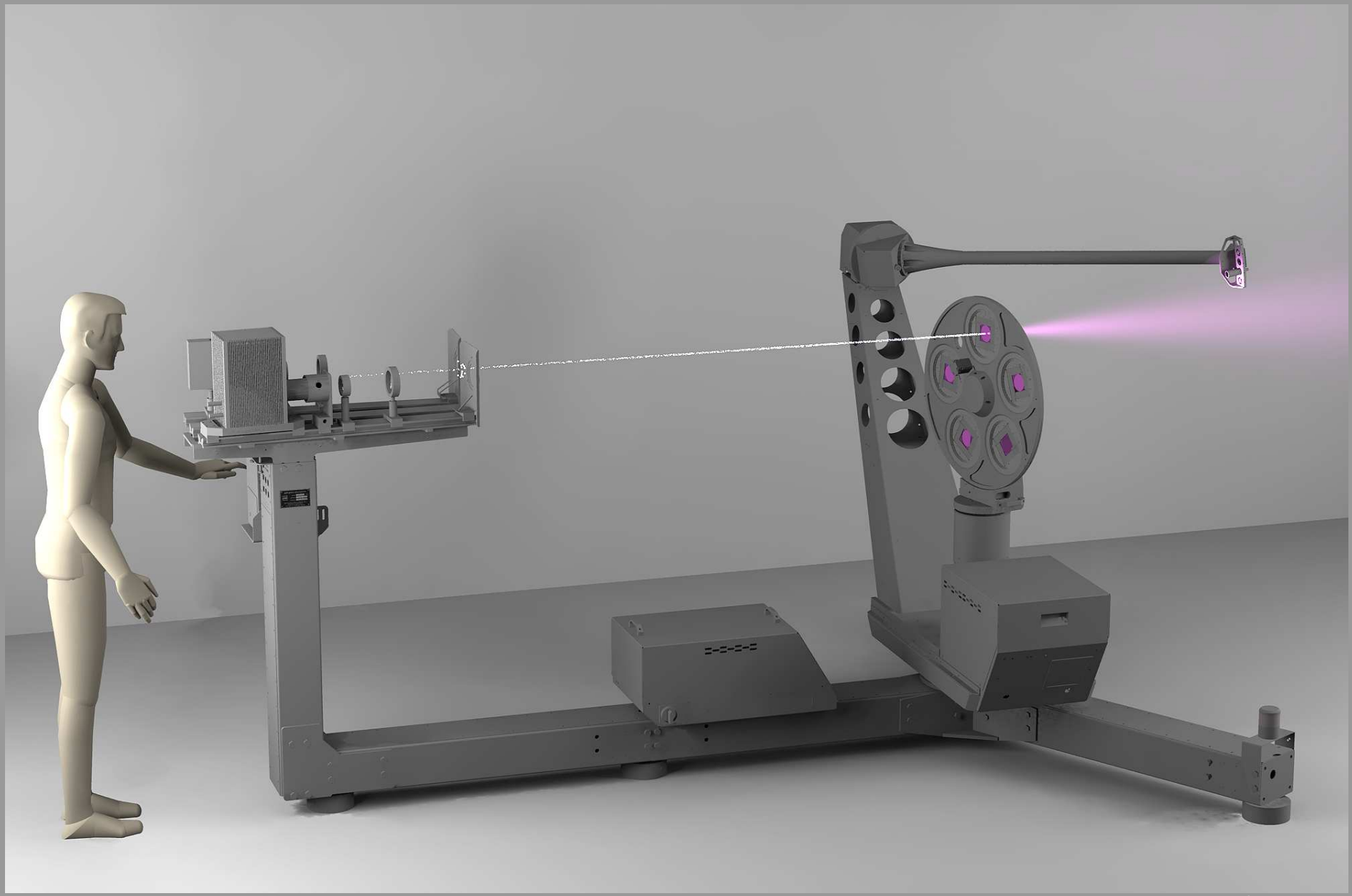
Introducing spectrally resolved BSDF and other updates on the PG2 gonio-photometer

Peter Apian-Bennewitz

pab advanced technologies Ltd
info@pab.eu

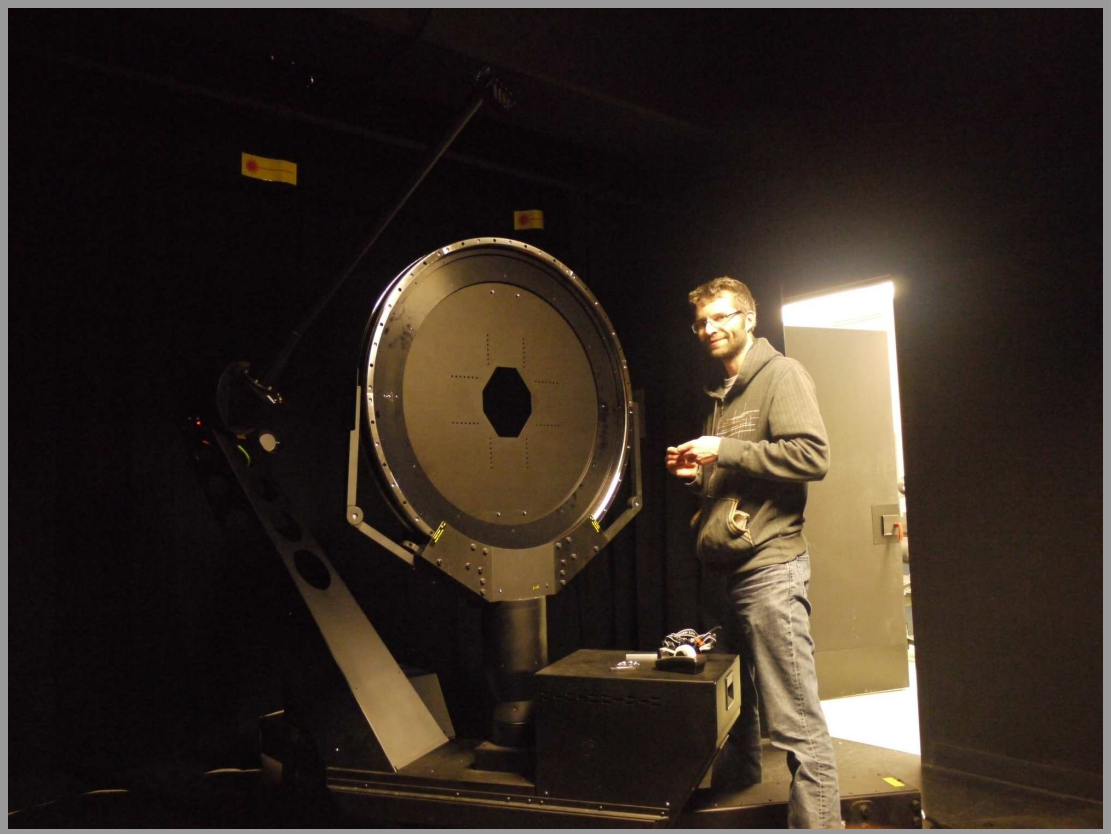
13th *Radiance* workshop, London

PG2 gonio-photometer layout

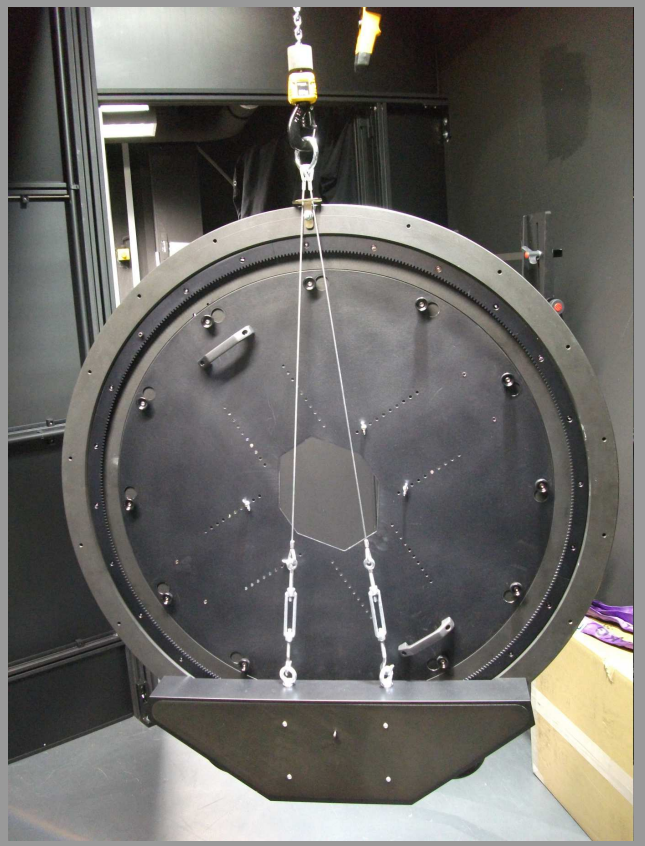


PG2 news 2014: *phirot* sample mount

large sample mount with rotation (ϕ_{in}), 1m radius



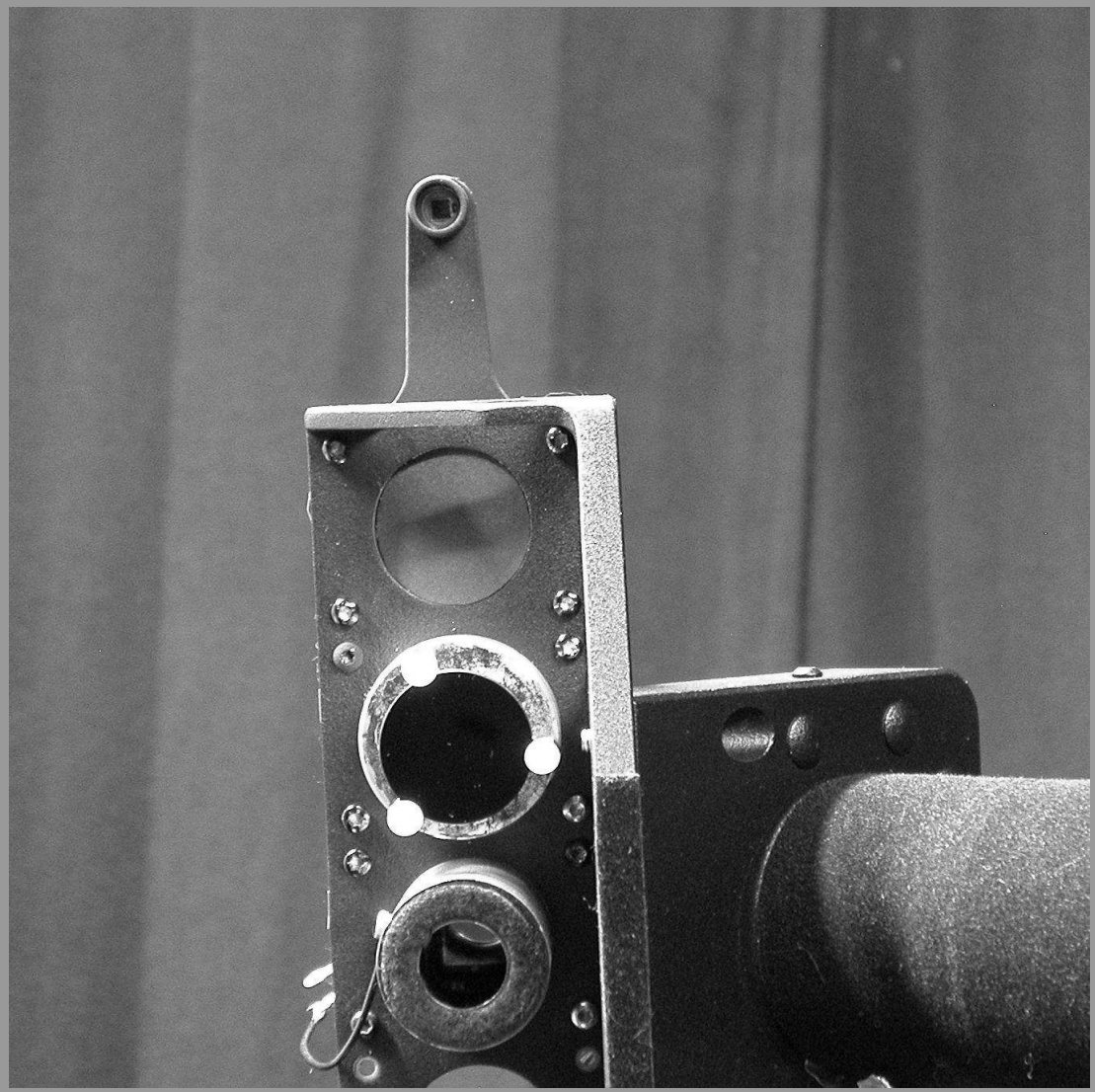
LBNL 2013



FhG-ISE 2014

standard sample diameter up to 760mm, adjustable mounting of different sizes

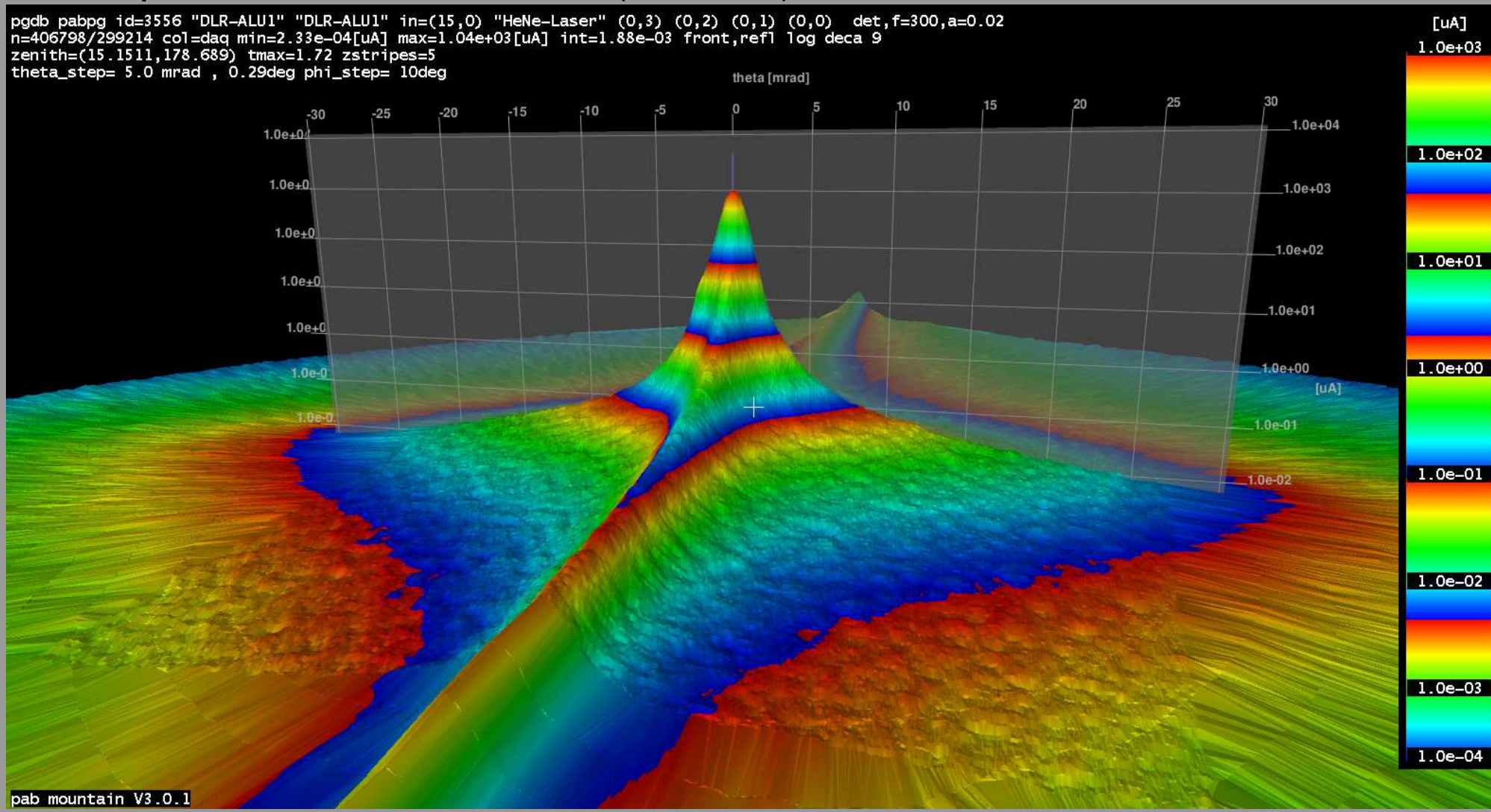
PG2 news 2014: sensor for retro-reflecting direction



closest angle 0.3^o to incident direction

PG2 news 2014: high angular resolution with HeNe

comparison of solar mirrors (for DLR):



solved with 1mm aperture (1m distance), filtered, focussed 7mW HeNe, special drive software

other bits of PG2 news:

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- and:
  first working spectral measurement heads in service:
  VIS and IR

BSDF, the formal way, (with wavelength)

Definition

$$\mathcal{L}_{out}(\vec{x}_{out}, \lambda) = \int_{\vec{x}_{in}}^{\Omega_{in}=2\pi} BSDF(\vec{x}_{in}, \vec{x}_{out}, \lambda)\ \mathcal{L}_{in}(\vec{x}_{in}, \lambda)\ \cos(\theta_{in})\ d\Omega_{in}$$

- 4 variables: $BSDF(\vec{x}_{in}, \vec{x}_{out}) = BSDF(\theta_{in}, \phi_{in}, \theta_{out}, \phi_{out})$ plus (optionally) wavelength λ

$\mathcal{L}_{out}$ outgoing, $\mathcal{L}_{in}$ incident radiance, λ wavelength, $\int_{\vec{x}_{in}}^{\Omega_{in}=2\pi}$ integral over hemisphere,

Ω_{in} inf. solid angle , see talk at 2010 workshop for more math

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- often applied approximation: $BSDF(\theta_{in}, \phi_{in}, \theta_{out}, \phi_{out}, \lambda) = \underbrace{BSDF^*(\theta_{in}, \phi_{in}, \theta_{out}, \phi_{out})}_{\text{angular part}}\ \underbrace{\rho^*(\lambda)}_{\text{spectral}}$

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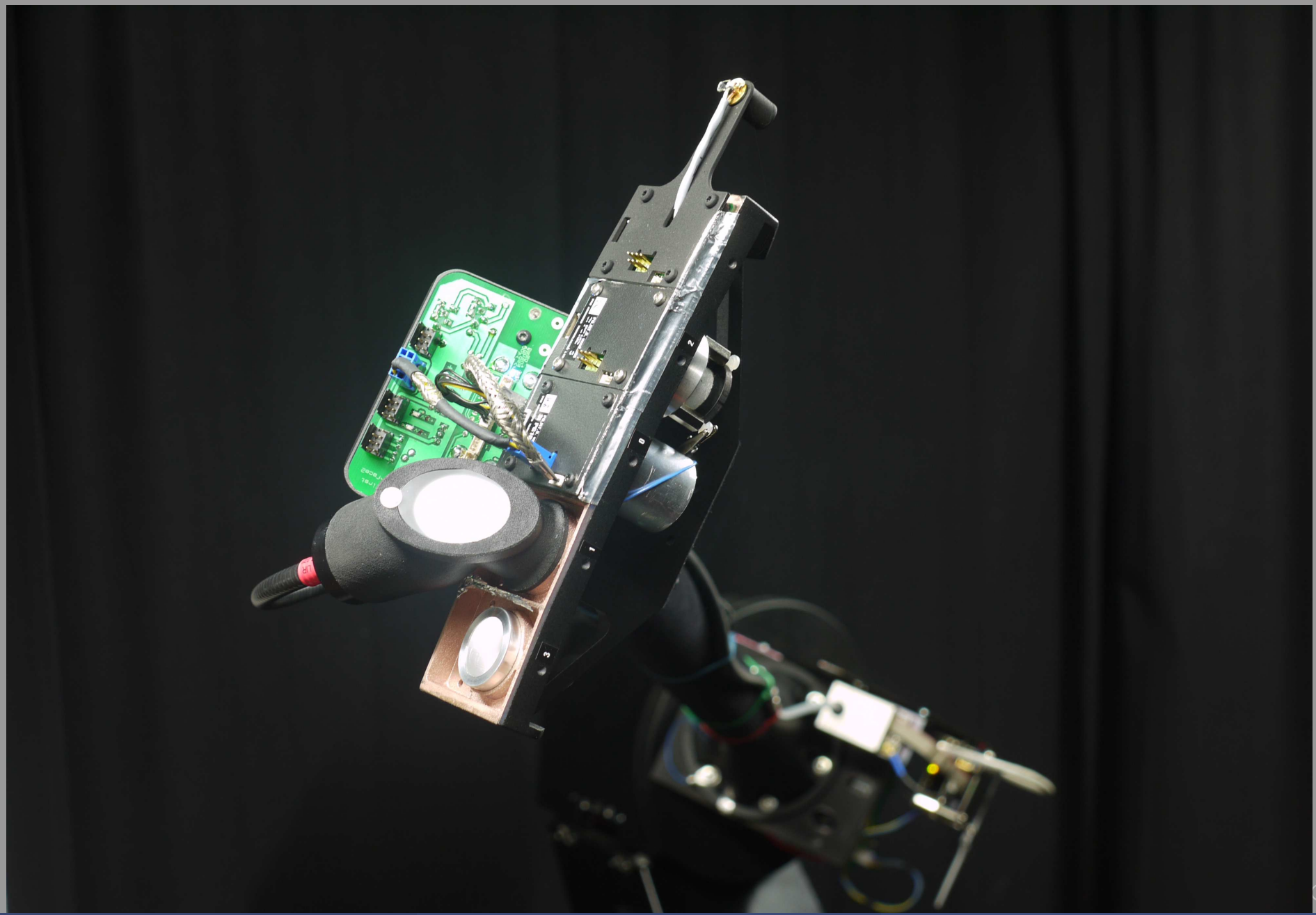
spectral BSDF, prototype hardware



spectral BSDF, key parameters

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- quality of optics (e.g. internal stray-light, pixel cross-talk)

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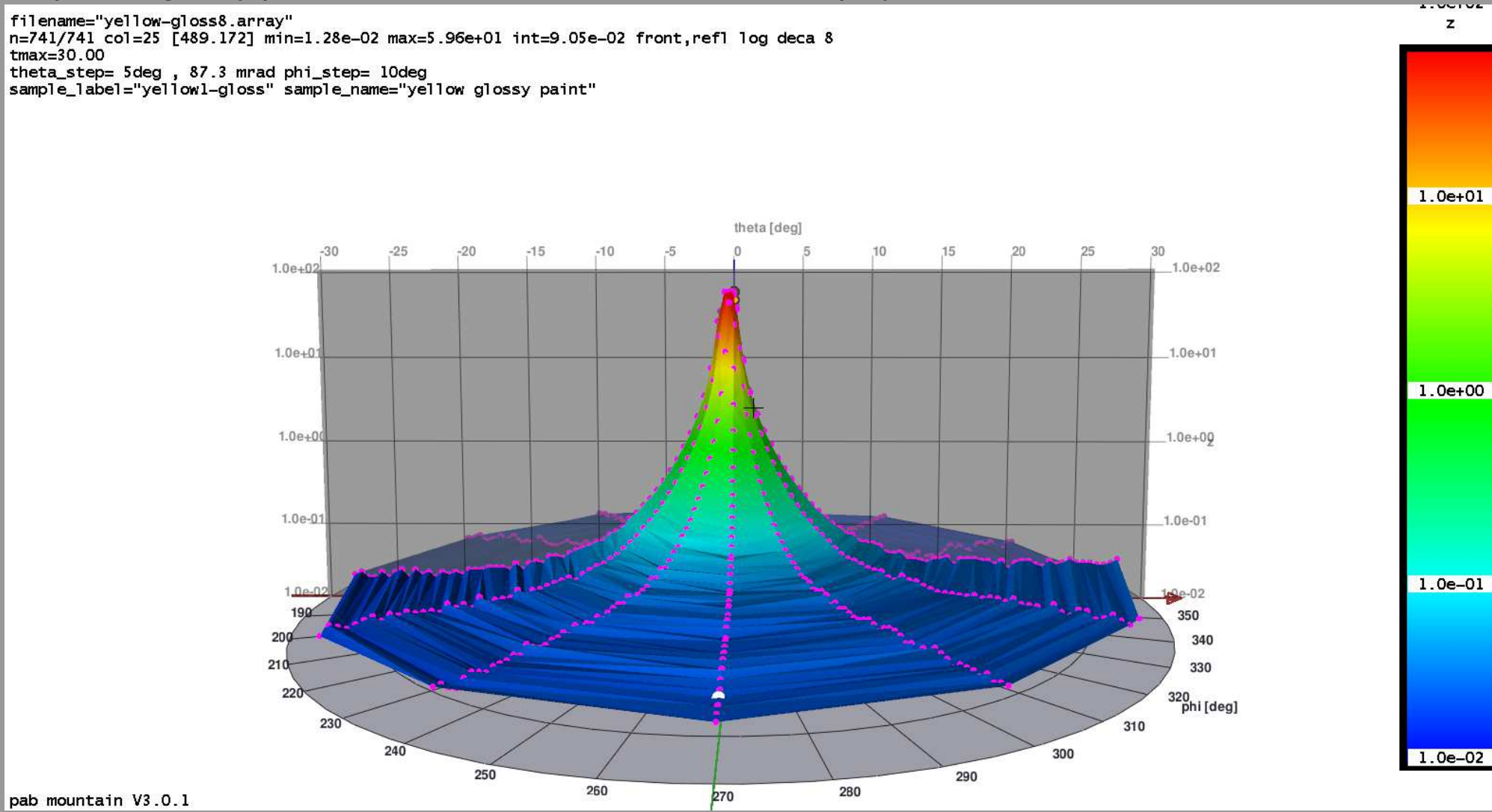
How to understand and check spectral BSDF

- introduces yet another variable for the BSDF
- adding neat new display and functions to `mountain` program
- new challenge to Radiance: handling spectral BSDF.

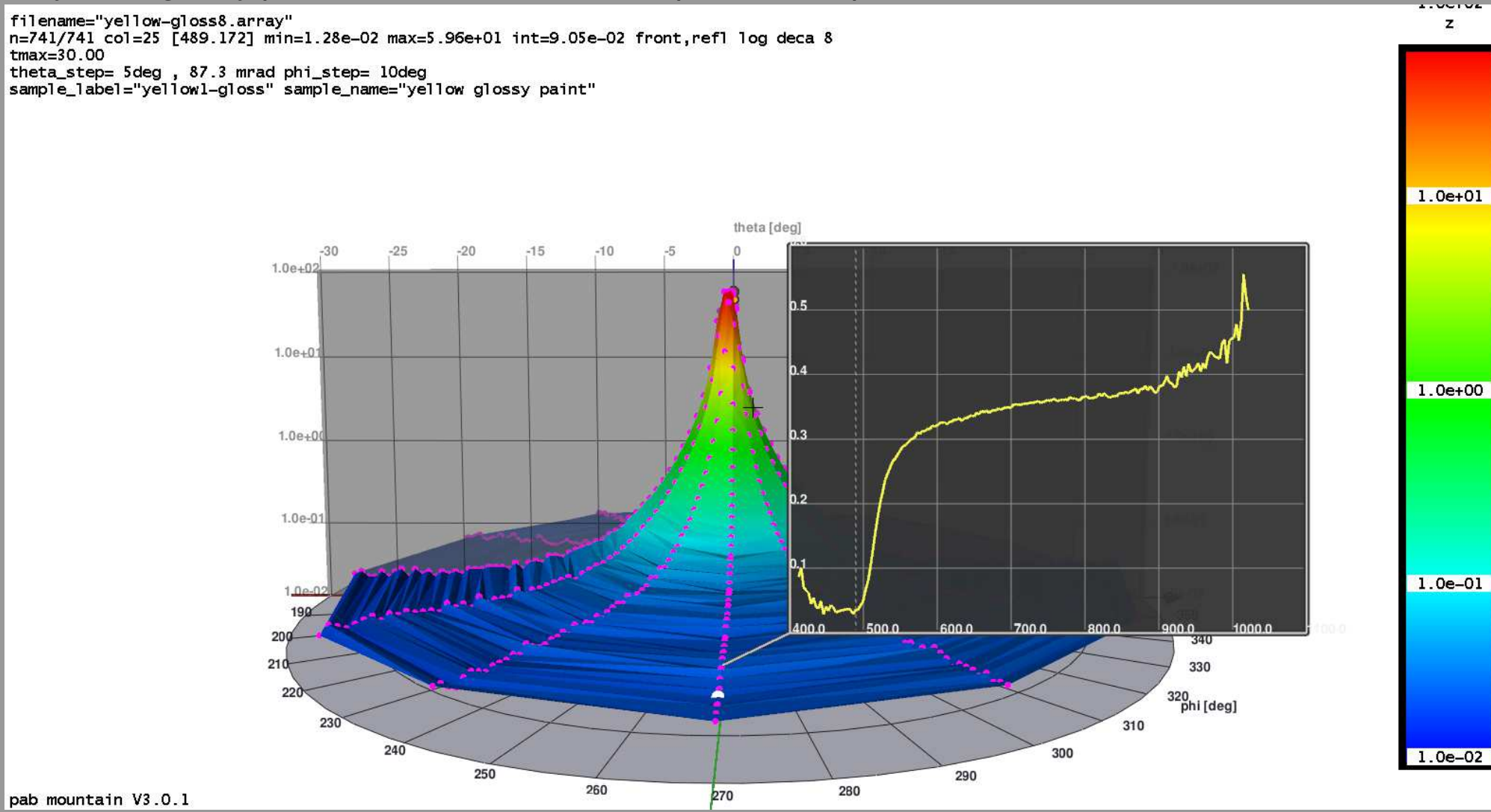
spectral BSDF mountain display

yellow, glossy paint, $\theta_{in} = 30^o$, @490nm, standard display



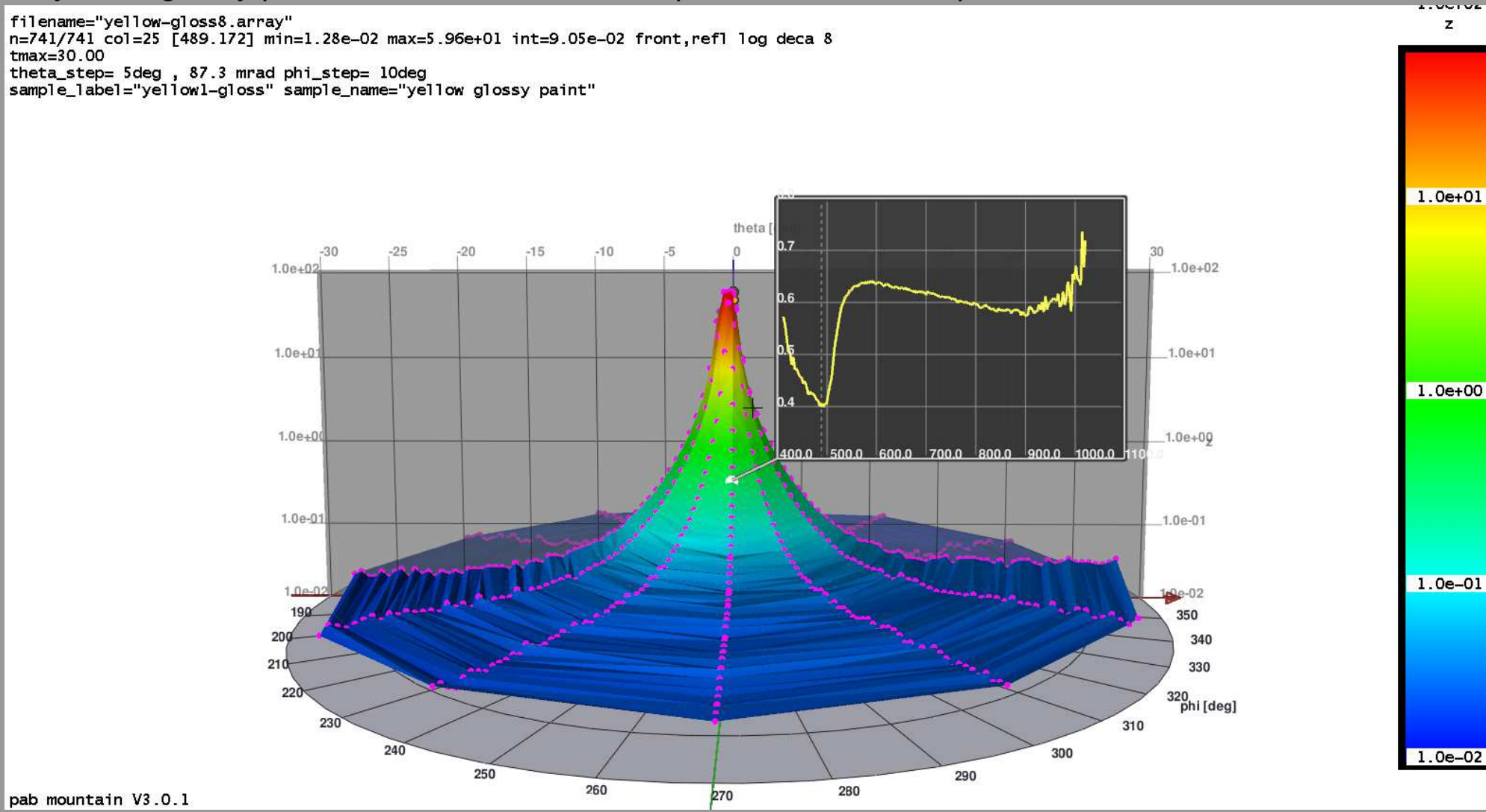
spectral BSDF mountain display

yellow, glossy paint, $\theta_{in} = 30^o$, @490nm, spectrum off-peak



spectral BSDF mountain display

yellow, glossy paint, $\theta_{in} = 30^o$, @490nm, spectrum at base of peak



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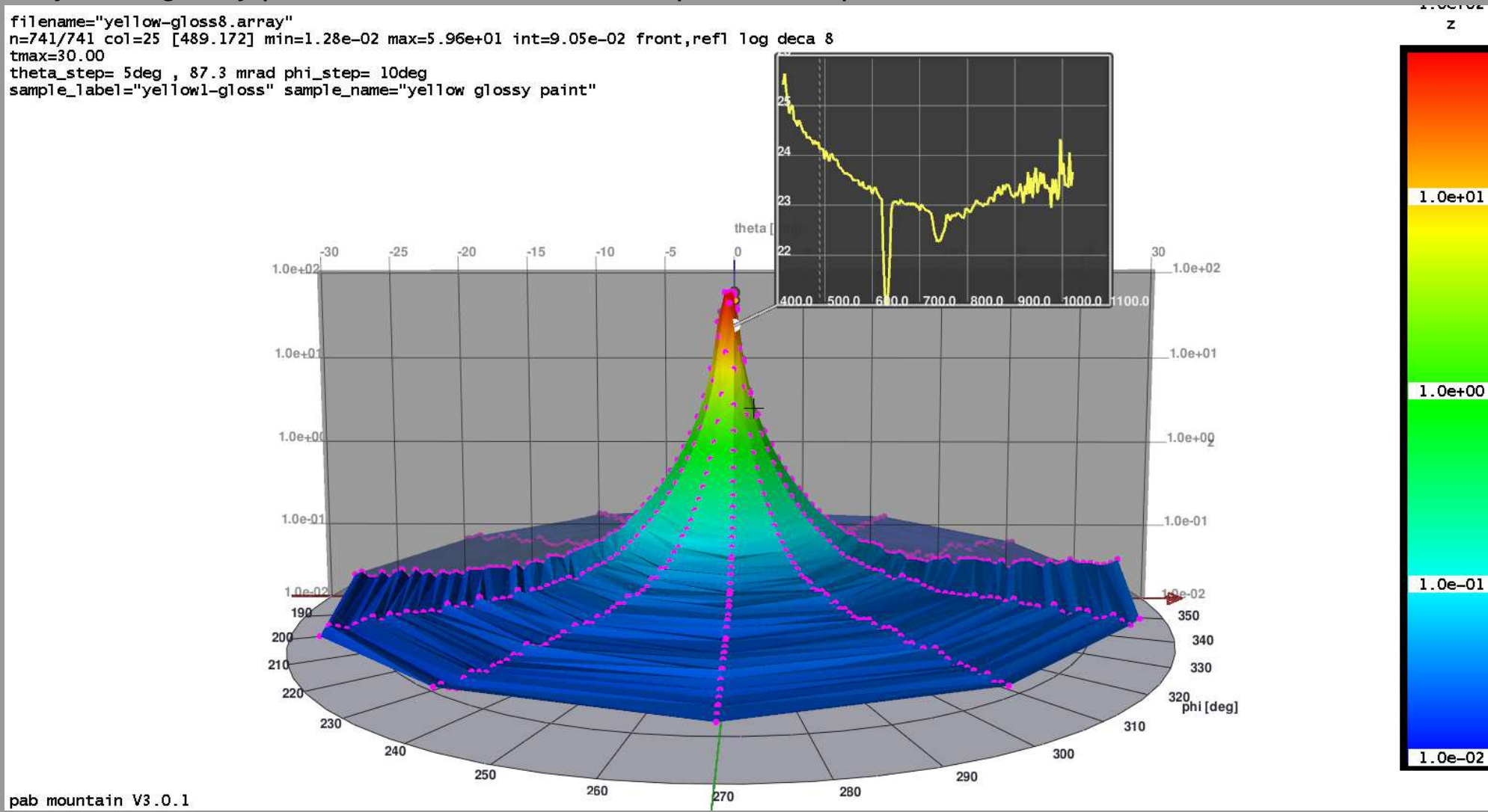
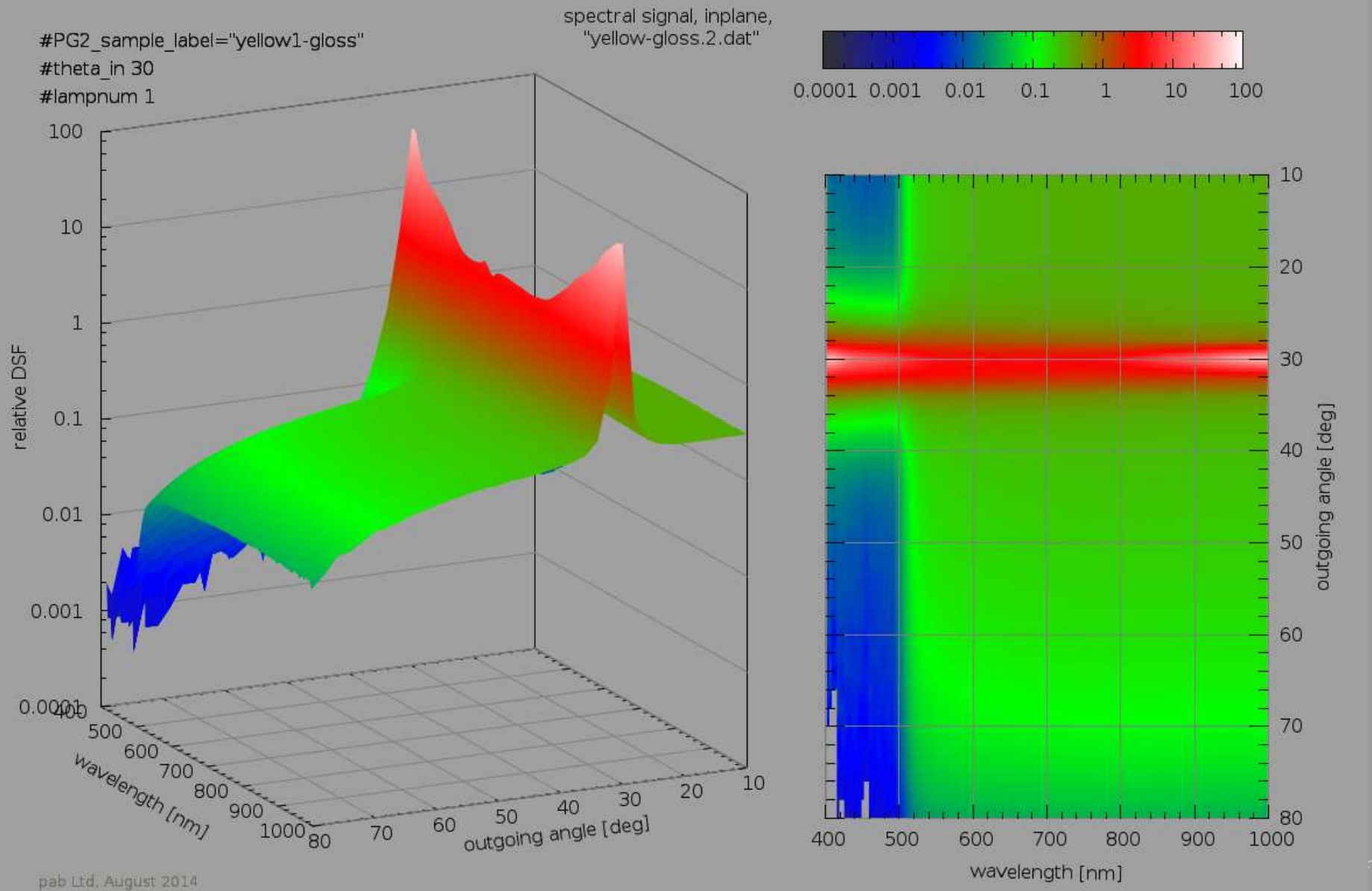


spectral BSDF graph of inplane scattering

yellow, glossy paint, $\theta_{in} = 30^o$, $\phi_{out} = 180^o$



pab Ltd, August 2014

...thanks

conclusion:

- PG2 is a fairly configurable machine *(... get one today!)*
- spectral BSDF: lots of fun, even for ”simple” materials
- works for more complex scattering too
- inspires more questions on modelling and materials

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- more BSDF math at 2010 pab workshop talk
- more measurement details: `http://www.pab.eu`

- happy rendering
- thank you for your attention

parameter of VIS spectrometer module

- 256 pixel, mean pixel pitch: 3.3nm
- resolution, half-width at 1/10 max : 7nm
- pixel-wavelength function: 3rd order polynomial
- spectral range, nominal: 310nm to 1100nm

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