



CHARA Michigan Phase-tracker



*Fringe Tracking
in the
Near Infrared*

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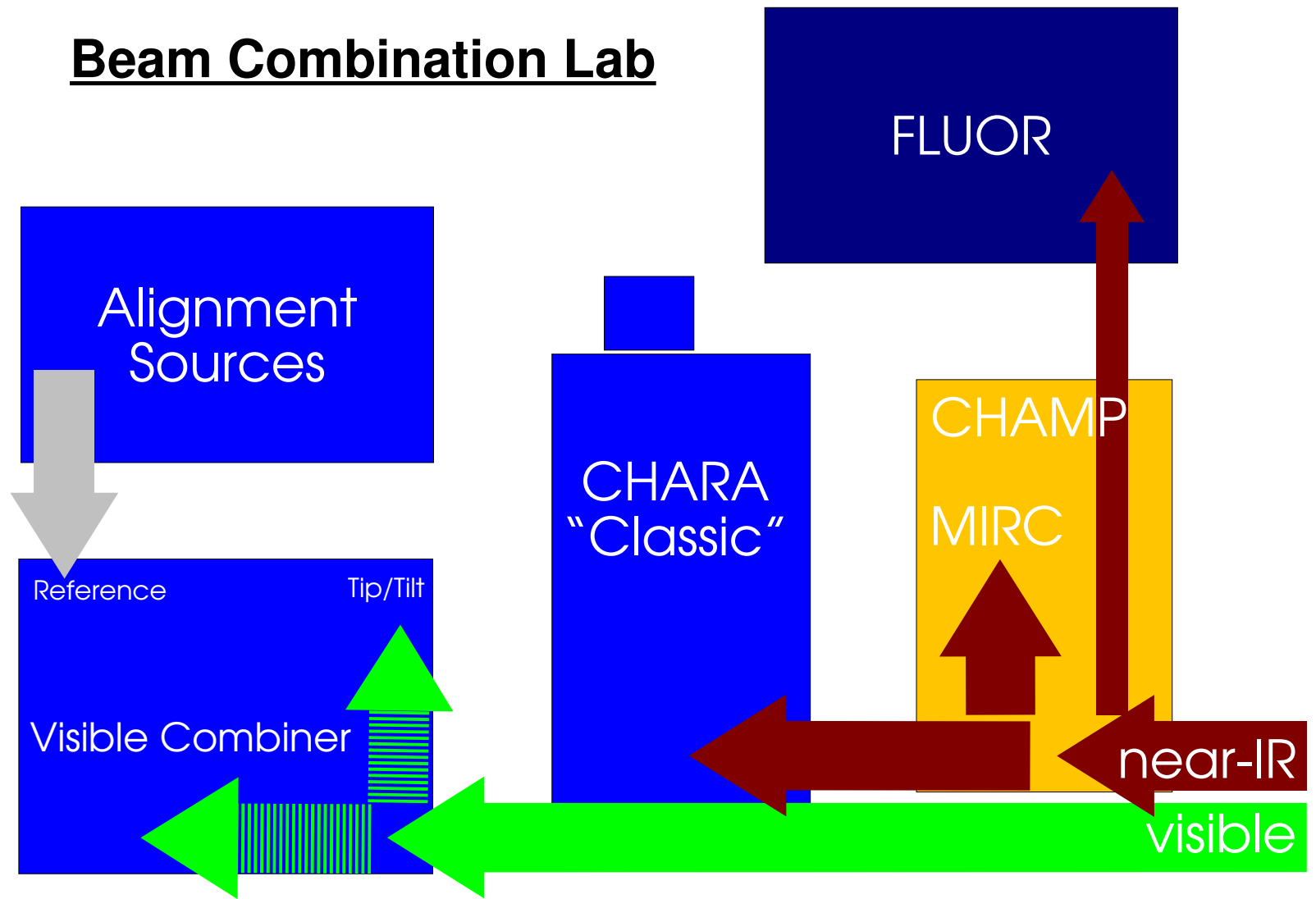


Overview

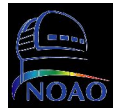
- ✦ removes atmospheric and mechanically induced phase changes (“freezes the fringes”)
- ✦ longer coherence and integration times
- ✦ increased sensitivity
 - ✦ for MIRC, ~3-4 magnitudes
 - ✦ shorter path length modulation for PP combiners
- ✦ separate fringe tracker from science combiner



Beam Combination Lab



adapted from J. Sturmann (priv. comm.)



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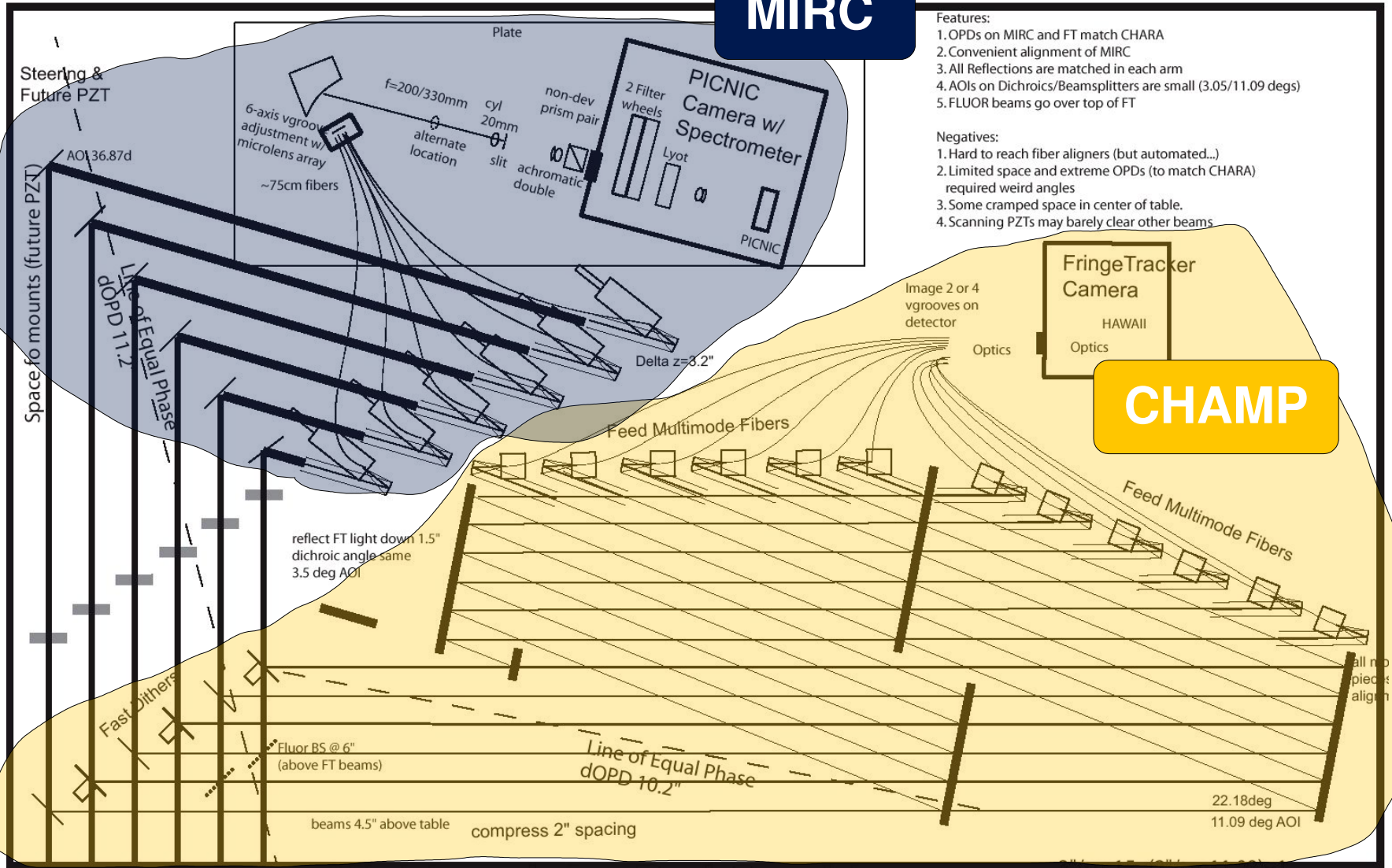




MIRC

- Features:
1. OPDs on MIRC and FT match CHARA
 2. Convenient alignment of MIRC
 3. All Reflections are matched in each arm
 4. AOIs on Dichroics/Beamsplitters are small (3.05/11.09 degs)
 5. FLUOR beams go over top of FT

- Negatives:
1. Hard to reach fiber aligners (but automated...)
 2. Limited space and extreme OPDs (to match CHARA) required weird angles
 3. Some cramped space in center of table.
 4. Scanning PZTs may barely clear other beams



CHAMP



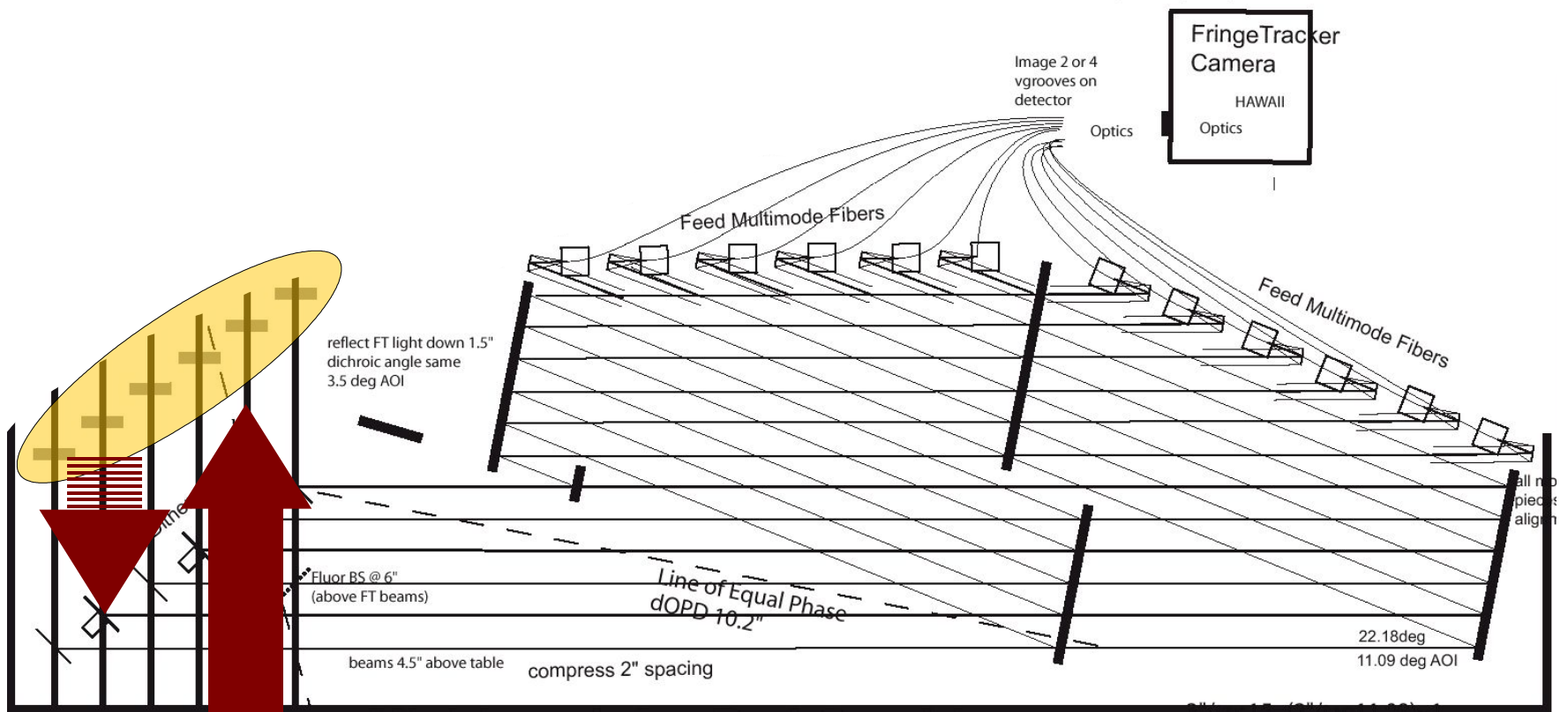
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Feeding CHAMP

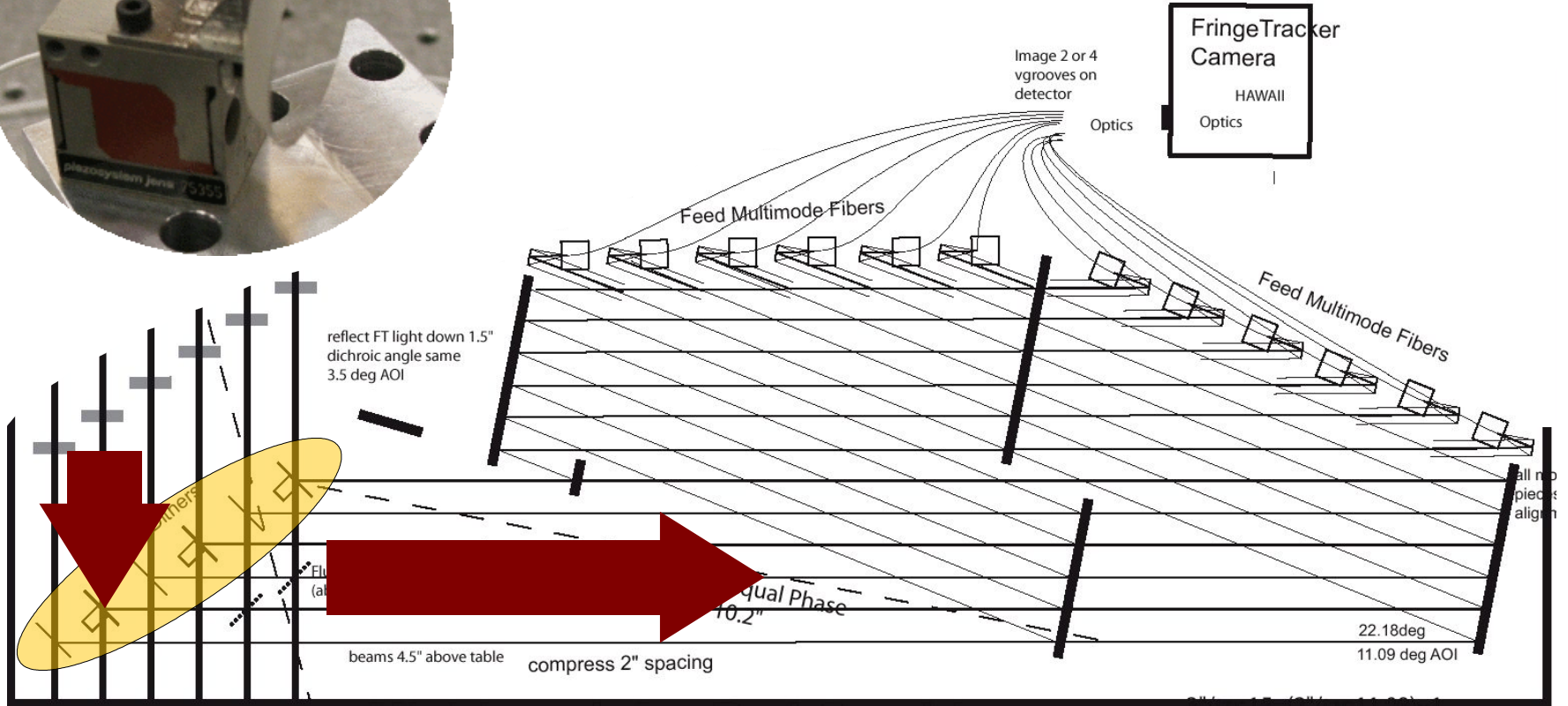
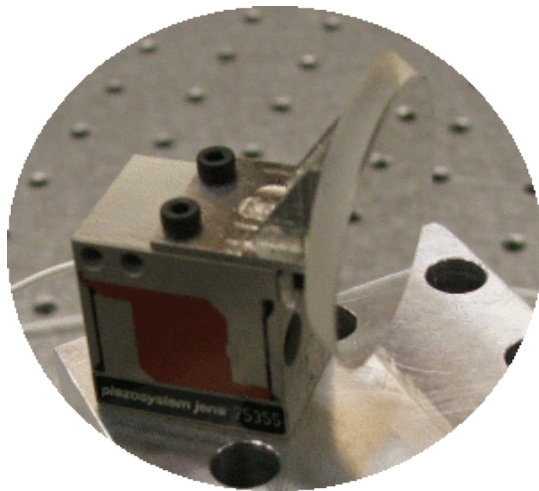
- ☀ gray (50/50) or chromatic (JHK) split options
- ☀ "hot-swappable" mount design to minimize re-alignment
- ☀ CaF₂ glass is being ordered
- ☀ angles beam down to 4.5" height





Path Modulation

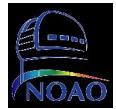
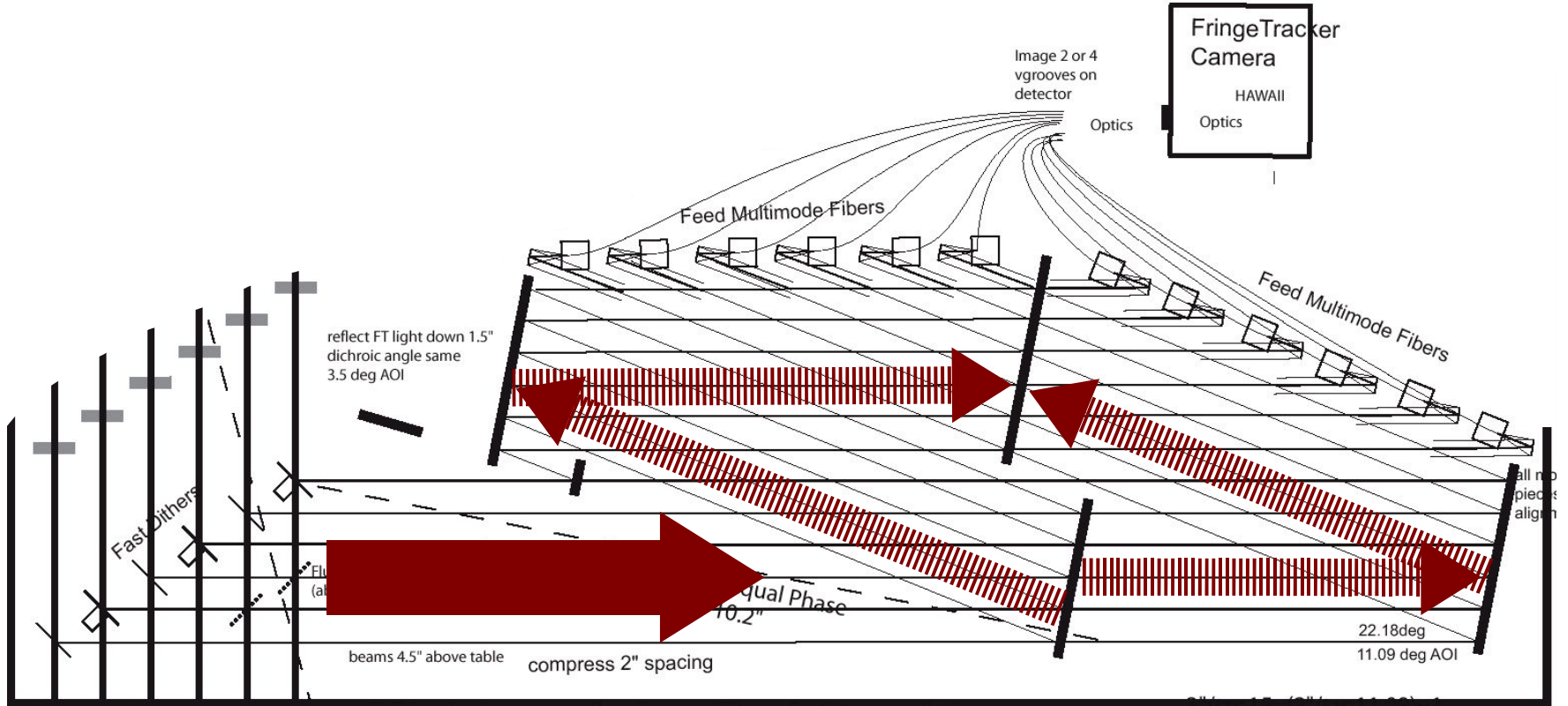
- ☀ changes beam spacing to 2"
- ☀ every other beam @ same freq
- ☀ $\Delta\text{OPD} = 1-2 \lambda$'s at up to 500 Hz
- ☀ resonant frequency @ 1.2 kHz
- ☀ elliptical flat mirror on invar mount
- ☀ design finalized, piezos ordered





Beam Combination

- ✦ small AOI (~11 deg) --> 1" optics
- ✦ pair-wise: 1+2, 2+3, 3+4, 4+5, 5+6, 6+1
- ✦ moveable mirror for use with 2 to 6 telescopes
- ✦ Infrasil glass is being ordered



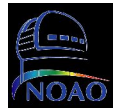
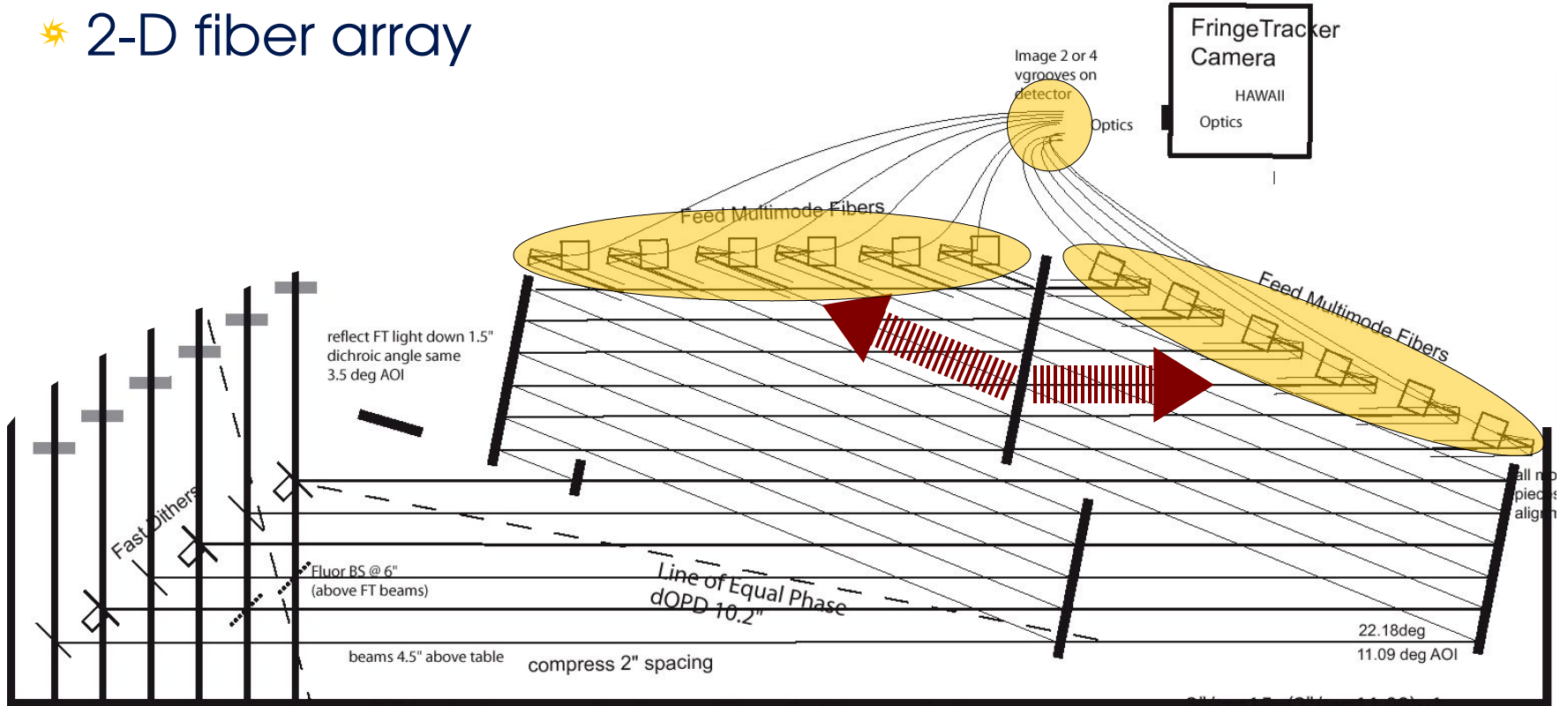
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Fiber Injection and Transport

- ✦ multi- or many- mode fibers
- ✦ easier beam transport
- ✦ 2-D fiber array



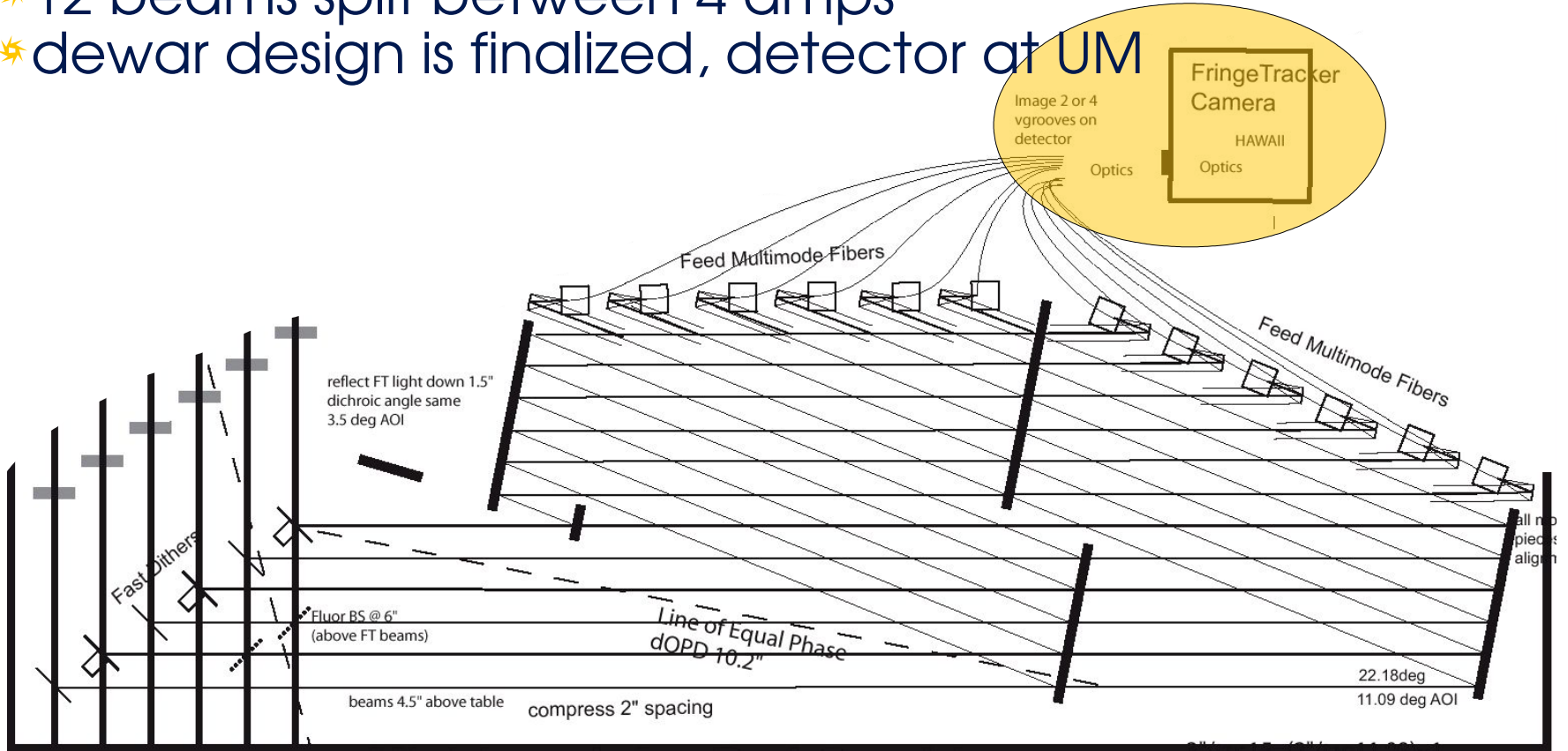
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Camera Dewar, Optics, and Detector

- ✦ reimaging optics
- ✦ 2 filter wheels
- ✦ 1k x 1k Hawaii detector (same as at Keck)
- ✦ 12 beams split between 4 amps
- ✦ dewar design is finalized, detector at UM

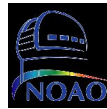
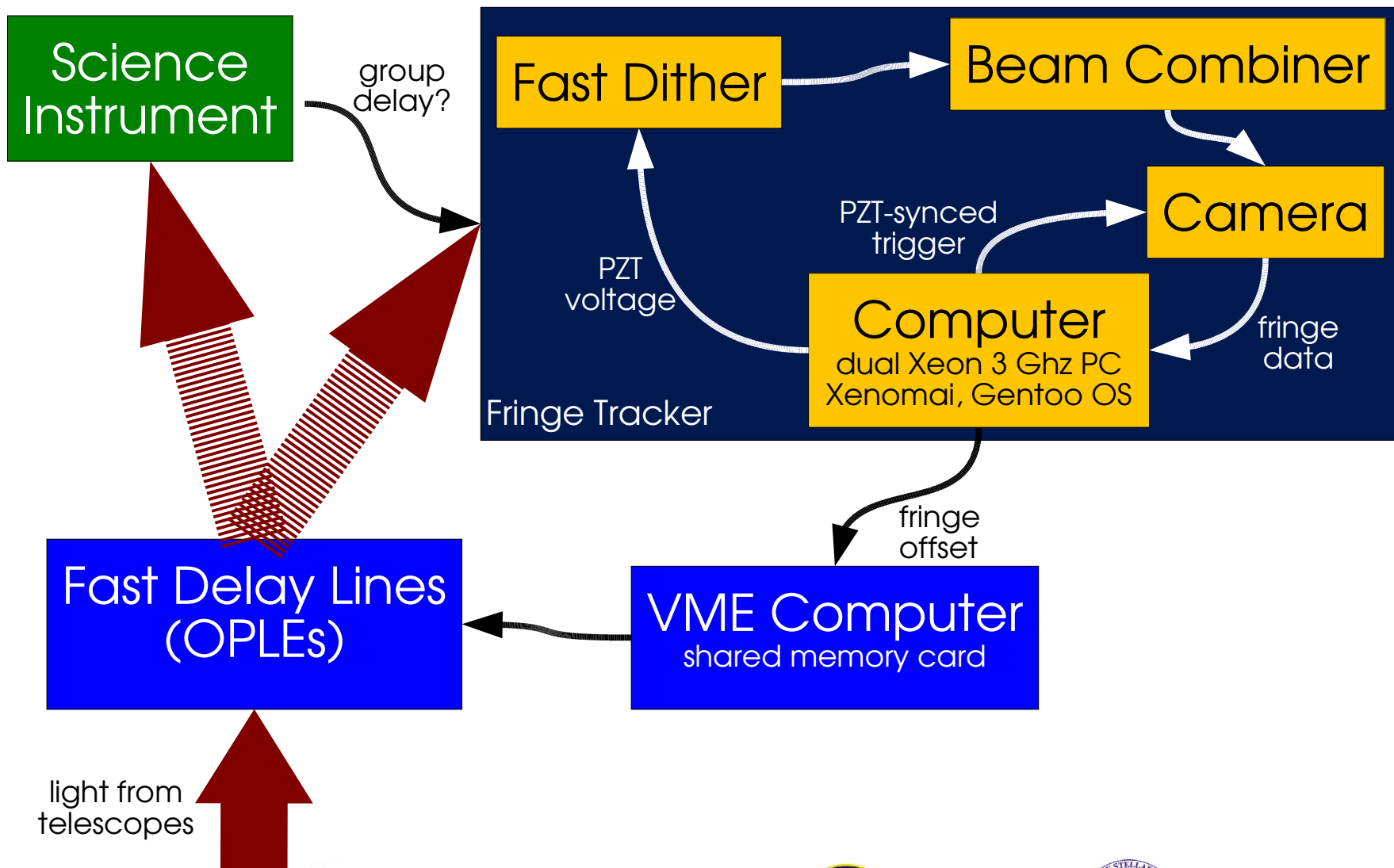


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Information Flow



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Project Status

beam feeds

- CaF2 glass being ordered

path modulation

- piezos have been lab tested and ordered
- design for custom mirror mount finalized
- elliptical mirrors at UM
- amplifiers have been ordered
- analog signal generator card and breakout box at UM

beam combiner

- Infrasil glass being ordered
- off the shelf mounts specified

camera

- dewar design finalized (delivery ~3 months)
- Hawaii chip and digital readout electronics at UM

computer

- computer at UM with Gentoo installed
- specified Xenomai RTOS

delay line control

- consultation with Hines & Irwin



Current Schedule

Spring '06

finish optical and mechanical fabrication

Summer '06

camera testing and dewar optics design

Fall/Winter '06

integrate camera with combiner and close loop with artificial turbulence; upgrades to CHARA VME

Summer '07

delivery to CHARA; sky testing