Drylabs: Databases of Interstellar Infrared Spectra and Laboratory Ices

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Scope

•Lecture 1 (Monday): What you need to know when planning, reducing, or analyzing infrared spectroscopic observations of dust and ices.

•Lecture 2 (Tuesday): Basic physical and chemical information derived from interstellar ice observations. *Not discussed:* laboratory techniques (see Palumbo lectures) and surface chemistry (see Cuppen lectures).

•Lecture 3 (Tuesday): Infrared spectroscopic databases. What's in them and how (not) to use them.

•Drylabs (Tuesday): Using databases of interstellar infrared spectra and of laboratory ices. Deriving ice abundances and analyzing ice band profiles.

NOTE: Please download all presentations and drylab tar file:

spider.ipac.caltech.edu/~aboogert/Cuijk/

Exercise 1: Estimate H_2O Ice Abundance

Estimate H_2O ice abundance in massive YSO NGC7538 IRS9 using formulae given in lecture 2:

- Download ISO/SWS spectrum of NGC7538 IRS9 from an online archive. It should be a spectrum taken in 'AOT1' mode, covering full 2-40 um range. Note: SIMBAD identifier is “NAME NGC 7538 IRS 9”.
- Plot the data in your favorite package
- *Estimate* H_2O ice column density
- *Estimate* hydrogen column density N_H
- Calculate H_2O ice abundance

- Note that exercise can also be done without downloading data, using online visualization with VOSpec (see lecture 3). May not work in lecture room (firewall issues)?

- People unable to plot spectra: use pdf file included in tar ball.

Exercise 2: 6 μm Absorption Band

Determine what fraction of 6.0 um absorption band is caused by pure, amorphous H_2O at 10 K in low mass YSO HH46 IRS:

- Download Spitzer/IRS spectrum of HH46 IRS from an online archive. It should be a spectrum covering full 5-30 um range.
- Read spectrum in an analysis package (e.g., IDL, GDL) and fit global polynomial continuum.
- Put HH46 spectrum on optical depth scale, using global continuum
- Get laboratory transmission spectrum of solid H_2O from online databases (see lecture 3 for database locations).
- Determine fraction of HH46 6.0 um absorption band not caused by pure, amorphous H_2O ice (note: ground based observations HH46 show 3 um band peak optical depth of 4.3)

Exercise 3: ^{12}CO and ^{13}CO Ice Band Profile Analysis

- Get file with M-band spectrum (*n7539irs9_mband_boogertetal2002.dat*) from tar ball and prepare it for comparison to laboratory spectra:
  - Put M band spectrum on optical depth scale
  - Heliocentric velocity of N7538 IRS9 is -67.0 km/s. Put M-band spectrum in source rest frame velocity.

- Get optical constants of CO from online databases (see lecture 3 for database locations).

- Compare absorption spectrum of small pure CO ice spheres to the ^{12}CO (4.67 um) and ^{13}CO (4.78 um) ice bands of N7538IRS9 by overplotting.

- The band of pure CO spheres is clearly narrower than the ^{12}CO, but not the ^{13}CO observation. Possible explanations?