

Second Announcement



Workshop on Submillimeter and Far-Infrared Laboratory Spectroscopy in Support of Herschel, SOFIA, and ALMA



October 19–20, 2006
410 Keith Spalding Building, Caltech, Pasadena, CA

Three new facilities for astronomy—Herschel, SOFIA and ALMA—will all become operational in the next few years exploiting the previously little explored far-infrared spectral region. They will offer unprecedented sensitivity, spectral coverage and instantaneous data bandwidth. The first instrument to operate will be Herschel, which drives the near-term needs for line identification at high resolution ($R=10^7$). It will open up the spectrum to 2 THz with 4 GHz of double sideband IF bandwidth. Many important lines and species not easily available from the ground will be accessible (e.g., H_2O , HF, CH^+ , etc.) The expected launch date for Herschel is 2008.

SOFIA will extend the frequency coverage of Herschel to at least 5.2 THz with similar IF bandwidths. ALMA with its small beam will not suffer from beam dilution as the other instruments do and will generate 8 or 16 GHz of spectrum per local oscillator setting with stunning sensitivity. Collectively, these instruments will offer complete access to the physical and chemical processes that govern the interstellar medium and an unprecedented potential to discover and classify the physical and chemical conditions most likely to be favorable for the formation of stars and planets, and ultimately for life itself.

Existing studies have revealed that the underlying spectrum of many astrophysical sources is highly complex at millimeter and shorter wavelengths. Unfortunately, the transition frequencies of molecules well-studied at lower frequencies cannot be extrapolated with required accuracy into the far-infrared frequency regime. In spite of the tremendous advances in the molecular theory, infrared and optical spectroscopy of molecules, the required accuracy to identify lines in the far-infrared cannot be achieved without resorting to far-infrared/submillimeter techniques in the laboratory. A symptom of the lack of necessary information is that the number of unidentified lines found in the existing ground-based spectral scans increases dramatically with frequency and sensitivity. The great capabilities of SOFIA and ALMA will only exacerbate the problem facing Herschel, making it essential that every effort be made in laboratory spectroscopy throughout the world to determine transition frequencies in an expanded range of frequencies so that proper planning and full exploitation of observations can take place. Without accurate and complete knowledge of expected features, it will be difficult or impossible to separate with confidence exciting, new species from a forest of imprecisely determined lines from known molecules.

Currently some 141 different molecular species and many of their isotopologues have been identified in the interstellar medium, leading to millions of potential spectral features. Software models and databases are being developed by Herschel, ALMA and SOFIA for identification of molecular species based on global, multi-line analysis of spectra, but the fundamental input for these models and databases—a listing of accurate transition frequencies, energy levels and transition strengths—can only be obtained by far-infrared laboratory spectroscopy. All of these new facilities and many of the models and databases are international projects, making it is clear that solving the spectral line identification problem will also require international cooperation. The purpose of this workshop then is to devise a plan that identifies the most urgent needs and takes into account the existing capabilities in the United States and other countries.

Goals of the workshop:

- 1) Identify the relevant existing spectroscopic capabilities in the US and other countries.
- 2) Categorize molecules in terms of difficulty in predicting sufficiently accurate transition frequencies in the wavelength and energy ranges required.
- 3) Prioritize the molecules most in need of further study according to their astrophysical importance.
- 4) Define a program and milestones that will generate the required data.
- 5) Determine the necessary facilities and any other enabling technologies for implementation of the program.
- 6) Determine the funding level and profile necessary for US laboratories to make their contribution of essential laboratory data.

We would welcome your participation in this workshop and assistance in developing a plan for far-infrared laboratory spectroscopy in support of Herschel, SOFIA, and ALMA. We do anticipate having limited funds available to support participants from most US institutions, and expect to be able to provide up to \$1000 toward travel and most expenses per participant. We request that interested parties register by September 11 by email to Rena Becerra-Rasti (rena@submm.caltech.edu). There is no registration fee. If you intend to request travel reimbursement, please so indicate. A list of Pasadena hotels is included following the Workshop Agenda (rates listed are for 2005) along with a local area Pasadena map showing the distance from the hotels/motels to Campus (some are in walking distance). Information about the Pasadena area bus service, including maps, schedules, and bus stop lists can be found at http://www.ci.pasadena.ca.us/trans/transit/trans_arts.asp. Also included is the Campus Map showing locations of the workshop (Keith Spalding Building) and the closest parking structure. Visitor parking permits may be purchased at an automated pay station inside the parking structure at the rate of \$1 per hour, or \$5 per day. Additional parking information is available at <http://parking.caltech.edu/permits.html#visitor>.

The workshop organizing committee:

Thomas G. Phillips
Paul F. Goldsmith
John C. Pearson
Dariusz C. Lis



Workshop Agenda

Thursday – October 19, 2006

- 9:00 AM Introduction [Phillips]
▪ Statement of problems
▪ Weeds and flowers
▪ Output of workshop
- 9:30 AM Status of Catalogs [Pearson]
- 10:20 AM Coffee Break
- 10:40 AM Lab Spectroscopic Techniques [Ziurys]
- 11:20 AM Examples of Weeds [Herbst]
- 11:40 AM Removing Weeds [De Lucia]
- 12:00 noon Lunch
- 1:20 PM Examples of Flowers [Goldsmith]
- 1:40 PM Herschel [DeGraauw 30min] + data reduction NHSC [Morris 30min]
SOFIA [Tielens 30min] + comparison with Europe
ALMA [Remijan 30min] + NRAO program
- 3:40 PM Coffee Break
- 4:00 PM Theory of Molecular Frequencies [Pickett]
- 4:30 PM Source Modeling [Doty]
X-Class [Schilke]
- 5:30 PM Adjourn

Friday – October 20, 2006

- 8:30 AM Canadian Program [McKellar]
Japanese Program [Amano]
European Program [Cernicharo]
- 10:30 AM Coffee Break
- 10:50 AM Water Program [Drouin]
- 11:30 AM CASSIS etc.: tools for line identification [Caux]
- 12:00 noon Lunch
- 1:30 PM Funding Situation – NASA [Hudgins]
- 2:00 PM Panel Discussion
Goldsmith (Chair), Bergin, Blake, De Lucia, Hasan, Melnick, Pearson
- 5:00 PM Adjourn

CALIFORNIA INSTITUTE OF TECHNOLOGY LOCAL HOTEL AGREEMENT 2005

Important: Please review Caltech's Policy regarding booking events at hotels (see page 4-of- 4)

Request the Caltech preferred rates, but also ask if there are rates available that are lower than our negotiated rates.

State and Local taxes in the Pasadena/Los Angeles area are 14.5%.

(Other charges may apply-inquire when reservation is made.)

Most rates are not valid during Holidays or special events such as the Tournament of Roses.

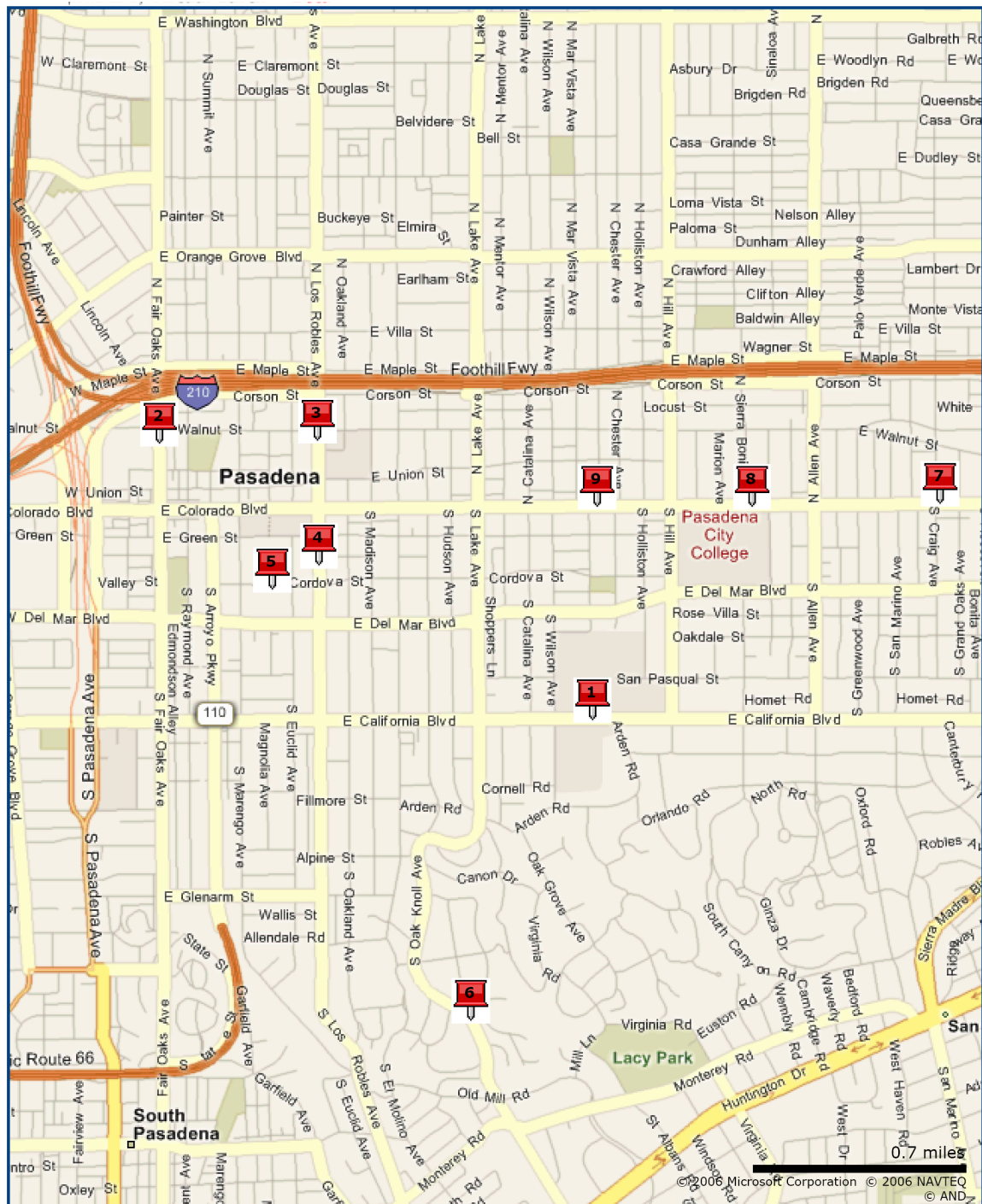
Contact Caltech Travel Specialist, Georgia Mendoza, at (626) 395-8101 if you need assistance obtaining group rates.

PASADENA AREA HOTELS

Courtyard by Marriott 180 N. Fair Oaks Ave. Pasadena, CA 91103 Phone (626) 403-7600 or (800) 321-2211 Fax (626) 403-7700 http://www.courtyard.com \$122 Single/Double Complimentary transp. to Caltech must be arranged in advance.	Westin Hotel (Formerly the Doubletree) 191 N. Los Robles Ave. Pasadena, CA 91101 Preferred reservation line Phone (626) 304-1444 Fax (626) 795-7669 http://www.westin.com \$144 Single \$174 Double Complimentary transp. to Caltech must be arranged in advance.	Hilton Pasadena 168 S. Los Robles Ave. Pasadena, CA 91101 Phone (626) 577-1000 or 1-800-HILTONS Fax (626) 584-3148 www.pasadena.hilton.com \$134 Single/Double Book the Caltech rate online, use Corporate Account #: 9881035	Sheraton Pasadena 303 E. Cordova St. Pasadena, CA 91101 Phone (626) 449-4000 or 1-800-325-3535 http://www.sheratonpasadena.com \$125 Single \$155 Double Complimentary transp. to Caltech must be made in advance.	Ritz Carlton Pasadena 1401 S. Oak Knoll Ave. Pasadena, CA Phone (626) 568-3900 Fax (626) 585-6420 http://www.ritzcarlton.com/hotels/huntington/ \$169 Deluxe Guestroom \$265 Club Guestroom
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PASADENA AREA MOTELS

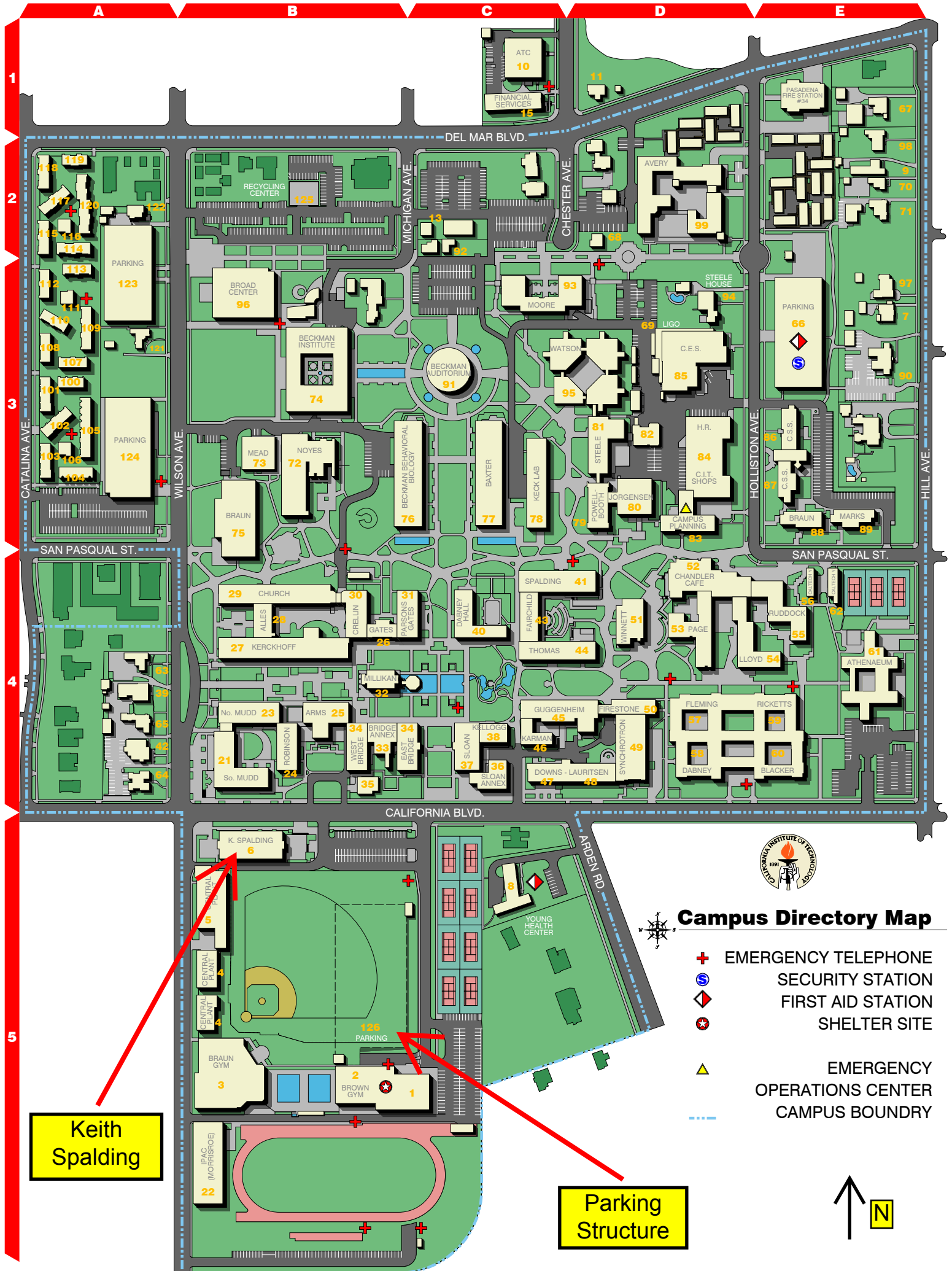
Best Western 2156 E. Colorado Blvd. Pasadena, CA 91107 Phone (626) 793-9339 <i>Caltech has a corporate discount with Best Western Worldwide. Provide ID number when booking: (Only available by calling 800-937-8376)</i> Best Western Worldwide Corporate ID# 01388930	SAGA Motor Hotel 1635 E. Colorado Blvd. Pasadena, CA 91106 Phone (626) 795-0431 http://www.thesagamotorhotel.com <table><tr><td></td><td>Single</td><td>Double</td></tr><tr><td></td><td>Occupancy</td><td>Occupancy</td></tr><tr><td>One Bed</td><td>\$66</td><td>\$69</td></tr><tr><td>Two Beds</td><td>\$70</td><td>\$73</td></tr><tr><td>King Bed</td><td>\$71</td><td>\$73</td></tr></table>		Single	Double		Occupancy	Occupancy	One Bed	\$66	\$69	Two Beds	\$70	\$73	King Bed	\$71	\$73	Vagabond Inn, Pasadena 1203 E. Colorado Blvd. Pasadena, CA 91106 Phone (626) 449-3170 www.vagabondinn.com \$64 Single \$69 Double	West Way Inn 1599 E. Colorado Blvd. Pasadena, CA 91106 Phone (626) 304-9678 www.westwayinn.com <u>Single or double occupancy</u> \$59 One King Bed \$65 Two Queen Beds
	Single	Double																
	Occupancy	Occupancy																
One Bed	\$66	\$69																
Two Beds	\$70	\$73																
King Bed	\$71	\$73																



Scratch pad

- 1: Caltech
- 2: Courtyard by Marriott
- 3: Westin Hotel
- 4: Hilton
- 5: Sheraton
- 6: Ritz Carlton
- 7: Best Western
- 8: Saga Motor Hotel/West Way Inn
- 9: Vagabond Inn





Campus Directory Map

- EMERGENCY TELEPHONE
- SECURITY STATION
- FIRST AID STATION
- SHELTER SITE
- EMERGENCY OPERATIONS CENTER
- CAMPUS BOUNDARY



Keith Spalding

Parking Structure