FRACTAL S.L.N.E.
C/ Tulipán nº 2, portal 13, 1º A
E-28231 Las Rozas de Madrid
e-mail: info@fractal-es.com
http://www.fractal-es.com

Course Information
Scientific imaging in the visible and near infra-red

SCIENTIFIC IMAGING IN THE VISIBLE AND NEAR INFRA-RED

Madrid, 20, 21 y 22 de Junio de 2012

Idioma del curso: Inglés (el profesor habla también castellano)

Lugar de celebración del curso

Hotel Preciados VIP
C/ Preciados, 37. 28013, MADRID
(ver debajo los detalles de su localización)

Horario

El horario lo hemos adaptado de modo que el primer día empezamos tarde y el último día terminamos pronto para que las personas que viajan puedan acomodarse mejor al mismo.

Horario: primer día (miércoles 20 de junio)

10:30 – 11:30	Clase
11:30 – 12:00	Descanso y café
12:00 – 14:00	Clase
14:00 – 15:30	Descanso y comida
15:30 – 18:15	Clase

Horario: segundo día (jueves 21 de junio)

09:00 – 11:15	Clase
11:15 – 11:45	Descanso y café
11:45 – 14:00	Clase
14:00 – 15:30	Descanso y comida
15:30 – 18:15	Clase

Horario del tercer día (viernes 22 de junio)

09:00 – 11:15	Clase
11:15 – 11:45	Descanso y café
11:45 – 14:30	Clase

Entrega de Diplomas / Fin del curso

14:30 – 16:00	Comida

Precio

El precio por persona es de 1.140 euros (+IVA). Incluye la comida y los refrigerios los tres días del curso. Los descuentos aplicables (acumulables) son: 10% a quienes hayan asistido a alguno de los cursos de Fractal; 20% a personas cuyos centros pertenezcan a SECPhO y AstroMadrid y 20% a personas cuyos centros hayan contratado este mismo curso en cliente previamente.

Comidas y refrigerios

La inscripción incluye la comida y los refrigerios en los descansos los tres días del curso. Los menús de los almuerzos (en el restaurante del hotel) han sido preseleccionados para evitar demoras. Si es vegetariano lo necesitaríamos saber para incluir platos apropiados. Asimismo si piensa irse más temprano el último día y no asistir a la comida, le agradeceríamos nos avisara.

Hotel VIP Preciados: situación

Hotel Preciados VIP
http://www.preciadoshotel.com/
C/ Preciados, 37. 28013, MADRID
91-4544400 Teléfono
91-4544401 Fax

El Hotel Preciados VIP es un moderno hotel de 4 estrellas emplazado en el Madrid antiguo. El hotel está muy bien comunicado, a 3 minutos andando de las paradas de metro de Callao y Santo Domingo. Está relativamente cerca de la estación Puerta de Atocha (10 minutos en metro) La información detallada de cómo llegar se encuentra en la página web del hotel http://www.preciadoshotel.com/. El hotel dispone de parking propio (el parking no está incluido en el precio del curso).

El uso de wifi es gratuito en todas las dependencias del hotel.

Tarifas especiales de alojamiento en el Hotel Preciados VIP

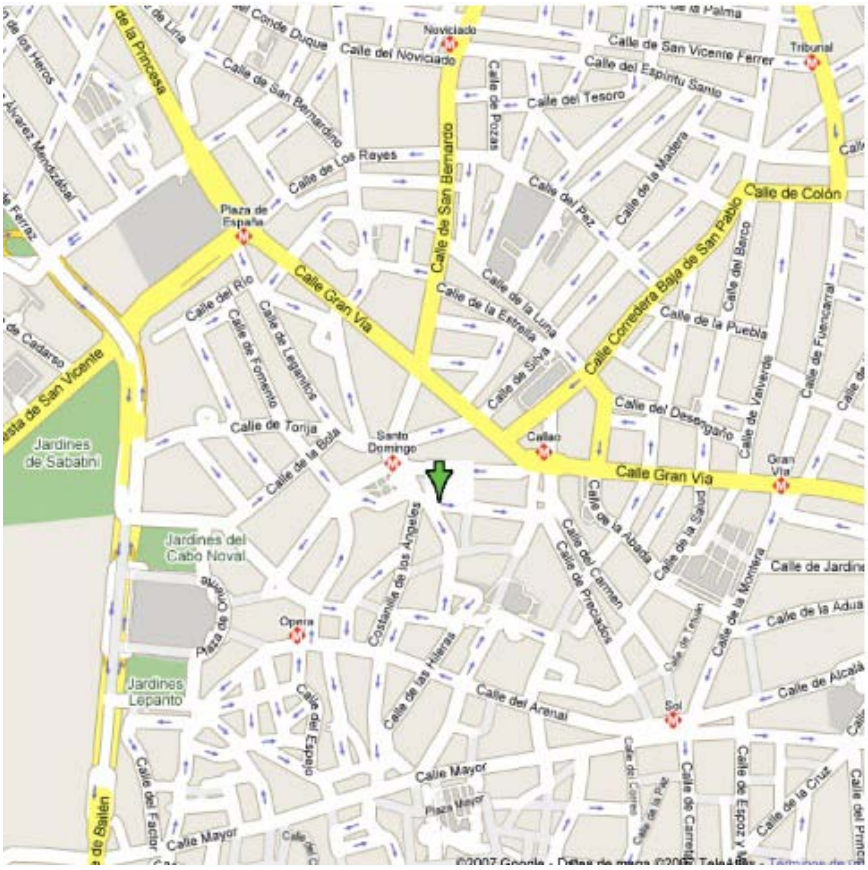
La inscripción al curso no incluye el alojamiento. Sin embargo hemos alcanzado un acuerdo con el hotel de modo que los precios garantizados para los asistentes al curso son:

Habitación individual	115 + 8% IVA
Habitaciones doble (de uso doble)	130 + 8% IVA

El precio incluye el desayuno buffet, todas las consumiciones del minibar y el uso de wifi gratuito las 24 horas. Todas las habitaciones dobles son exteriores.

El hotel pone ofertas en su web por varias noches, pero estas tarifas de Internet dependen de las fechas y la disponibilidad. Si van a quedarse en el hotel les recomendamos mirar también estas tarifas por si hubiera alguna oferta de última hora.

Si van a hacer una reserva en el hotel con la tarifa de FRACTAL, pueden enviar un e-mail a direccion@preciadoshotel.com, la atención de Javier Calle Gutiérrez. La tarifa se mantiene para estancias antes y/o después del curso. Si lo prefieren pueden copiarme en el e-mail (marisa.garcia@fractal-es.com) para que hagamos un seguimiento de la reserva.



Durante el curso pueden localizarme en el teléfono móvil 630737981 (Marisa). Estamos a su disposición para ayudarles en cualquier eventualidad.

En nombre del equipo de FRACTAL SLNE le agradezco la confianza que ha puesto en nuestra empresa y esperamos estar a la altura de sus expectativas.

Un afectuoso saludo,

Marisa

Dra. María Luisa García Vargas
Directora de FRACTAL S.L.N.E.
Teléfono: 916379640
Móvil: 630737981
e-mail: marisa.garcia@fractal-es.com

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SCIENTIFIC IMAGING IN THE VISIBLE AND NEAR INFRA-RED

Teacher: Dr. Simon Tulloch (smt@qucam.com). Has worked for 15 years in the fields of instrumentation and operations at astronomical observatories both in the UK and Spain. For 8 years he was the head of the detector group at the Isaac Newton Group of Telescopes in La Palma, Canarias. He has recently completed his Ph.D. at the University of Sheffield. The subject of his thesis was "Astronomical Spectroscopy with Electron Multiplying CCDs".

Course Summary: The course begins with an introduction to the solid-state physics underlying the operation of modern scientific visible and near infra-red detectors. The basic principles of photo-diodes, CMOS and CCD detectors are then outlined. The course continues with a explanation of how CCD detectors have been progressively improved over the last 40 years and how their performance is now closely approaching that of an ideal detector. The current state of alternative CMOS design detectors and how they compare to CCDs is also described. Finally, the optimisation, characterisation and operation of practical camera systems are discussed. The course as a whole is very much biased towards CCD technology. CMOS detectors are discussed, but mainly in order to contrast the performance of the two competing technologies.

At whom the course is oriented: The course is oriented at physicists, engineers and astronomers that have worked or are working in instrumental projects that involve the use of CCDs, who feel that that they would benefit from a more in-depth knowledge of the detectors that play such a central role in the performance of their instruments. The course would also be a valuable introduction for those wishing to become scientific detector specialists.

Previous grounding: A basic grounding in physics is required. Some knowledge of electronics would be desirable but is not essential. The course contains very little mathematics.

At the end, the attendances will get:

- To gain an in-depth knowledge of the physics underlying modern scientific visible and near infra-red detectors.
- An appreciation of the current advanced level of detector technology and the likely paths that further development will take in the near future.
- To be in a position to identify a suitable detector technology for their particular engineering application and to understand the various performance parameters described in manufacturers data sheets.
- A knowledge of the techniques of detector characterisation in practical camera systems.

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CONTENTS

- **1.4 The charge-coupled device (CCD)**
    - Bucket brigade structure
    - Charge Collection
    - The Buried channel
    - Charge transfer
    - Frame transfer and Interline transfer
    - Output amplifier structure
    - Video Processor and CDS
    - Charge Transfer Efficiency (CTE)
    - Traps
    - Full Well and Blooming
    - Dark Current
    - Inverted Mode Operation
    - Dither Clocking
    - Cosmetic defects
    - Remnance
    - Bias areas
    - Binning and Windowing
    - Cosmic Rays
    - CCDs in Space

Module 2: Approaching the Ideal Detector

Summary: *This module is devoted to explaining the evolutionary changes that have steadily improved optical detector technologies over the last 40 year.*

- **2.1 CCDs: Boosting performance of the basic design**
    - Backside Illumination
    - Thinning
    - Problem of Fringing
    - Backside passivation
    - Anti-reflective coatings
    - Deep Depletion CCDs
    - Hi-Rho CCDs
    - Anti-fringing structure
    - Low-noise amplifiers
    - Multiple outputs
    - Mosaics
    - Orthogonal transfer CCDs (OTCCD)

- **2.2 The electron multiplying CCD (EMCCD)**
    - Structure
    - Multiplication noise
    - Clock-induced charge
    - Output signal distribution
    - Modes of operation
    - Photon-counting
    - Application: Adaptive optics
    - Application: Lucky Imaging
    - Application: Astronomical spectroscopy

- **2.3 CMOS detectors: Boosting performance of the basic design**

  - Microlenses
  - Backside Illumination
  - Hybridisation

- **2.4 Ultimate-performance future detectors**

  - Repetitive non-destructive read (RNDR)
  - Silicon APD arrays for photon counting in the visible
  - HgCdTe APD arrays for photon counting in the NIR

Module 3: Scientific Camera Systems

Summary: *This module is devoted to explaining the process of characterization of a practical scientific camera system.*

- **3.1 Additional Camera Elements**

  - Thermal Control
  - Cooling Options
  - Vacuum Materials
  - Controller Electronics
  - Putting it all together
  - Detector Handling Precautions

- **3.2 Camera Testing**

  - Measurement of Gain
  - The photon-transfer method
  - Characterisation using X-rays
  - The EPER method
  - Measurement of Quantum Efficiency
  - Tuning the output amplifier
  - Flat-field illumination
  - Measurement of Linearity
  - Measurement of Dark Current
  - Measurement of Point Spread Function (PSF)
  - Measurement of Coplanarity

- **3.3 Project Issues**

  - Detector price/lead-time
  - Detector economy
  - Importance of early detector choice
  - Key detector-related project tasks