Inner STAR Tracker proposal

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STAR TUP review
BNL, Dec. 7, 2006

Inner STAR Tracker Specs

- Fits in between HPD and SSD $-1 < \eta < +1$
- Material budget $\leq$ 1.5% X_o per layer
- Resolve individual beam bunches (213 ns)
- Handles RHIC II luminosities
  (AA: $90 \cdot 10^{26}$ cm^{-2} s^{-1}, pp: $4 \cdot 10^{32}$ cm^{-2} s^{-1})
- Handles central 200 GeV Au+Au occupancy
  (1 particles per cm^2 at first layer)
- Minimize hit ambiguities, i.e. ghosts
- Good pointing accuracy to HFT
  ($\leqslant$ 150 μm for 750 MeV Kaons)
- Good vertex resolution for 500 GeV p+p

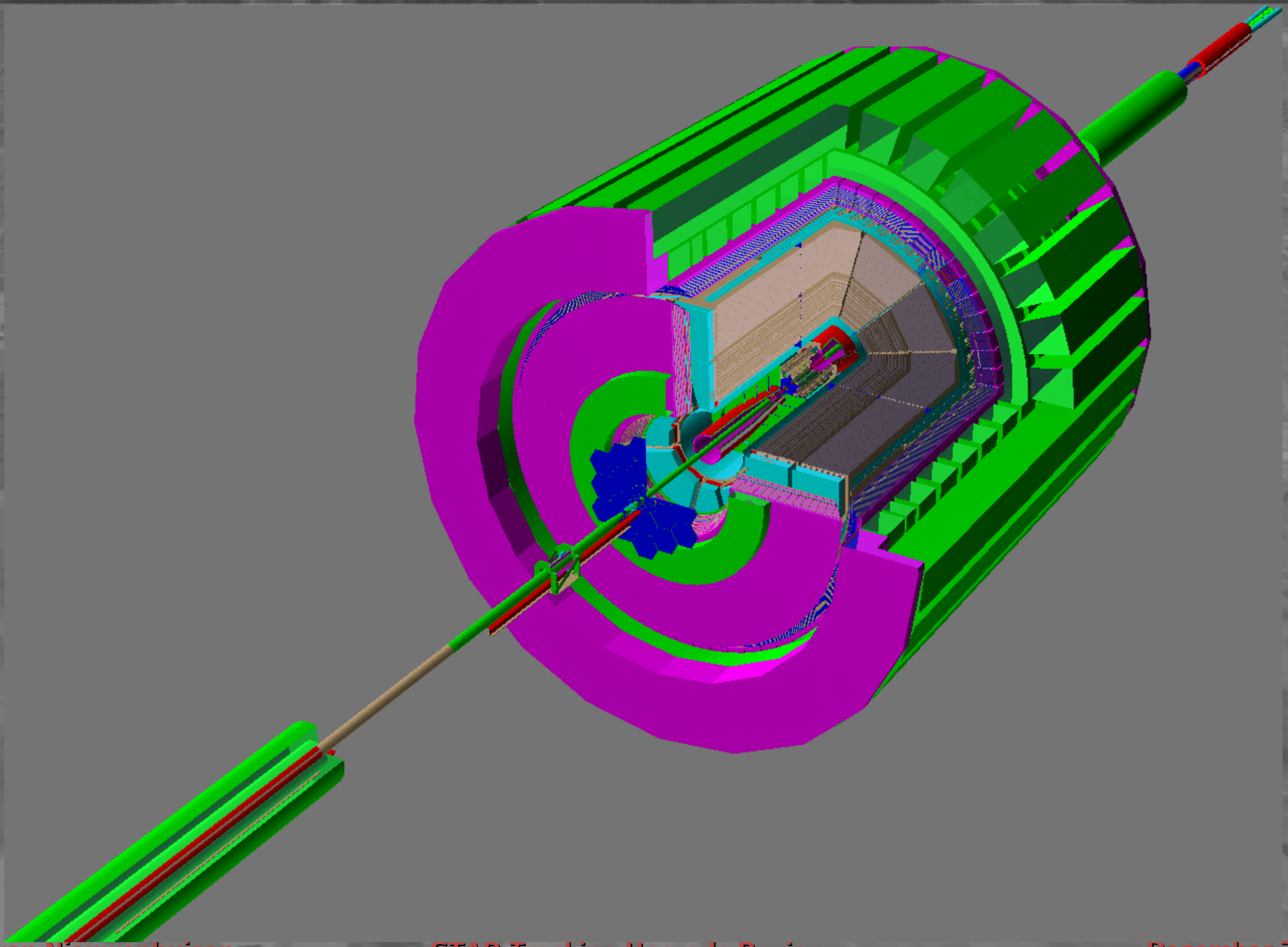
IST technology choices

- Conservative approach to minimize risk
- Build upon existing expertise

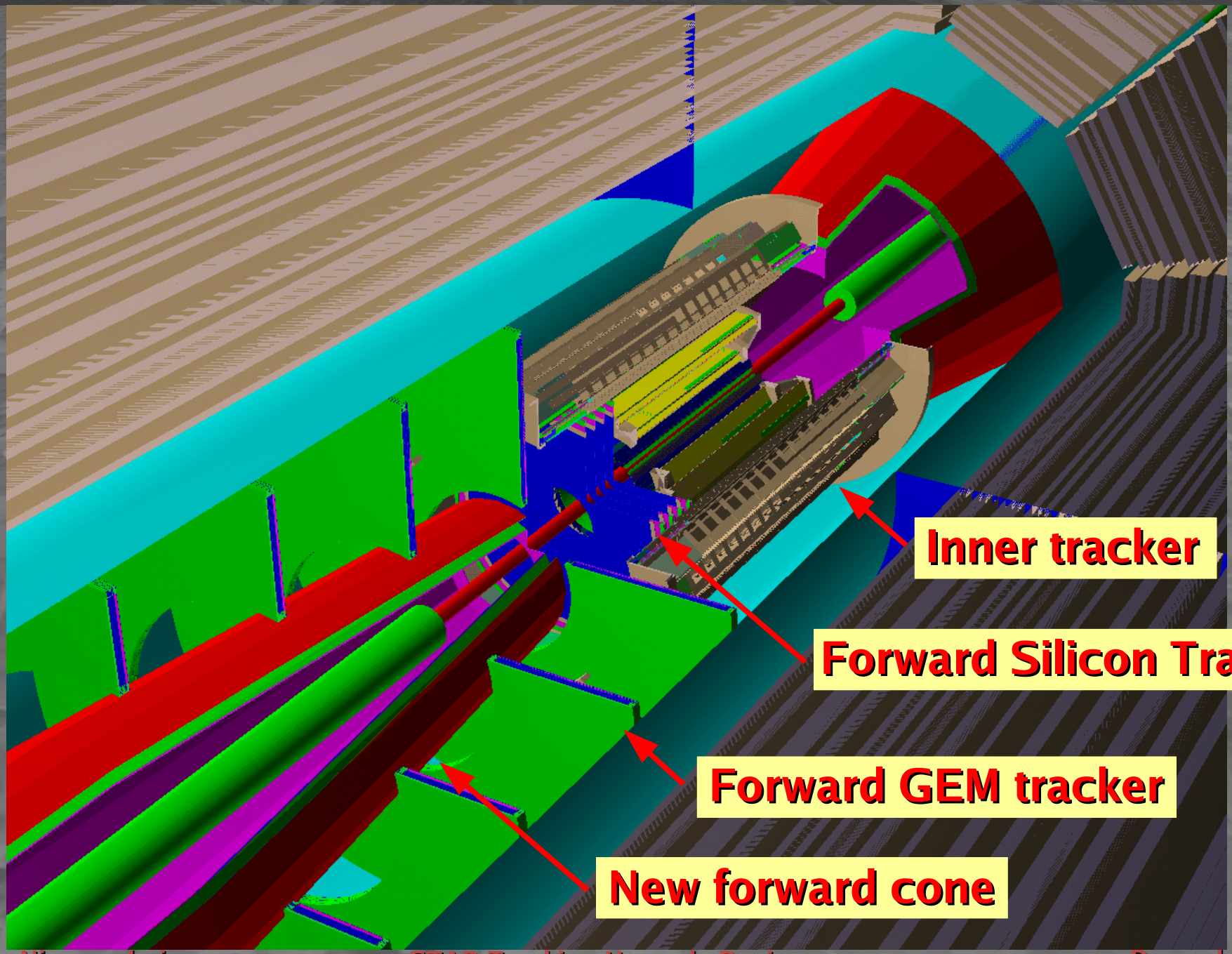
- Single sided silicon from commercial vendor
  - proven reliable technology
  - MIT-LNS silicon labs (PHOBOS

- Off the shelf readout chip, CMS APV25-S1

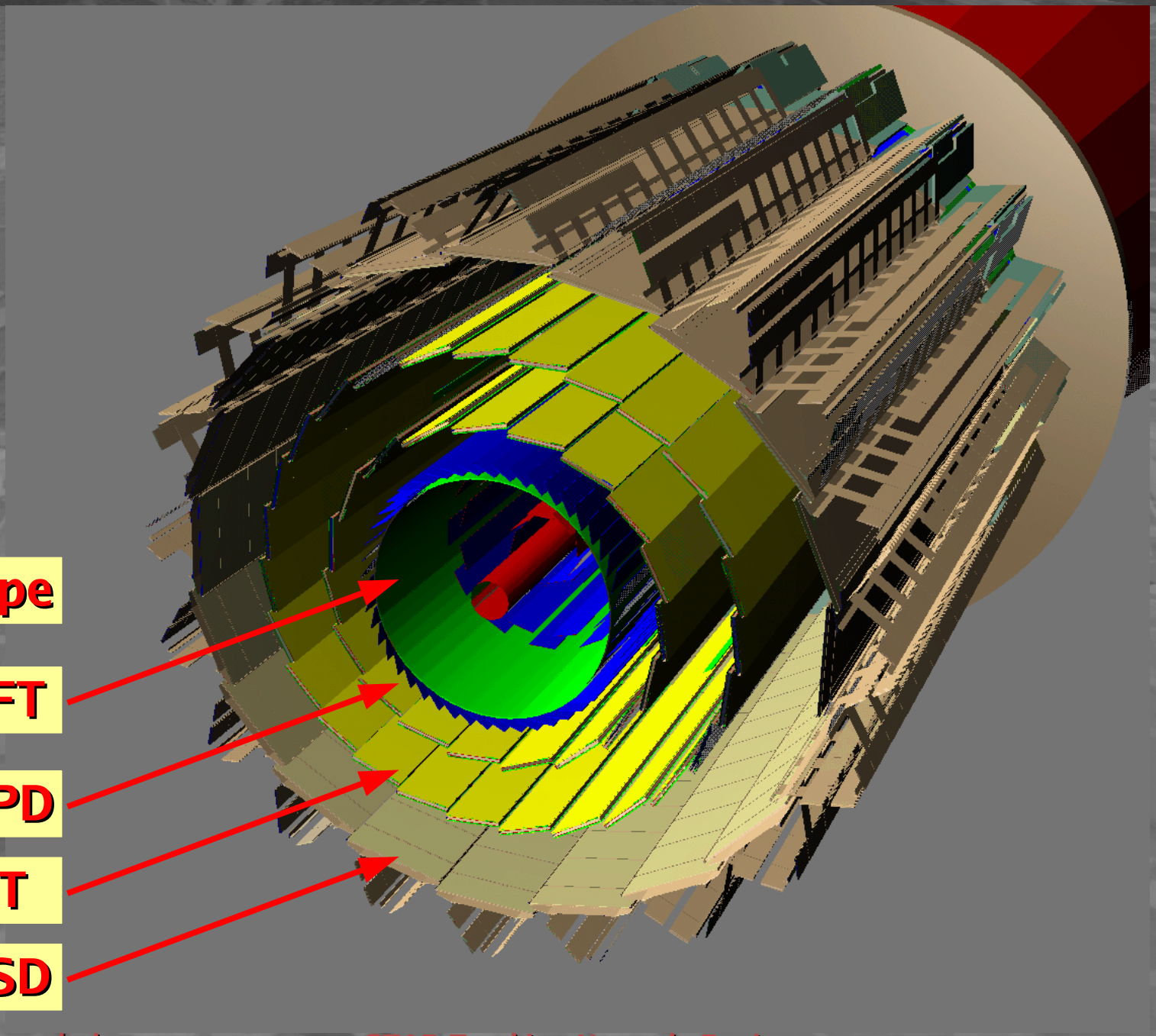
Tracking Upgrade in STAR



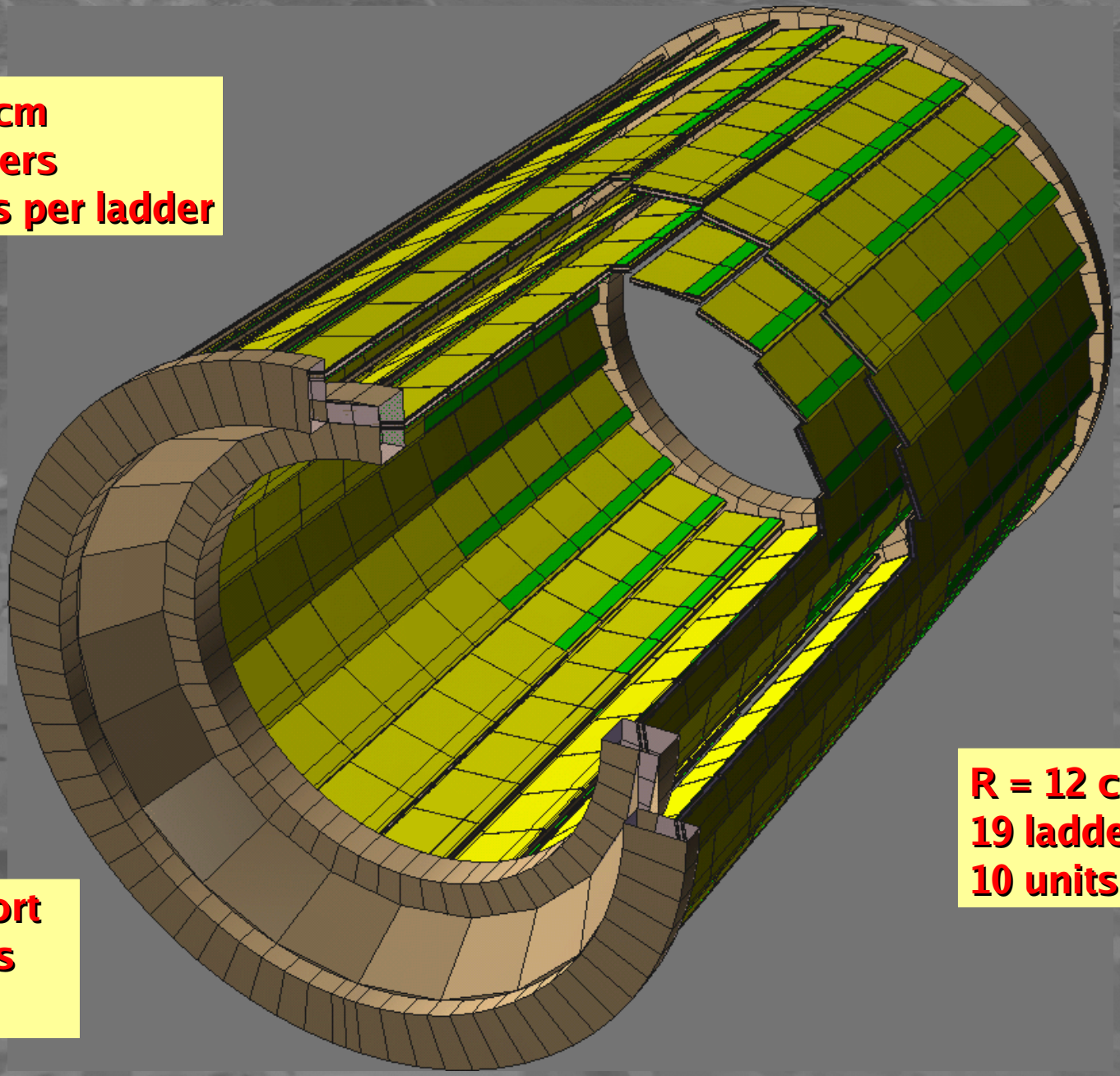
CloseUp Tracking UPgrade



The IST in the Tracking UPgrade



The 2 IST Barrels

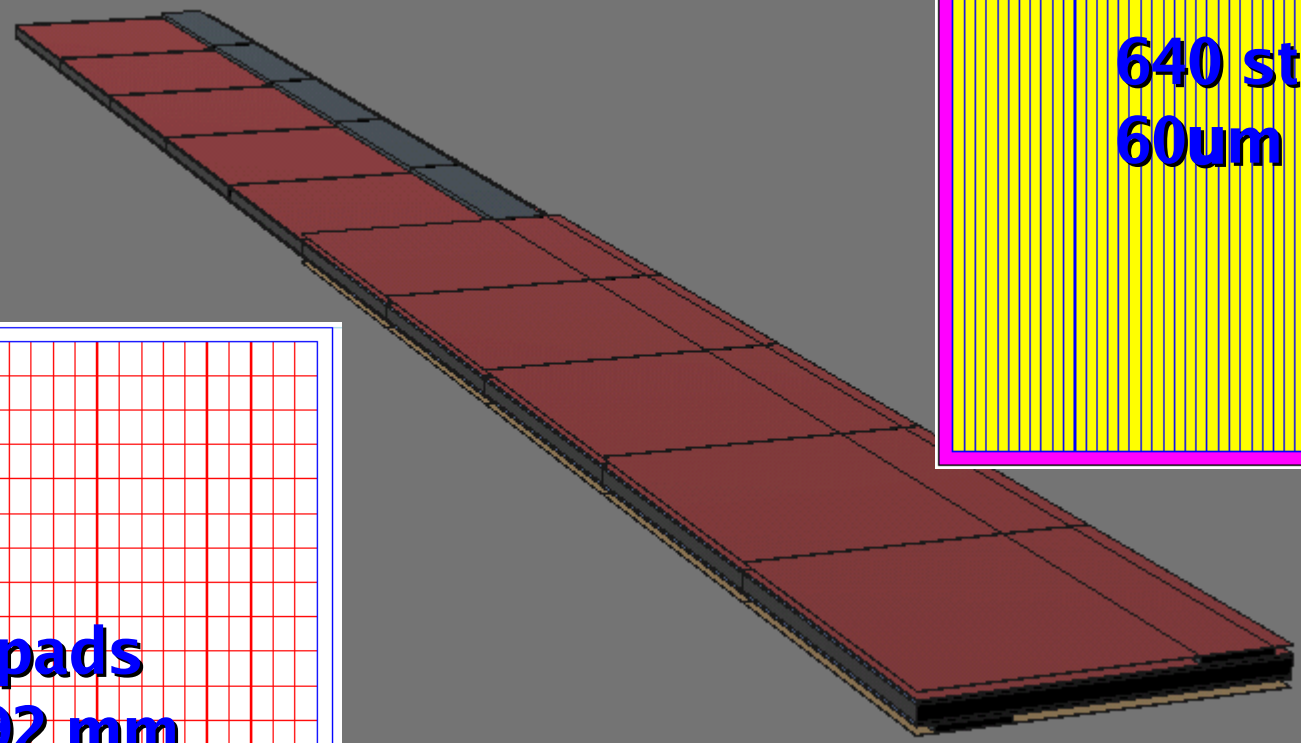


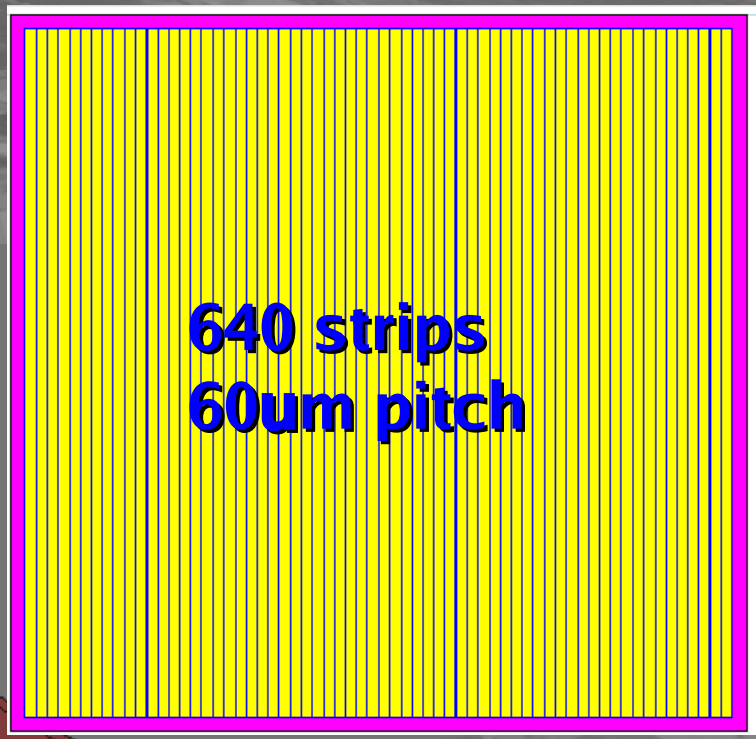
R = 17 cm
27 ladders
13 units per ladder

R = 12 cm
19 ladders
10 units per ladder

Realistic support
Realistic cables
No utilities yet

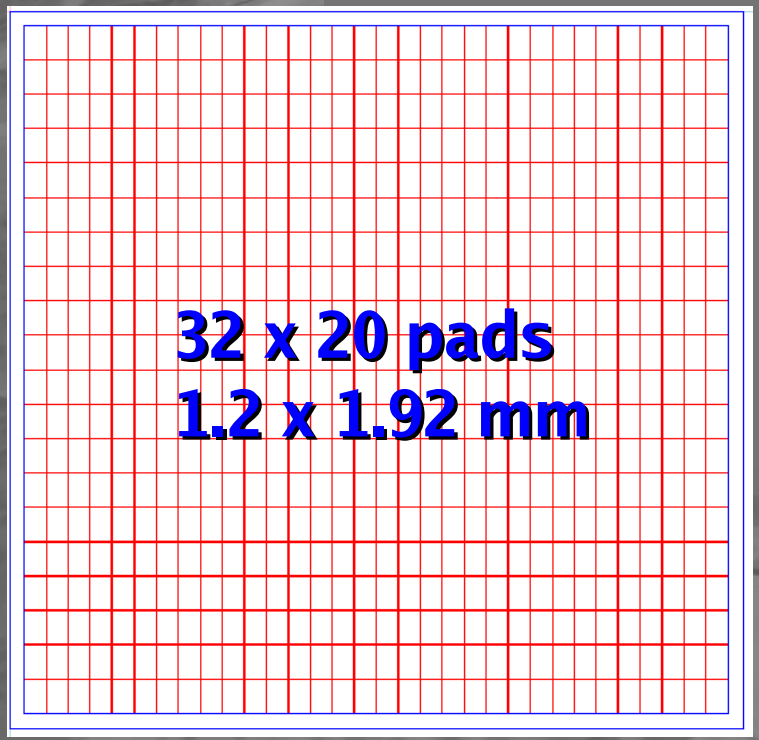
An IST ladder





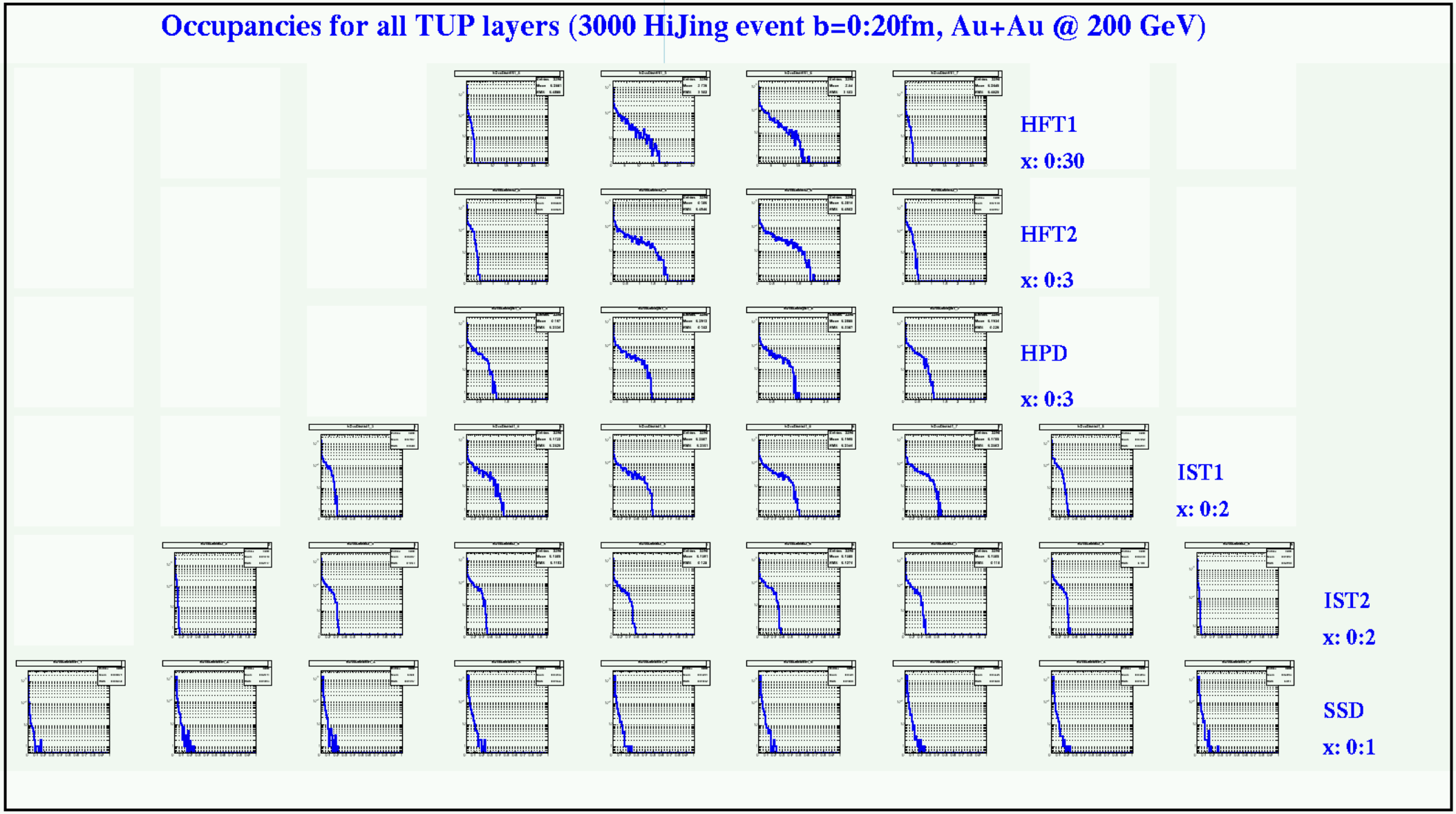
Silicon Strip

Silicon Pad

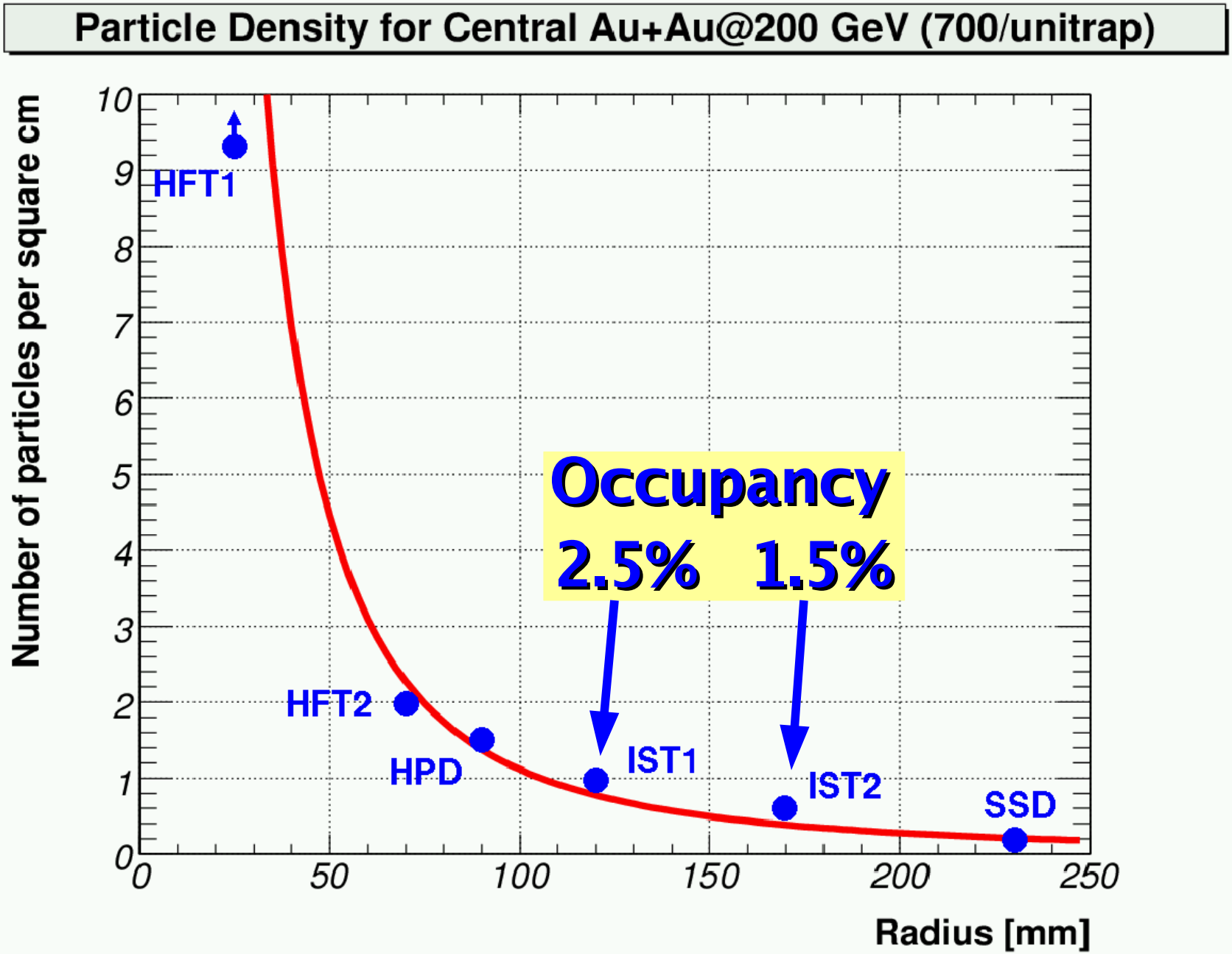


For the readout the pad sensors are identical to the strip sensors: 640 ch.
Orientations to be decided -> Simulations

Occupancies from simulations

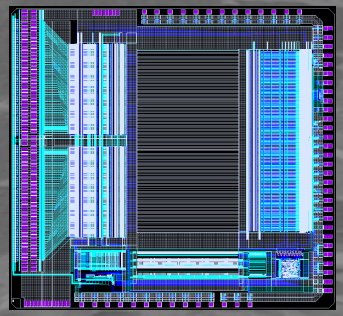


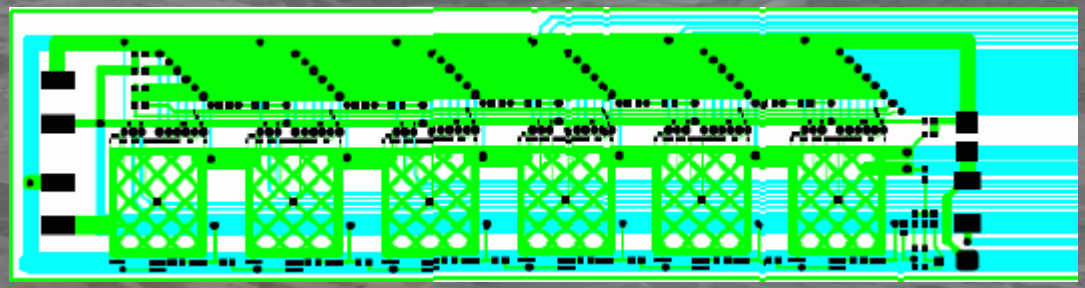
Compare to hand calculation



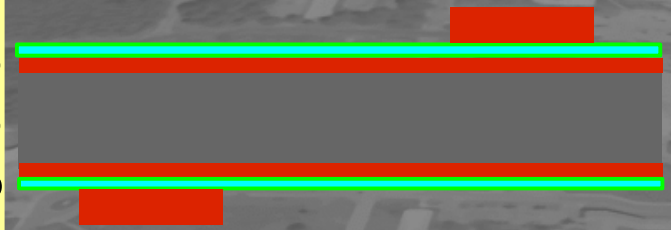
IST unit in detail

APV25-S1

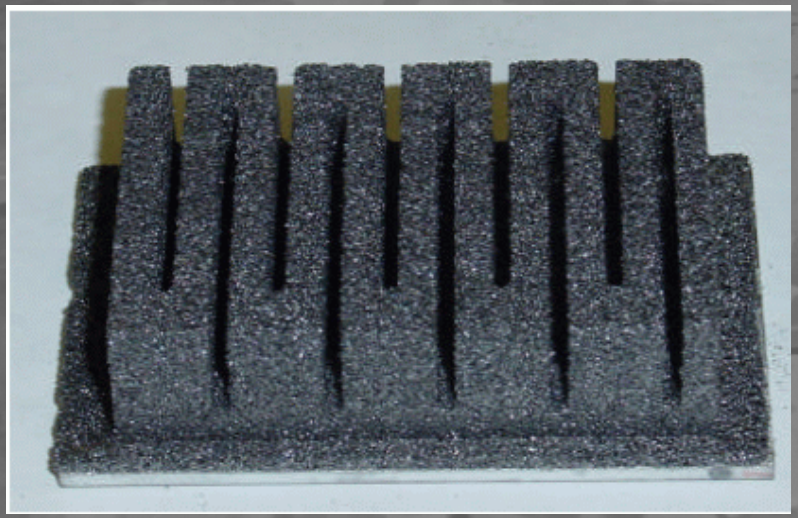


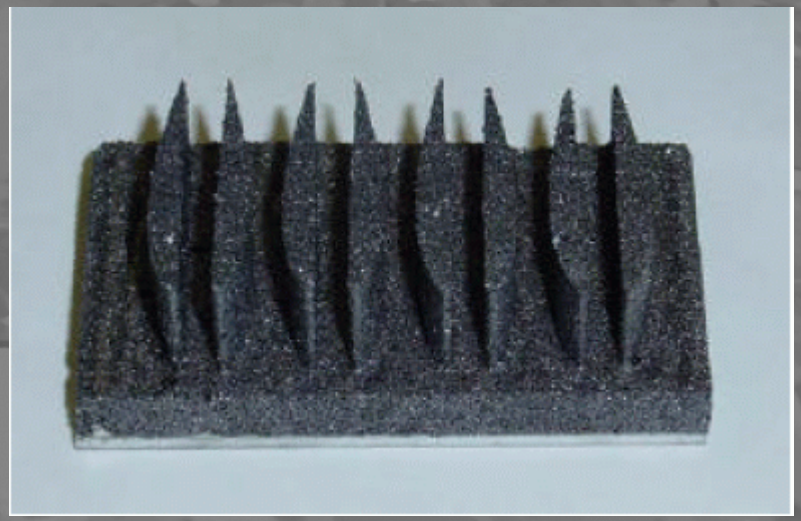


0.77 %
0.10 %
0.32 %
0.10 %
0.32 %
0.10 %
0.77 %



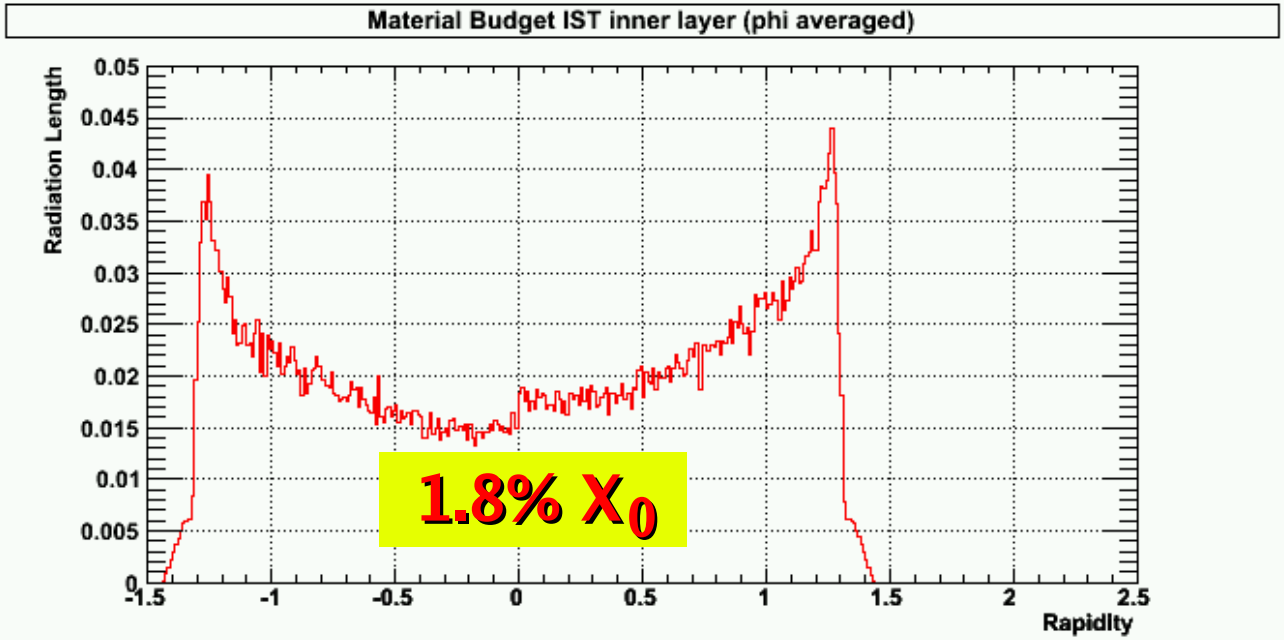
100um Kapton Hybrid
Silicon Sensor
Thermal conducting carbon foam
Silicon Sensor
100um Kapton Hybrid

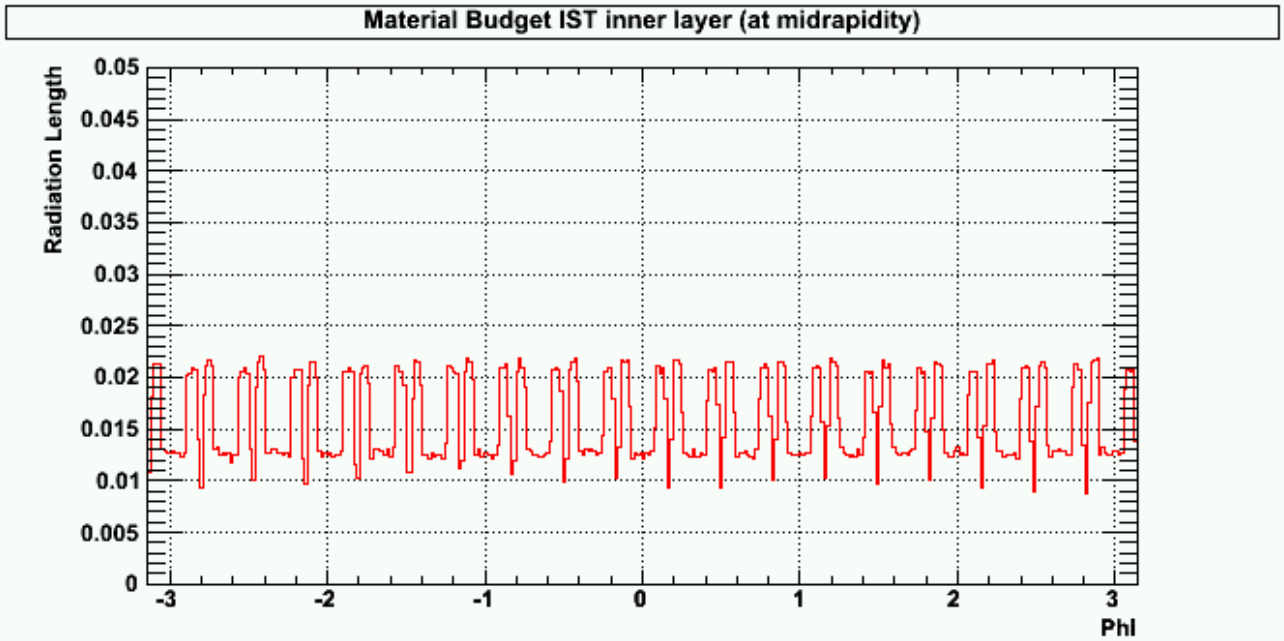




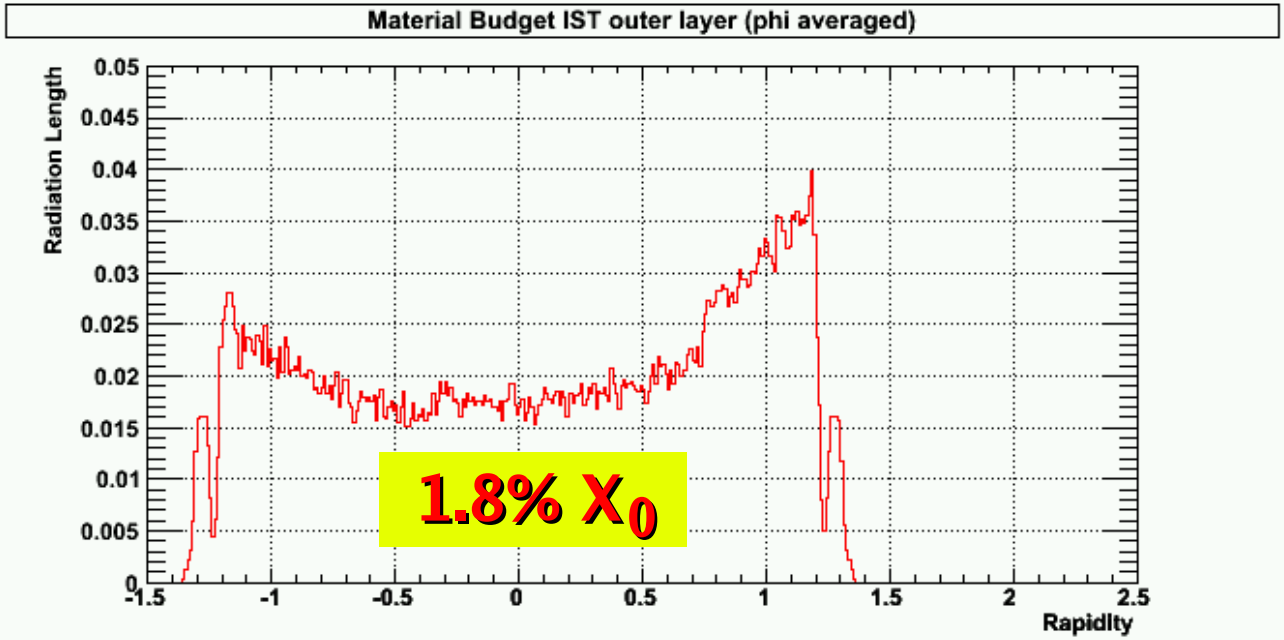
Investigating air cooling

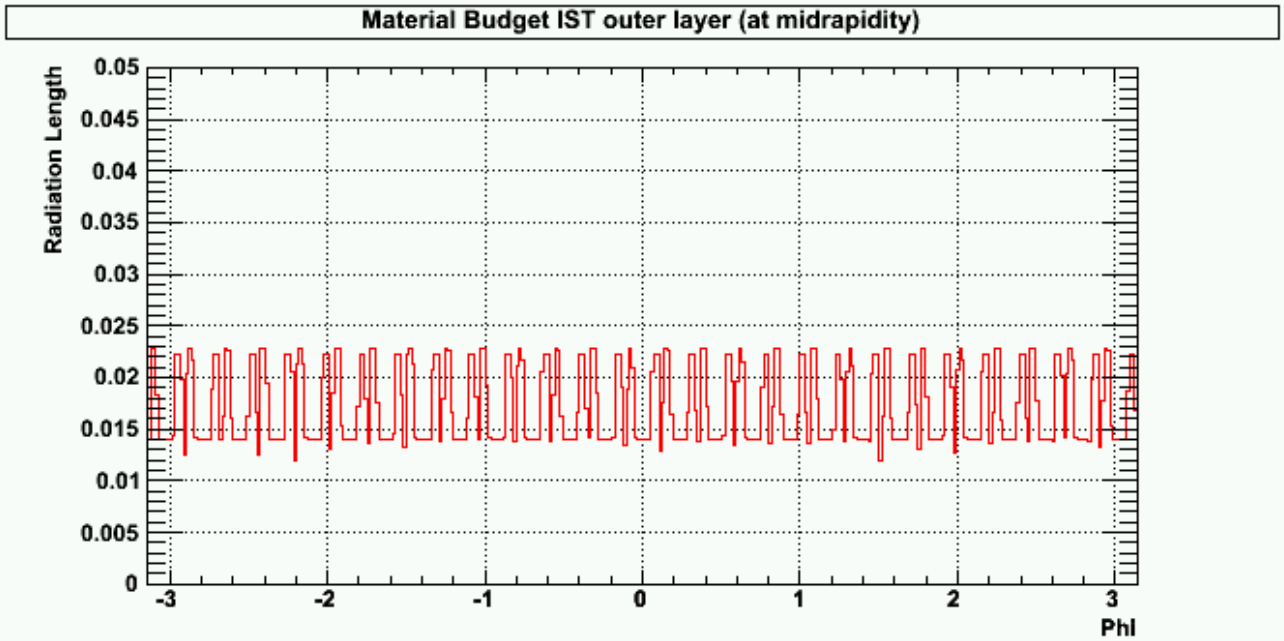
Material budget Inner IST layer



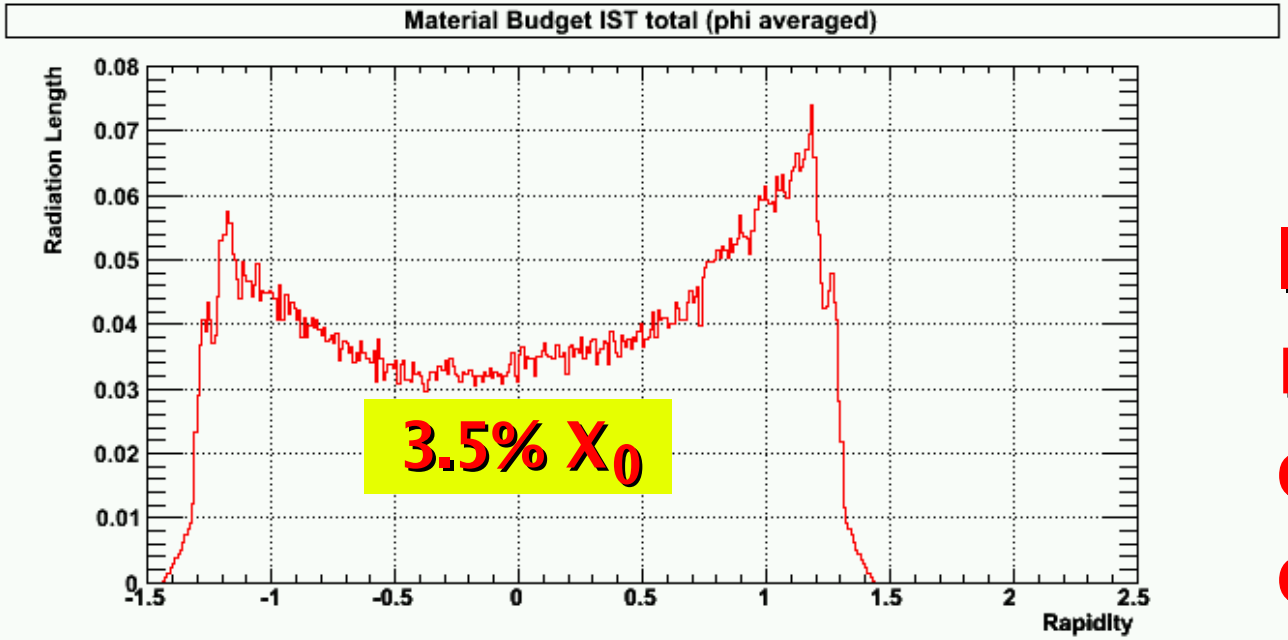


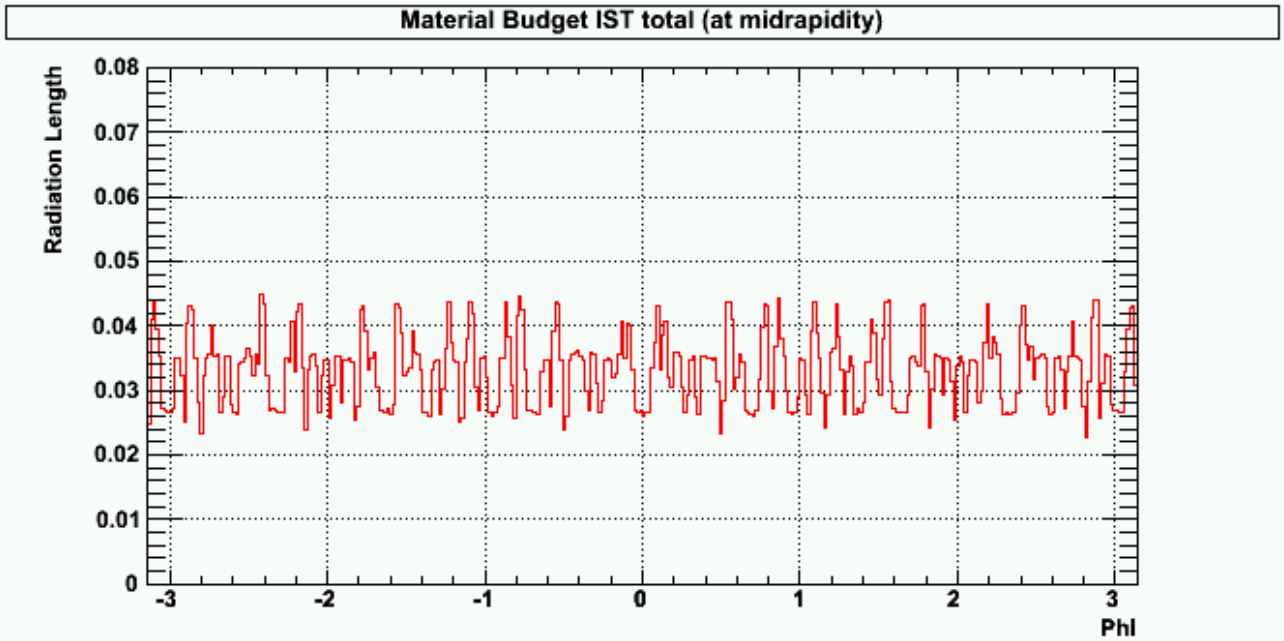
Material budget Outer IST layer





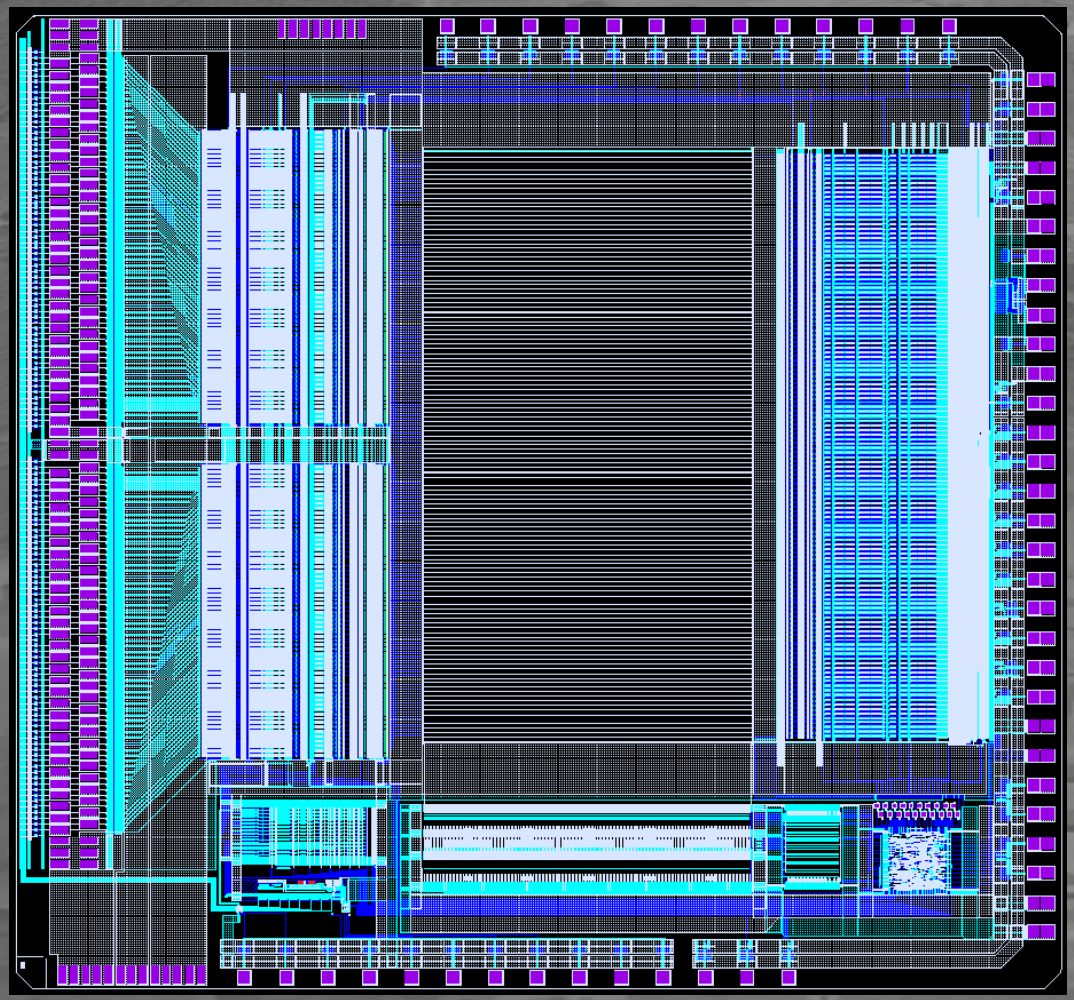
Total Material budget IST





Includes realistic cable estimate

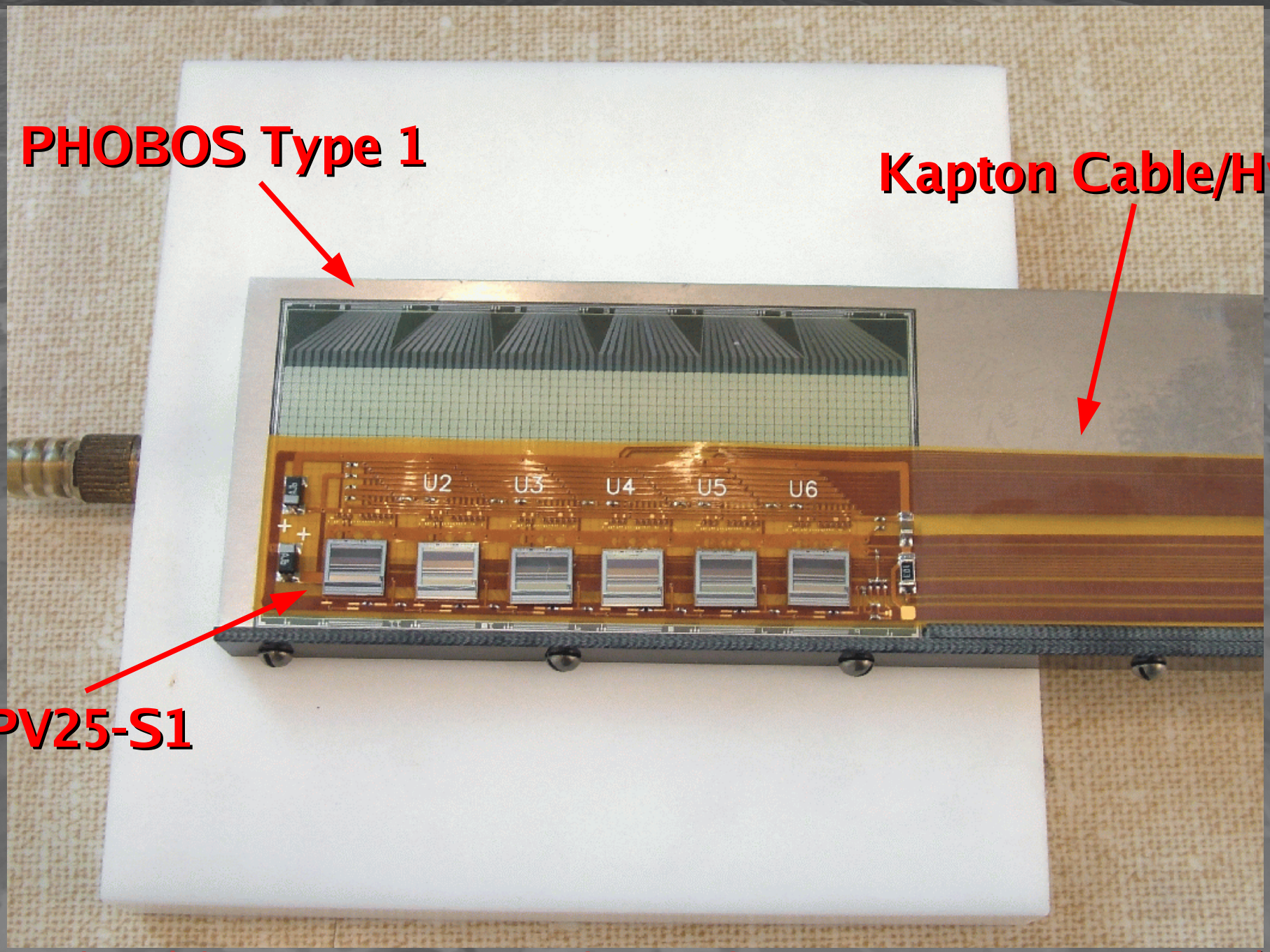
The APV25-S1 readout chip



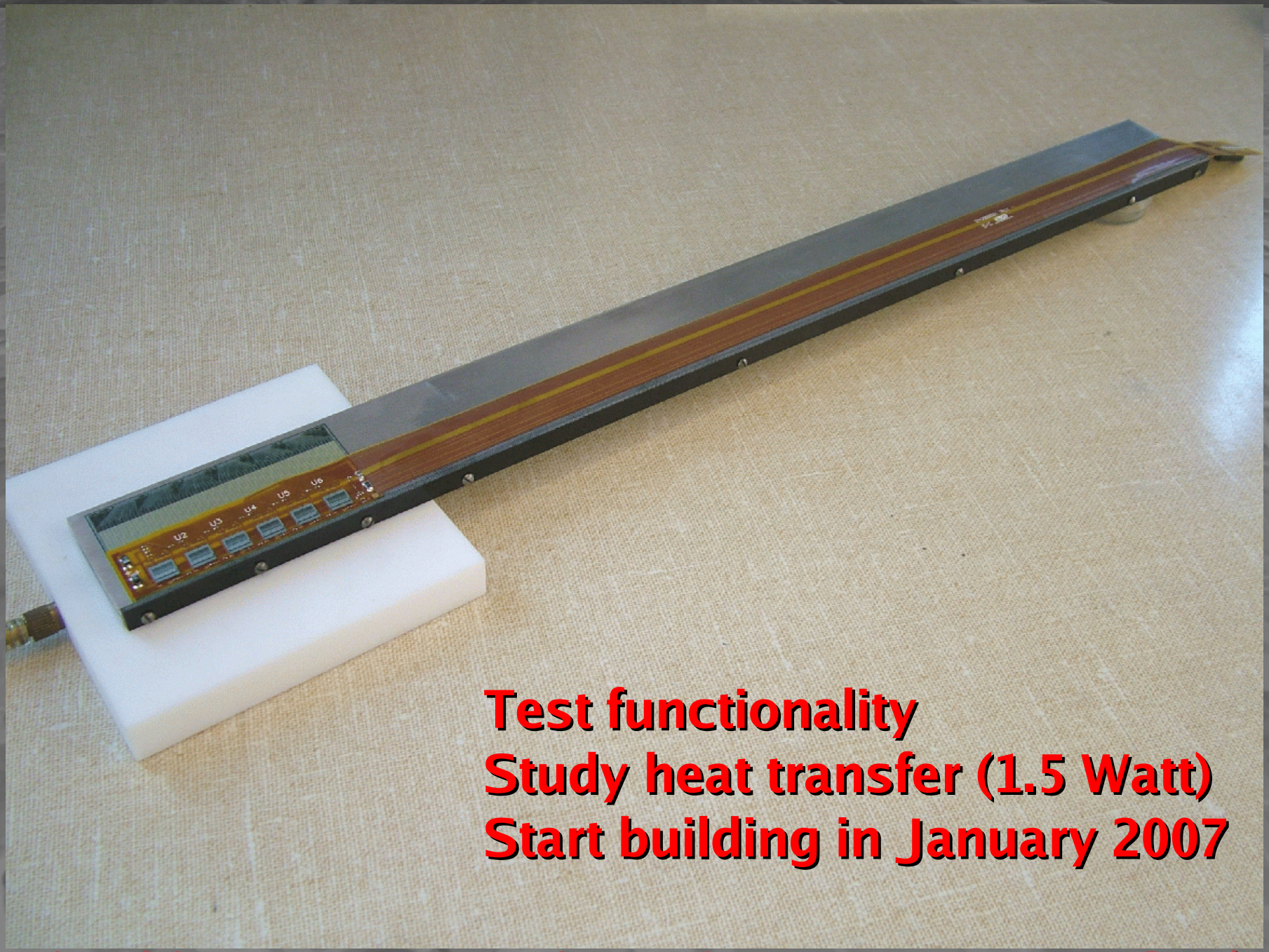
- developed for CMS
- 75000 in CMS tracker
- 128 channels
- 40 Mhz sample rate
- 4 us analogue pipeline
- < 2000 e ENC
- 11:1 signal/noise
- 0.25 Watt/chip
- 0.25 um CMOS
- rad hard
- SEU resilient

To be used in IST, FST, FGT -> 1 readout!

IST prototype module



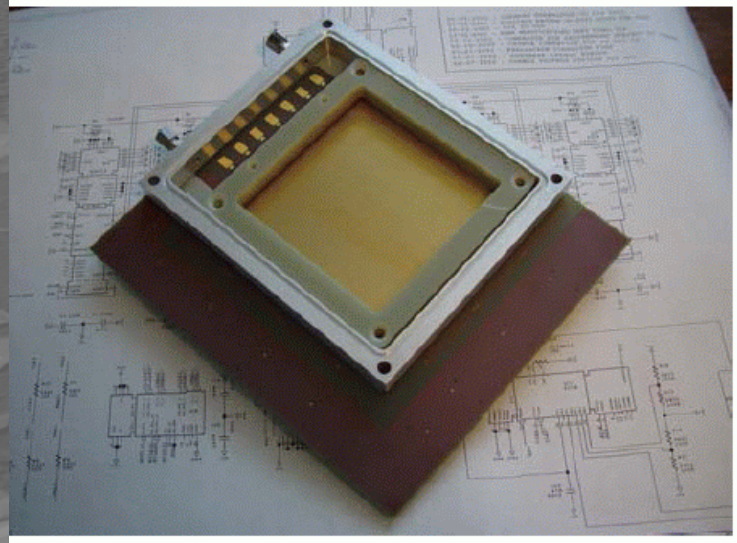
IST prototype module



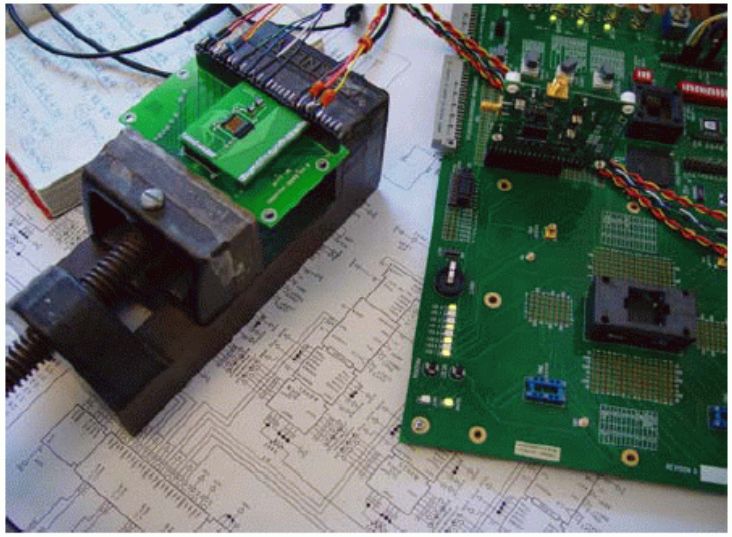
Test functionality
Study heat transfer (1.5 Watt)
Start building in January 2007

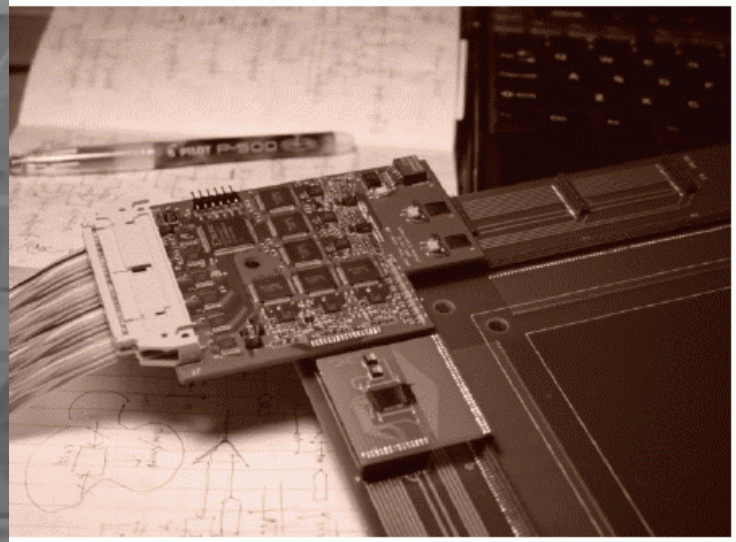
IST (APV25-S1) readout system

GEM Detector

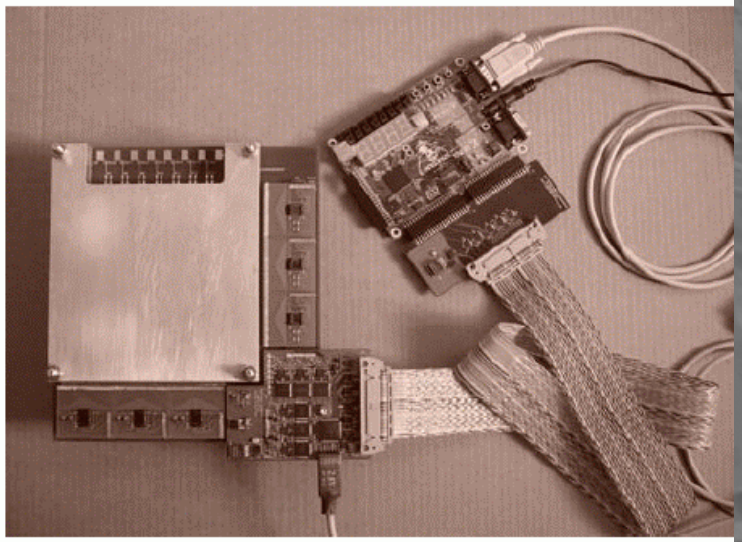


APV25-S1 Module





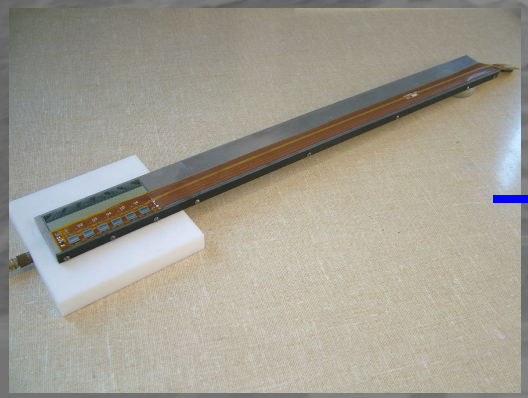
GEM Readout Controller



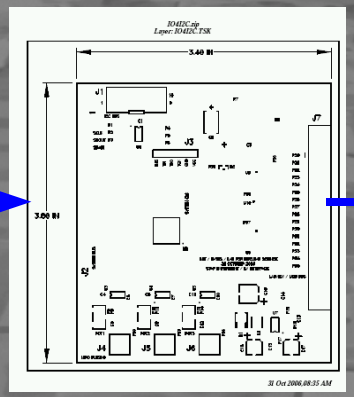
GEM Readout Prototype

Readout design: Miro Plesko STAR-DAQ: Dave Underwood

Cheapo USB readout system

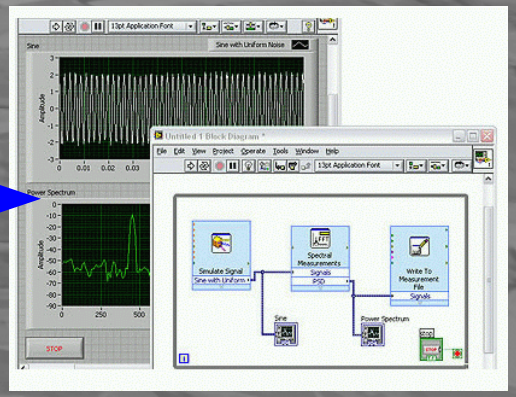


IST prototype



IO412C

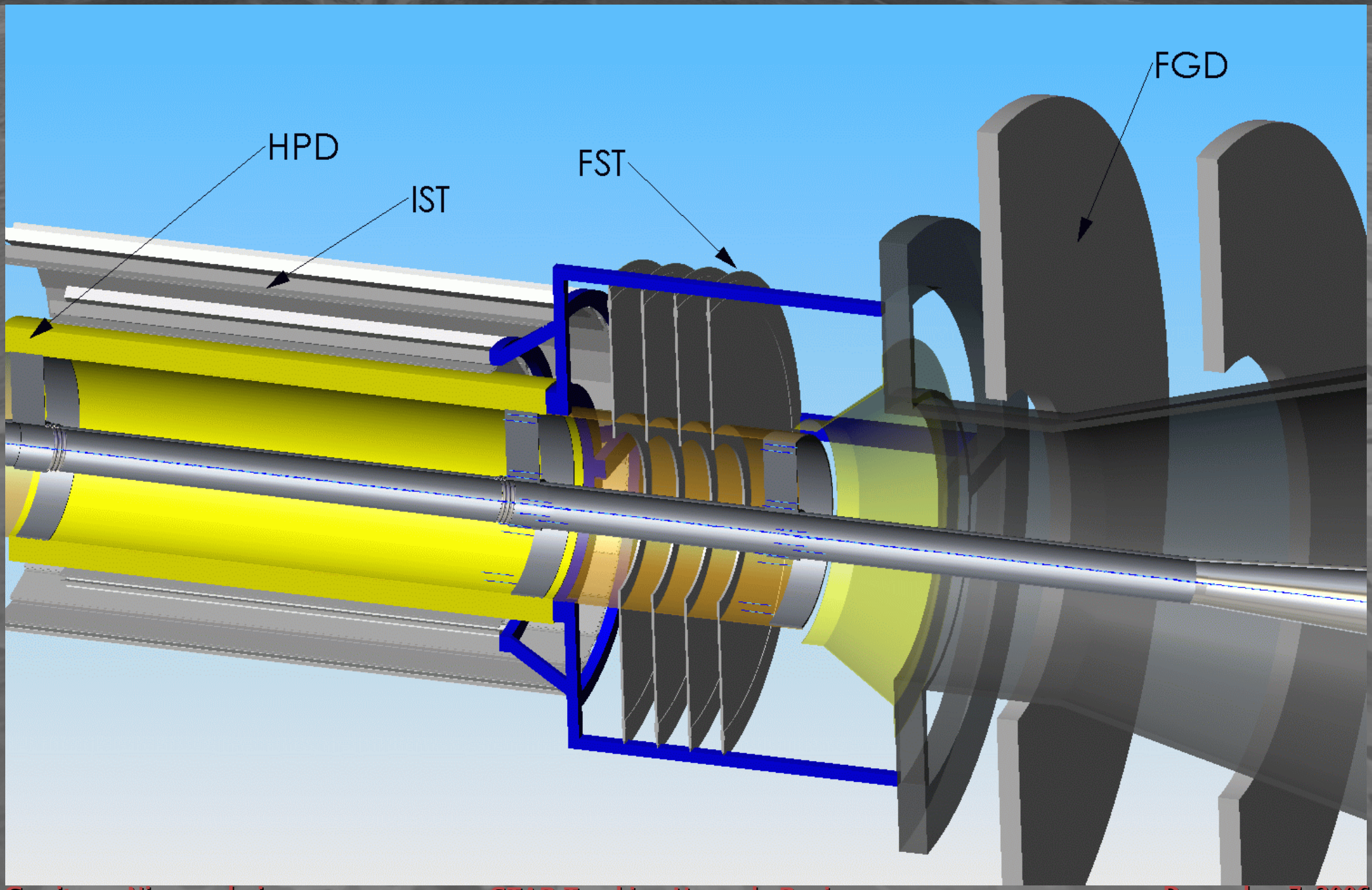
USB 2.0



LabView

Same system can also be used for GEM readout
Multiple testing stations feasible

Mechanics



Summary

We are working on multiple levels to keep the material
budget down, carbon foam, kapton hybrids, etc.
Occupancy doesn't seem to be a problem
Thanks to APV25-S1 we can handle high luminosity
IST prototypes are in the planning
Starts in January 2007
APV25 readout system is ready, needs to be battle proved
A low cost alternative is being build
Still studying strip-pad configurations
r-phi and/or z preferred resolution
The inner tracking software is well on track
see after lunch
The mechanical integration is ongoing
see late(r) today

BlaBla