Proposal Time

Applying for McDonald Telescope Time

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TEXES

- Test grating should be ready by Christmas
- Ground-based instrument nearly ready
  - need larger support structure for echelon grating
  - need to test echelle cross disperser
  - need lens holder that can be heated to prevent ice formation
  - generally needs a cold test to see if mechanisms work well
- Need telescope time to test sensitivity and resolution

Telescope Time

- Engineering
  - scientific results need not be produced
  - used to shake down instrument
- Observing
  - idea with scientific merit
  - should lead to publishable results
- Awarded based on competitive comparison of proposals
  - Time Allocation Committee (TAC)
  - Made of astronomers at facility
  - usually more proposals than time

Writing Telescope Proposals

- Web pages
  - Available instruments and characteristics
  - Proposal forms
    - one page science justification
    - estimate of time needed
    - status of past data
    - phase of moon
  - Deadlines
- McDonald Observatory
  - trimesters
    - Sep 30 deadline for December - March period
  - 107”, 82”, and 30” available

TEXES proposals

- 1 week on 107”
- Engineering time
  - mate TEXES to telescope
  - test all modes
  - determine sensitivities and capabilities
  - 4 nights
  - use scientifically interesting targets; study molecules in circumstellar shells
- Observing time
  - magnetic fields in stars
  - carbonates in Mars

Molecules in Circumstellar Shells

- Old stars expand and lose mass
  - red giant phase
  - sun's radius will be size of Earth's orbit
  - mass loss on order 10^{-5} M_o per year
  - a major source of elements heavier than hydrogen
- molecules form in dense gas surrounding star
  - circumstellar shell
  - lead to dust grains
  - mass-loss stars are very bright in IR since dust reprocesses visible light

Molecules in Circumstellar Shells (continued)

- chemical makeup of star influences molecules and dust formed
  - carbon rich star, IRC +10216, will form C_2H_2 first
  - oxygen rich star, VY CMa, will form SiO first
- kinematics; study of motion
  - P Cygni profiles
  - emitting gas around star expanding outward
    - motion Doppler shifts radiation
    - radiation emitted in all directions
    - material in direct line of sight absorbs the stellar continuum
  - maybe learn about mechanism driving mass-loss

Molecules in Circumstellar Shells (continued)

- isotopic studies
  - isotopes have same number of protons (same element) but different number of neutrons (different atomic weight)
  - differnt mass in a molecule shifts frequency of transition
    - heavier molecules have lower energy transitions
    - harmonic oscillator

$$m\ddot{x} = -kx \quad \Rightarrow \quad \omega \propto \sqrt{\frac{k}{m}}$$

  - three silicon isotopes and three oxygen isotopes

Magnetic Fields in Stars

- magnetic fields hard to measure
  - often ignored in models
  - often required in models
- sun's magnetic field linked to sunspots and flares
  - sunspots have
    - high magnetic field
    - lower temperature (magnetic pressure adds to gas pressure)
  - magnetic energy drives flares
- solar magnetic field formed in dynamo process

Zeeman effect

- used to directly measure magnetic fields

$$\Delta\lambda \propto \lambda^2 Bg$$

$\Delta\lambda$ is wavelength shift

λ is normal wavelength of line

B is magnetic field strength

g is the Landé g-factor (a measure of a line's magnetic sensitivity; g typically is betwen 0 and 1)

Zeeman effect (continued)

- changing electric current produces magnetic fields
- single electron in outermost shell gives magnetic field
- two magnets near another have potential energy
  - energy depends on orientation of fields
- electrons in atoms have distinct energy levels that relate to spectral lines

Zeeman effect (continued)

- atoms with single electron in outermost shell in external magnetic field will have energy level split depending on orientation of fields
  - results in multiple spectral lines from one level
  - small amount of energy involved in splitting
    - need high spectral resolution
- for long wavelength spectral line, splitting is larger fraction
  - long wavelength means low energy so Zeeman energy is larger fraction

Magnetic Fields in Stars (continued)

- Mg I lines at 12 μm
  - g ~ 1
- Sun indicates great potential
- To date detected in about half dozen stars
  - Theoretical prediction of line formation poorly tested
- List of ~25 stars with range of brightness
  - magnetically active stars faintest on list
- Testing theory more likely than actually measuring magnetic field strength

Carbonates in Mars

- ISO satellite detected possible signature of carbonate minerals
  - solids have broad features
  - ISO had good low resolution spectrograph, but poor spatial resolution
  - found possible signature of dolomite and / or magnesite at about 11.1 μm
    - will observe from 11.0 to 11.4 μm
- carbonates important because possible end state for CO_2
  - amount of carbonates leads to estimate of Martian atmosphere

Carbonates in Mars (continued)

- TEXES designed to switch to low-resolution easily
- TEXES has better spatial resolution than ISO
  - map features across Martian disk
  - 1 night in March to map about half of surface
  - will propose for 1 night in April for other half