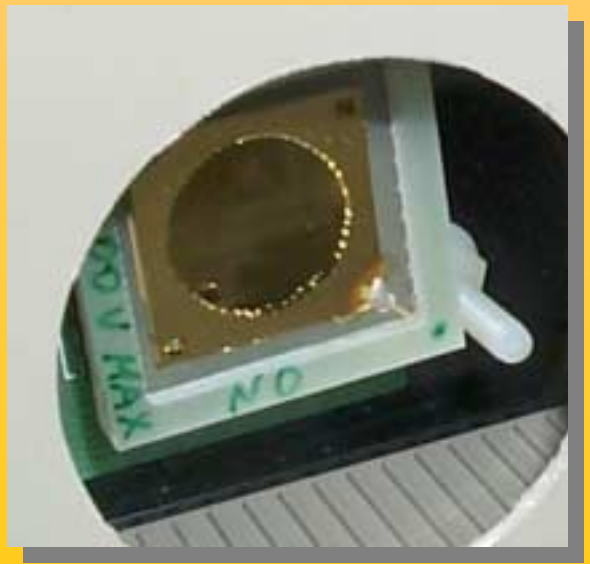
McMath-Pierce Adaptive Optics

- Premier facility for infrared observations from 2 to 28 μm
- Adding AO is most important improvement that can be made
- For diffraction limited images above 2.3 μm under median seeing, 28 actuators with a closed-loop bandwidth of 30 Hz are sufficient
- Less stringent requirements than in the visible make low-cost approach feasible
- Wavefront sensing at 1.5-m telescope and 4-cm median seeing at 500 nm require about 200 subapertures, significantly more than any other solar AO system
- Spot/limb/correlation tracker in scientific use since April 1, 2002

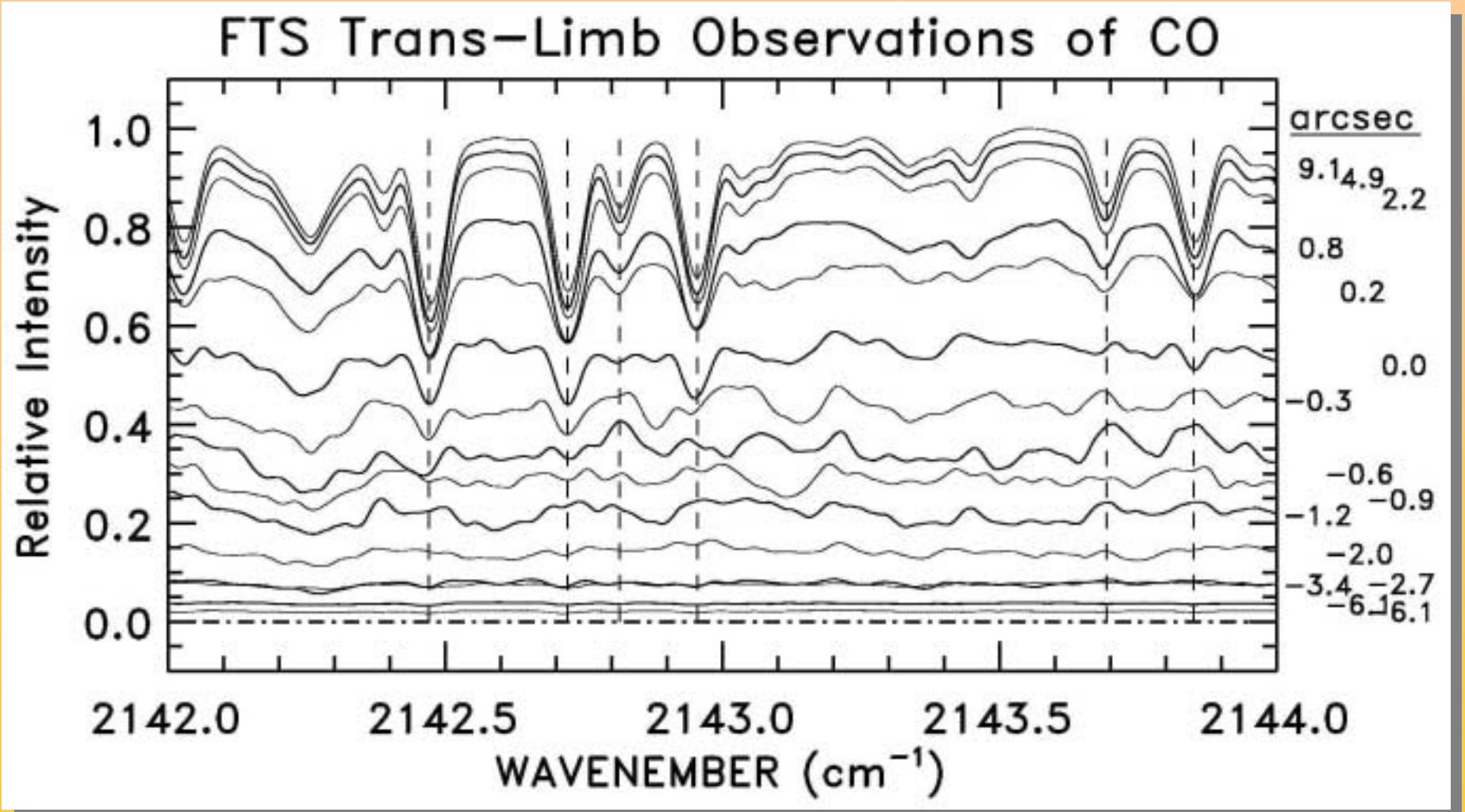
Low-Cost Approach to AO in the IR

Low-cost, commercial off-the-shelf parts for a complete AO system have been purchased for less than $25k:

- all-reflective, gold-coated off-the-shelf optics
- PiezoJena fast tip-tilt stage with large angular range
- Flexible Optics micromachined deformable mirror with 37 actuators
- DALSA 1kHz frame rate 256 by 256 CCD camera
- Industrial PC with 1 GHz Pentium III processor and digital frame grabber running Linux RedHat 7.1 in soft real-time mode



Science Example



- First FTS observations of CO limb emission at 4.8 µm
- Observations, figure, and draft ApJ paper courtesy Tom Ayres

Status and Outlook

- Universal Tracker (image motion correction only) is in scientific use since April 2002
- More than half of the observations since April 2002 requested the Universal Tracker
- Two scientific papers for refereed journals in draft form

- Slow closed-loop AO demonstrated in the lab with <$7k hardware cost, 1 REU summer student (Summer 2001)
- Fast, stable closed-loop operation using 193 subapertures at 250 Hz demonstrated (June 2002)
- First corrected solar images and increase of update rate to 500 Hz within the next weeks
- Construction of user system during FY2003