ATLAS PIXEL SYSTEM OVERVIEW

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Pixel Institutions

SUNY Albany

UC Berkeley/LBNL

University of New Mexico

University of Oklahoma/Langston Univ.

Ohio State University

UC Santa Cruz

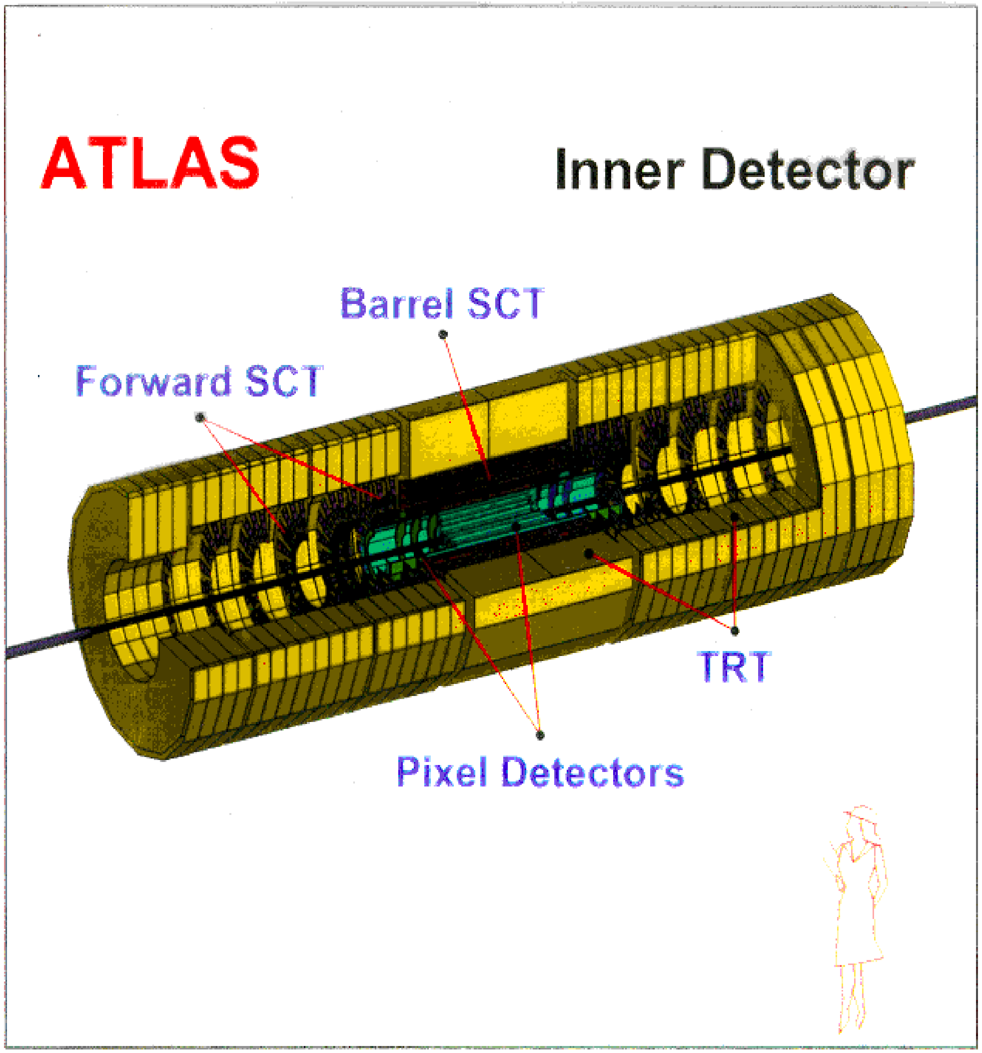
UC Irvine and Wisconsin support the pixel effort through the “Test Beam” activitities in the development of off-detector electronics, the ReadOut Drivers.

Outline

- ATLAS Inner Tracking Detector
- Pixel System
- Project Status
- U.S. Role
- Schedule Summary
- Purpose of This Review

ATLAS Inner Detector

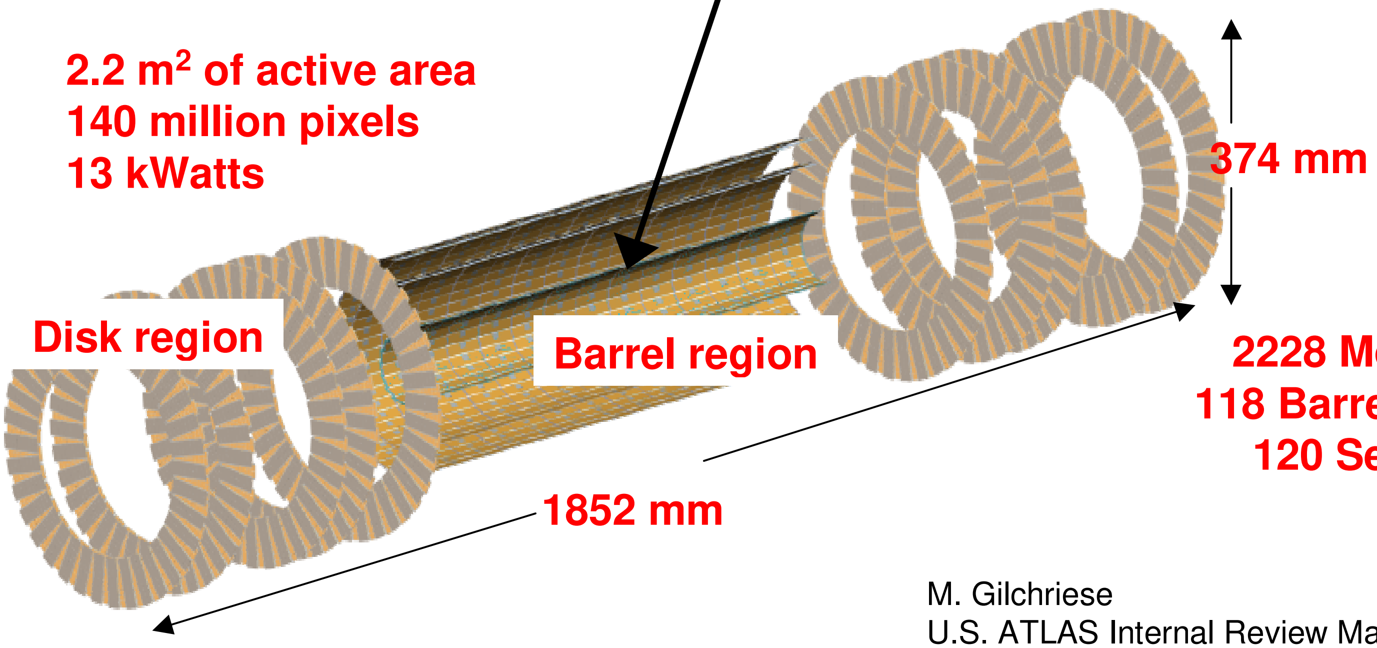
- We will not cover tracking requirements in this review.
- The ATLAS Inner Detector contains
  - Pixel System (PIX)(4<r<25 cm)
  - Semiconductor Tracker - silicon strips (SCT)(30<r<60 cm)
  - Straw-tube transition radiation tracking (TRT)(<60<r<100 cm)



The ATLAS Pixel System

- Layout
  - 3 barrel layers, 2 x 5 disk layers
  - Three space points for $|\eta| < 2.5$
  - Modular construction(2228 modules)
- Radiation hardness
  - Lifetime dose - 25 MRad at 10 cm
  - Leakage current in 50µx300µ pixel is - 30 nA after 25 MRad.
  - Signal loss in silicon by factor 4-5 after 25 MRad(or - 10^{15} n/cm^2)
- Pattern recognition
  - Space points(1.4 x 10^8 pixels)
  - Occupany of - 10^{-4}
- Parametric performance
  - Impact parameter
  - z resolution
- Trigger
  - Space points-> L2 trigger
- B-Layer
  - More demanding in almost all aspects

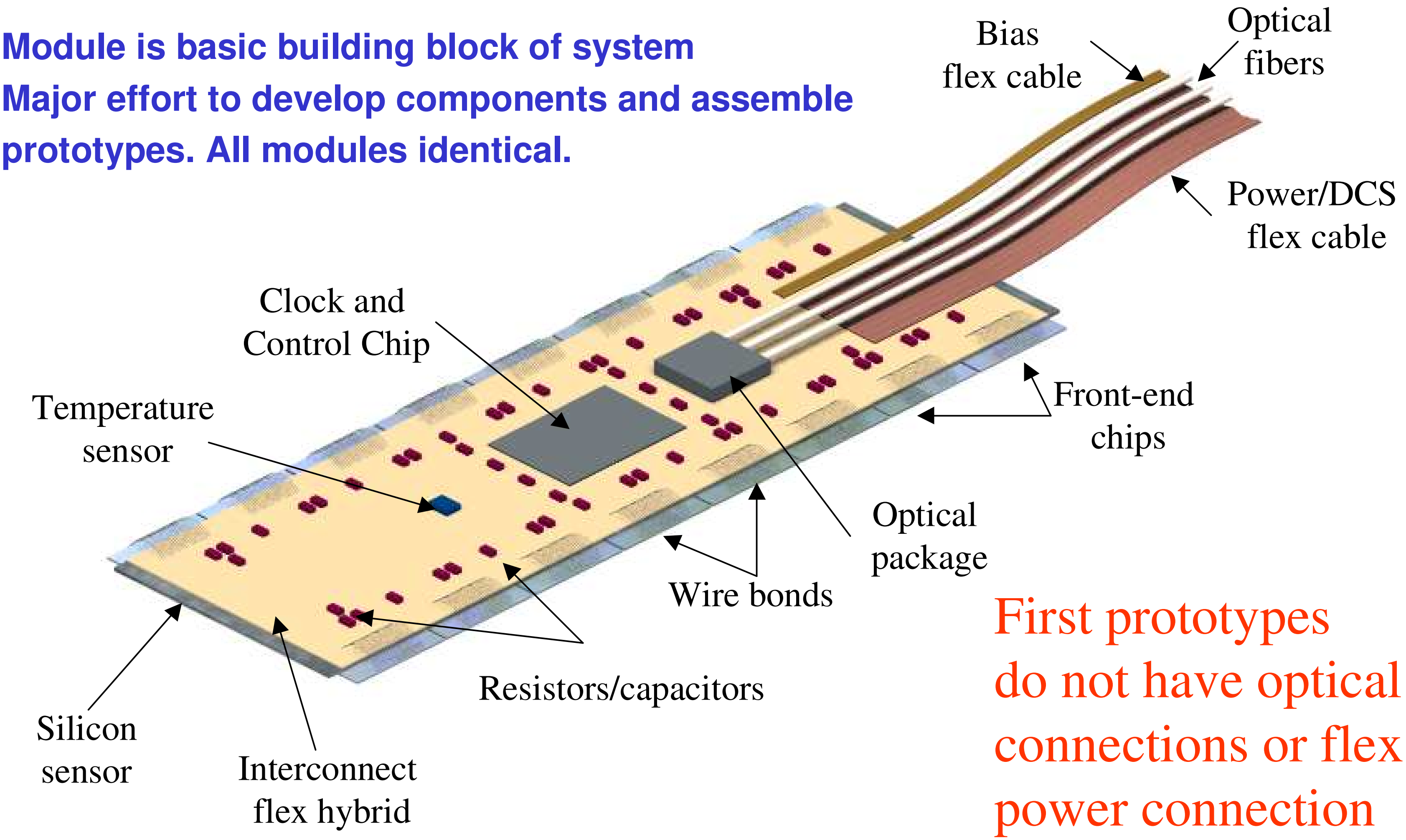
2.2 m^2 of active area
140 million pixels
13 kWatts



2228 Modules
118 Barrel Staves
120 Sectors

Pixel Module

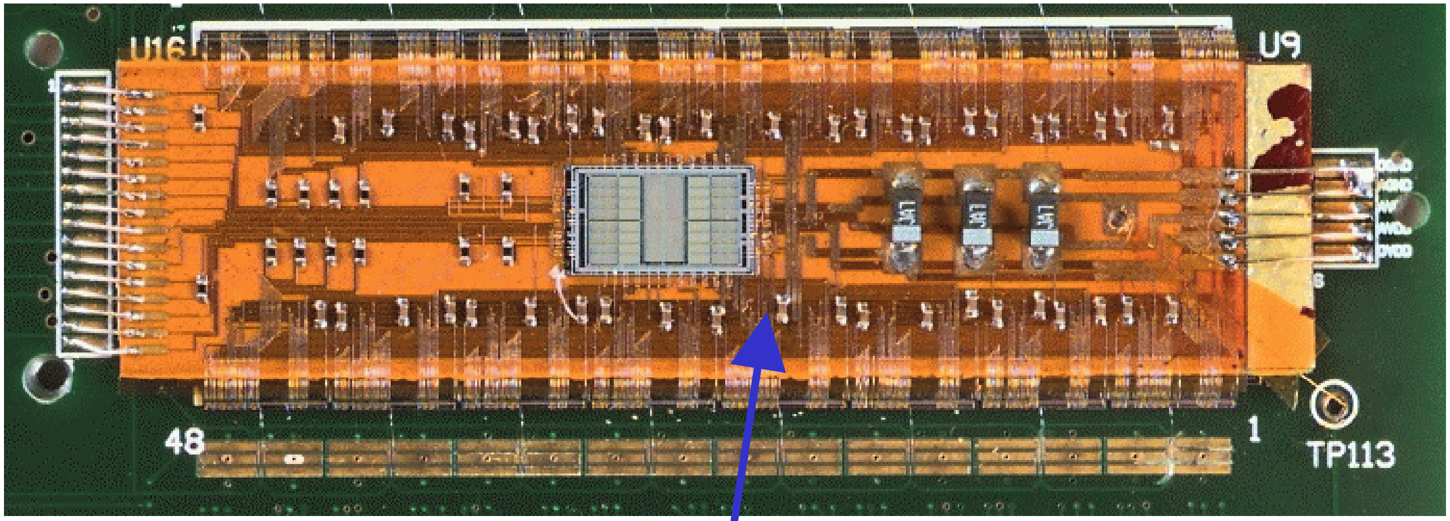
Module is basic building block of system
Major effort to develop components and assemble prototypes. All modules identical.

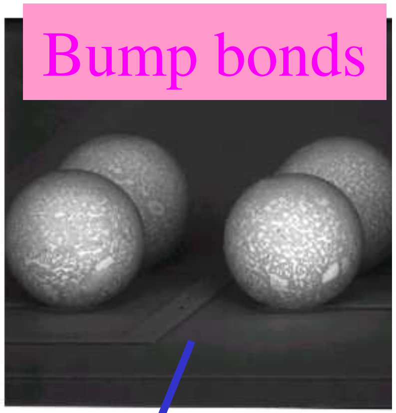


First prototypes do not have optical connections or flex power connection

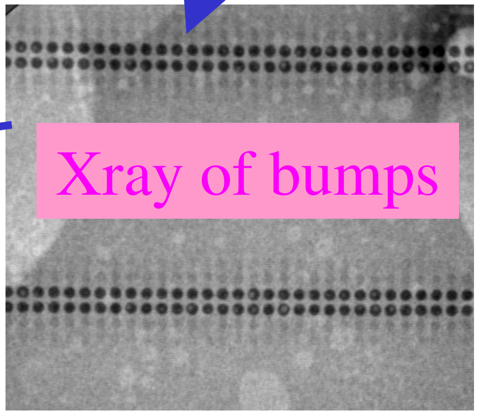
Pixel Modules

Module with flex hybrid and controller chip on PC board




Bump bonds


16 chips with 46,000 bump bonds

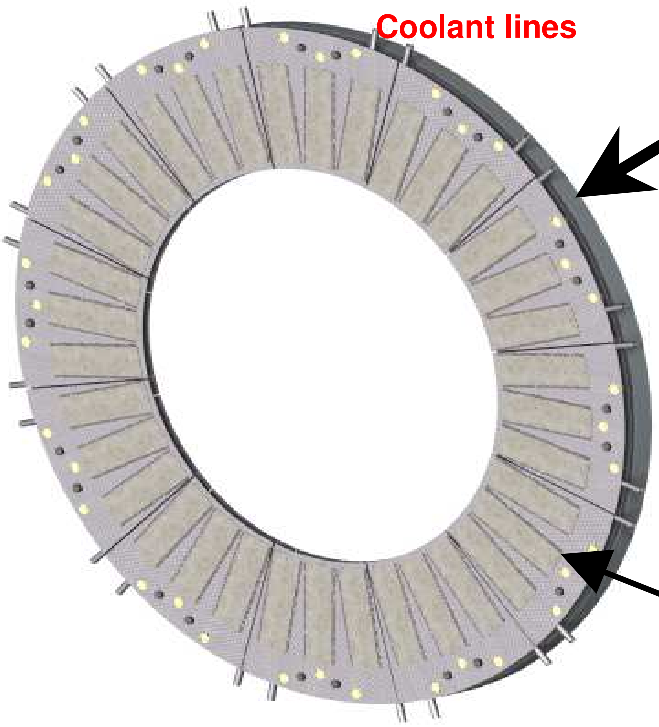

Xray of bumps

Sensor

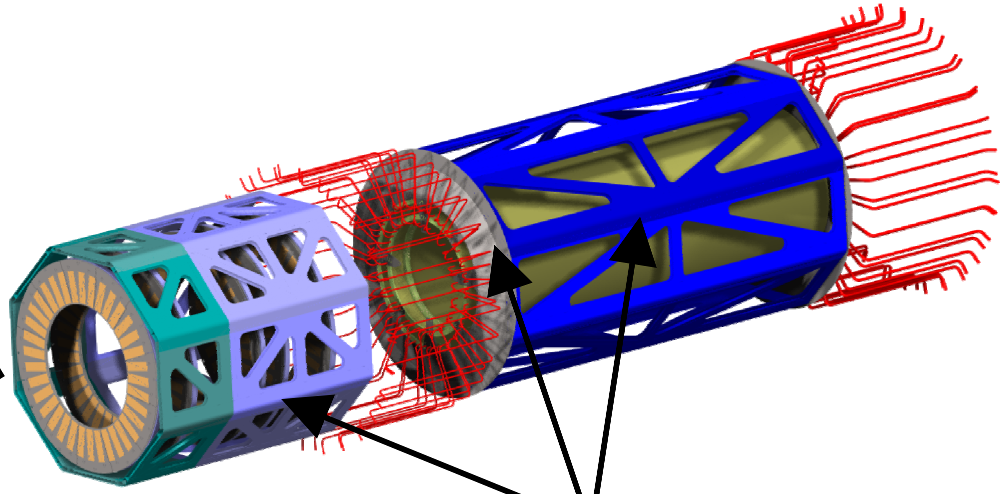
ICs

Disk Region

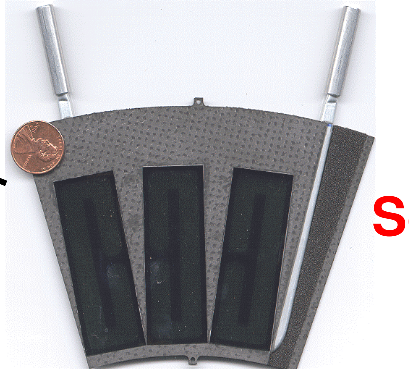
Disk with 12 Sectors



Coolant lines



Support frame



Sector- local support for modules

Sector support, cantilevered from outer edge

Project Status

- ATLAS
  - Technical Design Report approved
  - All countries but U.S. approved for construction
- U.S. ATLAS
  - Approved October 1998 for development through about FY2000 with fixed project support of $2582K(FY97) covering FY1996-2000(this includes funds already spent -$830K through FY98)
  - Baseline review in summer 2000 leading to construction approval
  - Two internal reviews before baseline, this one and one again in about December 1999

U.S. Role

- Do now what is necessary to advance the project, keeping in mind likely construction responsibilities
- Mechanics(LBNL)
  - Deliver disk region and complete outer support frame
  - Overall integration participation(currently lead)
- Sensors(UNM, Albany)
  - Primarily testing(UNM, Albany) and comparison with simulations(UNM)
- IC electronics(LBNL, Ohio State, Santa Cruz)
  - All aspects of front-end design and testing(LBNL, Santa Cruz)
  - Optical drivers/receivers(OSU)
- Off-detector electronics(Irvine/Wisconsin)
  - Test beam support(PLLs)
  - Design and deliver Readout Drivers,
- Hybrids(Oklahoma, Albany)
  - Design and fabrication lead(UOK) and test(UOK, Albany) flex hybrids
- Modules(LBNL, Albany, UNM, UOK, OSU)
  - Optical component mechanical design(OSU)
  - Design and assembly(LBNL) and testing(all groups)

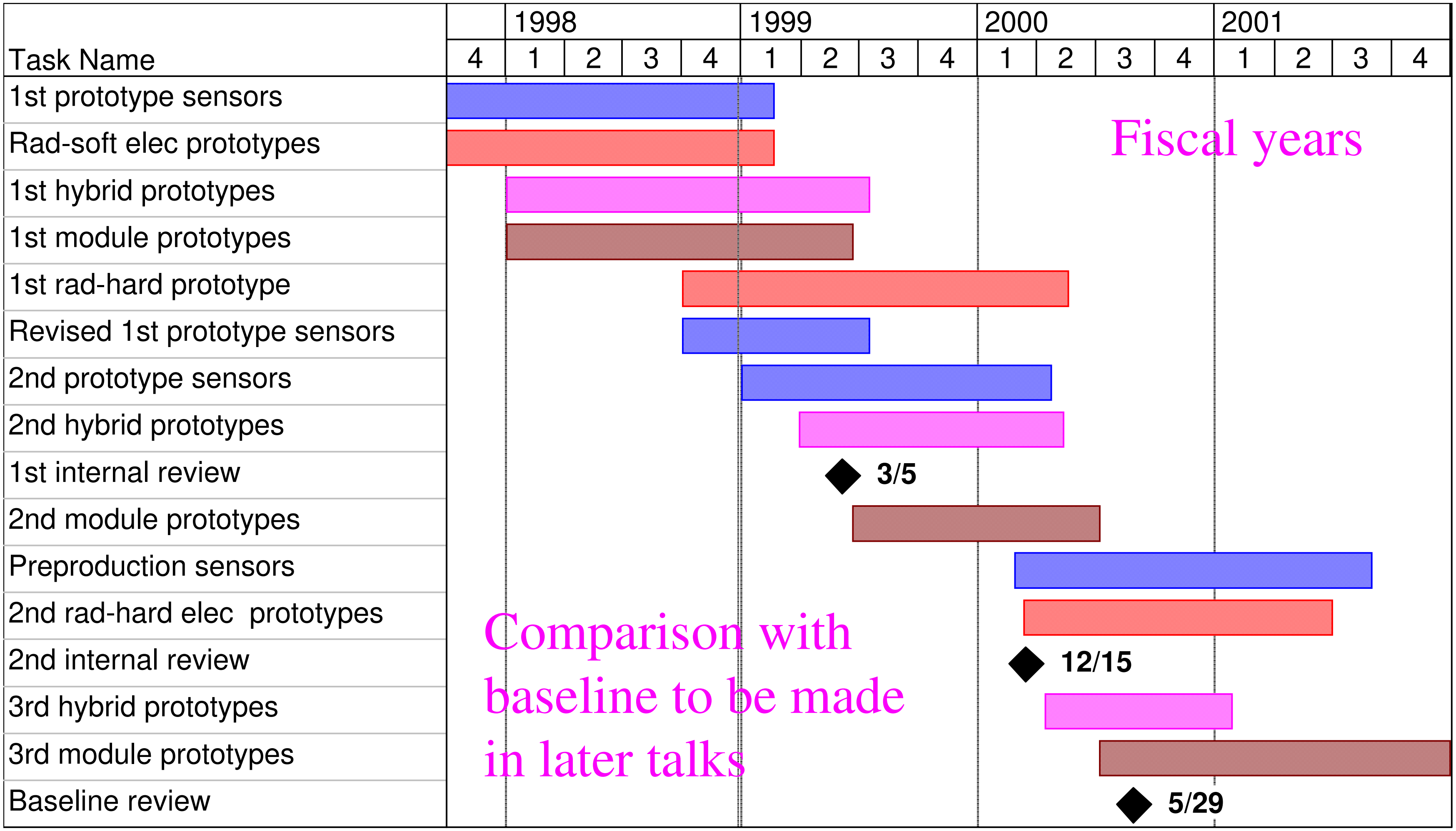
Major Technical Choices

- Most technical choices have been made but some remain.
- Mechanics
  - Sector baseline(all carbon) chosen but with full backup
  - Fixed design concept for support structures and full-size prototyping underway
  - Evaporative cooling but final fluid to be selected.
- Sensors
  - Baseline design selected, exploring parameter range in next prototypes
- Electronics
  - Unified design approach with two vendors but vendor selection is THE remaining choice to be made for project.
- Hybrids
  - Flex hybrid chosen as baseline for all but B-layer
- Modules
  - Choice of solder or indium bump bonding to be made, and choice of vendor(s).
  - Choice of optical components and vendor(s) to be made

Schedule Summary - In Words

- **Mechanics**
  - About a dozen prototype sectors have already been built and tested.
  - Expect to have full-scale prototypes(many sectors, 1-2 disks, end frame section) built and tested by early 2000.
  - Design and build first module placement tooling by about same time
- **Sensors**
  - Completed first prototype round successfully
  - 2nd round fabrication starts in April.
  - If successful, ready to go into preproduction early, before baseline review
- **IC Electronics**
  - Already behind our schedule, have concentrated limited manpower on nearly serial development in two rad-hard technologies(DMILL first)
  - First rad-hard chips by about September, other vendor(Honeywell) some months later.
  - Vendor selection in 2000, another prototype round before preproduction planned.
- **Hybrids**
  - 1st flex prototypes successfully fabricated.
  - Next round almost to fab
  - One more round this year, another spring 2000, all before preproduction
- **Modules**
  - Bump bonding under control for prototypes, vendor selection by 2000.
  - Assembled a few and tested successfully(but problems exist) on PC boards
  - First optical connections by end 1999
  - First real prototypes(no PC board) in 2000
  - Make many more. Develop tooling, procedures starting summer 1999

Baseline Non-Mechanics Schedule

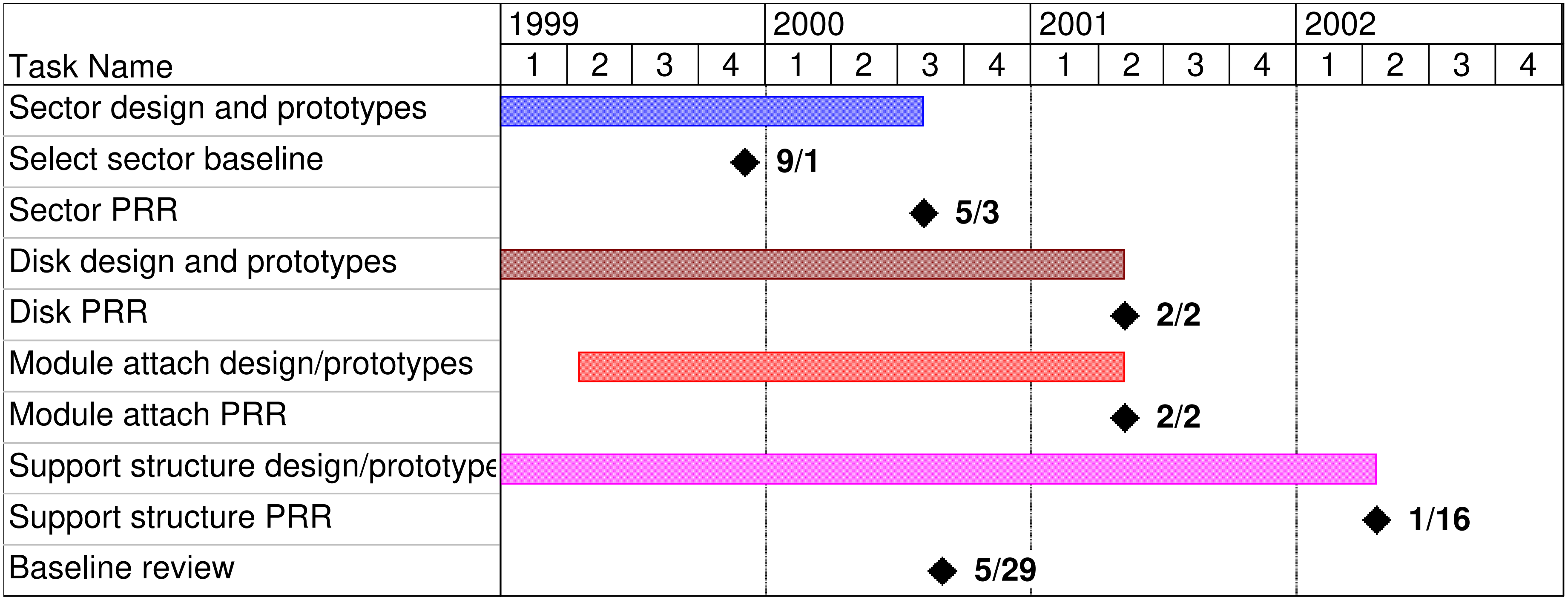


Fiscal years

Comparison with baseline to be made in later talks

Does not include mechanics

Baseline Mechanics Schedule



PRR = Production Readiness Review
Dates beyond baseline review are preliminary

Purpose of This Review

- Assess technical progress in all areas
  - Are we on right track?
  - What are weak points?
  - What is missing?
- Institutional responsibilities
  - Do they make sense?
- Schedule
  - Are we on track for a construction baseline review in summer 2000?
  - Too soon? Too late?
- Costs
  - Will not cover costs in this review - major part of next internal review
- Advice on specific issues
  - We seek your advice on specific issues that will be raised during the presentations, particularly at the end.