Status Report on Michigan Group Tracker Alignment R&D

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Goal:

Carry out R&D toward a low-mass, real-time tracker alignment system with $O(1 \text{ micron})$ precision

Why?

Assumption:

Inner detector subject to thermal drifts on time scales too short to collect adequate control sample of tracks for determining alignment from data

Conclusion:

Need independent alignment system with rapid tracking of drifts $\Rightarrow$ “Real time alignment”
Two optical alignment schemes used in present / future experiments:

• RASNIK system -- L3 → CHORUS → CDF

• Frequency Scanned Interferometer (FSI) – ATLAS


Focusing efforts here on FSI approach

→ Seems more promising for low-material tracker

Basic idea:

Measure hundreds of absolute point-to-point distances on tracker structure, using an interferometer “fanout” of optical fibers from a central laser.

Laser frequency is scanned and fringes counted for each channel to determine absolute distances. Infer tracker distortions from fit.
Status:

- Requested funds in joint UCLC/LCRD proposal – waiting…
- Former graduate student (Jin Yamamoto) has been spending part-time laying groundwork for acquiring equipment
- Big-ticket item – Scannable laser
  - First choice: New Focus “Velocity” series (~630 nm) Tuning range: >3.5 THz (nominal f = 480 THz)
  - Cost: ~$20K
  - Infrared (~1.5 µm) laser with comparable range available for ~$10K – fallback option but visible light preferable
Other components planned for first bench test:

- Photodiode
- Corner reflector
- Optical fibers and couplers
- Etalons (reference cavities)

Conceptual design:

- Need straw man configuration of interferometer beams
- Need simulation infrastructure for optimizing design
- Seeking talented student to write simulation program
Summary

Poised to order laser (and wavelength-dependent components) – awaiting signal of funding likelihood:

In parallel will develop simulation tools to optimize design

Would love to know funding situation better…