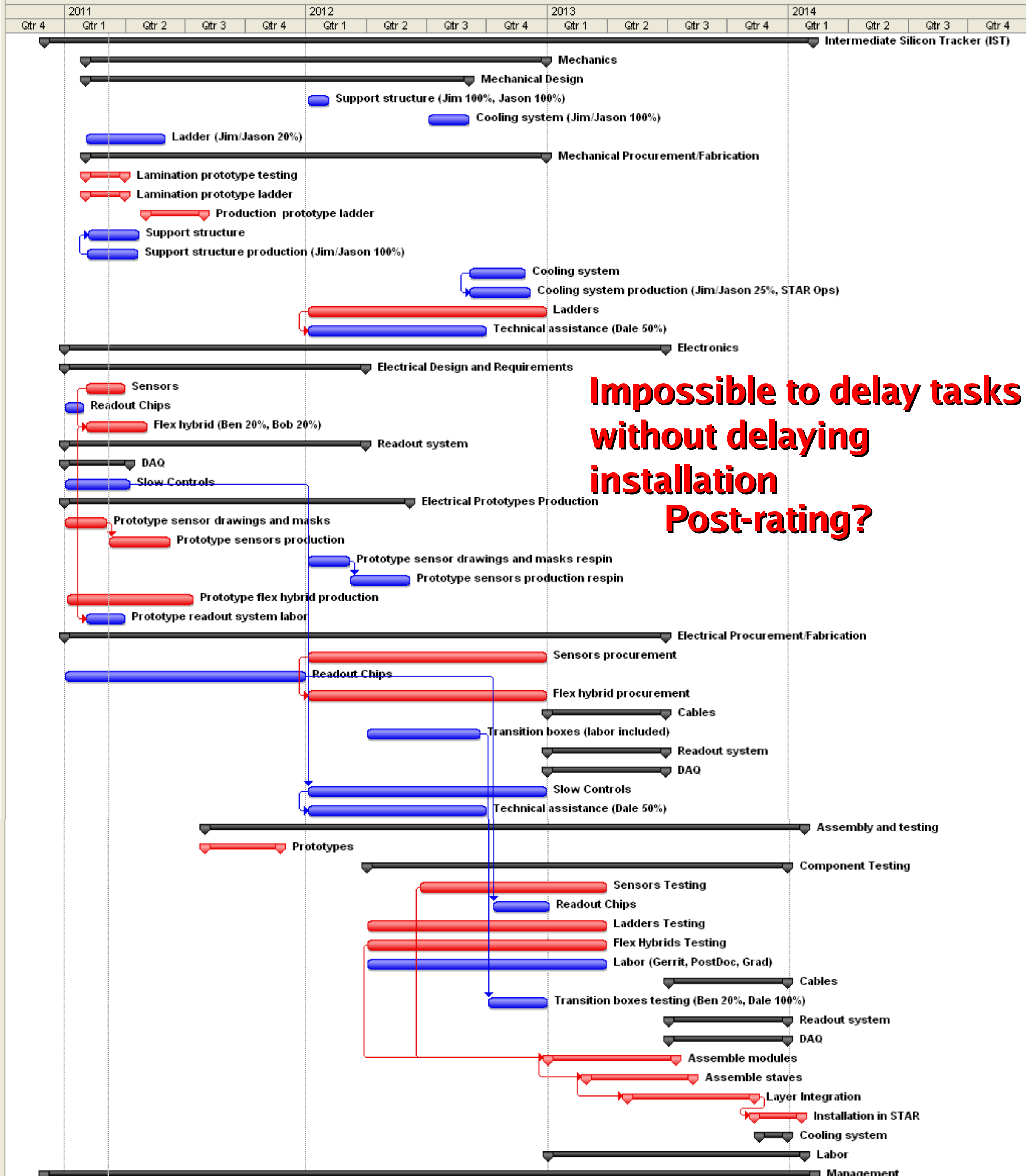
IST
Cost and Schedule

Gerrit van Nieuwenhuizen
HFT Management meeting
December 8, 2010

ID	WBS	Task Name
320	1.3	**Intermediate Silicon Tracker (IST)**
321	1.3.1	**Mechanics**
322	1.3.1.1	**Mechanical Design**
323	1.3.1.1.1	Support structure (Jim 100%, Jason 100%)
324	1.3.1.1.2	Cooling system (Jim/Jason 100%)
325	1.3.1.1.3	Ladder (Jim/Jason 20%)
326	1.3.1.2	**Mechanical Procurement/Fabrication**
327	1.3.1.2.1	**Lamination prototype testing**
335	1.3.1.2.2	**Lamination prototype ladder**
343	1.3.1.2.3	**Production prototype ladder**
366	1.3.1.2.4	Support structure
367	1.3.1.2.5	Support structure production (Jim/Jason 100%)
368	1.3.1.2.6	Cooling system
369	1.3.1.2.7	Cooling system production (Jim/Jason 25%, STAR Ops
370	1.3.1.2.8	Ladders
371	1.3.1.2.9	Technical assistance (Dale 50%)
372	1.3.2	**Electronics**
373	1.3.2.1	**Electrical Design and Requirements**
374	1.3.2.1.1	Sensors
375	1.3.2.1.2	Readout Chips
376	1.3.2.1.3	Flex hybrid (Ben 20%, Bob 20%)
377	1.3.2.1.4	**Readout system**
384	1.3.2.1.5	**DAQ**
388	1.3.2.1.6	Slow Controls
389	1.3.2.2	**Electrical Prototypes Production**
390	1.3.2.2.1	Prototype sensor drawings and masks
391	1.3.2.2.2	Prototype sensors production
392	1.3.2.2.3	Prototype sensor drawings and masks respin
393	1.3.2.2.4	Prototype sensors production respin
394	1.3.2.2.5	Prototype flex hybrid production
395	1.3.2.2.6	Prototype readout system labor
396	1.3.2.3	**Electrical Procurement/Fabrication**
397	1.3.2.3.1	Sensors procurement
398	1.3.2.3.2	Readout Chips
399	1.3.2.3.3	Flex hybrid procurement
400	1.3.2.3.4	**Cables**
404	1.3.2.3.5	Transition boxes (labor included)
405	1.3.2.3.6	**Readout system**
411	1.3.2.3.7	**DAQ**
415	1.3.2.3.8	Slow Controls
416	1.3.2.3.9	Technical assistance (Dale 50%)
417	1.3.3	**Assembly and testing**
418	1.3.3.1	**Prototypes**
422	1.3.3.2	**Component Testing**
423	1.3.3.2.1	Sensors Testing
424	1.3.3.2.2	Readout Chips
425	1.3.3.2.3	Ladders Testing
426	1.3.3.2.4	Flex Hybrids Testing
427	1.3.3.2.5	Labor (Gerrit, PostDoc, Grad)
428	1.3.3.2.6	**Cables**
433	1.3.3.2.7	Transition boxes testing (Ben 20%, Dale 100%)
434	1.3.3.2.8	**Readout system**
442	1.3.3.2.9	**DAQ**
446	1.3.3.3	**Assemble modules**
453	1.3.3.4	**Assemble staves**
457	1.3.3.5	**Layer Integration**
464	1.3.3.6	**Installation in STAR**
467	1.3.3.7	**Cooling system**
47	1.3.3.8	**Labor**
475	1.3.4	**Management**



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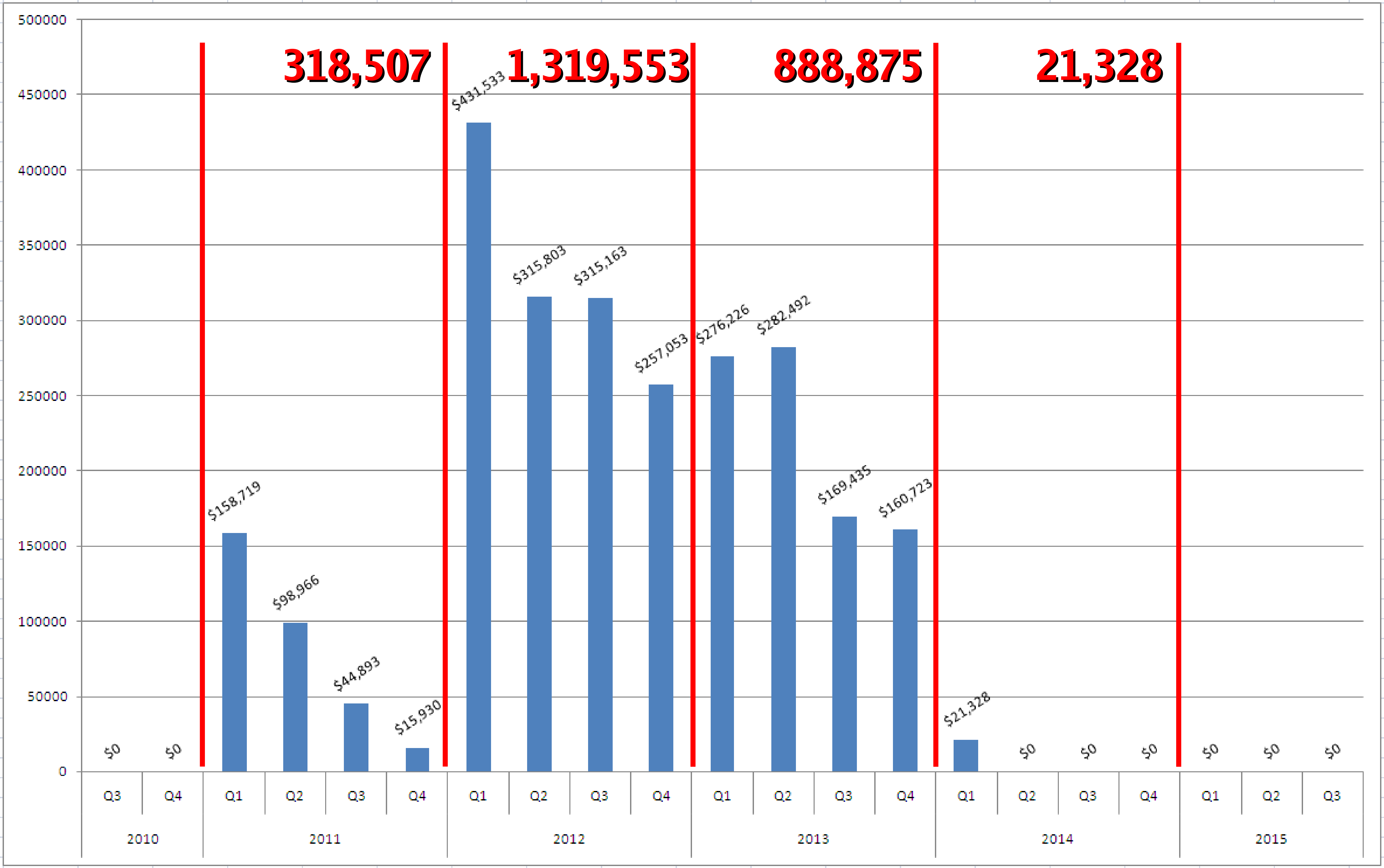
IST funding profile

$2,548,263 (22% cont. = $565,678)



IST resources

Human resources:

- Bernd (Project Leadership, 20%)
- Gerrit (Technical Coordination, 80%)
  PostDoc (?)
  Grad Students (2---3)
- Jim/Jason (Mech Eng)
- Ben (Elec Eng)
- Dale Ross (Tech Support, bonding)
  Bates Tech (bonding)
- Eric & Co (Carbon Fiber work)

Infrastructure:

- LNS Silicon Facility (Testing Sensors, Ladders, etc.)
- Bates Lab (Mech and Elec Fab)
- LBNL CFF (CF Ladders Fab)
- BNL Instr Div (Wire Bonding)

IST Cost Estimate

Material cost

- Already procured (APV chips)
- Manufacturers quotes (Sensors)
- Estimates based on similar (Hybrids, Readout)
- Estimates by engineers (CF work, Cooling)

Hi Gerrit,

It is good to hear all of the proposed specs are acceptable.
Pricing for this detector is as mentioned below.
Regarding payment, we typically invoice the completed
parts as they are shipped from NJ (net 30 days).
As for the NRE fee I am checking with the factory
when that portion of the order would need to be paid.

As for your comments regarding lead time,
I am asking the factory if they think they can improve
the lead time to meet your schedule and I will let
you know there comments asap.

NRE fee: $67,500.00
6-8 pcs.: $5,475.00 ea.
192 pcs.: $1,742.00 ea.

Please let me know if you need an official quote.

Best regards,
Norm

Norm Schiller
PHOTON IS OUR BUSINESS
Executive Sales Engineer
(P) 718.352.2026 | (F) 718.352.0823
http://sales.hamamatsu.com

+++++++++++Mechanical prototypes+++++++++++++++++++++++++++++++
Lamination/Co-cure testing:
- 6tests @ 4hrs/test
- 24hrs MT4 = $2512
- $300 matl

Tooling for above:
- 16hrs Jr Machinist = $1702
- $150 matl (includes iteration)

---> $4214 labor
$450 material

Stave fabrication:
- 2 staves @ 40hrs/stave (includes all component fab and assy)
- 80hrs MT4 = $8372
- $2k matl

Tooling for above:
- 16hrs Jr Machinist = $1702
- 24hrs MT4 = $2512
- $400 matl

---> $12586 labor
$2400 material

Shipping: $200 (includes cool shipping container)

I can probably assure the MT4 (Mechanical Tech Level 4) (Tom) @ 25% or n

This is about $20k labor and $3k materials for 2 staves.

==================================> $16,800 labor
$ 3,050 material+shipping

+++++++++++Production prototypes+++++++++++++++++++++++++++++++
Tooling:
- 80hrs Jr Machinist = $8509
- $1.5k matl (vacuum chucks)

Tooling Prep/Assy:
- 24hrs MT4 = $2512
- $300 matl (guage pins, fasteners, vac fittings)

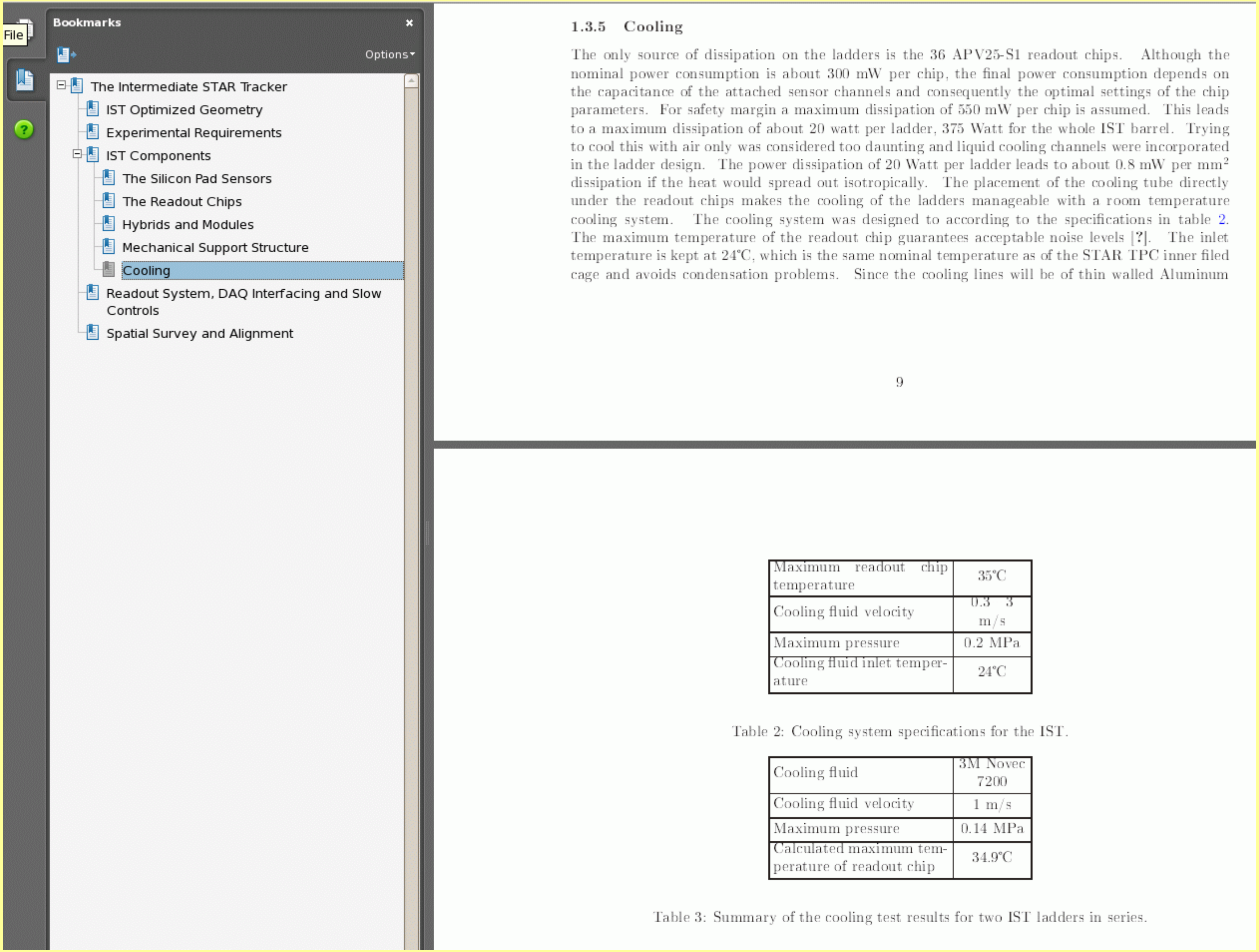
Tool Iteration/Modification:
- 40hrs MT4 = $4186

Labor

- Estimates based on similar (Assembly)
- Estimates by engineers (CF work at LBNL)

Gerrit is clearing house for most of docs

IST Design status: TDR



1.3.5 Cooling

The only source of dissipation on the ladders is the 36 APV25-S1 readout chips. Although the nominal power consumption is about 300 mW per chip, the final power consumption depends on the capacitance of the attached sensor channels and consequently the optimal settings of the chip parameters. For safety margin a maximum dissipation of 550 mW per chip is assumed. This leads to a maximum dissipation of about 20 watt per ladder, 375 Watt for the whole IST barrel. Trying to cool this with air only was considered too daunting and liquid cooling channels were incorporated in the ladder design. The power dissipation of 20 Watt per ladder leads to about 0.8 mW per mm^2 dissipation if the heat would spread out isotropically. The placement of the cooling tube directly under the readout chips makes the cooling of the ladders manageable with a room temperature cooling system. The cooling system was designed to according to the specifications in table 2. The maximum temperature of the readout chip guarantees acceptable noise levels [?]. The inlet temperature is kept at 24°C, which is the same nominal temperature as of the STAR TPC inner filed cage and avoids condensation problems. Since the cooling lines will be of thin walled Aluminum

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Maximum readout chip temperature	35°C
Cooling fluid velocity	0.3 – 3 m/s
Maximum pressure	0.2 MPa
Cooling fluid inlet temperature	24°C

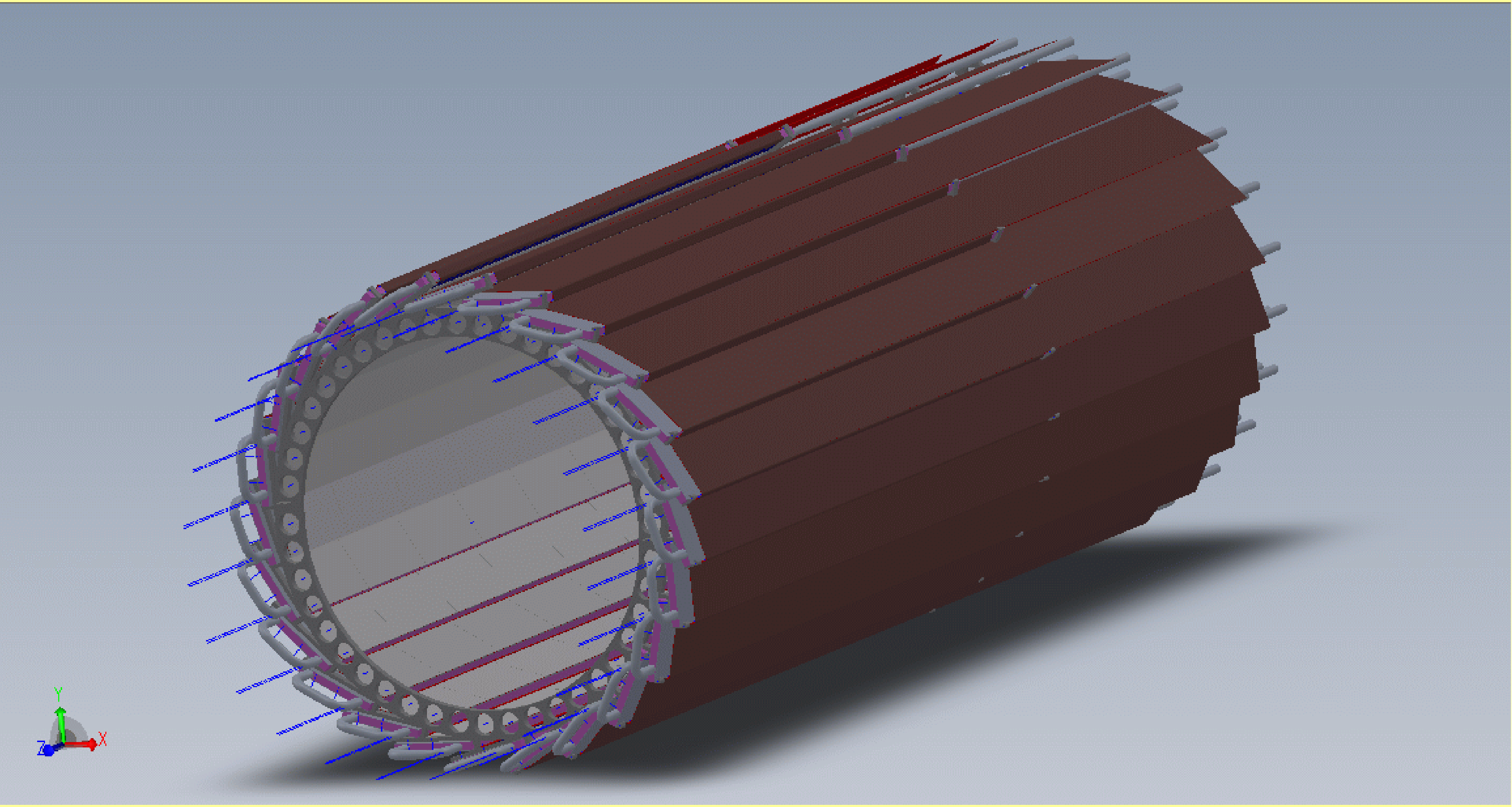
Table 2: Cooling system specifications for the IST.

Cooling fluid	3M Novec 7200
Cooling fluid velocity	1 m/s
Maximum pressure	0.14 MPa
Calculated maximum temperature of readout chip	34.9°C

Table 3: Summary of the cooling test results for two IST ladders in series.

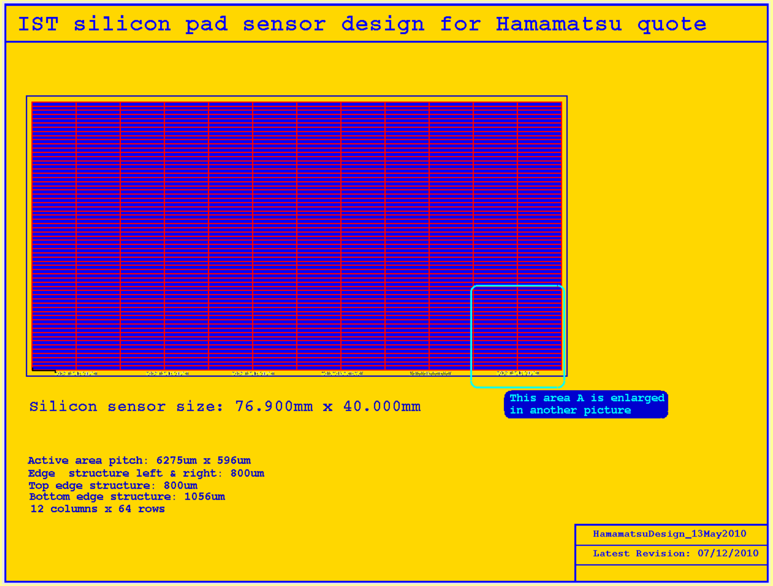
TDR needs to be updated and Wordified

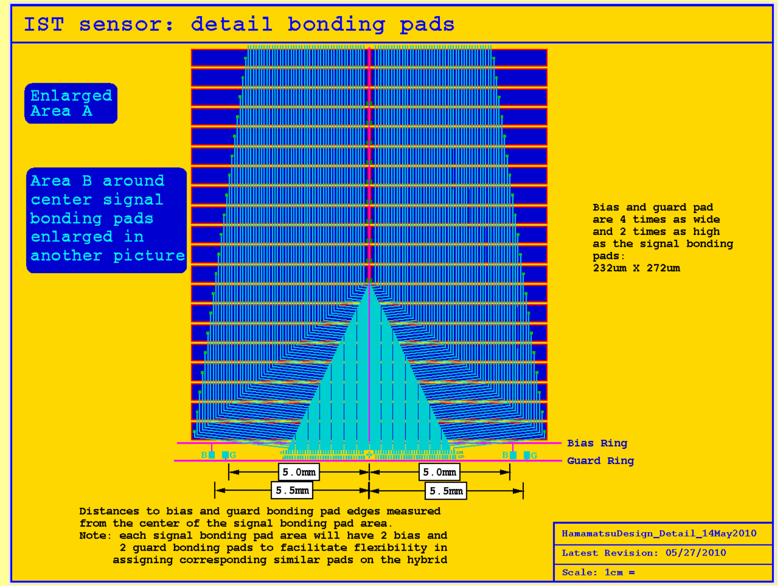
IST Design status: SolidWorks

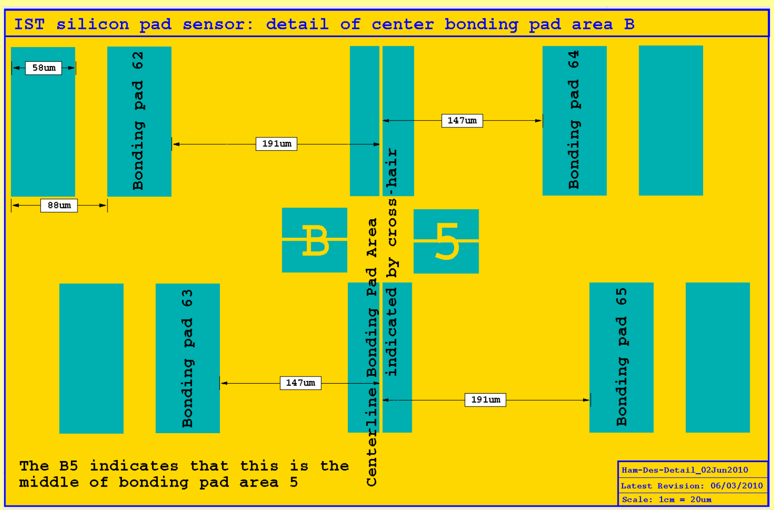


Detailed IST in SolidWorks, ladders need update

IST Design status: Sensors

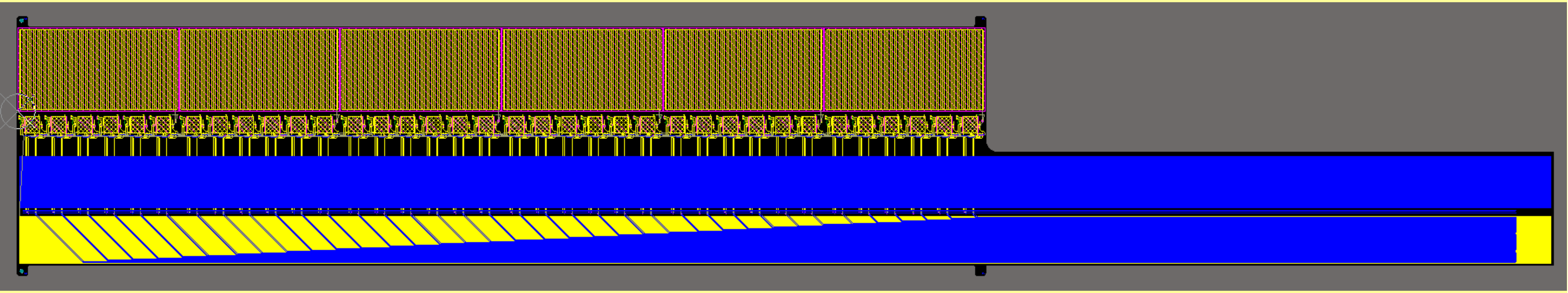


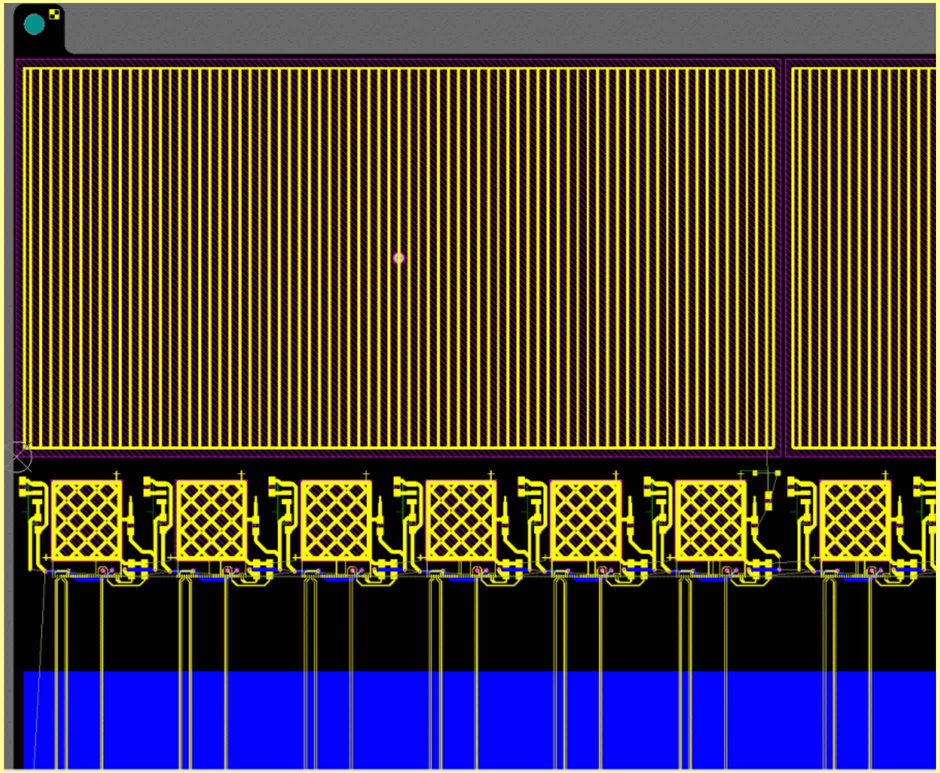


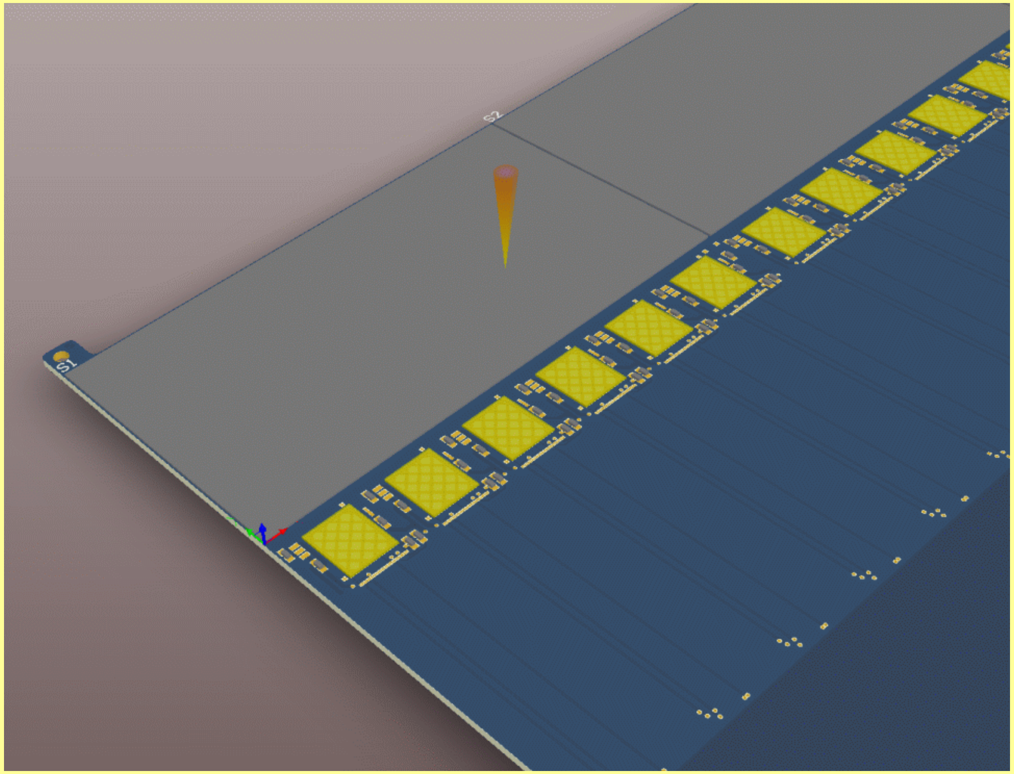


Preliminary designs approved by Hamamatsu engineers
Final design (masks!) will take 1+1 months

IST Design status: Hybrid







Prototype design finished on January 14, 2010

IST Design status: Readout system

Fully FGT parasitic

IST short term expenses

$257,685

IST L1/L2 milestones

Sorry, not finished yet