A Novel Optical Package for the ATLAS Pixel Detector

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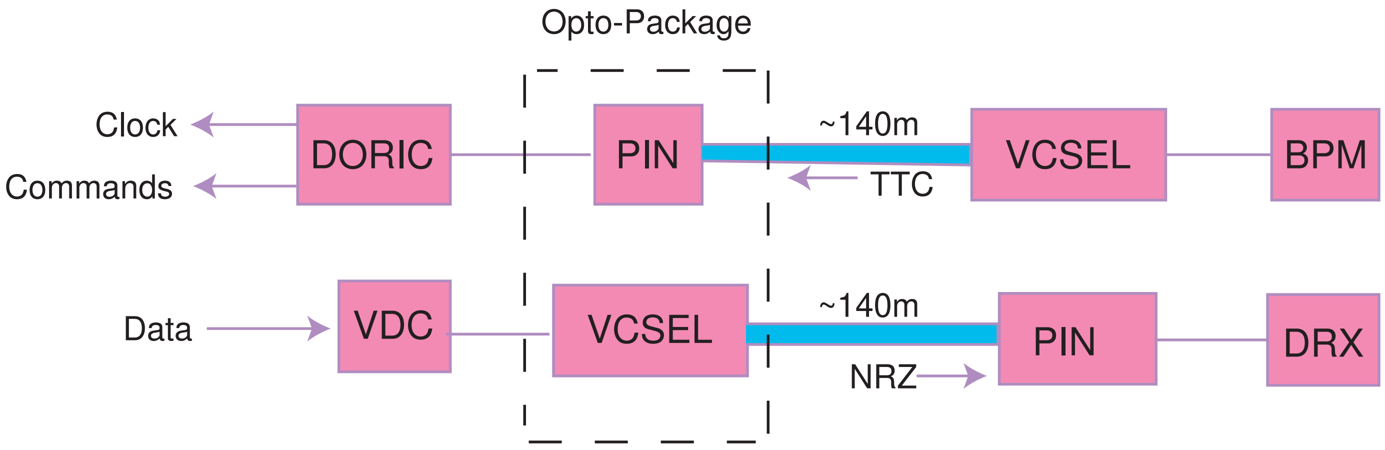
August 10, 2000
DPF2000

Outline of Talk

- Introduction
- Design
- Results
- Summary

ATLAS Pixel Opto-link



Optical Package

- 3 fibres + 2 VCSEL + 1 PIN
- Coupled VCSEL power $> 300\ \mu$W @ 10 mA
- VCSEL tolerance:
  - ◇ 50 μm in z (along fibre)
  - ◇ 25 μm in x and y (transverse to fibre)

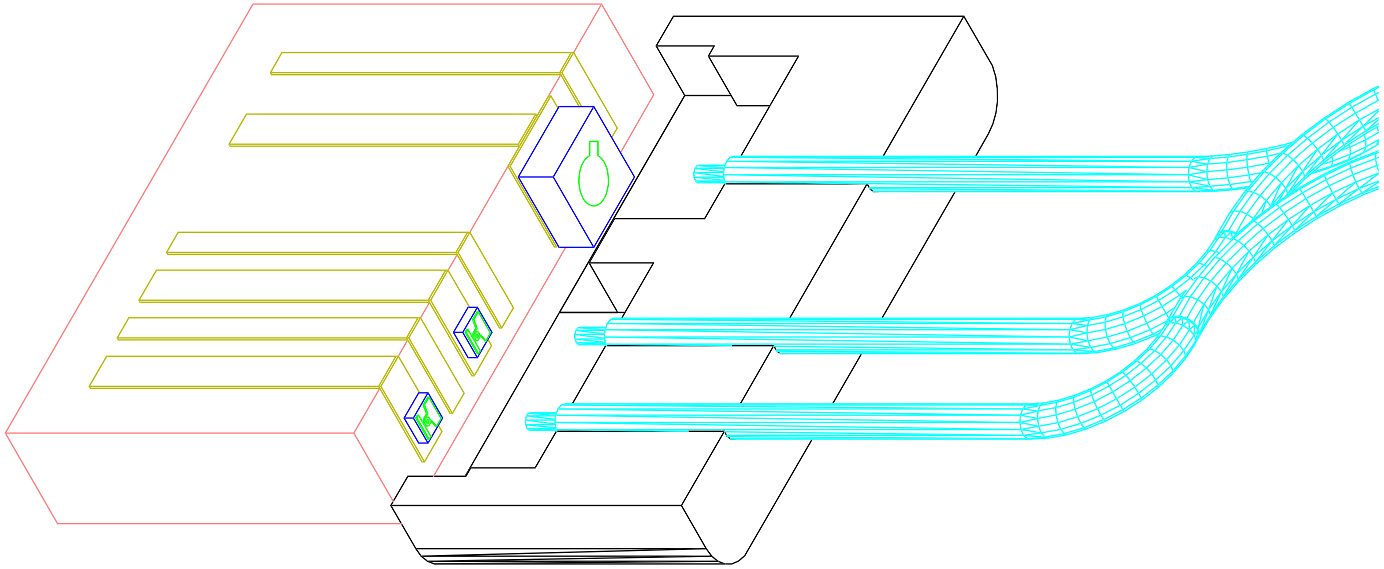
Package Designs

- Marconi
  - 8 silicon/alumina pieces
  - using silicon mirror for 45^{o} light reflection
  - high cost
- Taiwan
  - 3 G-10 pieces
  - cleave fibre at 45^{o}
  - fibers permanently attached to package
  - need voliton connector
  - low cost
- OSU
  - 2 pieces
  - cap with fibers can be attached to package at end of detector assembly
  - low cost

OSU Design

- Connector concept design
  - ◇ use precisely fabricated cap and base for alignment
  - ◇ simple two-piece design for mass production and cost reduction
- Cap
  - ◇ 3 holes for fibres
- Base
  - ◇ deposit gold traces for wire bonding, VCSEL and PIN placements

Base and Cap



Cap and Base Prototype

- Produced caps and bases using machinable ceramic
  - ◇ material tested: aluminum silicate and macor
  - ◇ difficult to obtain consistent precision

→ redesign base with square instead of round corners for ease of fabrication by Hybrid-Tek:

- ◇ alumina rod ground to proper thickness and cut
- ◇ have produced bases with precision within specification
- ◇ 3D traces have good connectivity

→ fabricate cap with Ultem (polyetherimide) for radiation tolerance (10 GRad)

- ◇ use manual micro mold injection to save development time
- ◇ can fabricate several quality caps per hour

Package Prototype

- Produced 6 prototypes

- VCSEL has fast rise and fall time: < 1 ns

- PIN has good responsitivity: 0.5 A/W

- Coupling power > 300 μW in both VCSELs simultaneously
  for different combinations of bases and caps
  - ◇ can achieve high coupled power sometimes without cap adjustment
  - $\rightarrow$ demonstrate feasibility of fabricating high precision caps and bases

- Some cross-talk between PIN and VCSEL
  - $\rightarrow$ shorten traces (base) to reduce capacitive coupling
  - $\rightarrow$ added ground pads between traces

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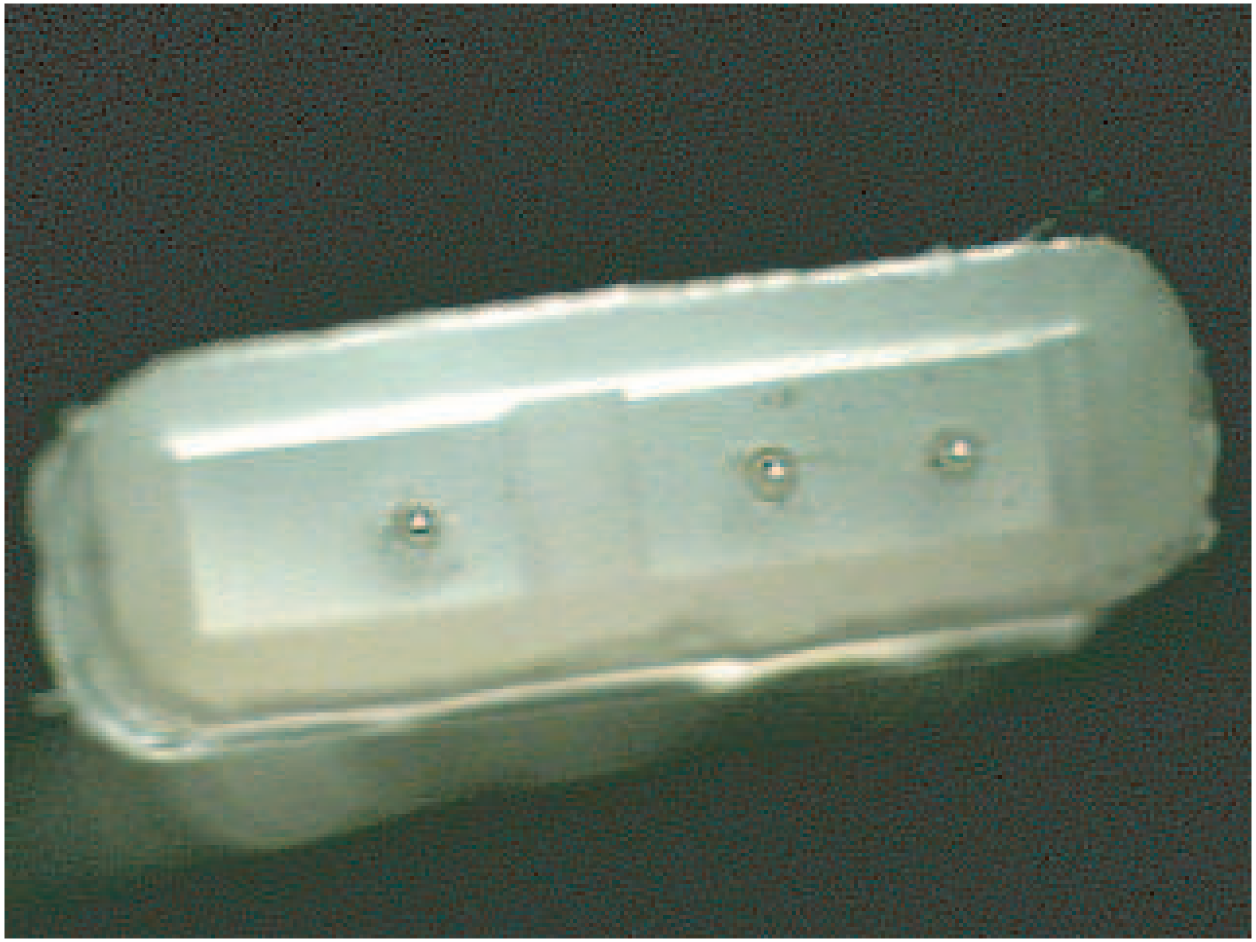
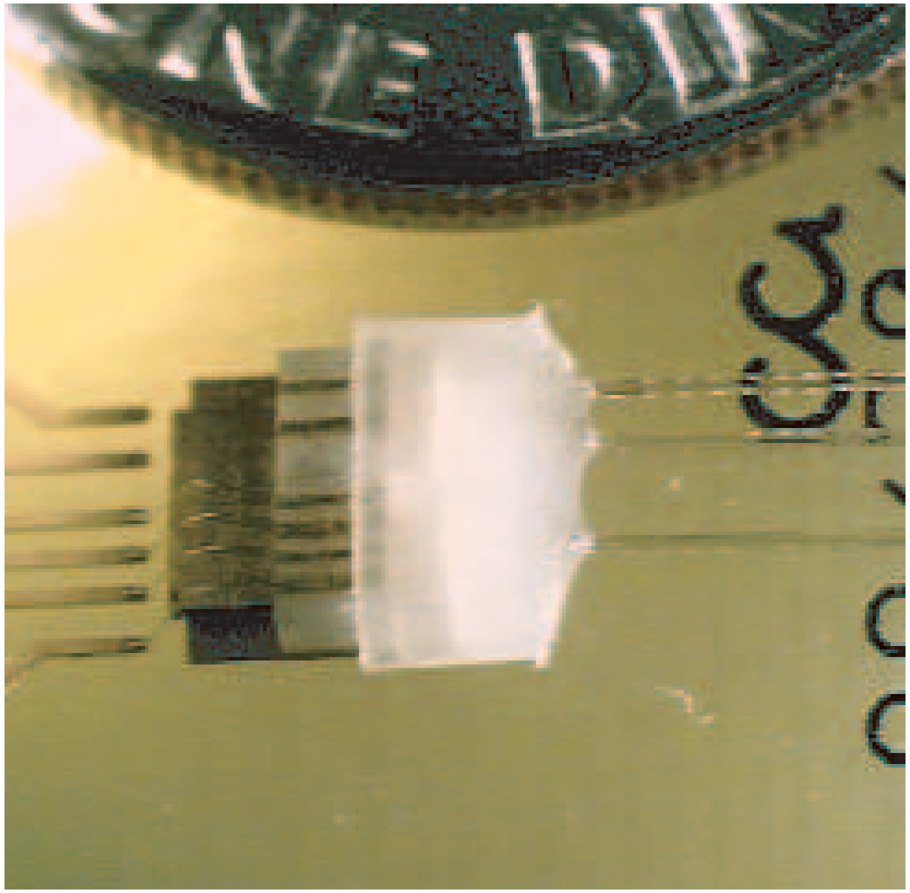
Cap with Precisely Fabricated Cavity

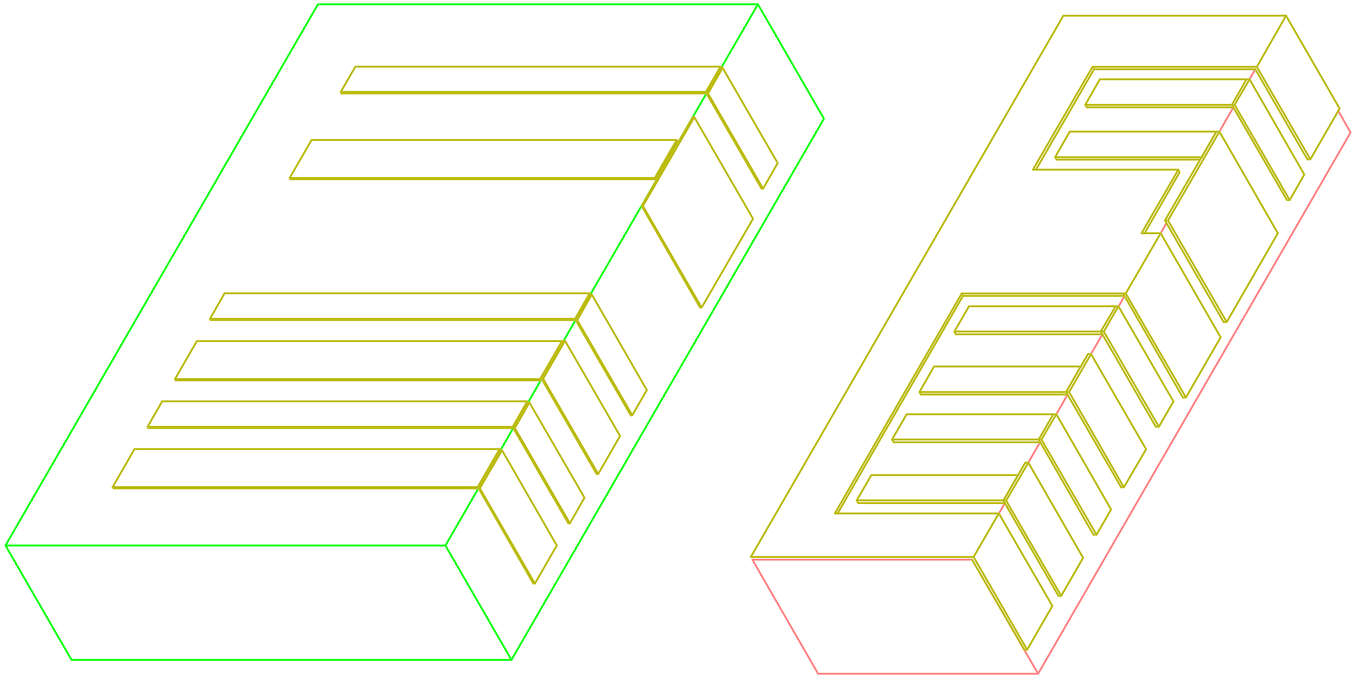


Base with PIN and VCSELs

Opto-package



Comparison of New vs Old Bases



Summary

- ◇ principle of two-piece connector concept optical package demonstrated:
  - ◇ precision bases with 3D traces of good connectivity fabricated
  - ◇ precision caps fabricated
  - → packages produce optical power above specification