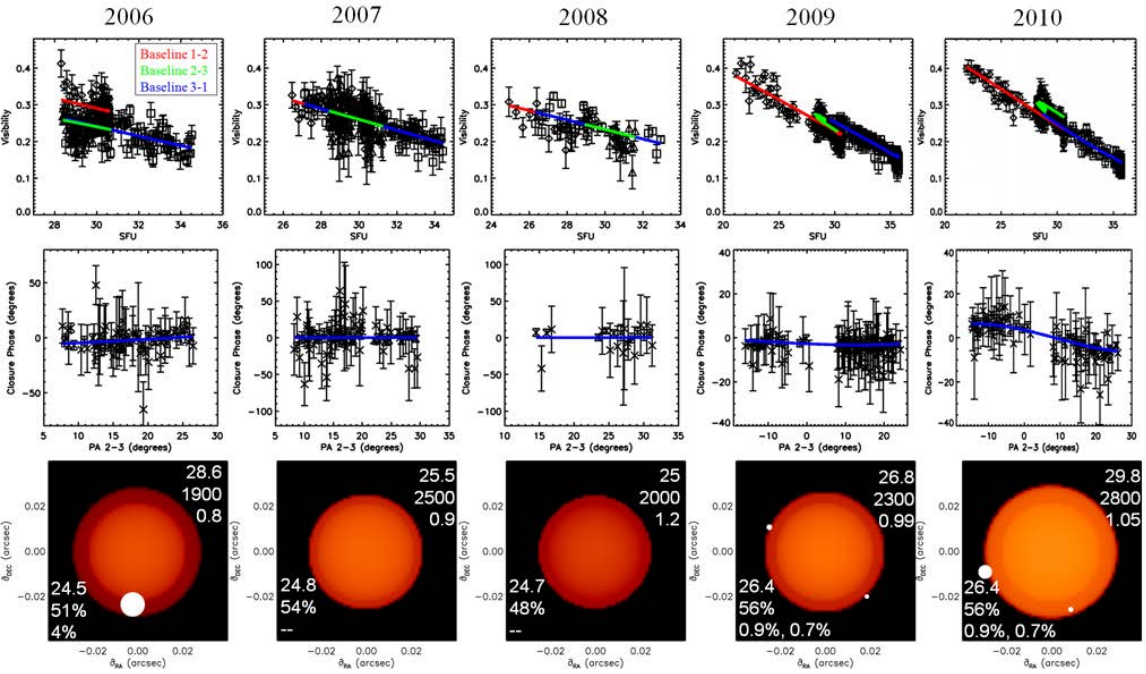
Infrared Spatial Interferometer (ISI)
three telescope array, 11 μm, Mt. Wilson

Unique heterodyne interferometer array
Measurements of changes in stellar sizes & shapes with frequent observations.
High spatial & high spectral resolution



Betelgeuse changes over 2006-2010
Visibility & Closure phase
Fits to simple model

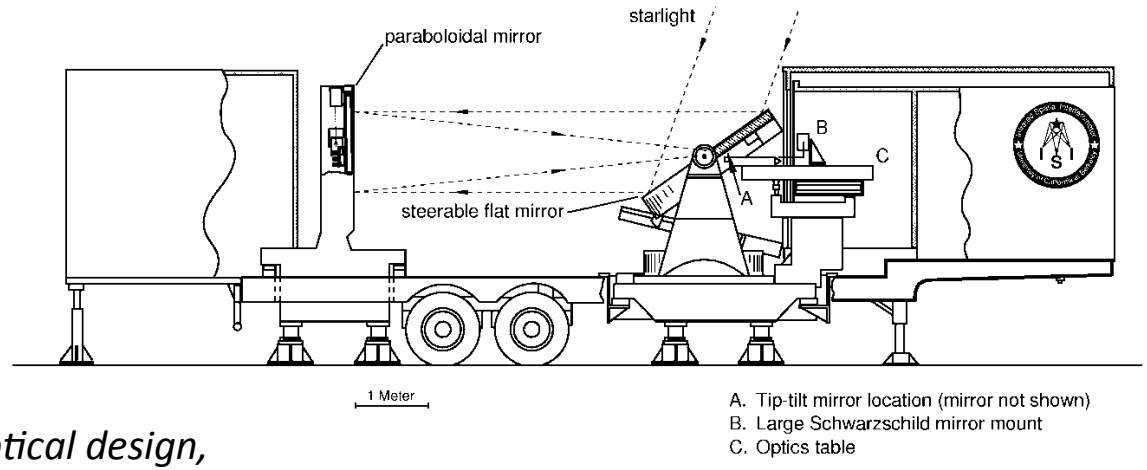
Infrared Spatial Interferometer

World's highest frequency radio telescope interferometer, operates at 27 THz (11 μm). Heterodyne detection using $^{13}C^{16}O_2$ lasers as local oscillators. Geometric delays removed using RF delay lines.

Currently located at Mt. Wilson Observatory, a site noted for very stable seeing.

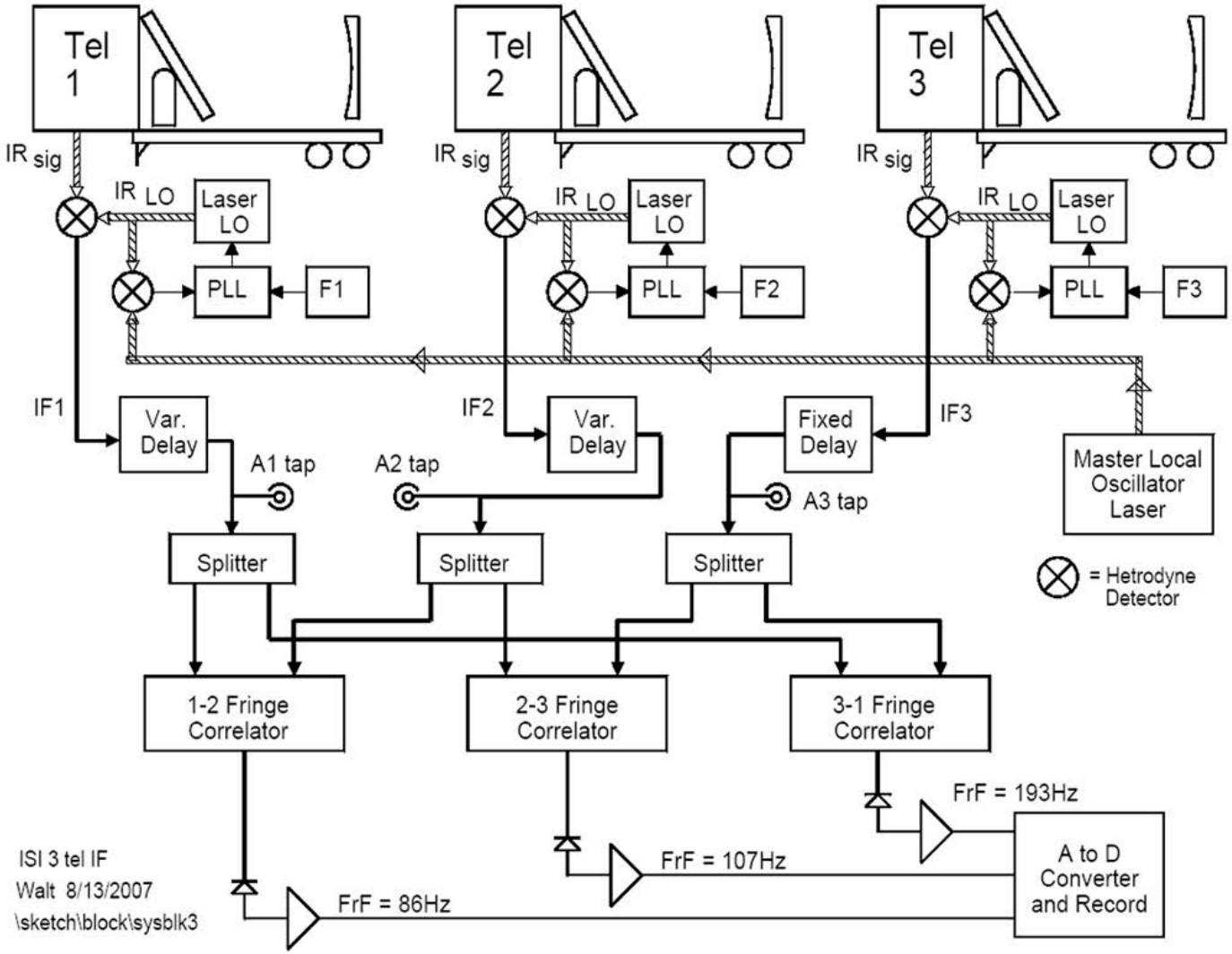
Two telescopes in operation 1988
First fringes 1989
Third telescope 2003
Closure phase measured 2004

Telescopes designed for transport as a standard semi-trailer



Pfund optical design,
65" f/3.14 parabolic primary, 80" flat mirror

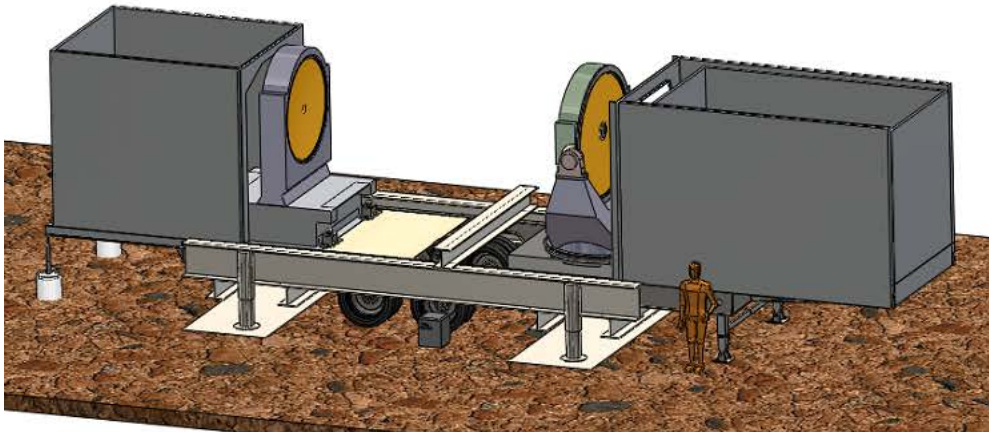
Current system, spectrometer taps A1,A2,A3



DARPA Galileo program to image geo-synchronous satellites

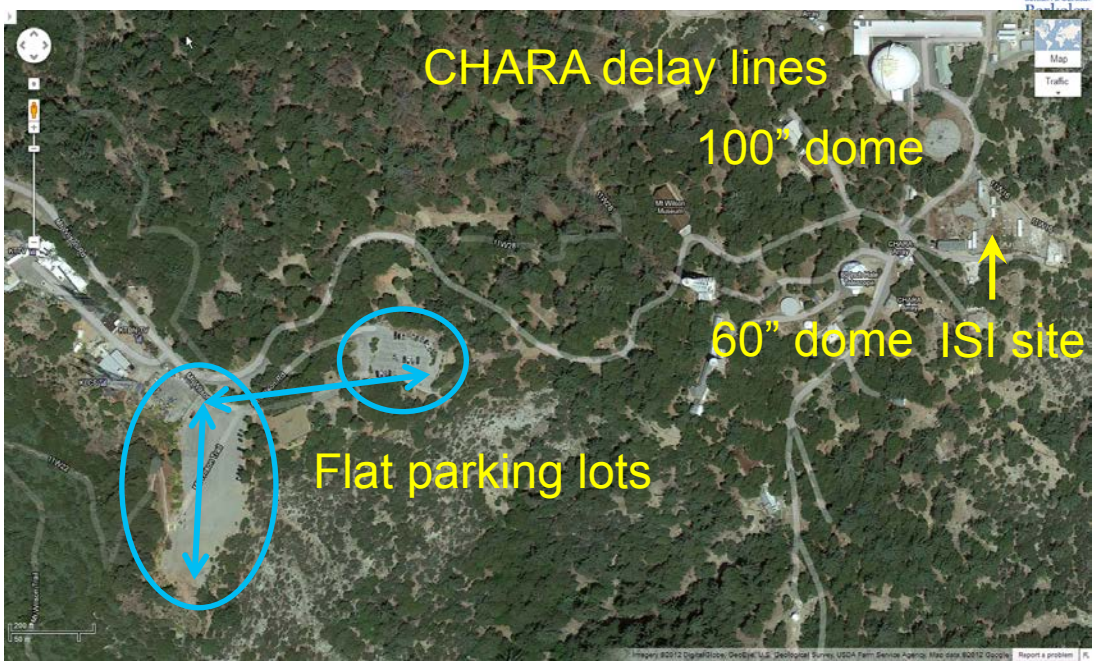
Interferometry of geo satellites
10 cm resolution @ 36000 km
~3 nrad ~ 0.6 mas, Mv=11
Many samples in UV plane, 20 nights
Telescopes (1.5m) w/ Rayleigh beacon AO linked with optical fibers
Move baselines in 5 min
Conduct meas. at Starfire in NM

Task1: movable telescopes w/AO to feed fibers
Task 2: fibers, delay lines, spectral combiner
Task 3: integration, site prep., conduct obs.



Site trades: including Mt. Wilson

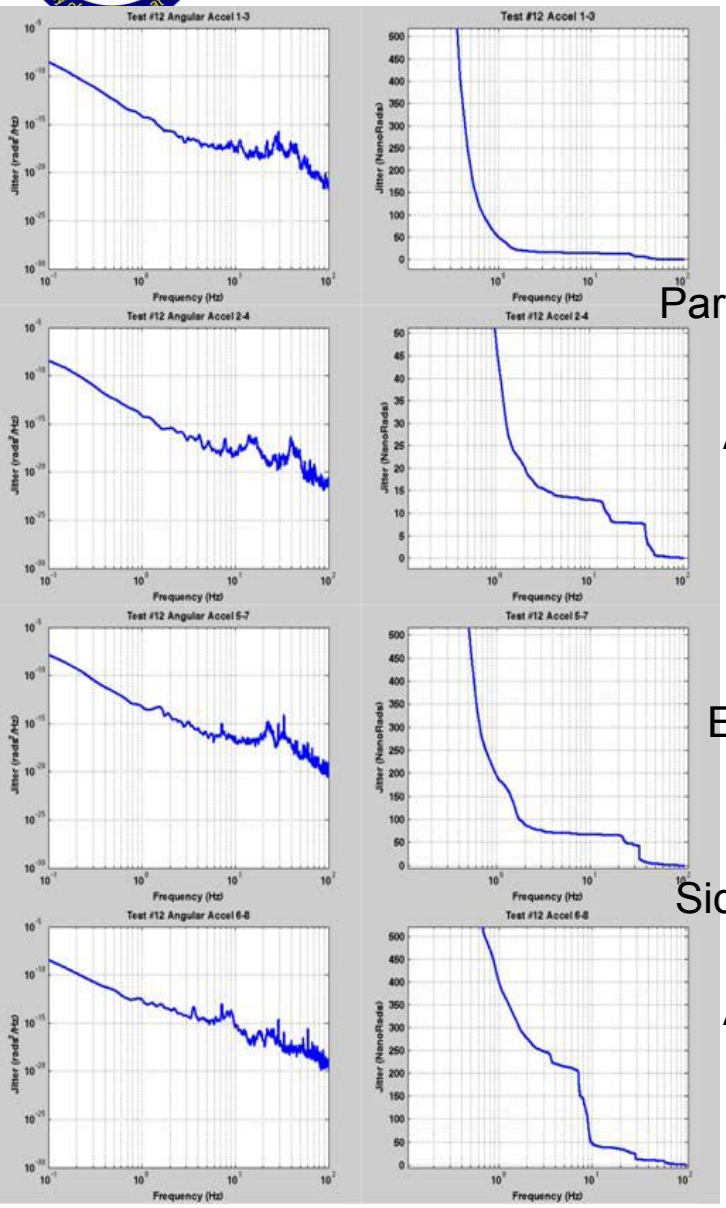
Dagr/Starfire telescope environs



Potential telescope locations at Mt. Wilson ~130 m N-S; ~165 m E-W baselines. Both lots are paved.
ISI current site on right side, entrance gate at left edge.

Neither site is being used. A new Lockheed 3 telescope array will be used instead. Lower spatial resolution imaging of satellites will be conducted.

ISI Vibration tests/Optical wavefront tests



EL

Parabola

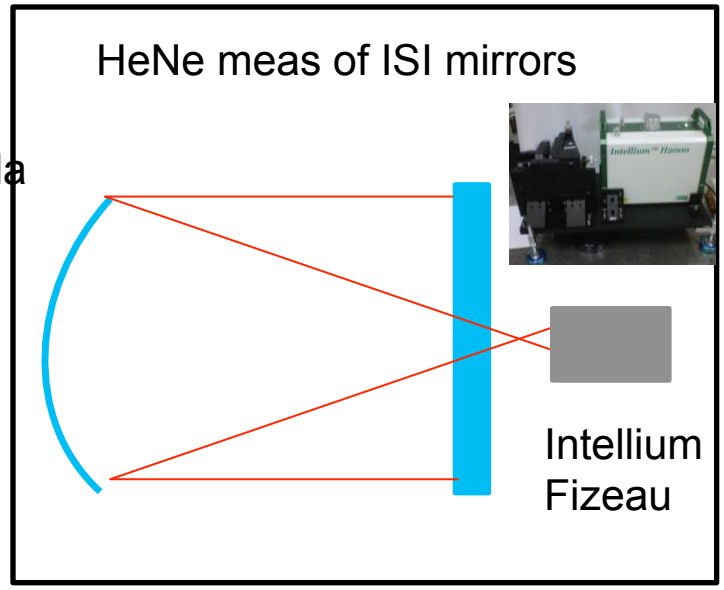
AZ

EL

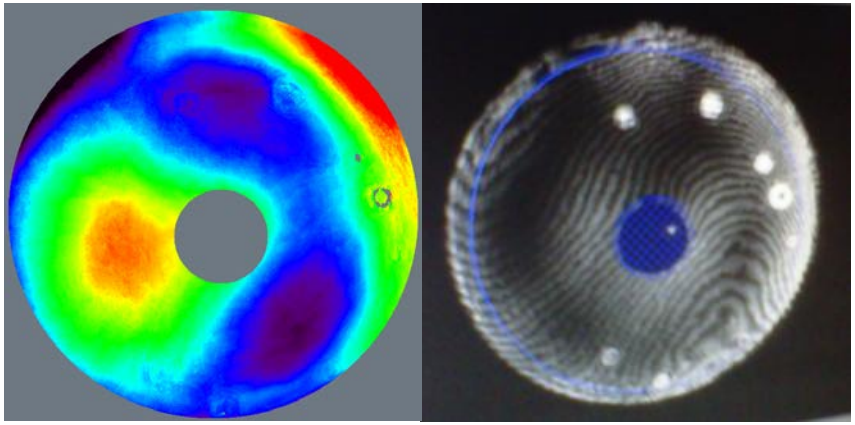
Siderostat

AZ

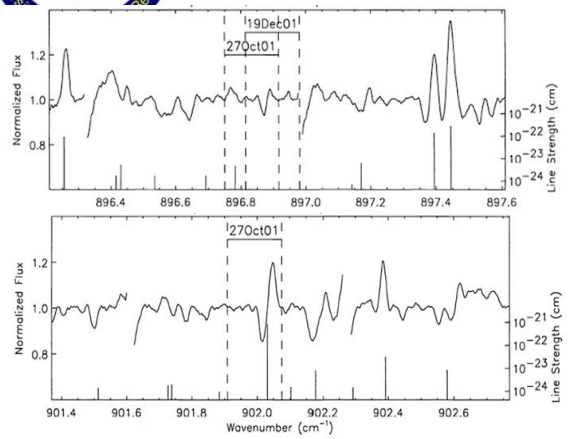
HeNe meas of ISI mirrors

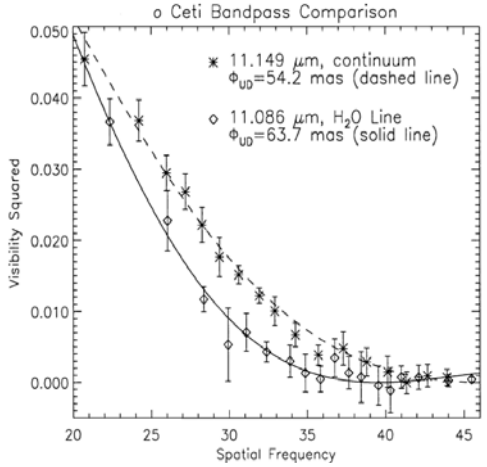


Date(measured): Mon Oct 29 23:20:02 2012			
Removed: X Tilt, Y Tilt			
Process: [3A1,M,PCG]			
IntelliWave Report Summary			
Parameter	Value	Units	QC
PV 98.00%	3.3937	waves	
RMS	0.791	waves	
4) Focus	-0.048	waves	
5) X Astig	0.5048	waves	
6) Y Astig	-0.9518	waves	
7) X Coma	1.5494	waves	
8) Y Coma	-0.5898	waves	
9) Spherical	0.3043	waves	

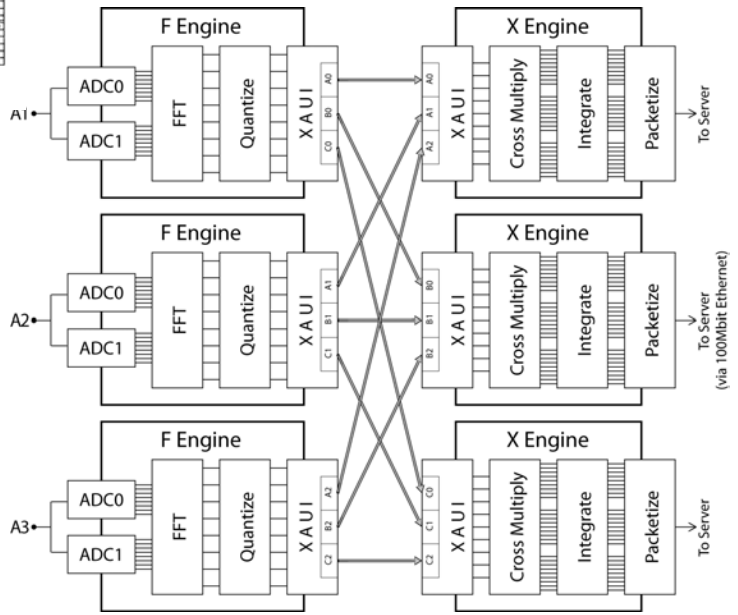


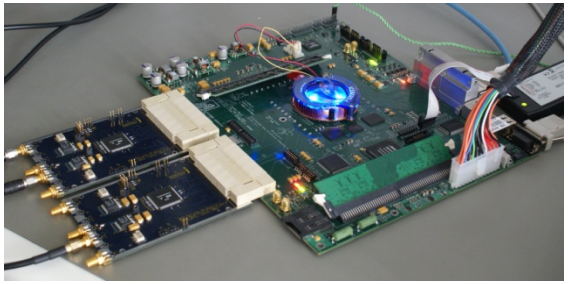
FPGA digital spectrometer-correlator





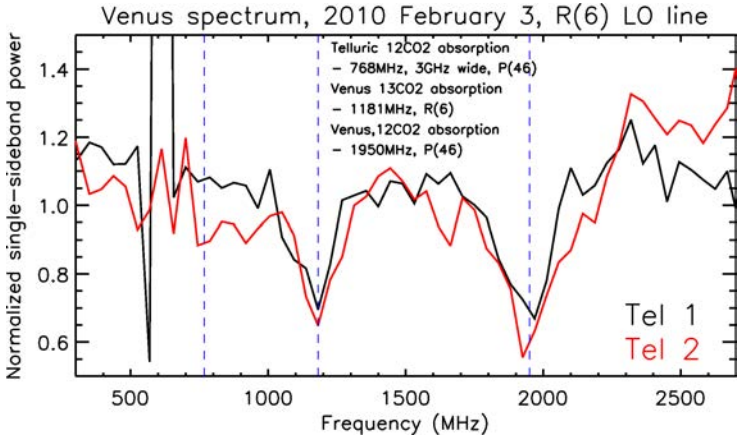
Prev. work by Monnier on SiH4, NH3 using analog correlator
Wiener on H2O, using full band by shifting laser LO frequency



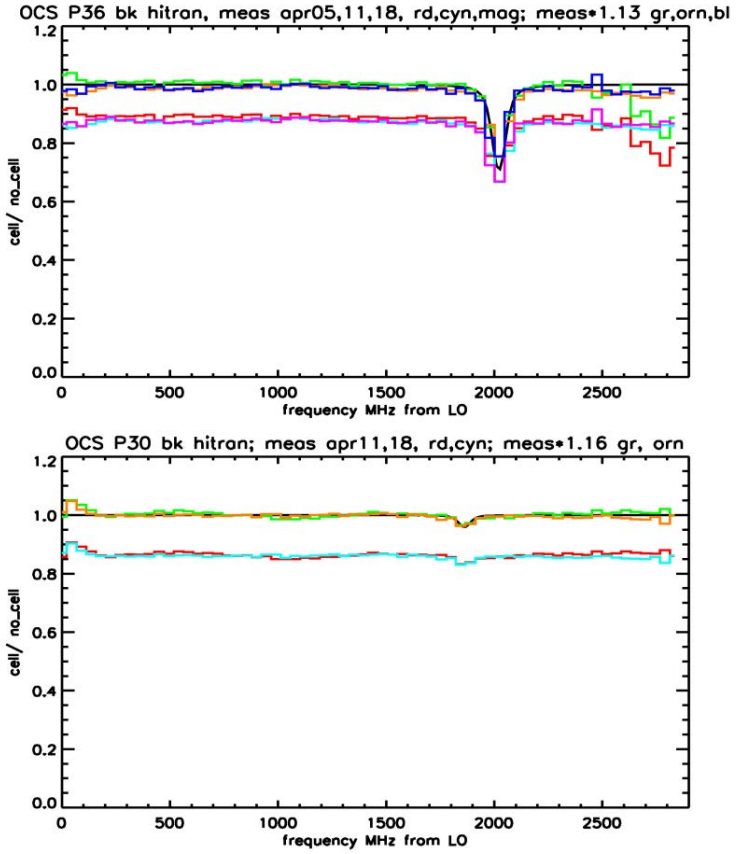


6 Gsamp/sec using interleaved ADCs
128 pt FFTs every 22 ns. Data swapped between boards for cross-correlation and accumulation.
45000 spectra, every ms.
Collaboration with Mallard, Werthimer, CASPER

Heterodyne spectrometer testing

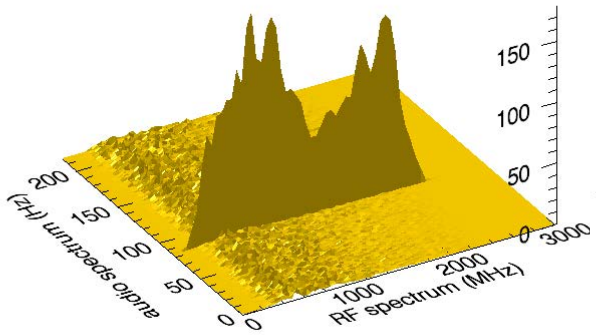


Digital spectrometer R~600000
Spectrum of Venus

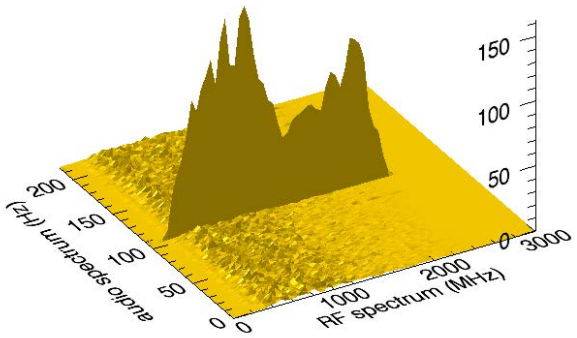


Laboratory testing, measuring OCS 4 Torr, 14 cm cell
Potential for CO2 isotopologue meas.
BUT at atm pressure natural line width is ~3 GHz HWHM

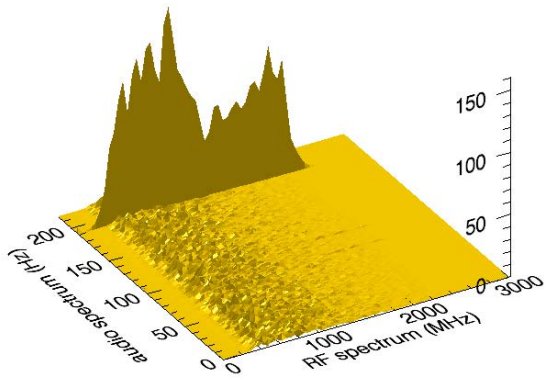
Spectrometer-correlator testing



ab fringe 86 Hz



bc fringe 107 Hz



ca fringe 193 Hz

3 uncorrelated RF noise sources ~-8 dBm—3 "lasers" applied to 3 independent detectors
Lasers noise sources are combined with small RF correlated noise source ~-26 dBm
Correlated noise source modulated at: 1MHz+193Hz, 1MHz+107Hz, 1MHz.
10 sec of data
Correlated RF source is recovered at the appropriate audio frequencies: 86, 107, 93 Hz

Fearless leader
Charles Townes

Backup memory
Walt Fitelson

Dave Jurasevich APOD 2008 Dec 03