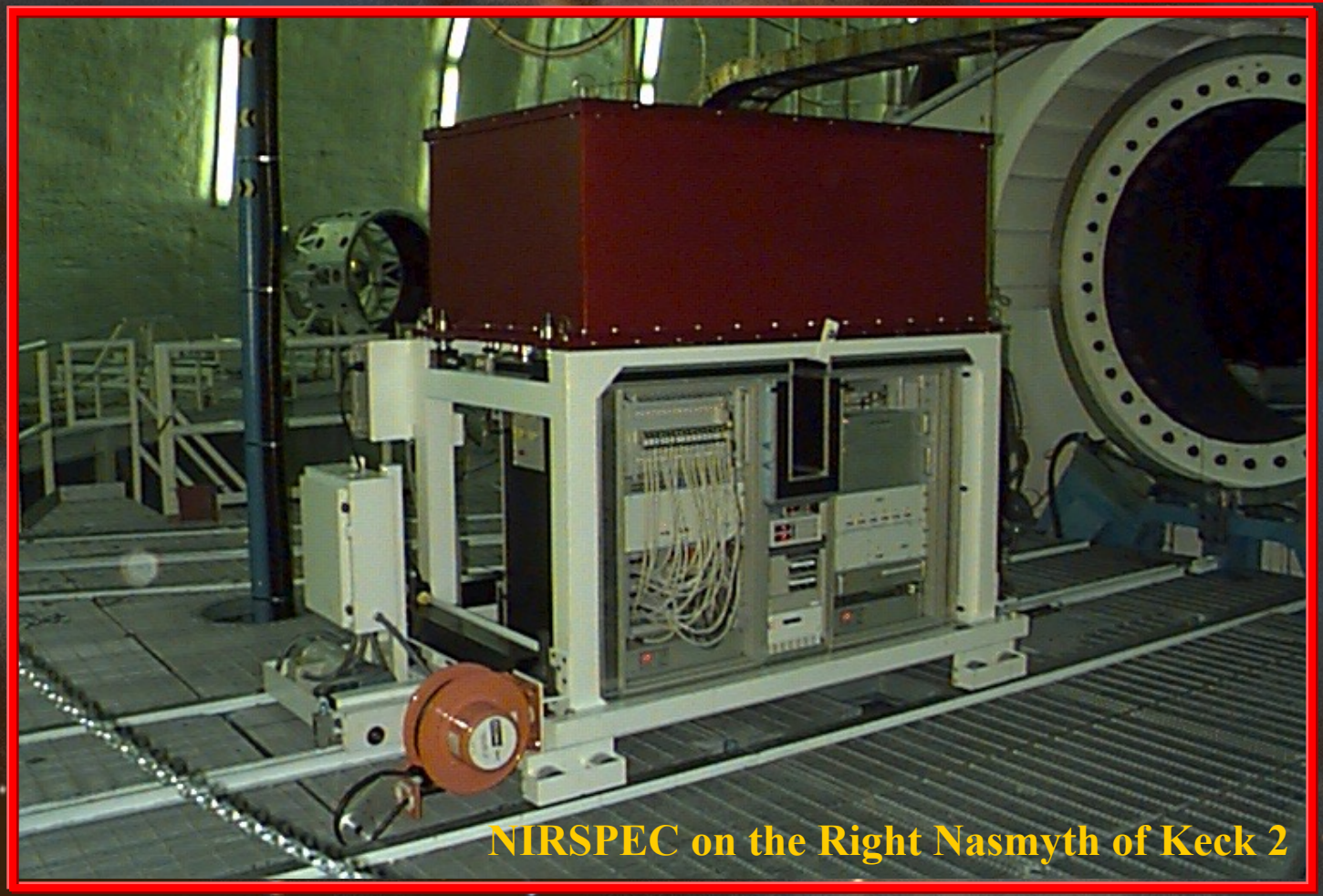
PRESS RELEASE

- WHO? Astronomers at UCLA and IPAC using the Keck Observatory.
  - Team members are Ian McLean (PI), Adam Burgasser, Davy Kirkpatrick (IPAC), Mark McGovern, Lisa Prato and Sungsoo Kim
- WHAT? Announce the release of an ATLAS of *infrared spectral fingerprints* for over 50 recently discovered Jupiter-sized objects called Brown Dwarfs.
  - Brown Dwarfs are objects about the size of Jupiter. They are composed mainly of hydrogen gas, but because they have less than about 75 times the mass of Jupiter they cannot sustain the nuclear reactions needed to shine like the Sun. As soon as they form, they fade in brightness. Only discovered within the last decade, the heat glow from these faint objects can be detected using infrared cameras.
  - Brown Dwarfs are the "missing link" between stars and gas giant planets. By obtaining their infrared spectra astronomers can discover the physical and chemical properties of Brown Dwarfs and relate them to the giant planets of our Solar System.
- WHERE? The W.M. Keck Observatory, Mauna Kea, Hawaii operated by the California Association for Research in Astronomy (CARA).
  - The twin telescopes of the Keck Observatory each have 10-m (400-in) diameter segmented mirrors, the largest in the world.
- WHEN? Results will appear in the October 10 issue of the *Astrophysical Journal*
  - *(McLean et al. 2003)*.
- HOW? The atlas was produced after 4 years of careful data-gathering using NIRSPEC, a unique 1-ton vacuum-cryogenic spectrometer, designed and built at UCLA in collaboration with UCB. NIRSPEC contains powerful new infrared imaging devices developed by companies in California.

NIRSPEC

The Near-Infrared Spectrometer at the Keck Observatory



NIRSPEC on the Right Nasmyth of Keck 2

INFRARED DETECTS COOLER OBJECTS

Infrared image of a star-forming region. Three infrared wavelengths are coded with the normal colors blue, green and red to make a picture of what our eyes might see if they were sensitive to infrared.

The reddest objects in this picture however, are completely invisible and *much too red* to see with our eyes.

Most of the energy emitted by very cool stars and Brown Dwarfs (failed stars) emerges in the INFRARED

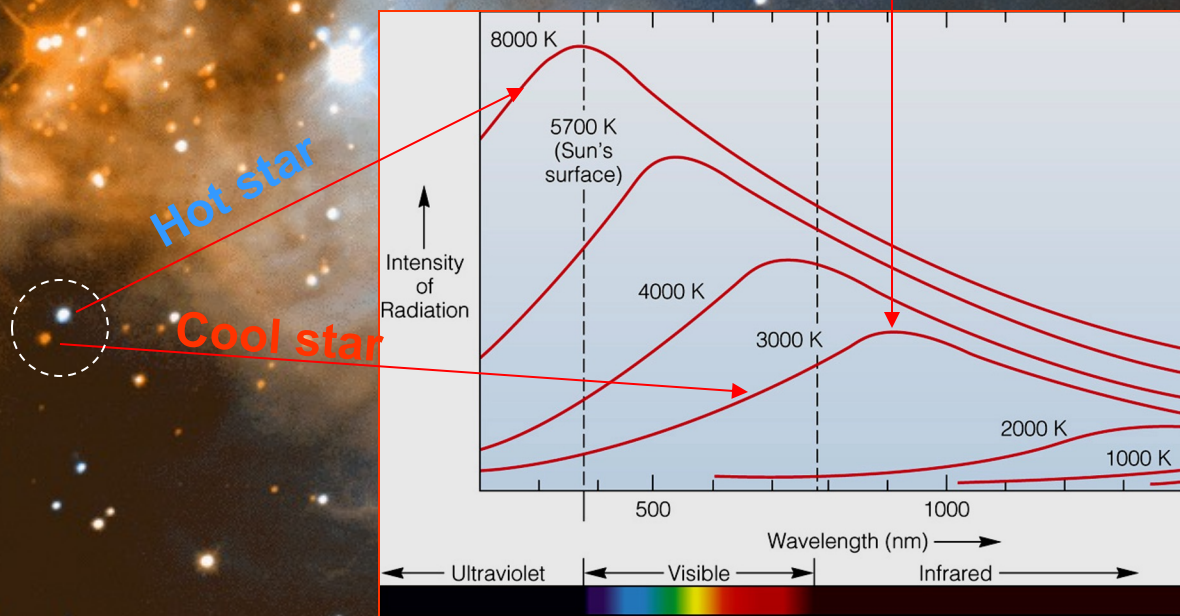


Image obtained with UCLA twin-channel infrared camera at Lick Observatory

SEARCHING FOR OBJECTS LESS MASSIVE THAN SMALLEST RED DWARF STARS – Brown Dwarfs

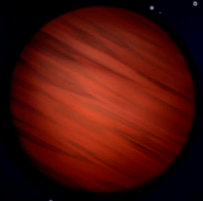
The 2 MICRON ALL SKY SURVEY (2MASS)

Discovery of 2 new spectral classes of objects: L dwarfs and T dwarfs.

The Letters are used to indicate a distinctive spectral appearance.

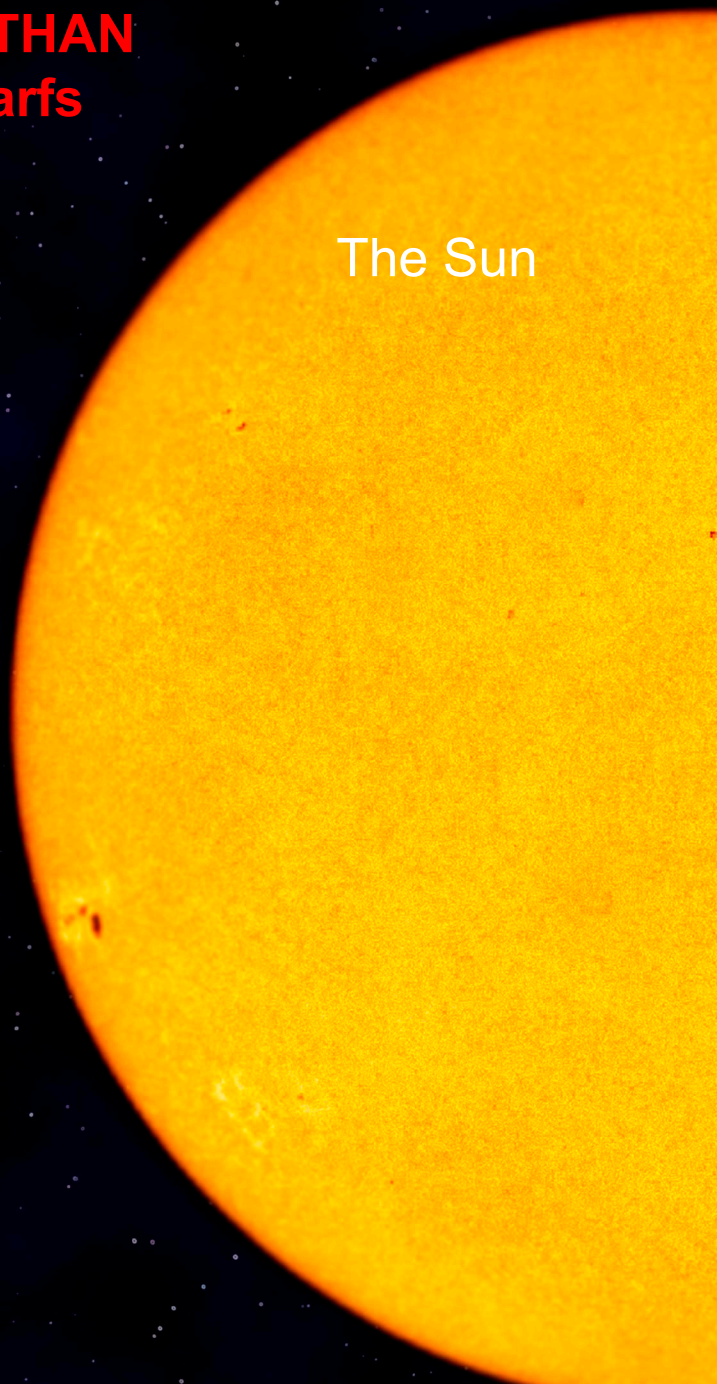
Jupiter

Brown Dwarf



About same size as Jupiter, but with a mass from 13-75 times greater. Above 75 Jupiter masses the temperature inside the object becomes hot enough to sustain nuclear fusion and the object is a Red Dwarf star. Brown Dwarfs have no sustainable energy source and simply fade like a hot coal pulled from the fire.

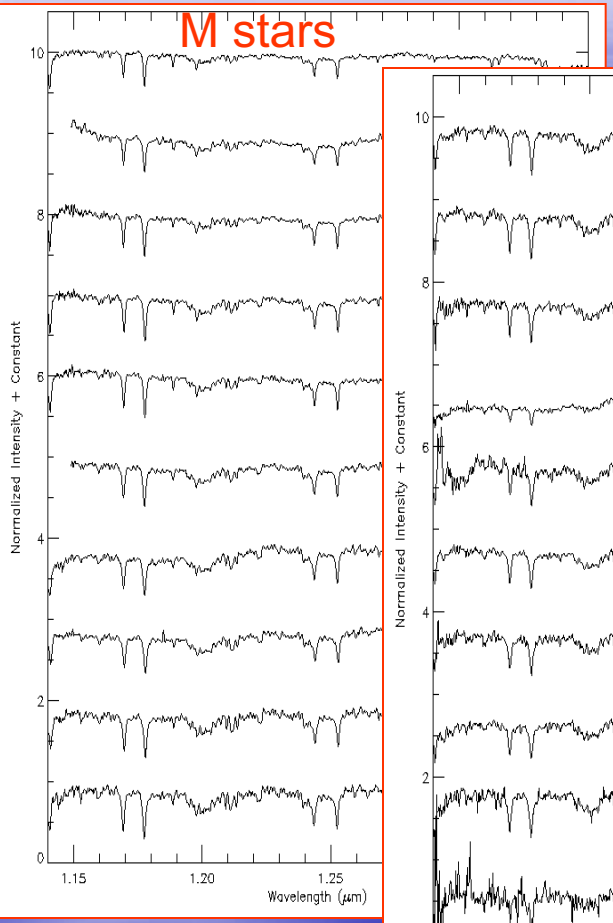
The Sun

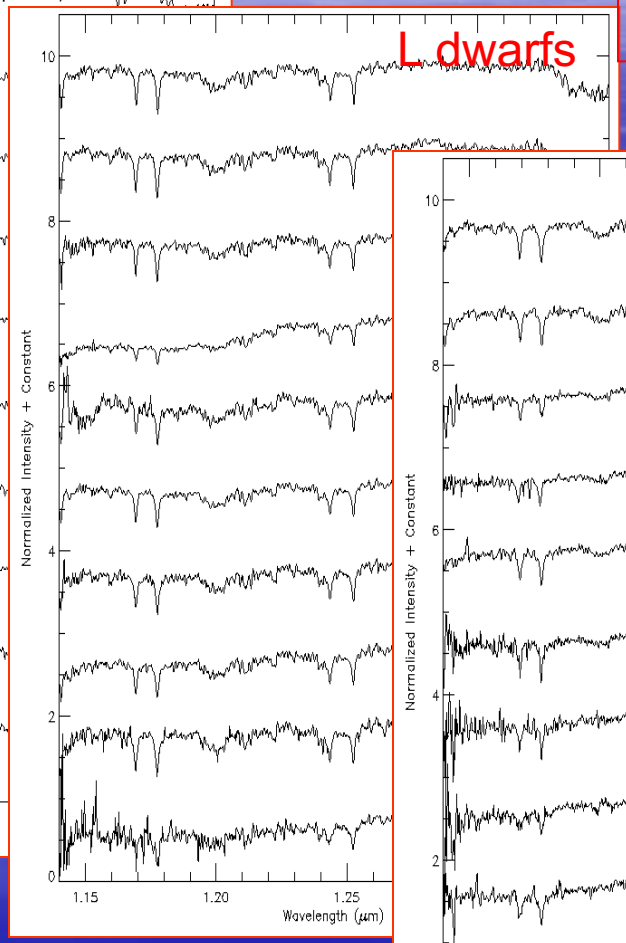


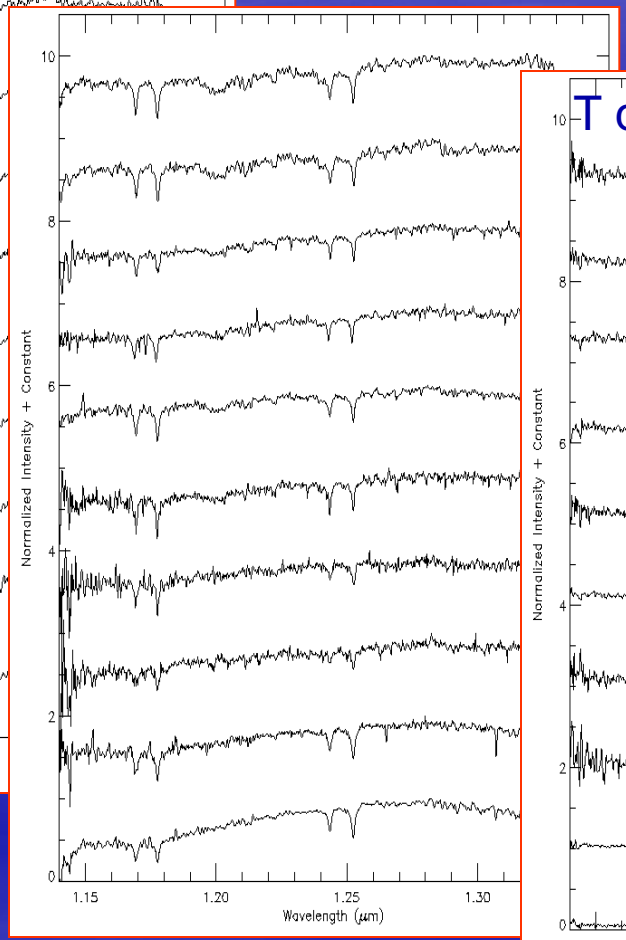
The W.M. Keck Observatory

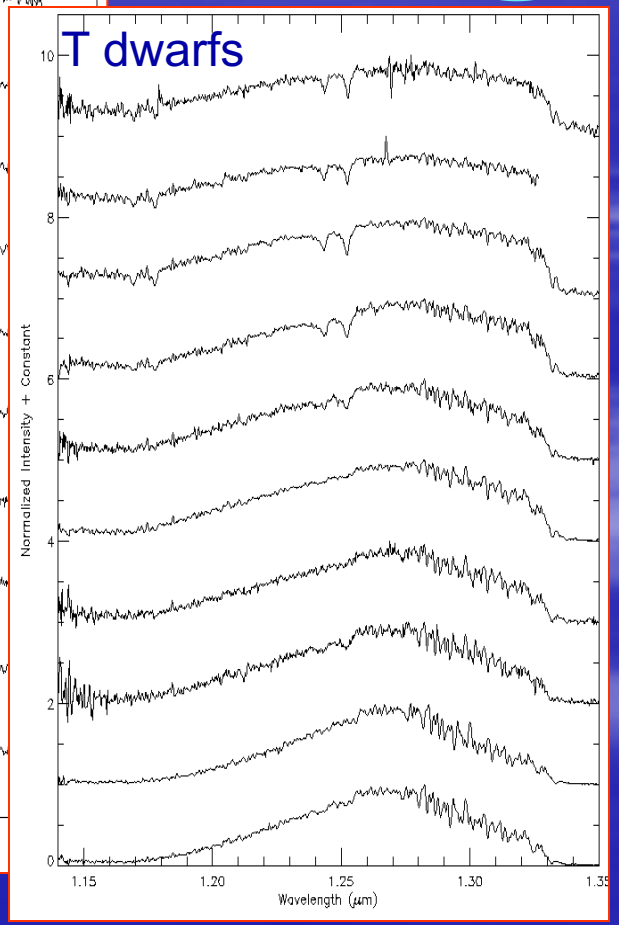
THE NIRSPEC BROWN DWARF SPECTROSCOPIC SURVEY

A Spectral Atlas: atomic and molecular fingerprints









McLean et al. (2003): to appear in the **Astrophysical Journal, Vol 596, October 10.**

THE NIRSPEC BROWN DWARF SPECTROSCOPIC SURVEY

UV

The Optical Spectrum of the Sun

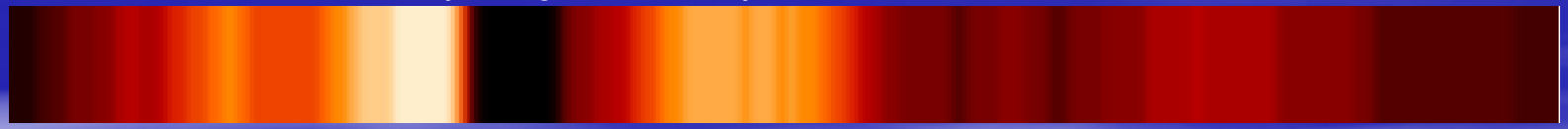
IR

Dark lines indicate “missing light” absorbed by the hot, thin hydrogen gas at the Sun’s outer edge

Optical Region
~ same scale

The Infrared Spectrum of an L dwarf

As our eyes might see it if they were infrared sensitive



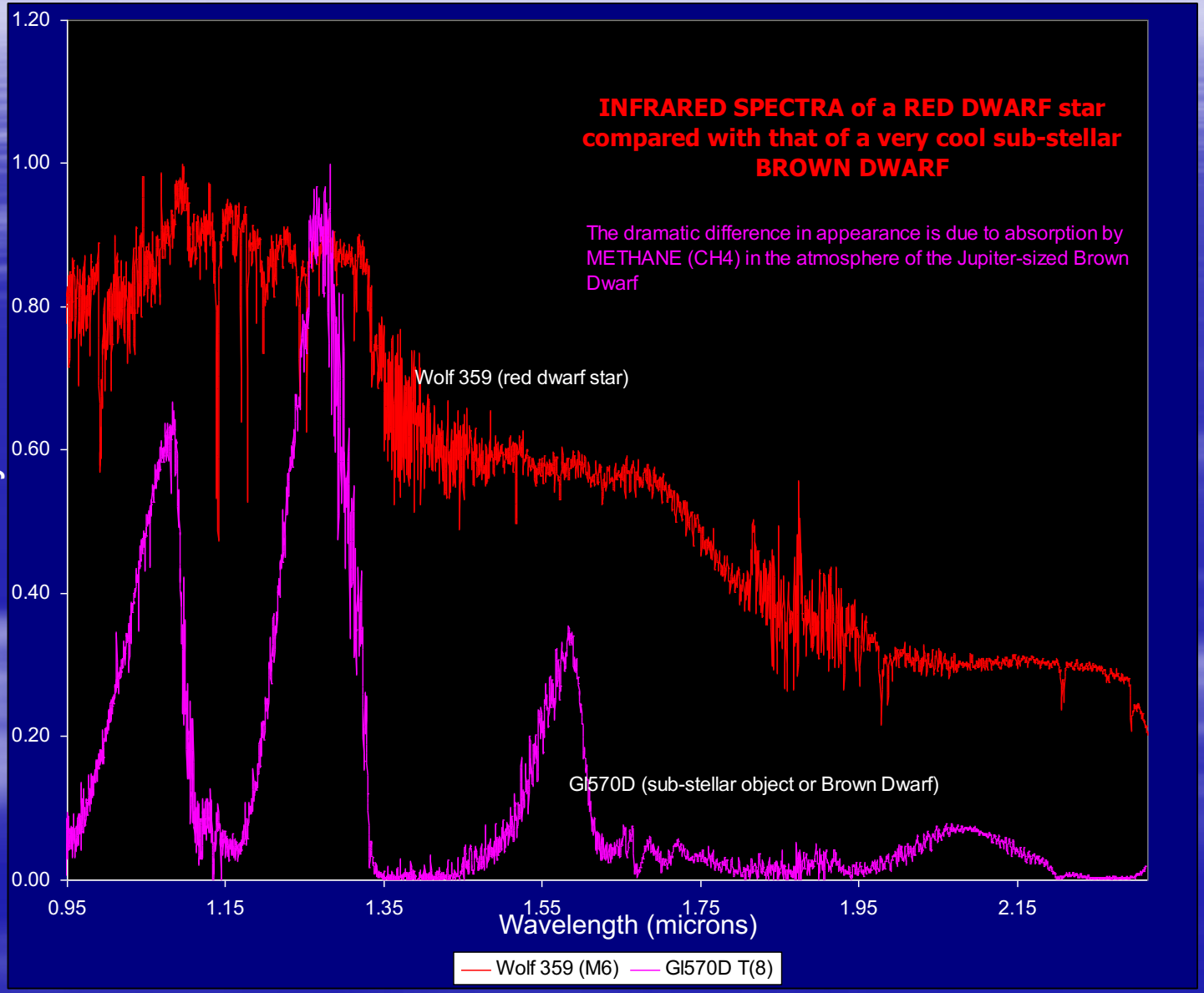
Dark bands are due to super-heated steam (H_2O) forming high in the cool atmosphere of the L dwarf

The Infrared Spectrum of a T dwarf

As our eyes might see it if they were infrared sensitive

Large dark regions are due to absorption by H_2O and methane (CH_4) – similar to the spectrum of Jupiter

THE NIRSPEC BROWN DWARF SPECTROSCOPIC SURVEY



THE NIRSPEC BROWN DWARF SPECTROSCOPIC SURVEY

RESULTS & HIGHLIGHTS

- Better resolution than in previous infrared spectra
- Higher quality spectra, revealing more subtle relationships
  - A fundamental data base for theoretical models
- J-band spectra of 53 objects covering temperature range from about 2500 K to about 750 K (M, L and T types)
- 25 objects with complete flux-calibrated near-infrared spectra, 12 of these have overlap region with optical spectra
- Results:
  - Combination of 4 bands due to H_2O, and 2 bands due to CH_4 can be used for identifying the type of Brown Dwarf and assigning an approximate Temperature
  - Strong absorption lines due to the alkali element potassium are sensitive to pressure in the Brown Dwarf atmosphere, which is controlled by the Mass of the object through gravity
  - Spectral shapes are influenced by formation of cloud layers