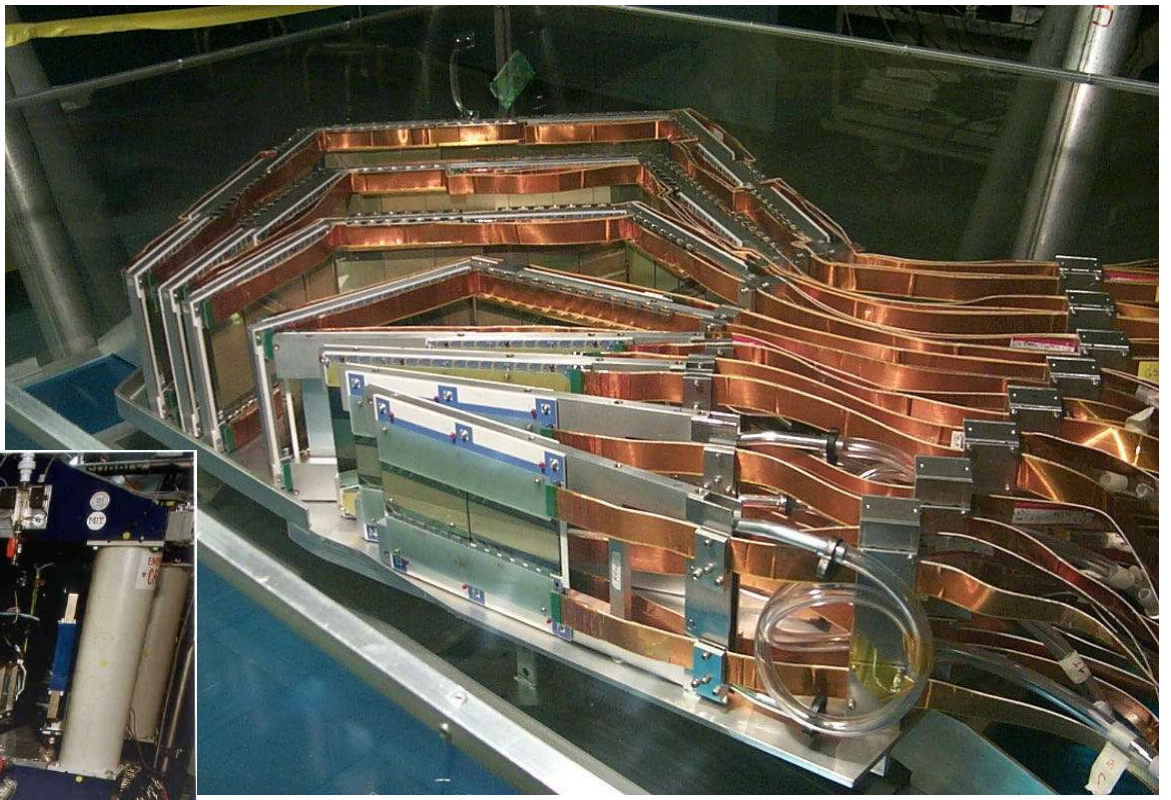
Clean Room

Survey Station

Source Test Stations

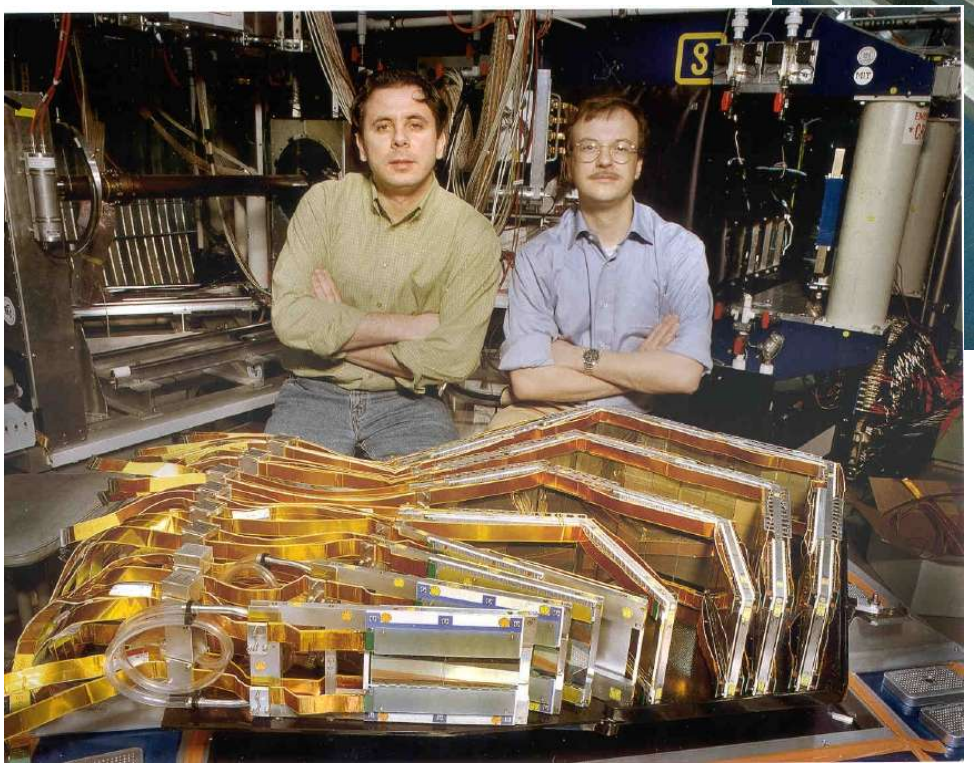
Wow, great, so what did you do with it?.....

Two PHOBOS Spectrometer Arms



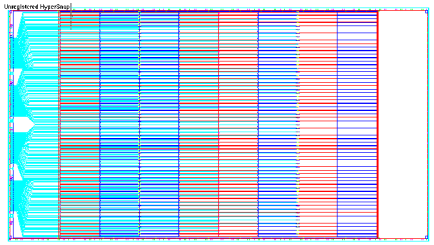
Negative Arm (1999)

Positive Arm (2001)

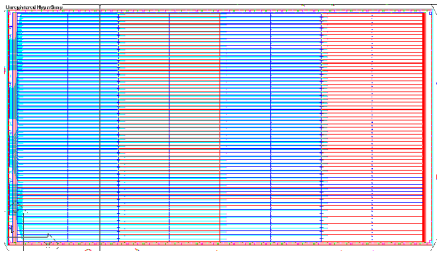


Light in the Tunnel, this is what it took.....

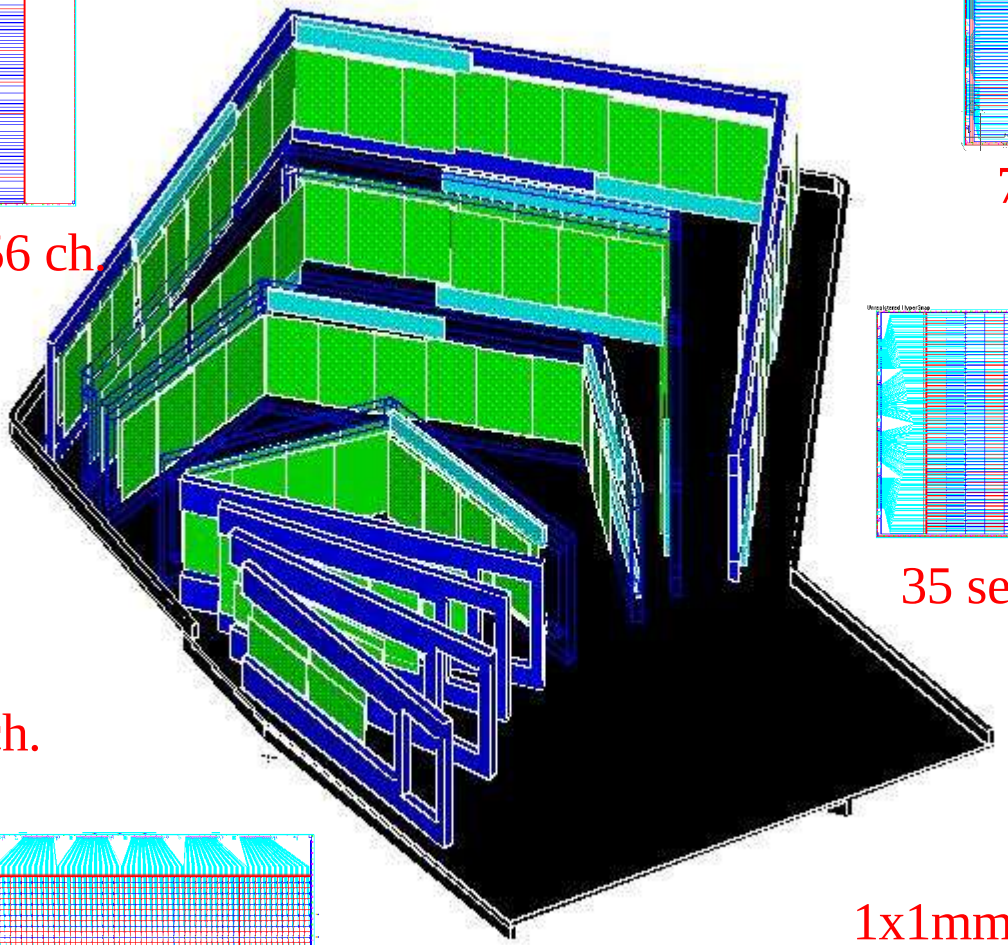
5 Sensor Types

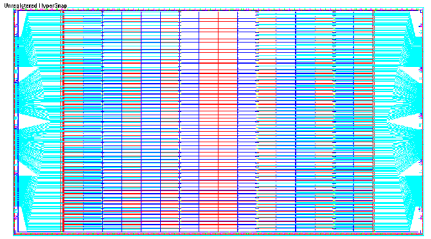


28 sensors x 256 ch.

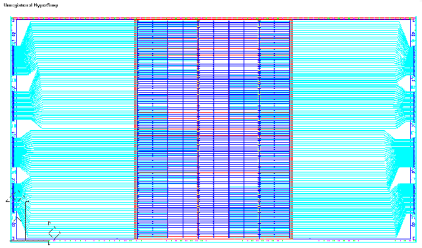


76 sensors x 256 ch

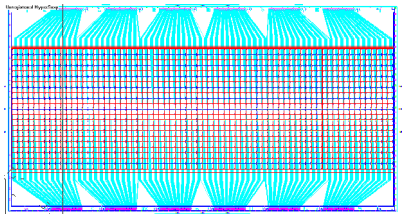




35 sensors x 512 ch.



21 sensors x 500 ch.

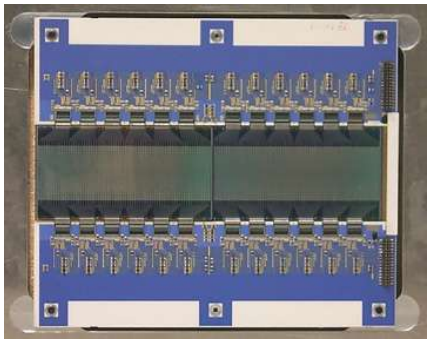


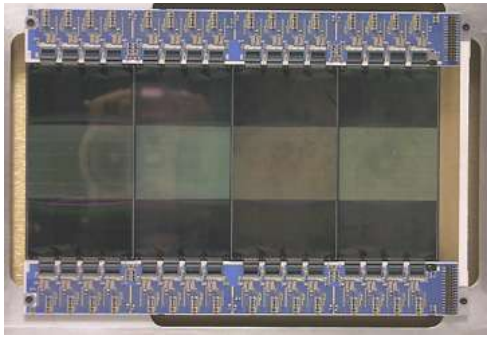
12 sensors x 1536 ch.

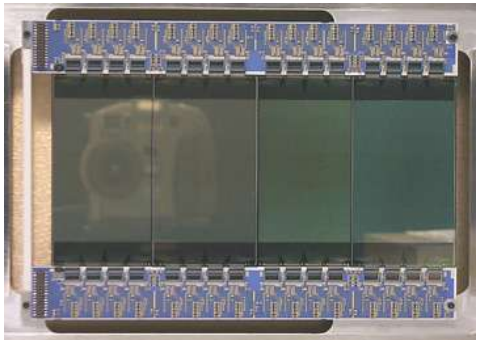
1x1mm to 0.7x19mm pads
73728 channels/arm

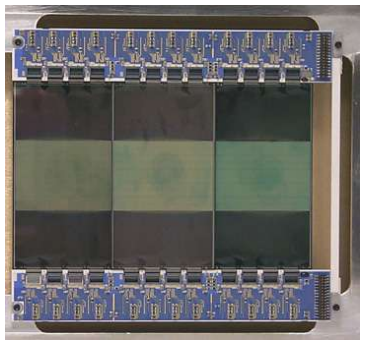
Total of 172 Sensors per Spectrometer Arm, mounted on.....

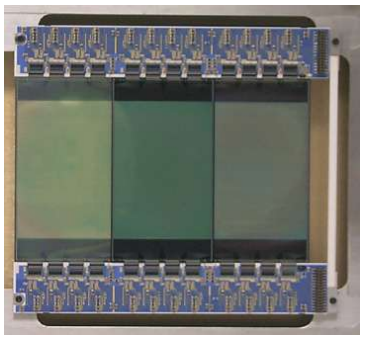
9 Module Types

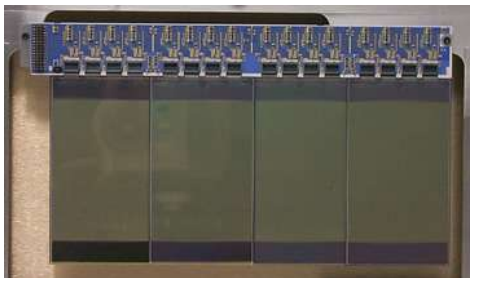
6* 

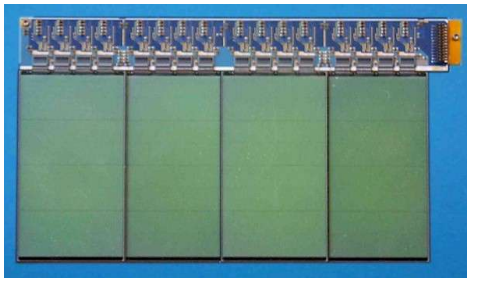
3* 

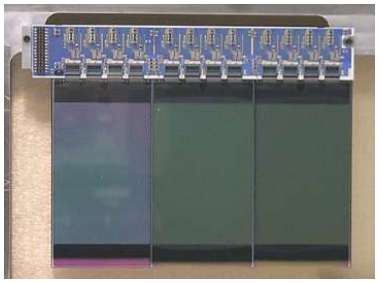
5* 

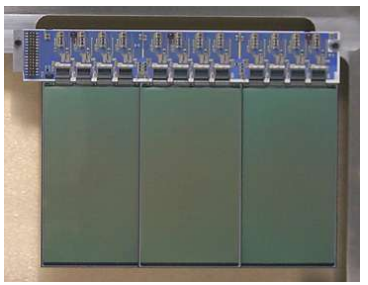
3* 

5* 

4* 

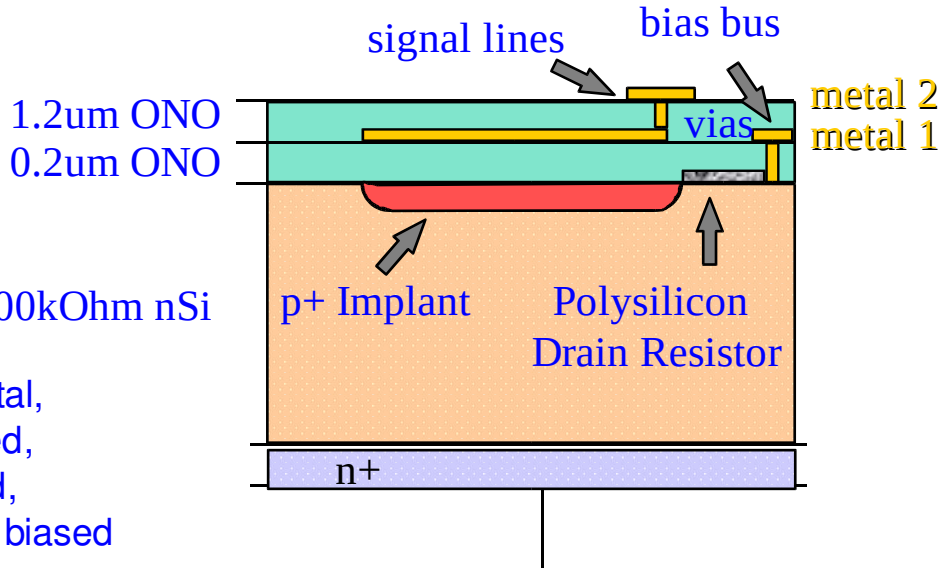
7* 

4* 

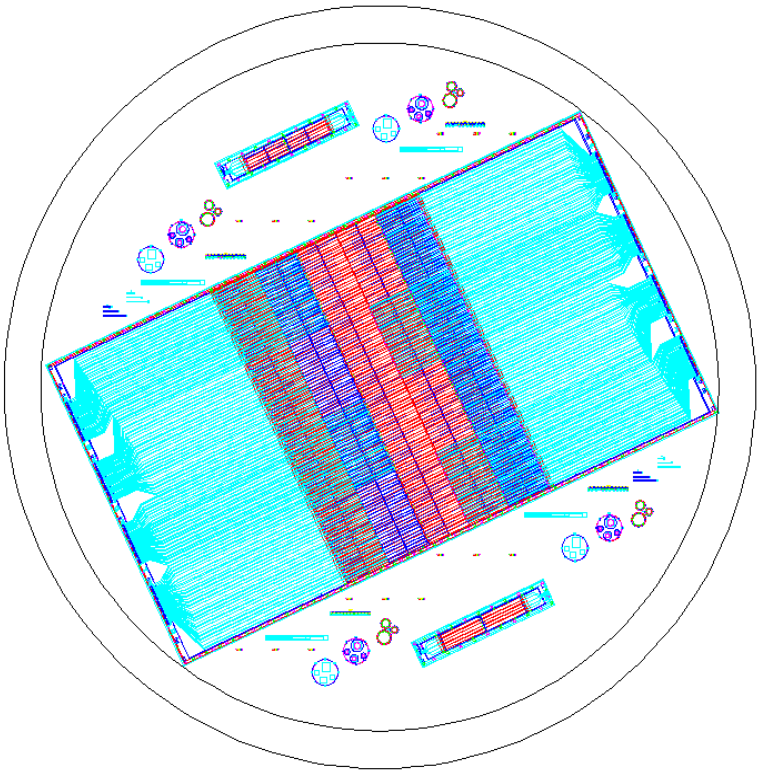
16* 

Total of 53 Modules per Spectrometer Arm

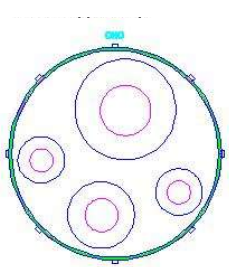
Silicon Sensor Testing: TestKeys



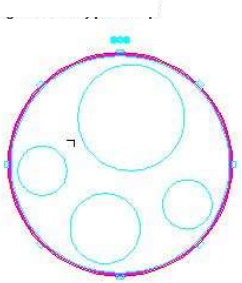
Double Metal,
Single sided,
AC coupled,
Polysilicon biased



TestKeys



Thin ONO



Thick ONO

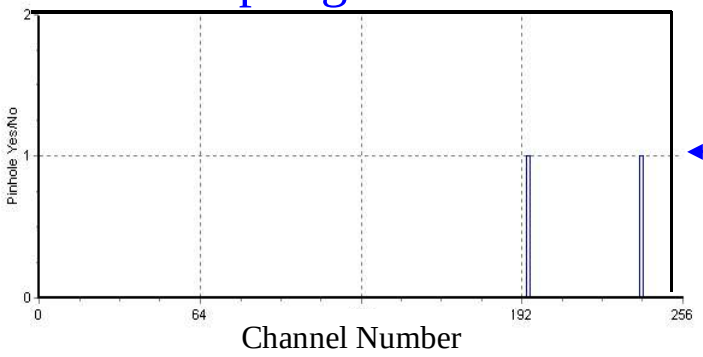
PN junction

Polysilicon

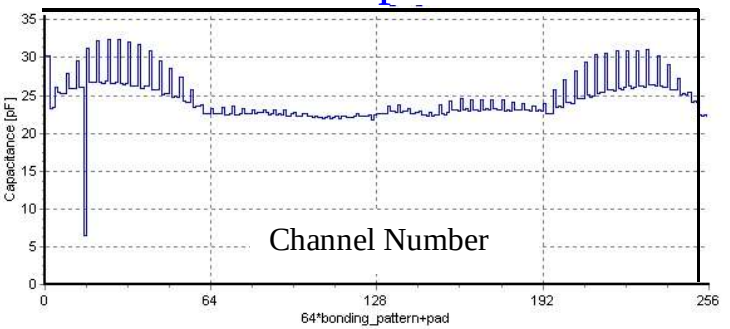
Testing Time negligible when compared to .....

Silicon Sensor Testing: Scans

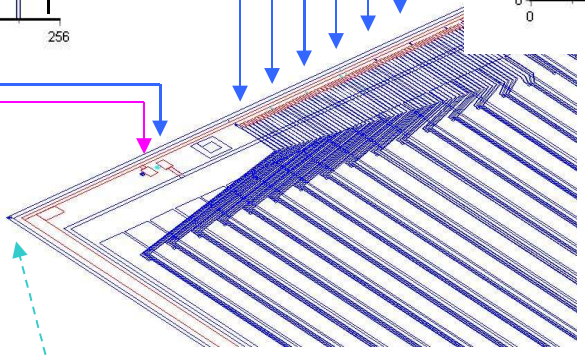
AC coupling Pinhole Scan



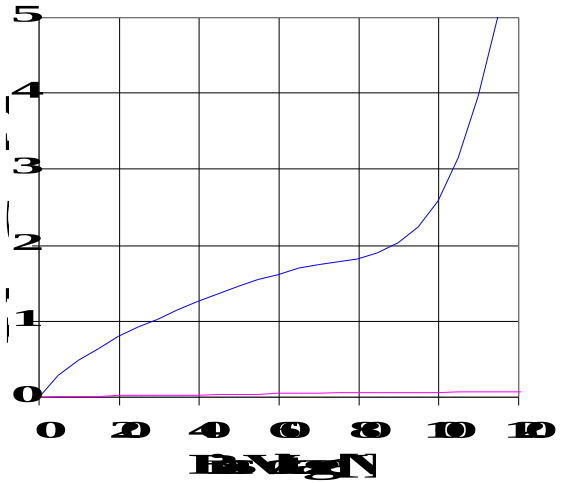
Sensor Pad Capacitance Scan



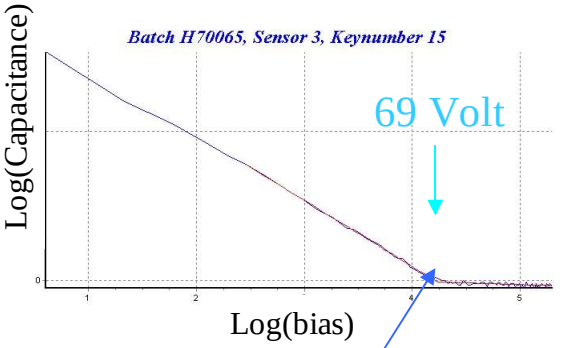
Automatic Probing

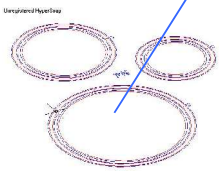


Leakage Currents

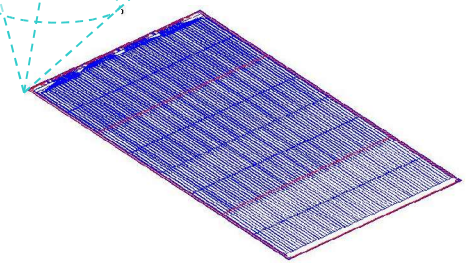


Full Depletion Voltage



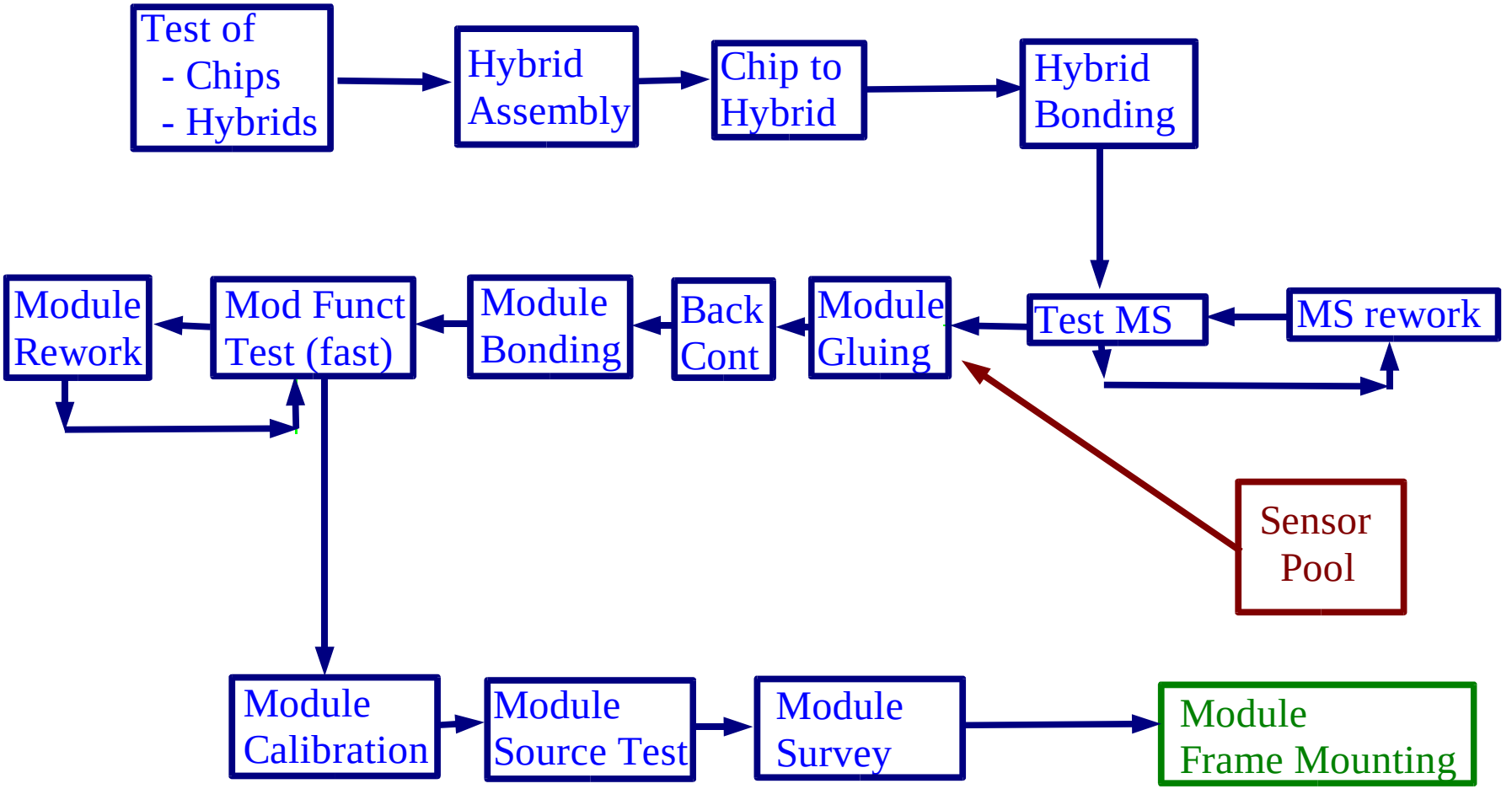


PN Testkey



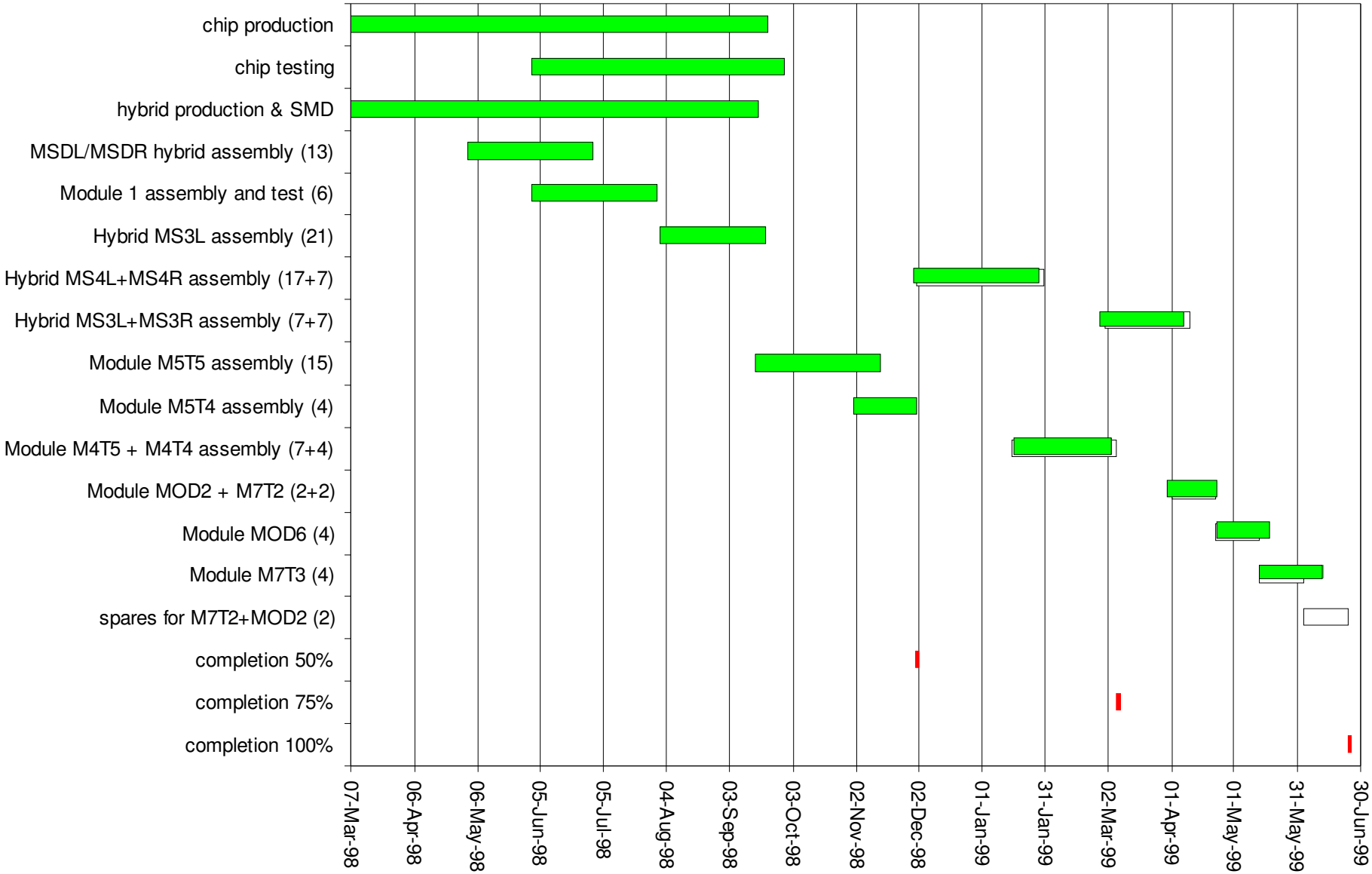
Each Scan takes about 10 seconds per Pad!

Module Assembly & Testing



That's a lot of work, how long did it take?.....

Time to Completion



Everything got build in a bit more than a year

Quality control simplified by.....

Information Management

Sensor Tests

Assembly

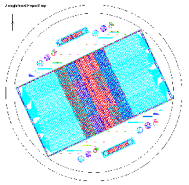
Module Tests

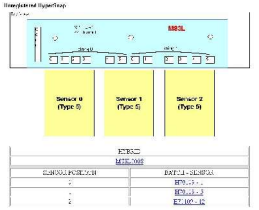
LabVIEW

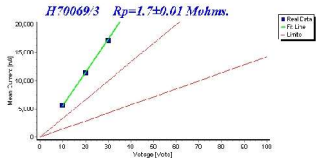
LabVIEW

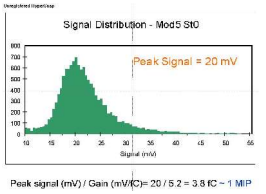
ORACLE

Phobos-srv









Peak signal (mV) / Gain (mV/fC)= 20 / 5.2 = 3.8 fC ~ 1 MIP

Si-Tracker Very Rough Estimates

- Geometry similar to STAR Si-Drift-Det
  - Radius = 6.9, 10.8, 14.5cm
  - Length = 25.2, 37.8, 44.4cm
- Assume strip sensors:
  - Size = 4x8cm
  - Pitch = 100um => 400 channels per sensor
  - 11, 17, 23 ladders => 51 total
- For 3 stereo layers gives a total of:
  - 512 sensors
  - 204800 channels
- Comparable to PHOBOS (if sensor yields better)

Conclusion

- MIT/LNS Si-Tracker modules
  - We have the facilities
  - We have experienced people
  - We have proven to deliver (PHOBOS)
- Time needed to build a 3(6) layer tracker modules
  - Assuming continuous delivery of parts
  - Assuming high sensor yield
  - 1 year