



# MERLIN Beamline @ ALS and CORPES11 @ Berkeley

**Zahid Hussain**

Division Deputy for Scientific Support  
Advanced Light Source  
Lawrence Berkeley National Laboratory

# meV Resolution Soft X-Ray Inelastic Scattering Beamline (MERLIN)

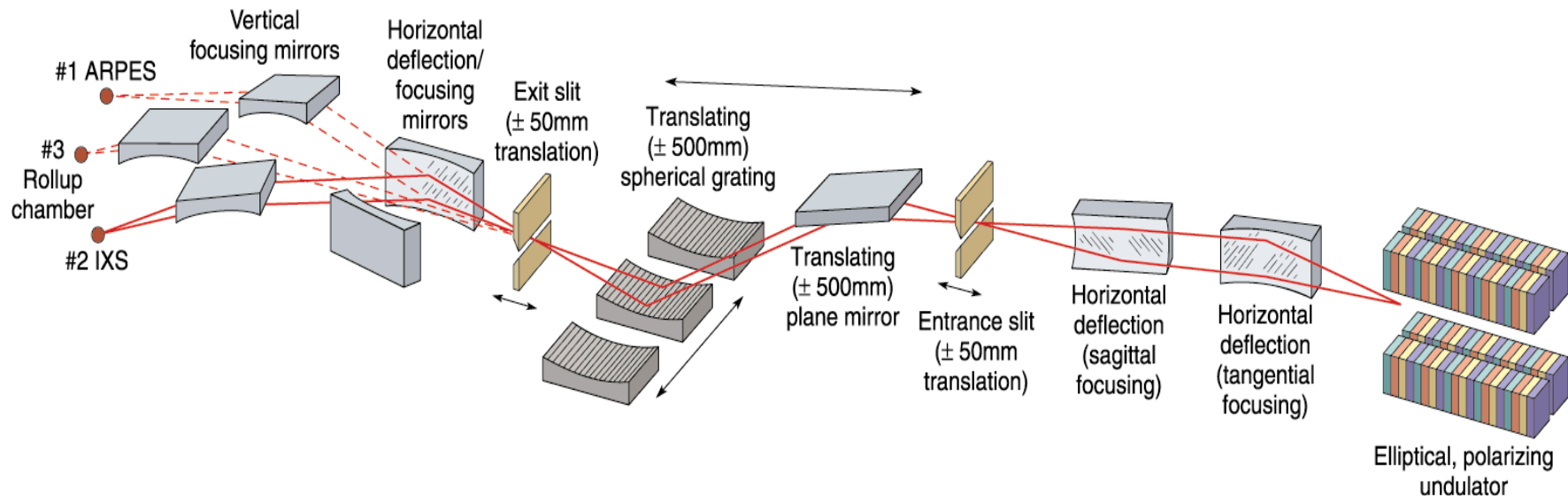


## Specifications:

- Resolving power:  $E/\Delta E=100,000$  with  $5\mu\text{m}$  slits  
i.e. better than 1 meV when photon energy is below 100eV
- Photon energy range: 15eV to 100eV, fully optimized  
maximum achievable photon energy  $\sim 140\text{eV}$
- Elliptically Polarized Undulator (EPU): full polarization selection (linear and/or circular)
- Photon Flux:  $\sim 5 \times 10^{11}$  photons/s/meV

## Optical Layout (SGM)

- ✓ Ultra High Resolution & High Resolution Modes
- ✓ Asymmetric Undulator to suppress higher orders



# meV Resolution Spectroscopy (MERLIN) Beamline

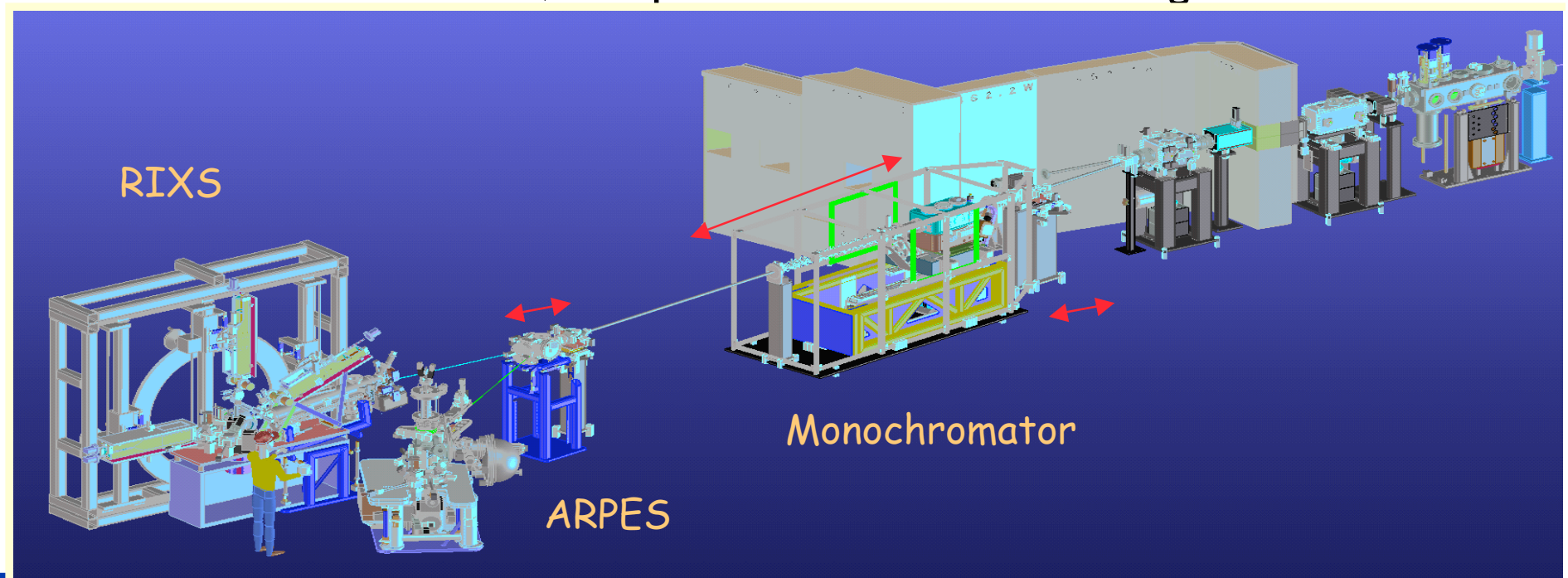


## Specifications:

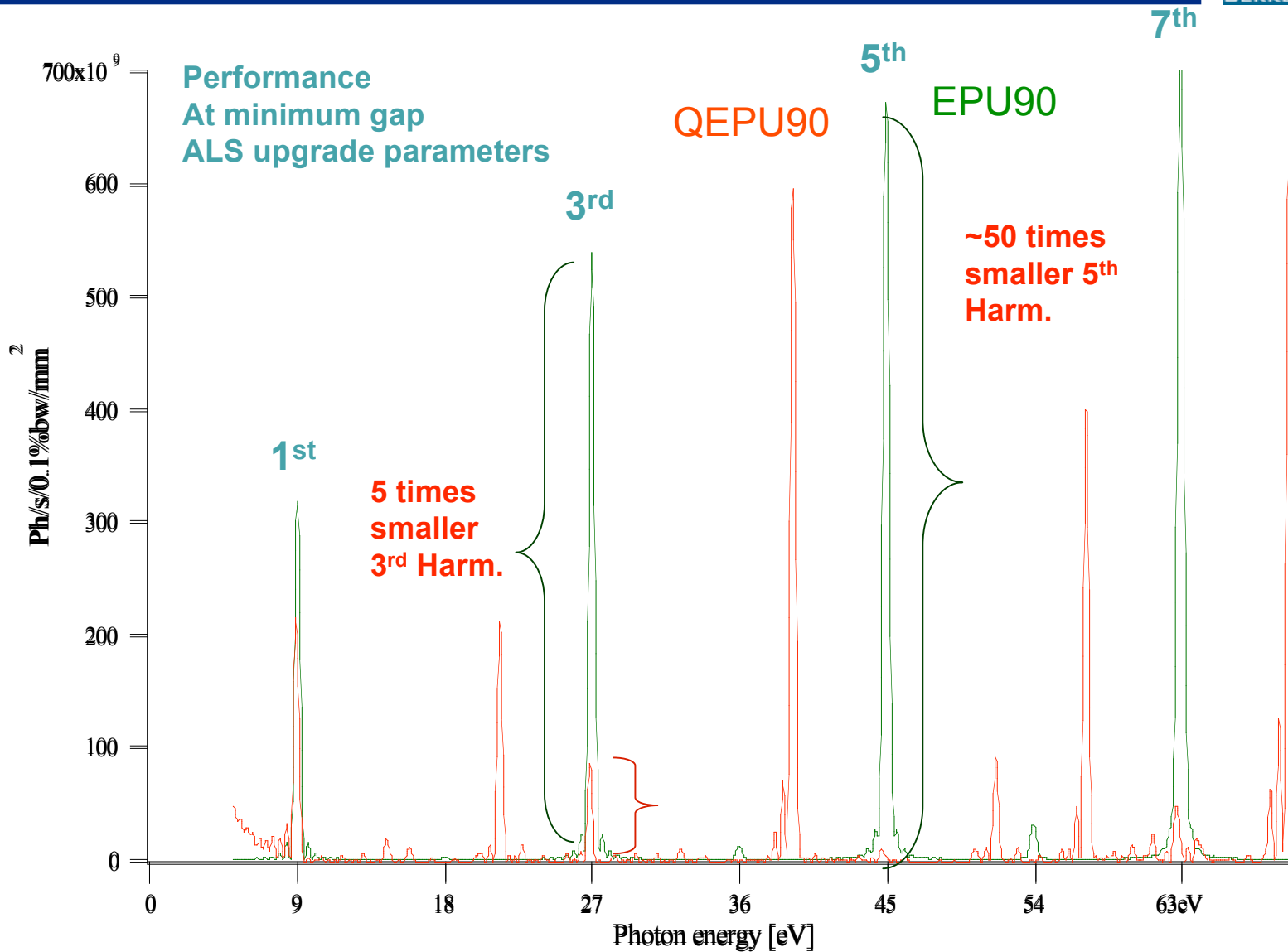
- Resolving power:  $E/\Delta E=100,000$  with  $5\mu\text{m}$  slits  
i.e. better than 1 meV when photon energy is below 100eV
- Photon energy range:  $\sim 8\text{eV}$  to  $100\text{eV}$ , fully optimized  
maximum achievable photon energy  $\sim 150\text{eV}$
- Elliptically Polarized Undulator (EPU): full polarization selection (linear and/or circular)
- Photon Flux:  $\sim 5 \times 10^{11}$  photons/s/meV

## MERLIN Layout

Ultra-High Resolution & High Resolution Modes  
Quasi-periodic undulator for Higher order

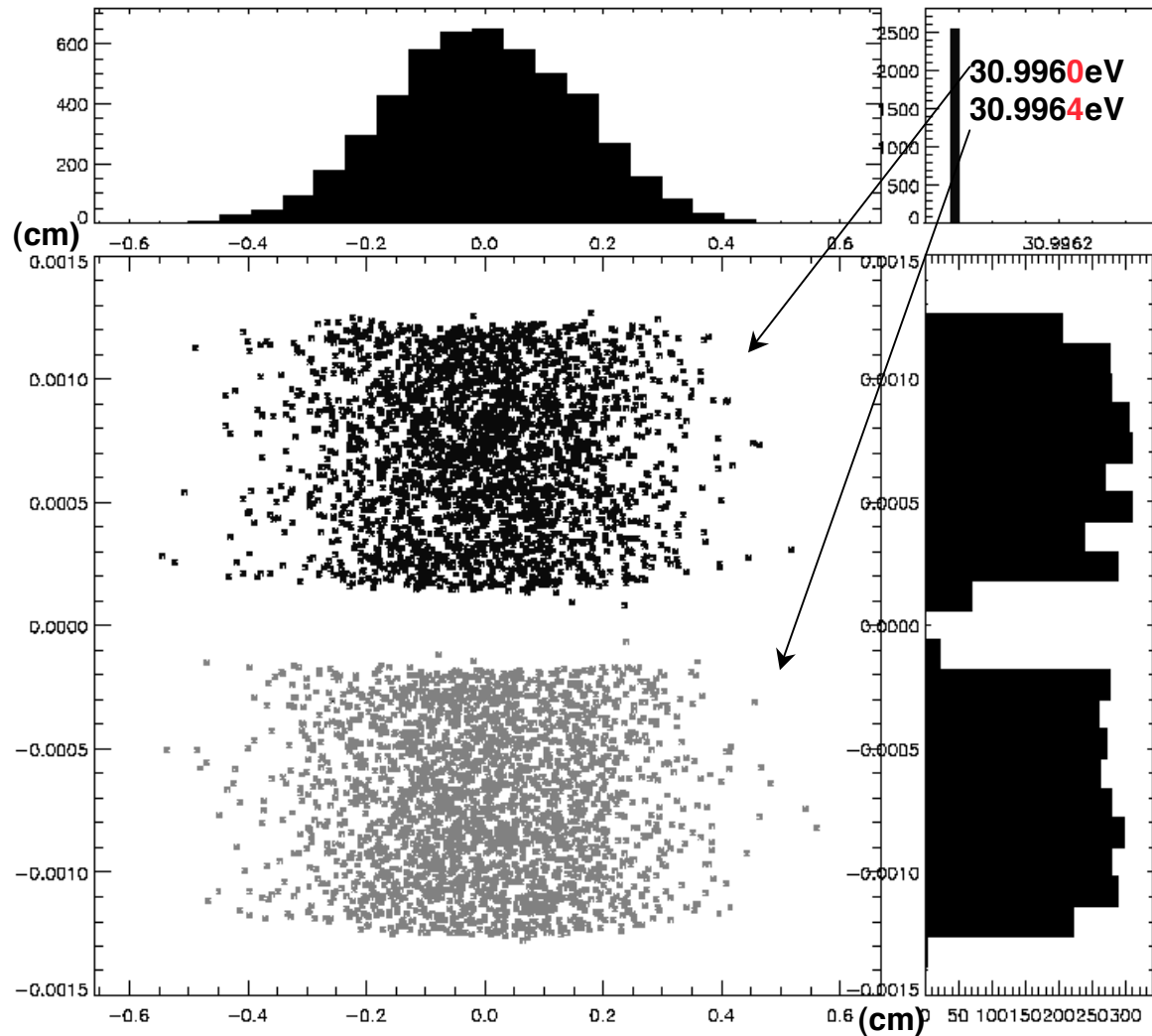


# Reduced Flux in Higher Harmonics





# Ray Tracing (Shadow)



**$h\nu \sim 30\text{eV}$**

Groove density=1,800 l/mm

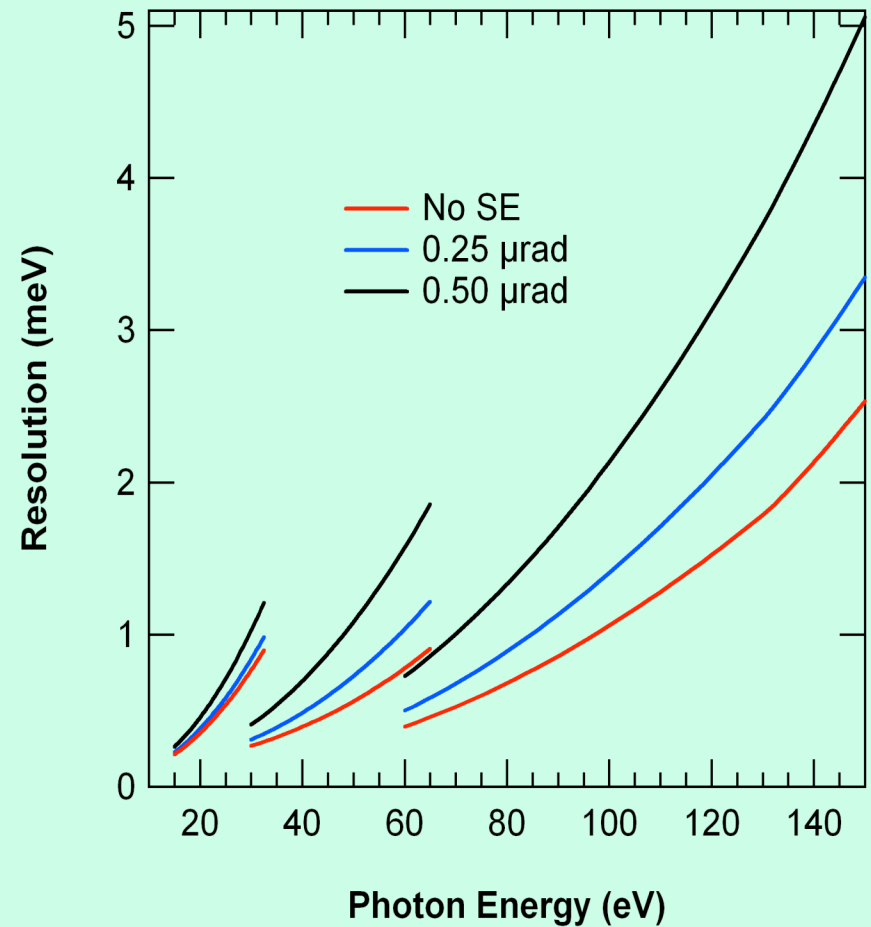
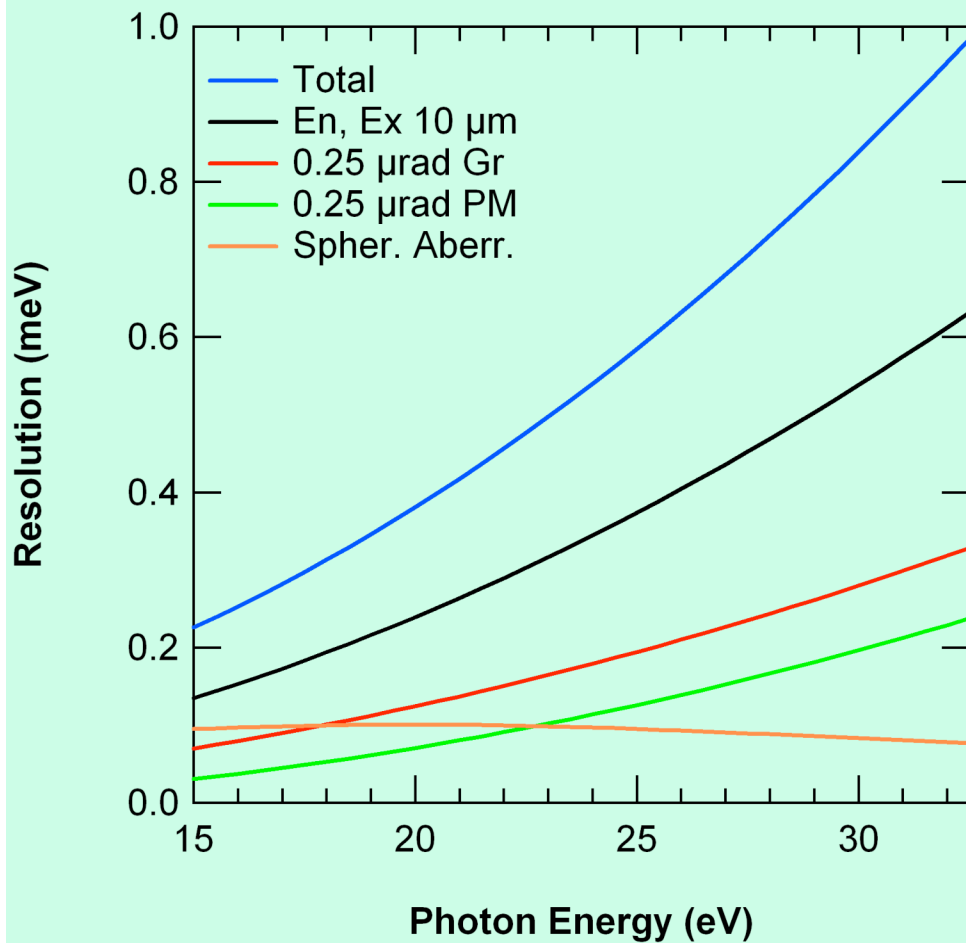
$\Delta E_{\text{slit}} = 0.029\text{meV}/\mu\text{m}$   
 $\Delta E_{\text{slope}} = 0.22\text{meV}/\mu\text{rad}$

**$\Delta E_{\text{slit}} = 0.14\text{meV @ } 5 \mu\text{m slit}$**

slope error ( $\mu\text{rad}$ )	<b>0.25</b>	0.50
$\Delta E_{\text{slope}}$ (meV)	<b>0.055</b>	0.11
$\Delta E_{\text{tot}} = (\Delta E_{\text{slit}}^2 + \Delta E_{\text{slope}}^2)^{1/2}$	<b>0.15</b>	0.18

**Yi-De Chuang**

# Resolution Rowland Mode

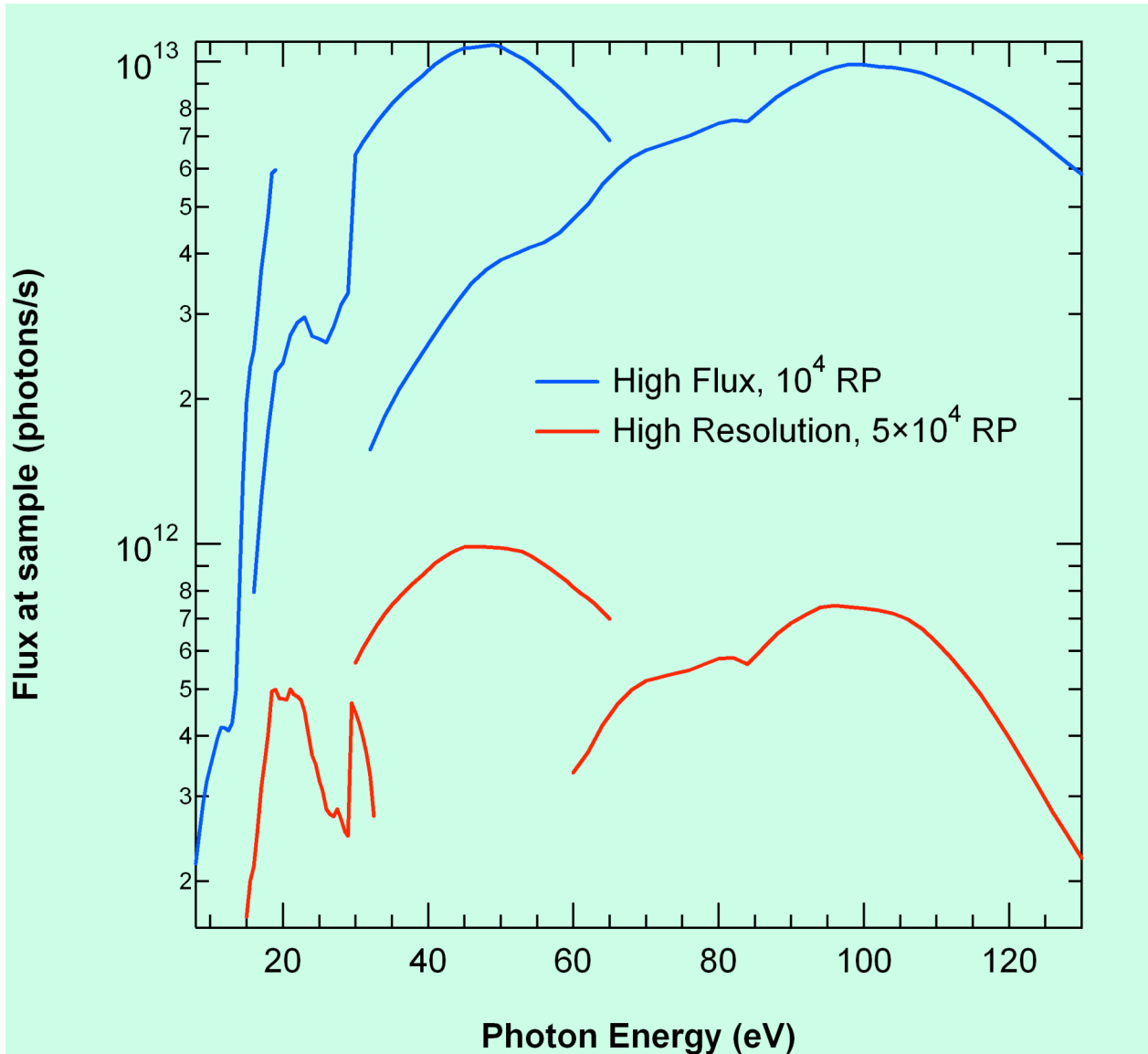


LEG: 900 l/mm

Defocus, coma = zero. Line curvature negligible.

LEG: 900 l/mm, 10 $\mu\text{m}$  slits  
 MEG: 1800 l/mm 5 $\mu\text{m}$  slits  
 HEG: 3600 l/mm, 5 $\mu\text{m}$  slit

# Flux @ sample



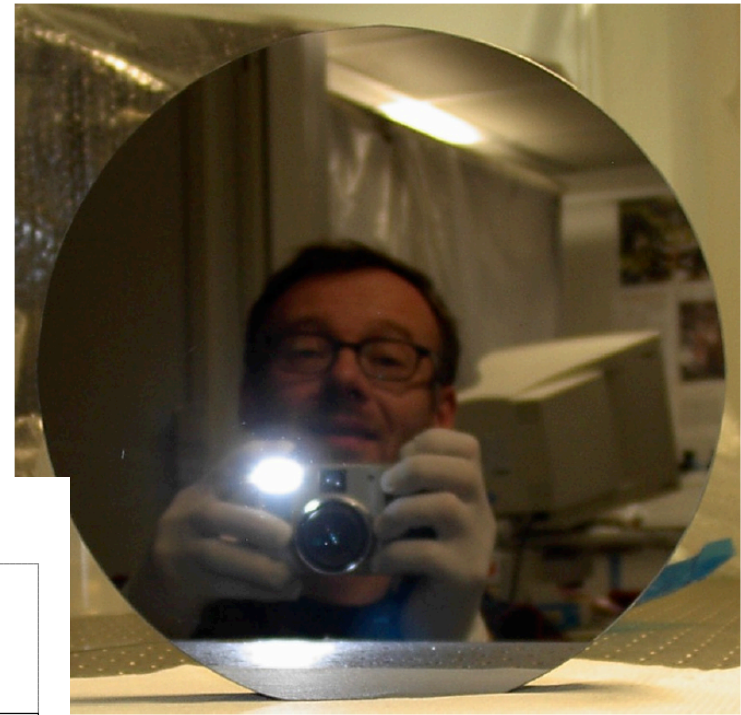
ID flux into  $0.9 \times 0.9$  mrad<sup>2</sup>  
Transmission entrance slit  
Reflectivity all mirrors  
Grating efficiencies  
Band width correction

# State-of-the-art grating substrate

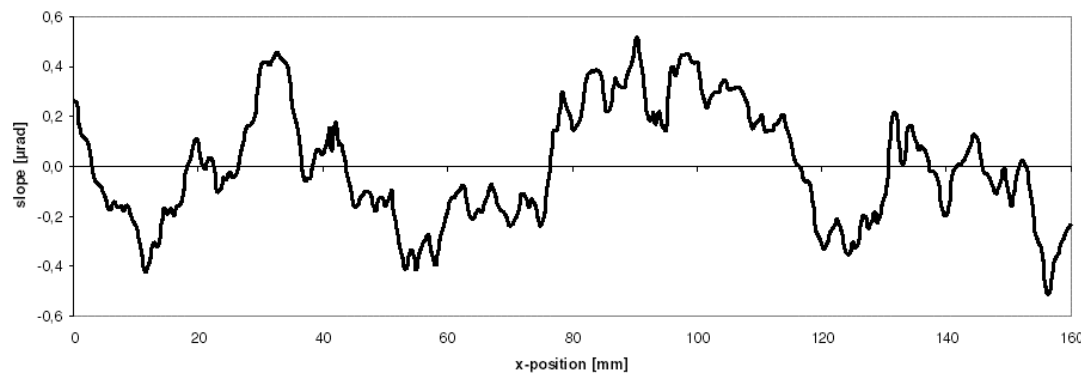


High resolution grating substrate (measured at BESSY metrology labor

**0.23  $\mu$ rad RMS slope error**



MERLIN R=15m, center line, profile of residual slope



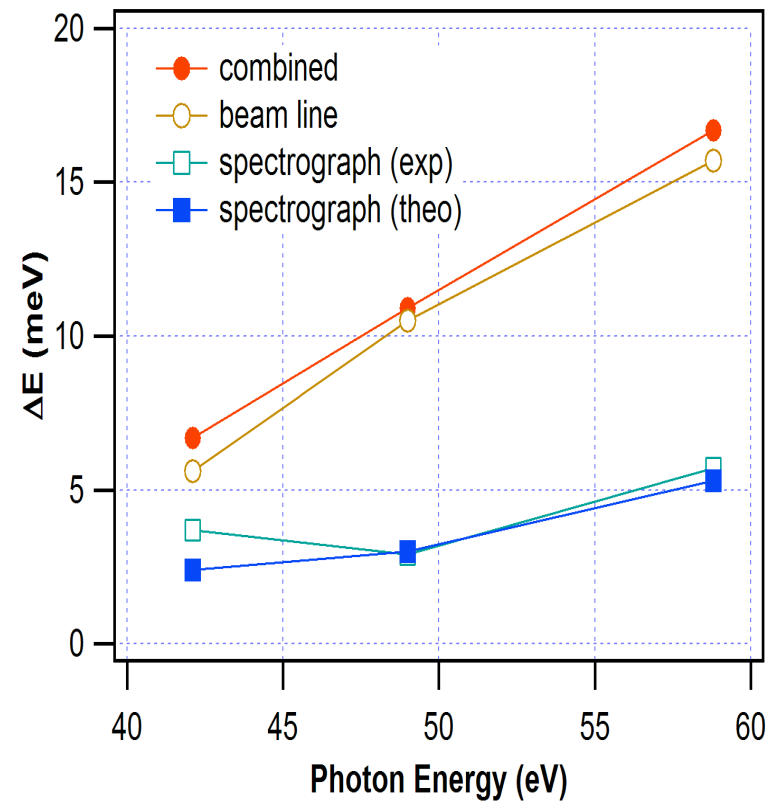
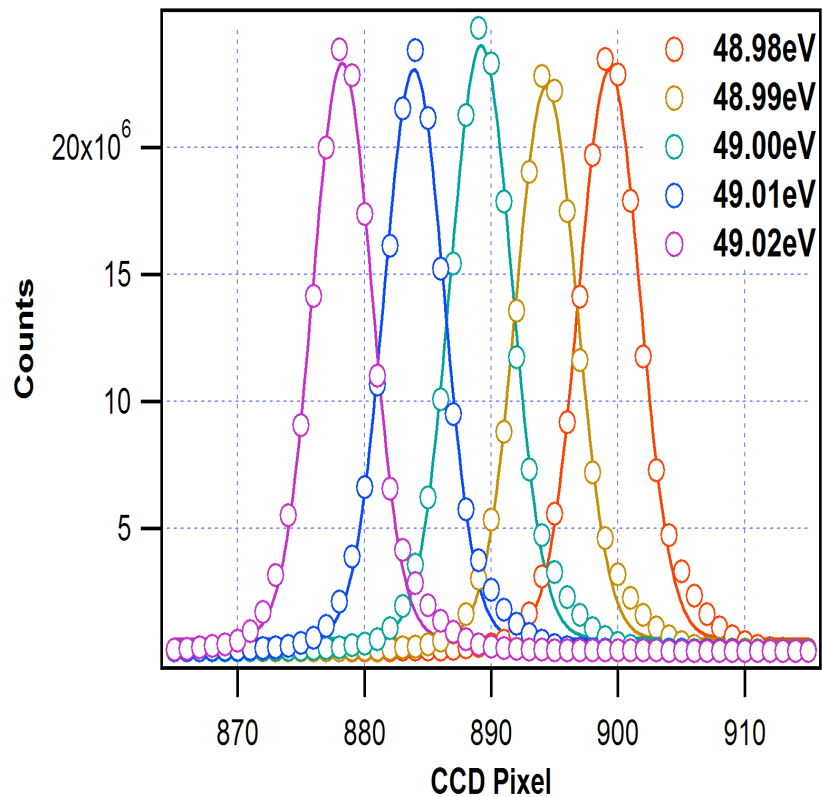
residual slope error: 1.03  $\mu$ rad pv / 0.23  $\mu$ rad rms, radius of curvature: 14.965 m

1: the substrate at the interferometer table at the BESSY Optics Lab.

# Spectrograph: Energy Resolution Test



Straight beam with  $\sim 6\mu\text{m}$  source size BL 12.0



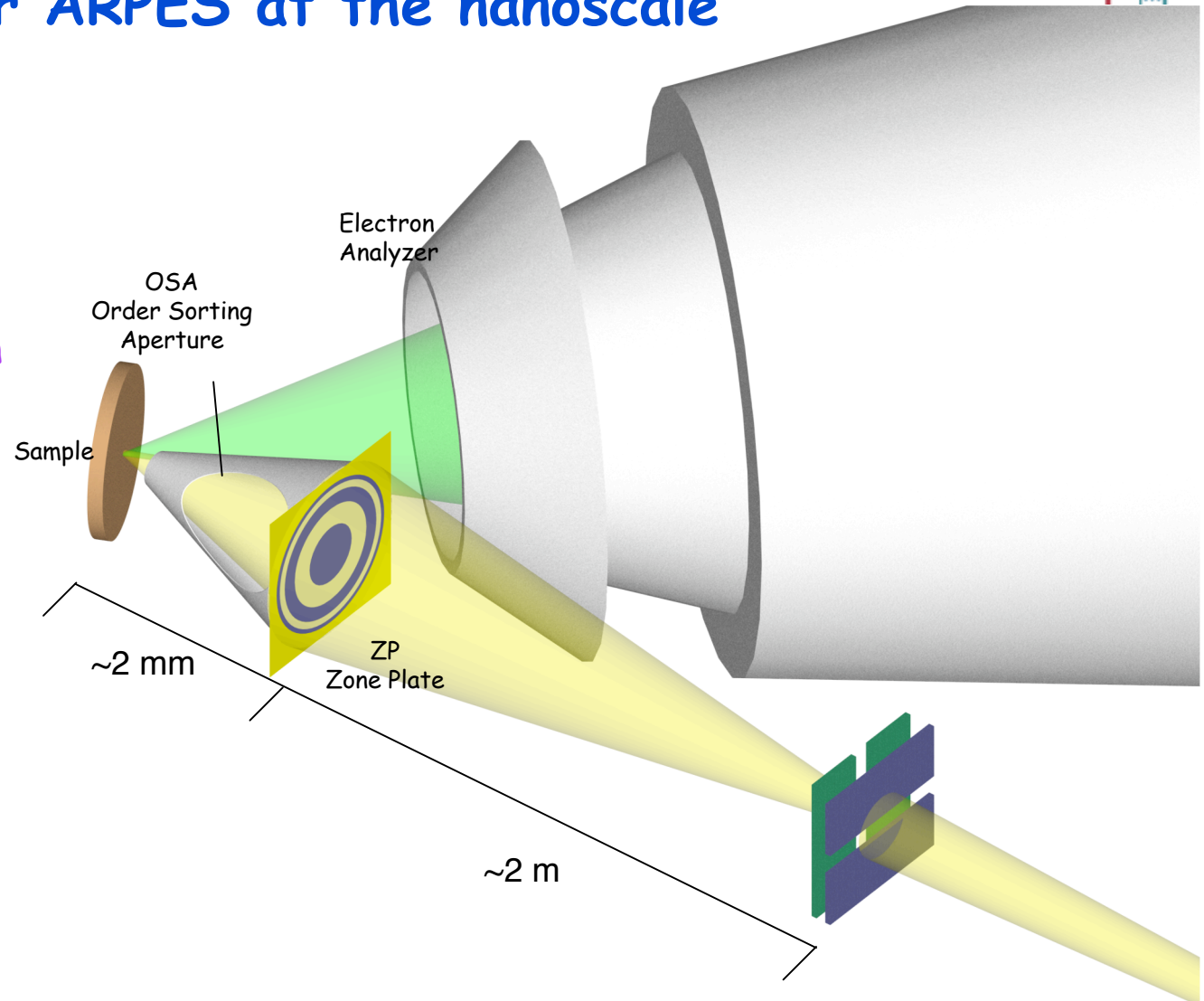
# nanoARPES

## a new facility for ARPES at the nanoscale



200 nm from 20-80 eV  
50 nm from 80-160 eV  
25 nm from 160-600 eV

10 meV energy resolution

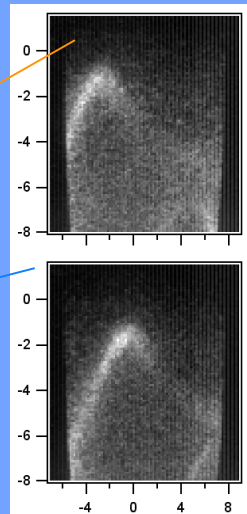
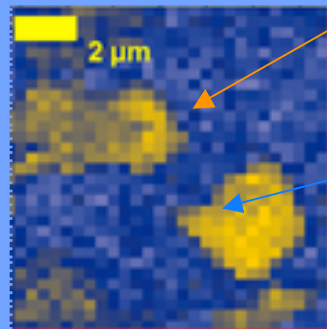
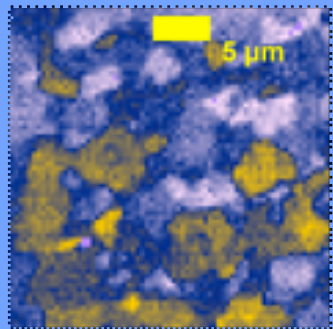


Developed by:  
Aaron Bostwick and Eli Rotenberg, ALS

# nanoARPES demonstration experiments

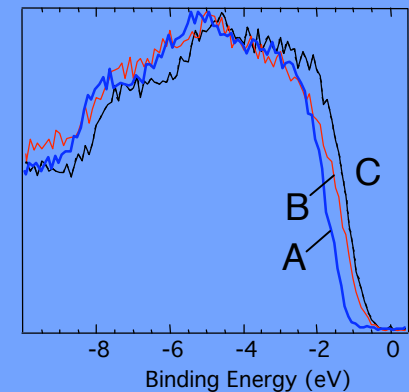
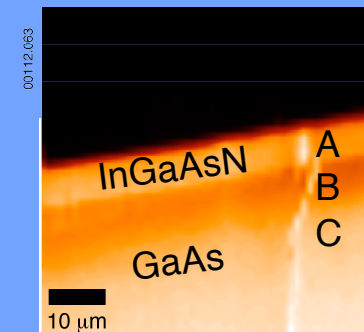
## imaging crystalline domains of polycrystalline HOPG

Valence Band Contrast Images



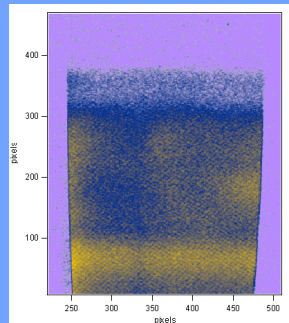
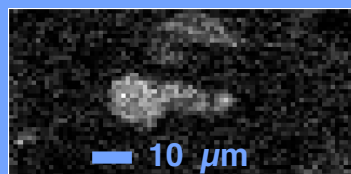
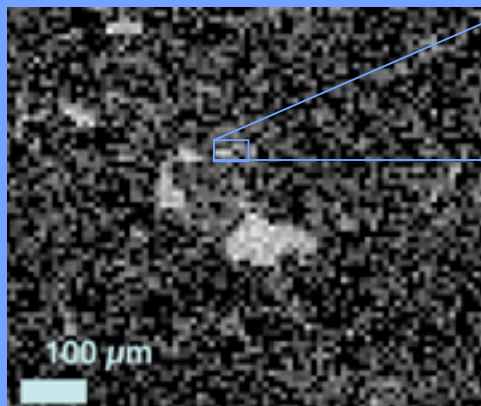
~10 sec/  
spectrum

band offset and  
band bending at on-  
edge cleaved  
semiconducting  
interfaces



## bandstructure of 10 μm cleaved crystal

TaSe<sub>2</sub>







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# Proposal for Hosting CORPES in 2011 at Berkeley, California - U.S.A

Scientific coordination (from USA):  
Dan Dessau (University of Colorado)  
Zahid Hussain (Berkeley Lab)  
ZX Shen (Stanford)  
Arun Bansil (Northeast Univ)  
Dung Hai Lee (UC Berkeley)  
+++++ International Coordinators



San Francisco

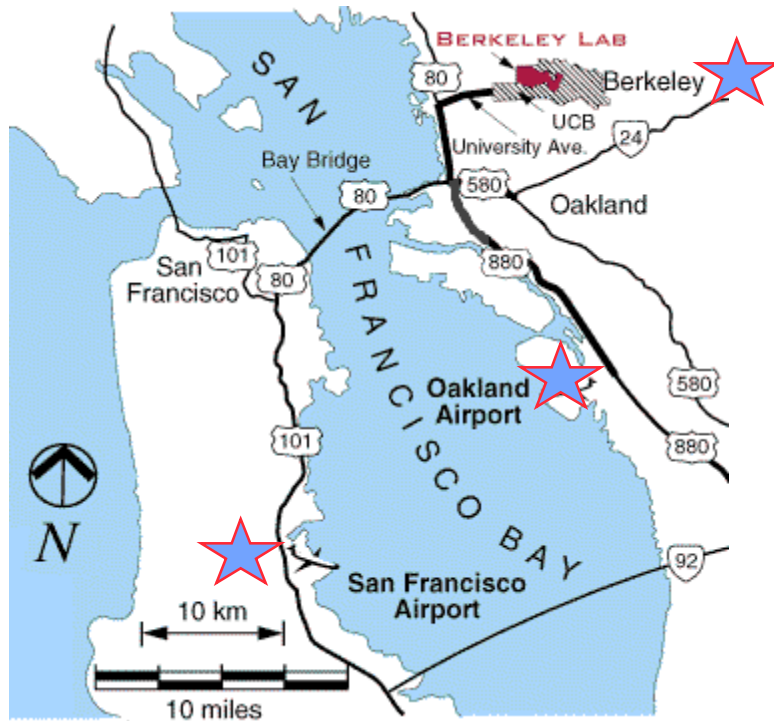
Golden Gate Bridge

Univ of California  
(~23 Nobel prizes)

ALS/LBNL (11 Nobel prizes)



# Conference location



San Francisco Int'l Airport -->  
Berkeley direct shuttle, (each way)s 1 hour, ~ \$22  
BART (RT): 1 hour, ~ \$7



★ Stanford/SSRL

(From Berkeley to Stanford = 50 miles)

# University of California Botanical Garden

The University of California Botanical Garden is a living museum open to the public featuring one of the most diverse plant collections in the United States. Established in 1890, the Garden's 34 acres contain over 12,000 different kinds of plants from all over the world arranged by region.

## UNIVERSITY OF CALIFORNIA BOTANICAL GARDEN

The University of California Botanical Garden's scientific collection of plants from around the world is arranged primarily by geographic origin. Nine major geographic regions and several special collections are represented. The area or collection name heading each brief description below is color coded to match its area on the map.

**MEDITERRANEAN** Located on the steep eastern edge of the Garden, this area is evocative of the rocky slopes above the Mediterranean Sea. Featured in this area of the Garden are plants found in places ranging from the Canary Islands to Israel. There are many species of aromatic lavenders (*Lavandula* spp.), oreganos (*Origanum* spp.) and thymes (*Thymus* spp.) from Italy and France. Strawberry trees (*Arbutus* spp.) and rockroses (*Cistus* spp.), olives (*Olea europaea*) and heaths (*Erica* spp.) are also in this collection. Bulbs can be seen flowering in fall, winter and spring.

**ASIA** Many elements of the vast Asian flora are represented in this older part of the Garden. An outstanding array of rhododendrons is featured, as well as a broad range of camellias, maples and hydrangeas. The first collections of the dawn redwood (*Metasequoia glyptostroboides*) on the West Coast are grouped along Strawberry Creek. The Japanese Pool has a rich display of fall color with maples (*Acer* spp.) and dogwoods (*Cornus* spp.). This Japanese exhibit, waterfall and pool, including the rocks and lanterns, was donated in 1939 from the San Francisco World's Fair and Exposition. In the spring the flowering of the empress tree (*Paulownia glabrata*) is spectacular. The Japanese Pool is an important breeding ground for newts (*Taricha* spp.) native to upper Strawberry Canyon.

**SOUTHERN AFRICA** This southwest-facing slope contains a stunning collection of plants from one of the most diverse botanical regions of the world. The prominent rocky succulent karoo habitat is a riot of color in spring with blooming bulbs and annuals such as Cape cowslips (*Lachenalia* spp.), baboon flowers (*Babiana* spp.) and Cape marigolds (*Dimorphotheca* spp.). The chaparral-like fynbos beds feature fine-leaved heaths (*Erica* spp.), proteas (*Protea* spp.), and rush-like restios (including *Restio* spp., *Elegia* spp.). See the fantastic blue squill (*Scilla natalensis*) and rare spiral aloe (*Aloe polyphylla*) from the mountains of southern Africa.

**NEW WORLD DESERT** This is one of the oldest and best-known collections in the Garden with some of the plants dating back to the 1930s. Rich in cacti, succulents and herbaceous desert dwellers, the plants in this area are from North and Central American deserts, as well as the high deserts of the Andes in South America. The Baja peninsula beds contain flora similar to that of southwestern California deserts. The giant cacti (*Echinopsis* spp.), similar to the saguaro cactus of the southwestern United States, are from South America.

**SOUTH AMERICA** This area features plants ranging from the mountain highlands of the Andes to southern-most Argentina and Chile. Chile's natural habitat, which has a mediterranean climate much like that of California's, includes plants similar to those of California's chaparral. This area features a young grove of monkey puzzle trees (*Araucaria* spp.), wild fuchsia (*Fuchsia* spp.), gigantic terrestrial bromeliads (*Polka* spp.), giant-leaved gunneras (*Gunnera* spp.) and several species of southern beech trees (*Nothofagus* spp.).

**AUSTRALASIA** This hillside features plants from Australia, New Zealand and high elevations of islands in the South Pacific. Representatives of the Myrtle family include tea trees (*Leptospermum* spp.), Kanakas spp. and paper barks (*Aldouina* spp.). You will also see banksias (*Banksia* spp.) and grevilleas (*Grevillea* spp.) of the protea family and southern beeches (*Nothofagus* spp.). Close relatives of these plants can be found in South America and southern Africa. This wide distribution can be traced back to an ancient geological time when these southern continents were grouped together in a single land mass called Gondwana.

**MEXICO/CENTRAL AMERICA** This sunny slope at the southeast corner of the Garden features an incredibly unique collection of plants including many that are utilized by the Aztecs in Mexico and the Mayans in Mexico and Central America. The western end of this area includes a unique cloud forest habitat. The oak-pine woodland in the eastern end of the area recreates habitats from the highlands of Mexico and Guatemala. Rich in salsvias (*Salvia* spp.) and peristemonas (*Peristemon* spp.), this is one of the most floriferous areas of the Garden, especially in winter. The hummingbirds love this area!

**EASTERN NORTH AMERICA** This small section of the Garden is reminiscent of the woodlands in North America east of the Mississippi River. Stands of yellow birch (*Betula alleghaniensis*), and paper birch (*Betula papyrifera*) create a canopy for understory specimens such as hollies (*Ilex* spp.), azaleas (*Rhododendron* spp.) and bayberries (*Myrica* spp.). Several species featured in this area are related to those found in Asia and western North America. The fall color is especially vivid on the sweet gum (*Liquidambar styraciflua*), dogwood (*Cornus florida*) and tulip tree (*Liriodendron tulipifera*).

**CALIFORNIA** This area showcases the state's extraordinarily rich native flora. Growing in the California area are more than 1,200 species, almost one-quarter of all species in the state, including many of the state's endemic and/or rare plants. The garden recreates many of California's most beautiful and interesting plant communities. Special community displays include an alpine fell field, vernal pool, pygmy forest, redwood forest, chaparral, and a unique garden of the plants adapted to serpentine soils. Outstanding collections include manzanitas (*Arctostaphylos* spp.), California lilacs (*Genettia* spp.), and bulbous monocots (including *Fritillaria* spp., *Calochortus* spp., *Lilium* spp., *Erythronium* spp. and *Brodiaea* spp.). The collection also features many annual wildflowers; from the abundant California poppy (*Echinoschia californica*), to a very rare Vine Hill larkspur (*Clarkia imbricata*). The most abundant displays of flowers, both annual and perennial, are seen from February through June.

### SPECIAL COLLECTIONS

**Orchid, Fern & Carnivorous Plant House.** This house contains a rotating exhibit of the Garden's species orchids, ferns and unusual insect-eating plants.

**Arid House.** Nestled between the Southern Africa and the New World Desert areas, the Arid House contains colorful cacti, succulents and other plants from cool dry and warm dry areas of the world.

**Tropical House.** Cool outside? Step into the warm, humid Tropical House and see plants from the tropical zone around the world, including many of economic value.

**Cycad & Palm Garden.** This area of the garden contains an exceptional collection of cycads, as well as palms from every continent except Antarctica, where they do not grow. The Garden's collection features hardy species that do well in the Bay Area.

**Garden of Old Roses.** Situated high on the east slope of the Garden with dramatic views of the San Francisco Bay and Golden Gate Bridge, rose cultivars from the 19th and early 20th centuries, and modern roses, are under-planted with many complementary flowering annuals and perennials including dwarf lavender. This splendid display peaks in May.

**Crops of the World Garden.** Food plants and other crops of the world are displayed according to their continents of origin.

**Herb Garden.** This is a semi-formal array of primarily European plants used for cooking, medicines and dye. Those used for beers and liquors, and for fragrance, are arranged around a central knot garden and sundial.

**Chinese Medicinal Herb Garden.** These herbs are organized according to their function in traditional Chinese medicine. Many are depicted in classical Asian art.

### Key to plant labels

Family Name	Accession #: year/order received
COMMON NAME	Scientific Name
Where Collected	
● A red dot marks rare or endangered species.	

### Key to Map

— bench	♻️ restrooms	☎️ public phone
♣️ table	🚰 drinking fountain	📞 emergency phone



<http://botanicalgarden.berkeley.edu/index.shtml>

LAWRENCE BERKELEY NATIO  
Corpes07\_Dresden\_Germany

The new UCBG map and Visitor Guide have been made possible by generous support from Dr. Klaus Dethleff and the Chindoff Fund for Garden Interpretation.

# Estimated Budget



## Assumptions:

*2 weeks (total):* one week seminar/lecture (100 participants)  
+ one week workshop (130 participants)

## Cost:

Lodging and per-diem allowance for 15 participants each weeks  
= \$17k + \$17 k

Logistics Staffing = \$6.4 + \$ 7.6k

Food Beverges(breakfast/lunch/coffee) = \$17k + \$ 22k

Conference/AV services = \$12.5k + 12.5k

Creative services (pub) = \$3k + 0.5k

Misc = XXX

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Grand Total = \$65k + \$ 70k

**= \$135k**

Income: Contributions: (ALS \$20k, ssrl/Stanford \$10k, others: 85k???)

Registration: (regular \$225, students \$125) = \$20k

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**Grand Total: = \$135k**