Simulations for the recalibration of the sFLASH FEL energy monitor

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Summer 2013

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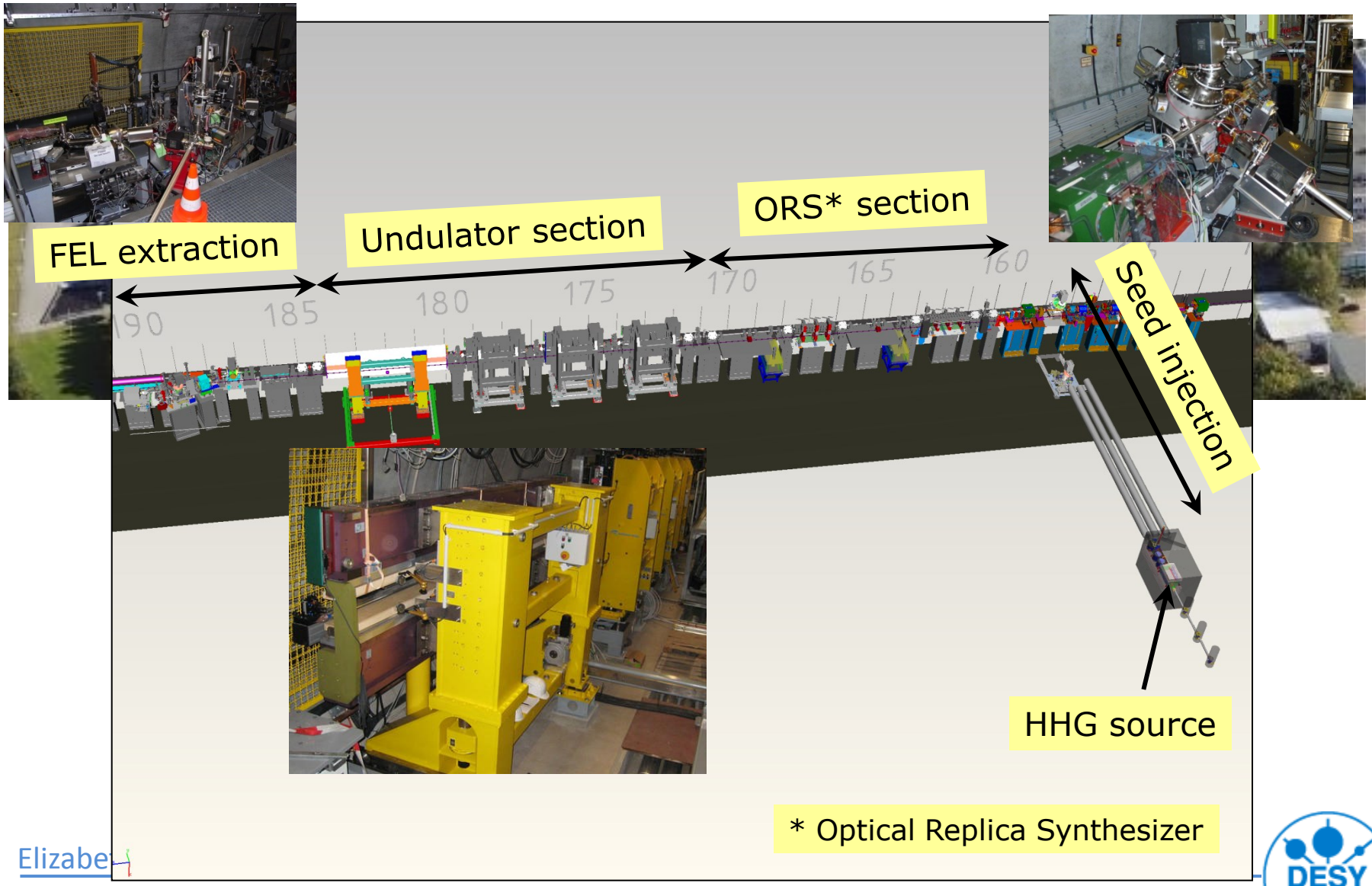
UNIVERSIDAD COMPLUTENSE MADRID

sFLASH experiment

hutch for first experiments with sFLASH pulses

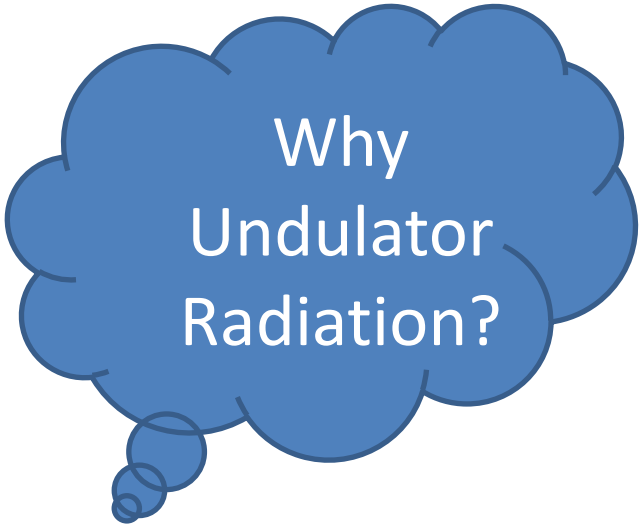
Ti:sapphire laser system and HHG source

sFLASH experiment



* Optical Replica Synthesizer

Motivation



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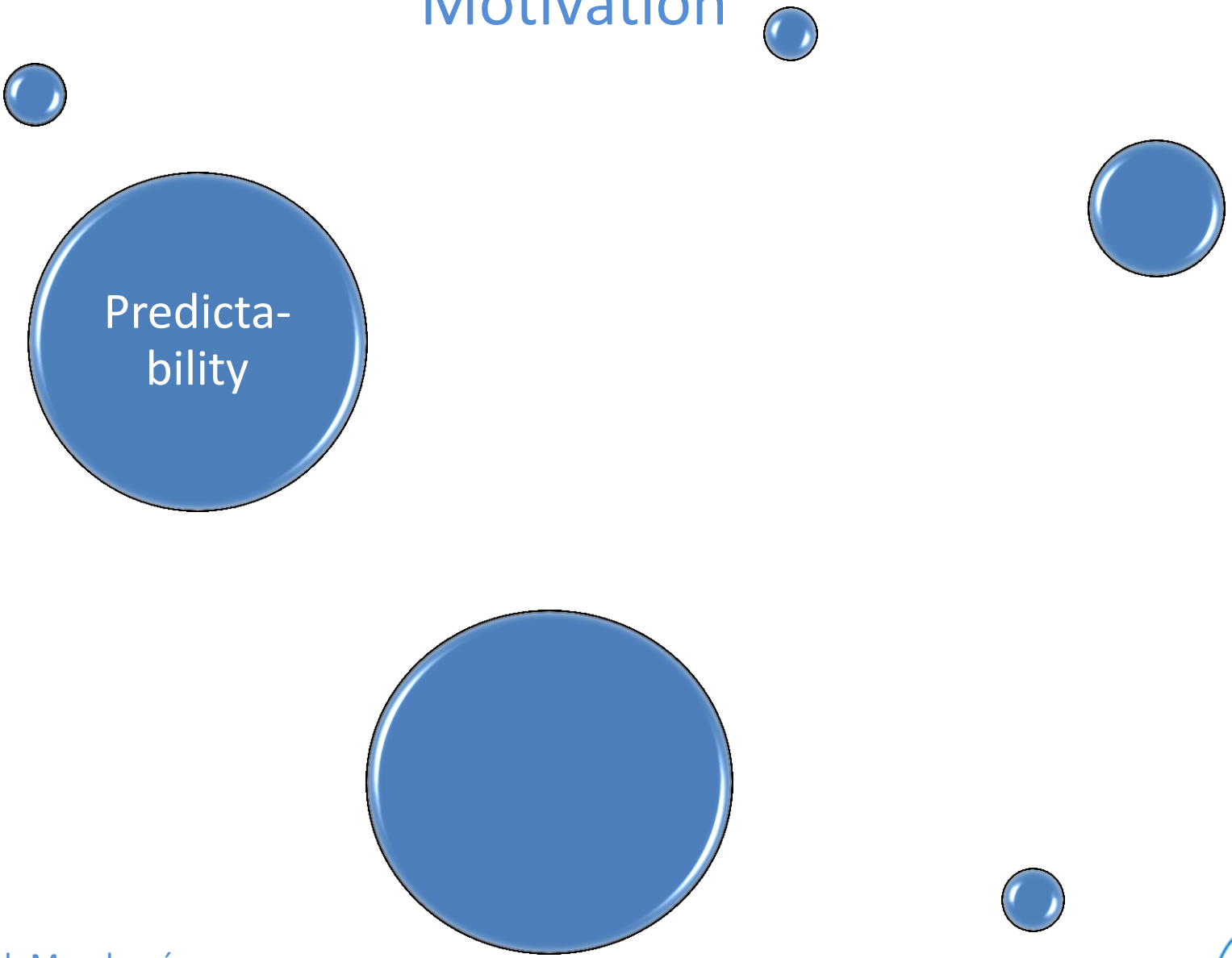
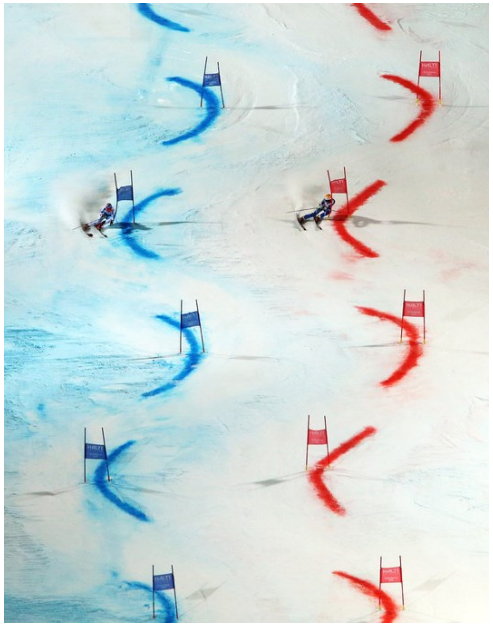
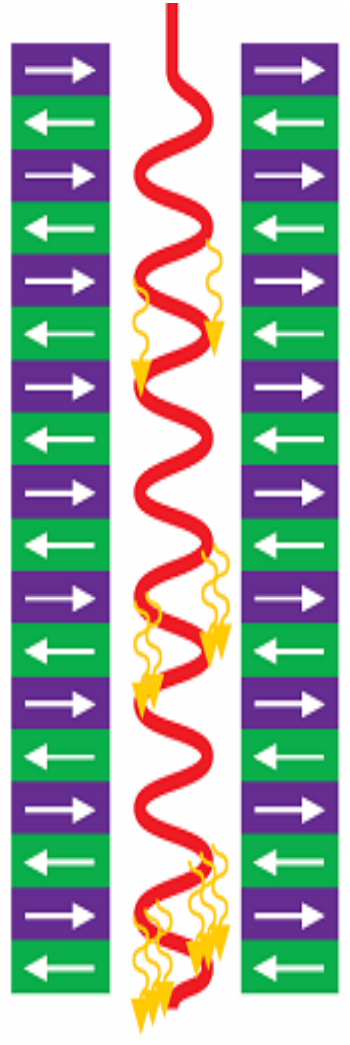
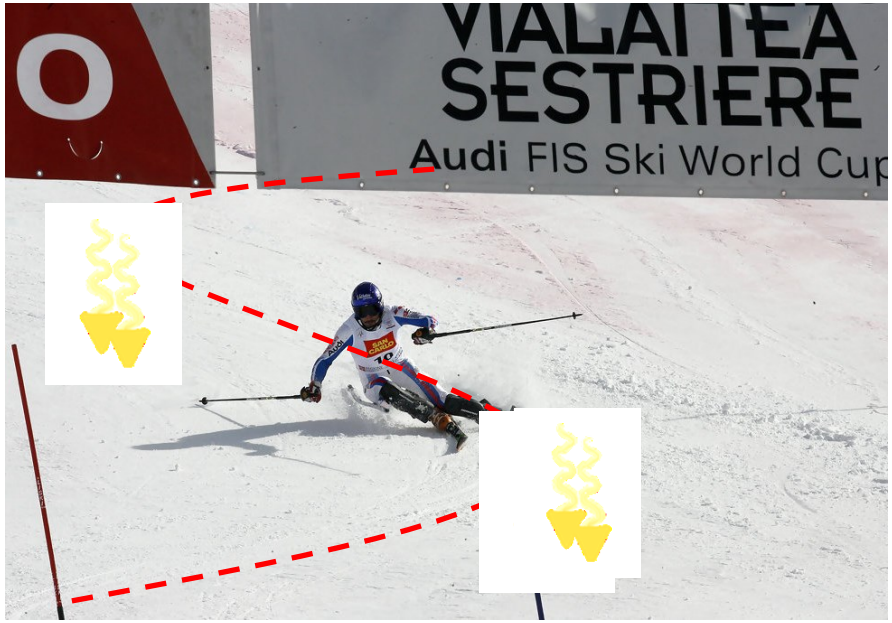


Motivation

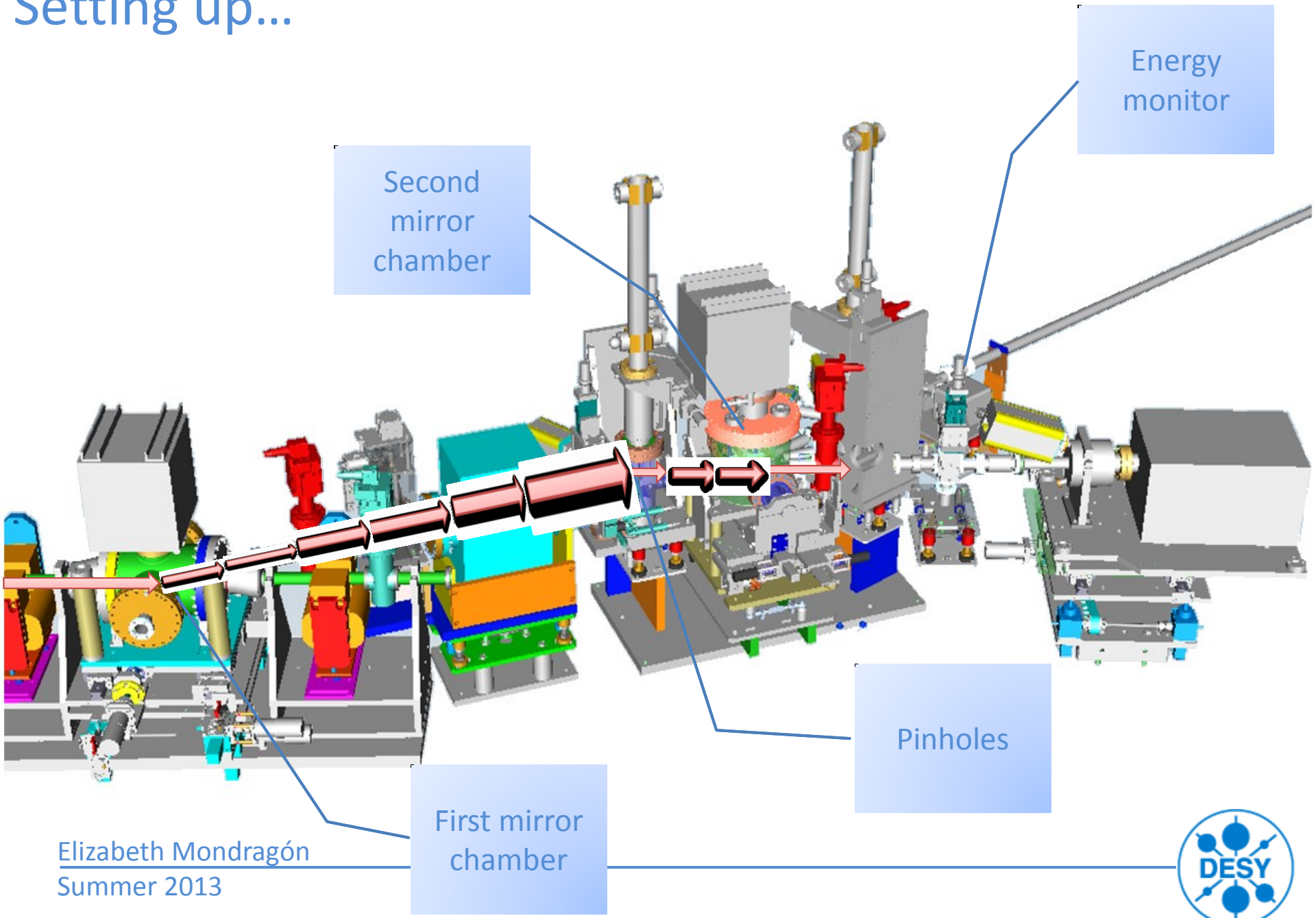




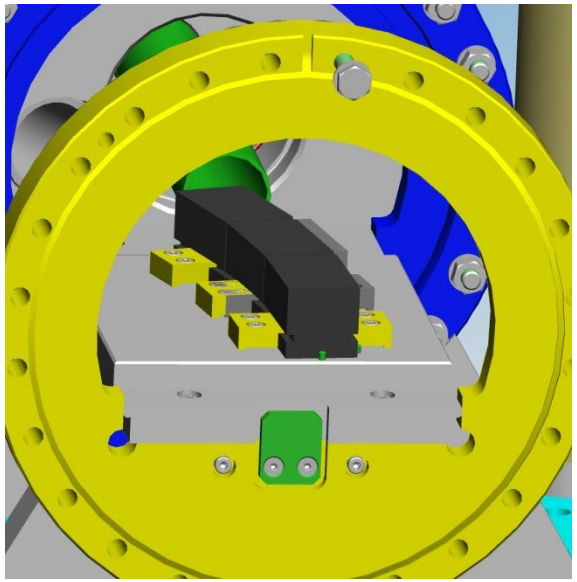
$$\lambda_i = \frac{\lambda_u}{2i\gamma^2}\left(1 + \frac{K^2}{2} + \gamma^2\theta^2\right)$$



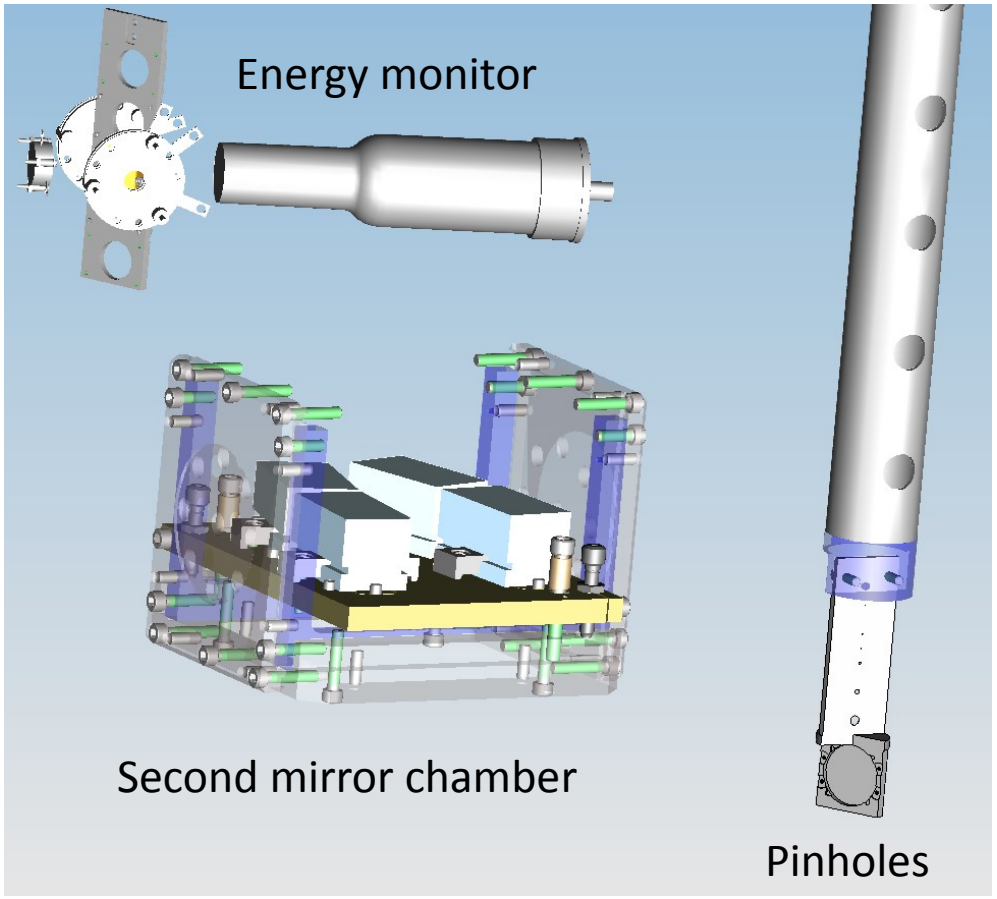
Setting up…


Energy monitor
Second mirror chamber
Pinholes
First mirror chamber

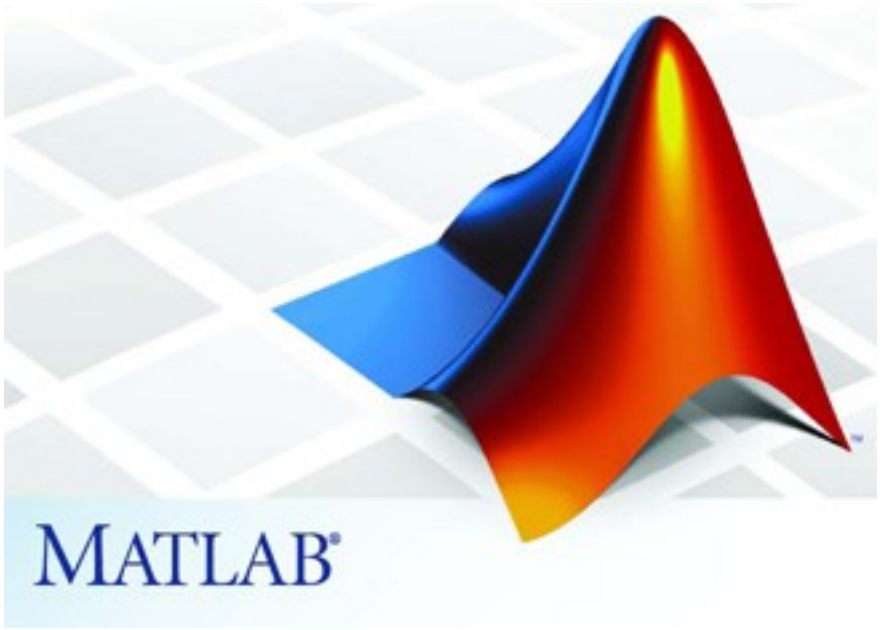
Setting up…



First mirror chamber

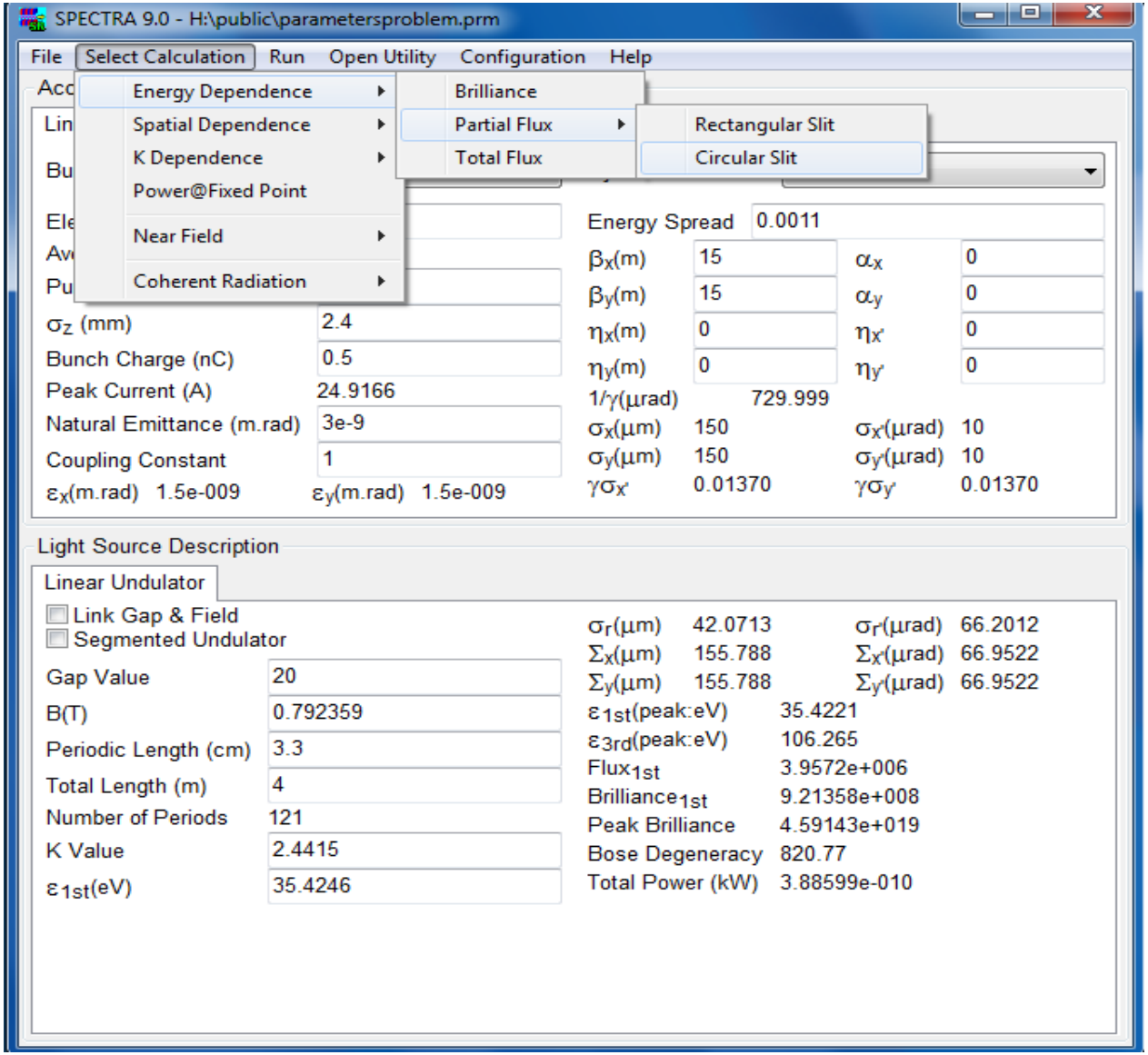


Setting up…

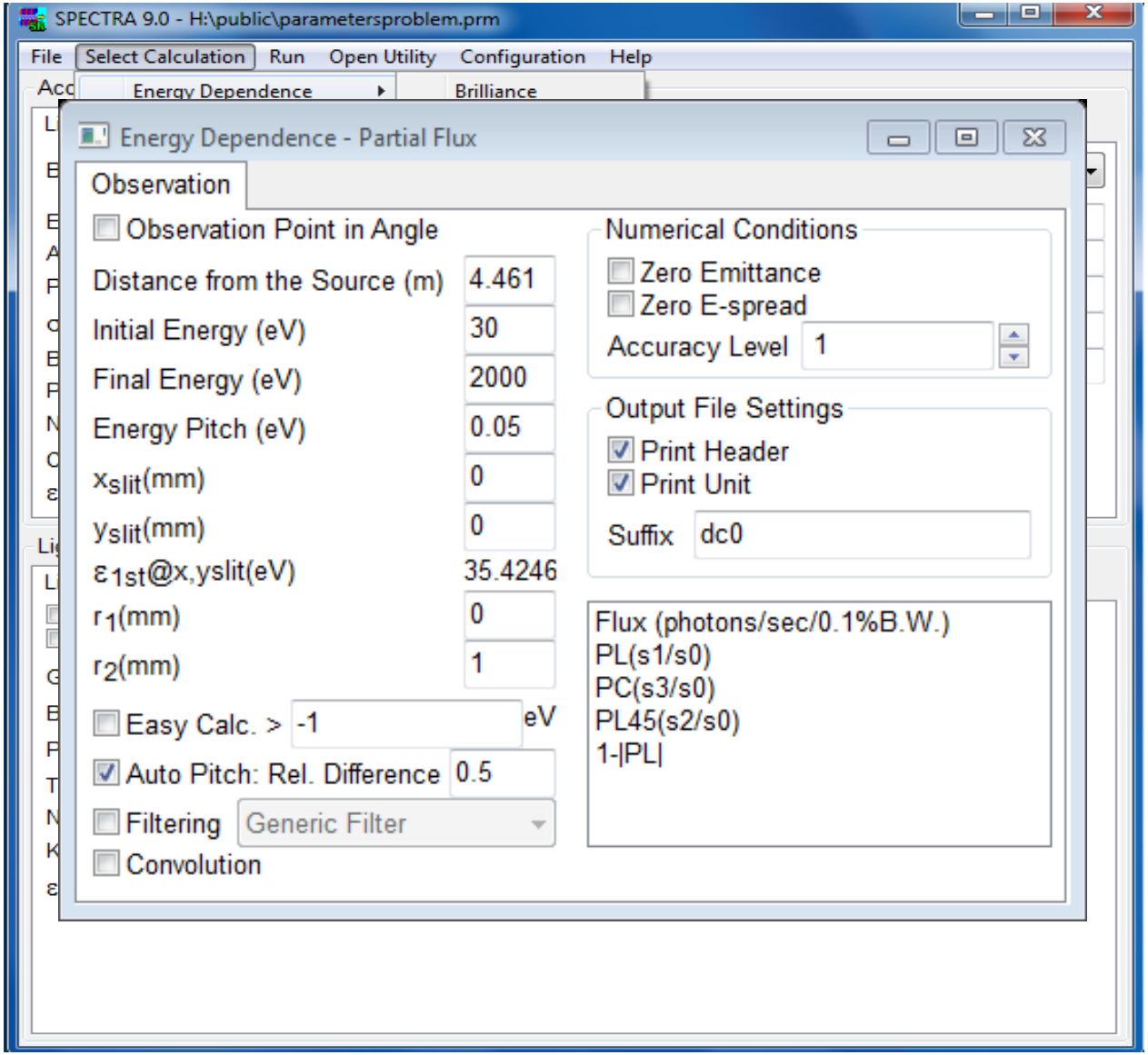


SPECTRA

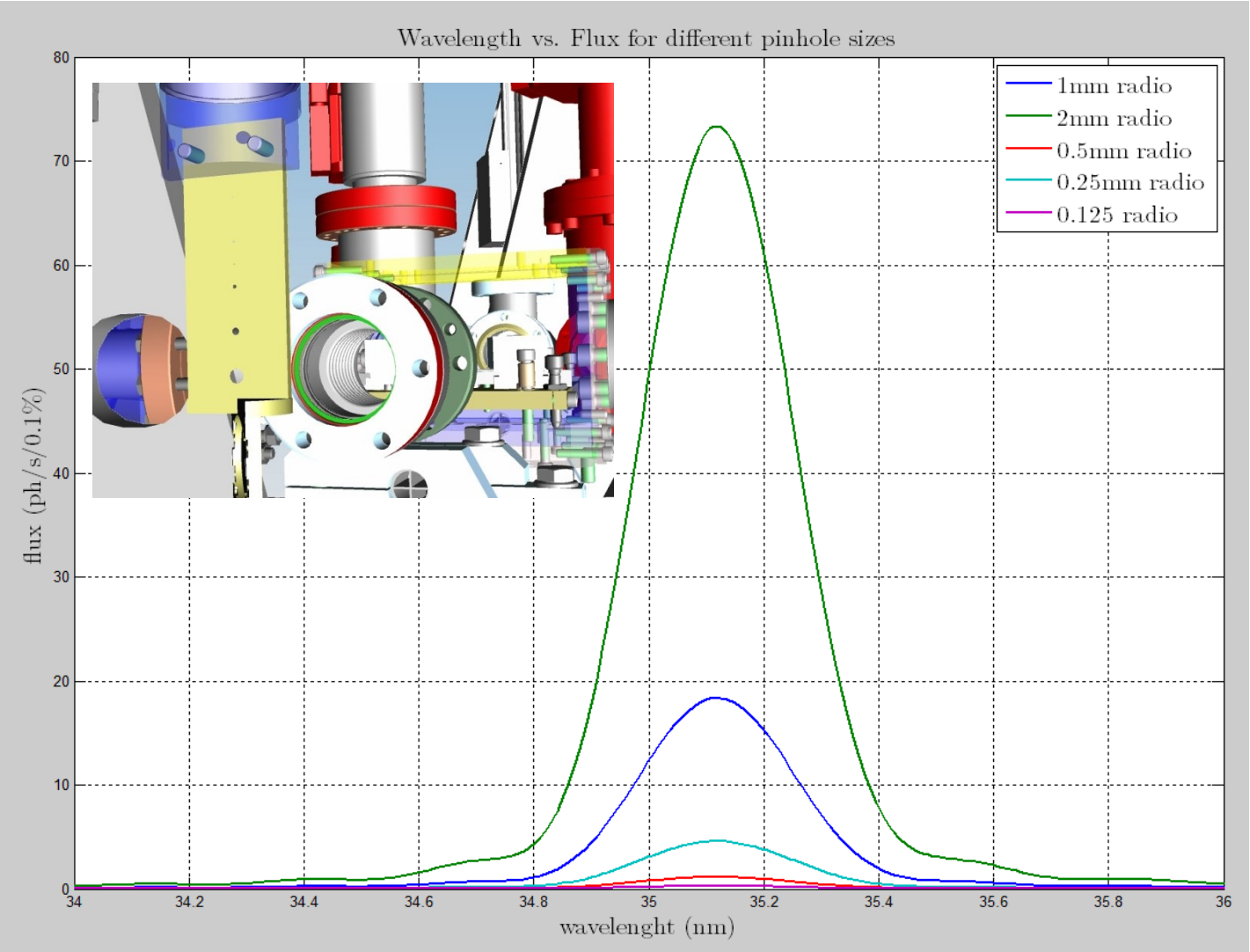
Setting up…


SPECTRA 9.0 - H:\public\parametersproblem.prm
File
Select Calculation
Run
Open Utility
Configuration
Help
Energy Dependence
Spatial Dependence
K Dependence
Power@Fixed Point
Near Field
Coherent Radiation
Brilliance
Partial Flux
Total Flux
Rectangular Slit
Circular Slit
Energy Spread 0.0011
βx(m) 15
βy(m) 15
ηx(m) 0
ηy(m) 0
αx 0
αy 0
ηx' 0
ηy' 0
σz (mm) 2.4
Bunch Charge (nC) 0.5
Peak Current (A) 24.9166
Natural Emittance (m.rad) 3e-9
Coupling Constant 1
εx(m.rad) 1.5e-009
εy(m.rad) 1.5e-009
1/γ(μrad) 729.999
σx(μm) 150
σy(μm) 150
γσx' 0.01370
σx'(μrad) 10
σy'(μrad) 10
γσy' 0.01370
Light Source Description
Linear Undulator
Link Gap & Field
Segmented Undulator
Gap Value 20
B(T) 0.792359
Periodic Length (cm) 3.3
Total Length (m) 4
Number of Periods 121
K Value 2.4415
ε1st(eV) 35.4246
σr(μm) 42.0713
Σx(μm) 155.788
Σy(μm) 155.788
σr'(μrad) 66.2012
Σx'(μrad) 66.9522
Σy'(μrad) 66.9522
ε1st(peak:eV) 35.4221
ε3rd(peak:eV) 106.265
Flux1st 3.9572e+006
Brilliance1st 9.21358e+008
Peak Brilliance 4.59143e+019
Bose Degeneracy 820.77
Total Power (kW) 3.88599e-010

Setting up…


SPECTRA 9.0 - H:\public\parametersproblem.prm
File
Select Calculation
Run
Open Utility
Configuration
Help
Energy Dependence
Brilliance
Energy Dependence - Partial Flux
Observation
Observation Point in Angle
Distance from the Source (m) 4.461
Initial Energy (eV) 30
Final Energy (eV) 2000
Energy Pitch (eV) 0.05
xslit(mm) 0
yslit(mm) 0
ε1st@x,yslit(eV) 35.4246
r1(mm) 0
r2(mm) 1
Easy Calc. > -1 eV
Auto Pitch: Rel. Difference 0.5
Filtering Generic Filter
Convolution
Numerical Conditions
Zero Emittance
Zero E-spread
Accuracy Level 1
Output File Settings
Print Header
Print Unit
Suffix dc0
Flux (photons/sec/0.1%B.W.)
PL(s1/s0)
PC(s3/s0)
PL45(s2/s0)
1-|PL|

Results & Plots



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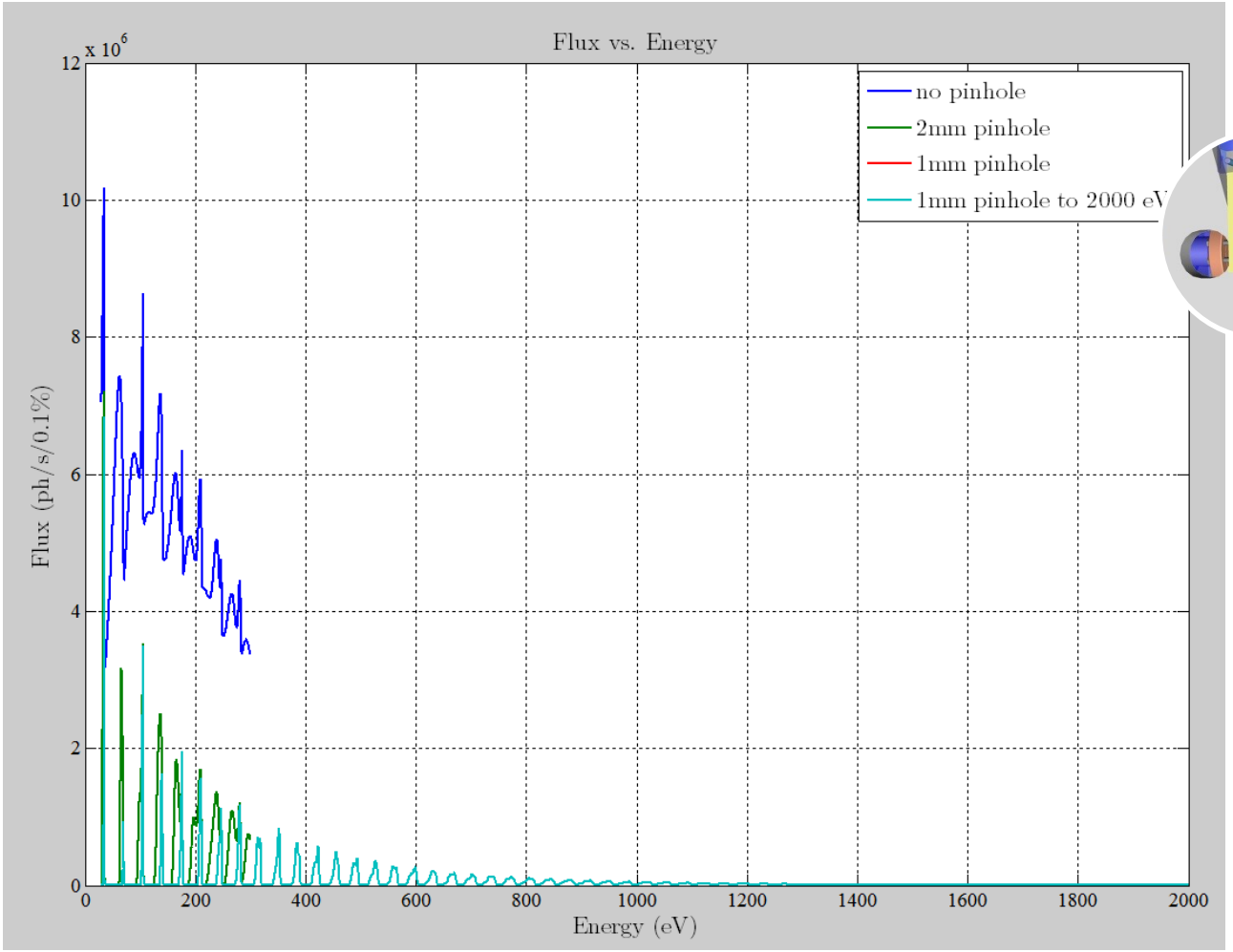
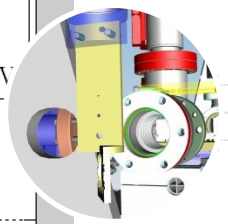
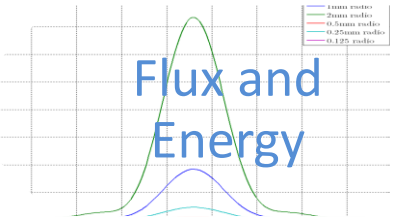
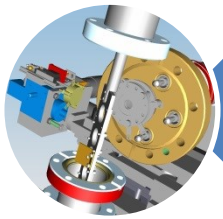
Results & Plots

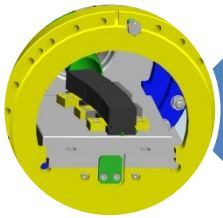








Power



Mirrors

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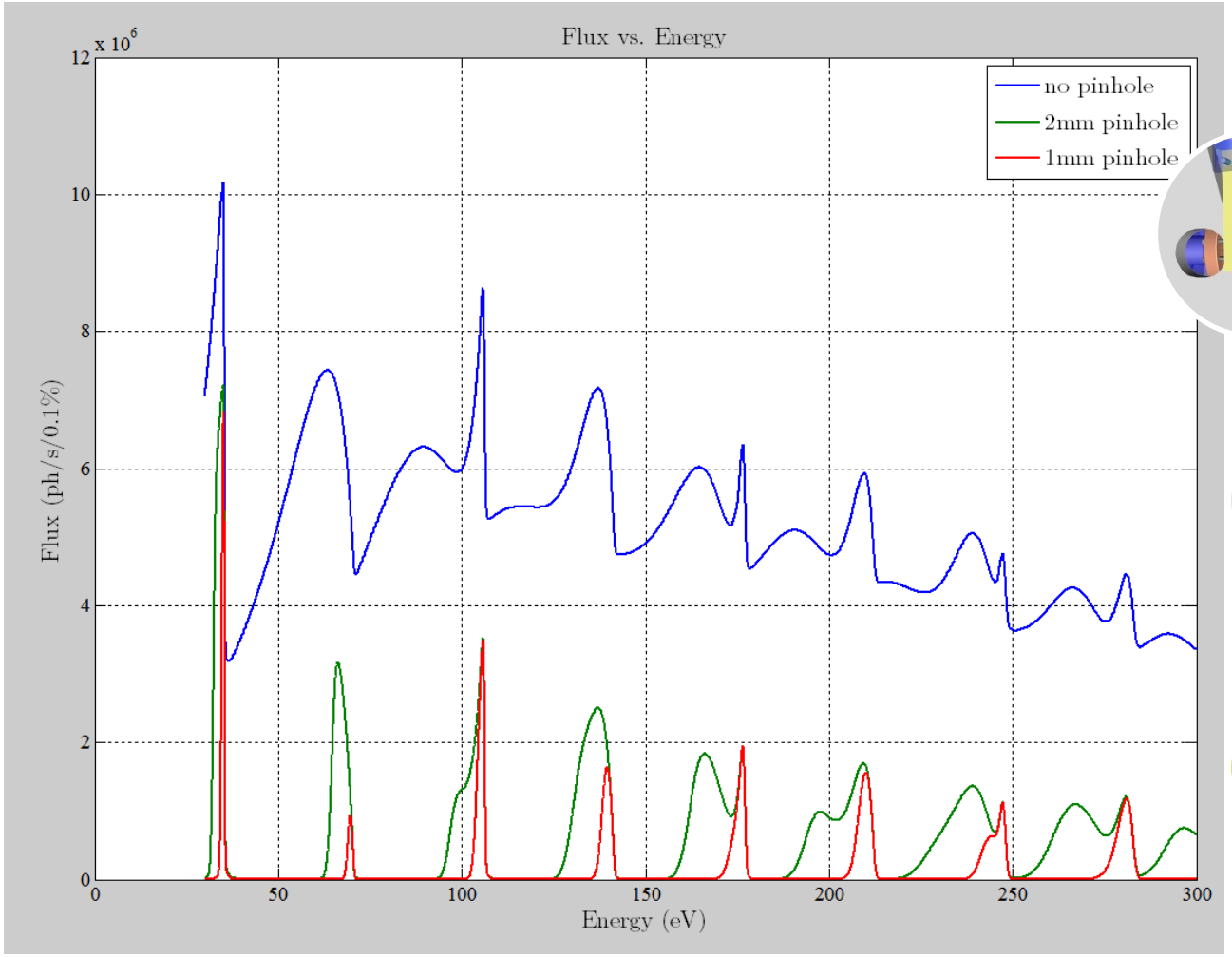
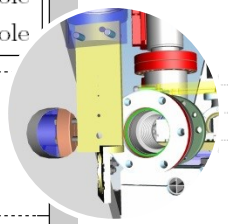
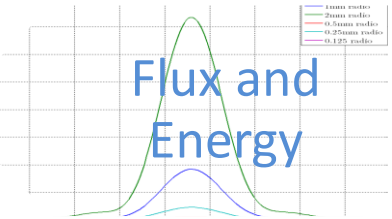
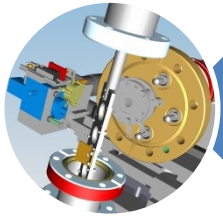
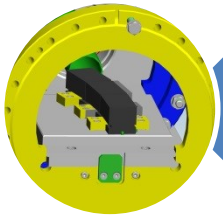








Power



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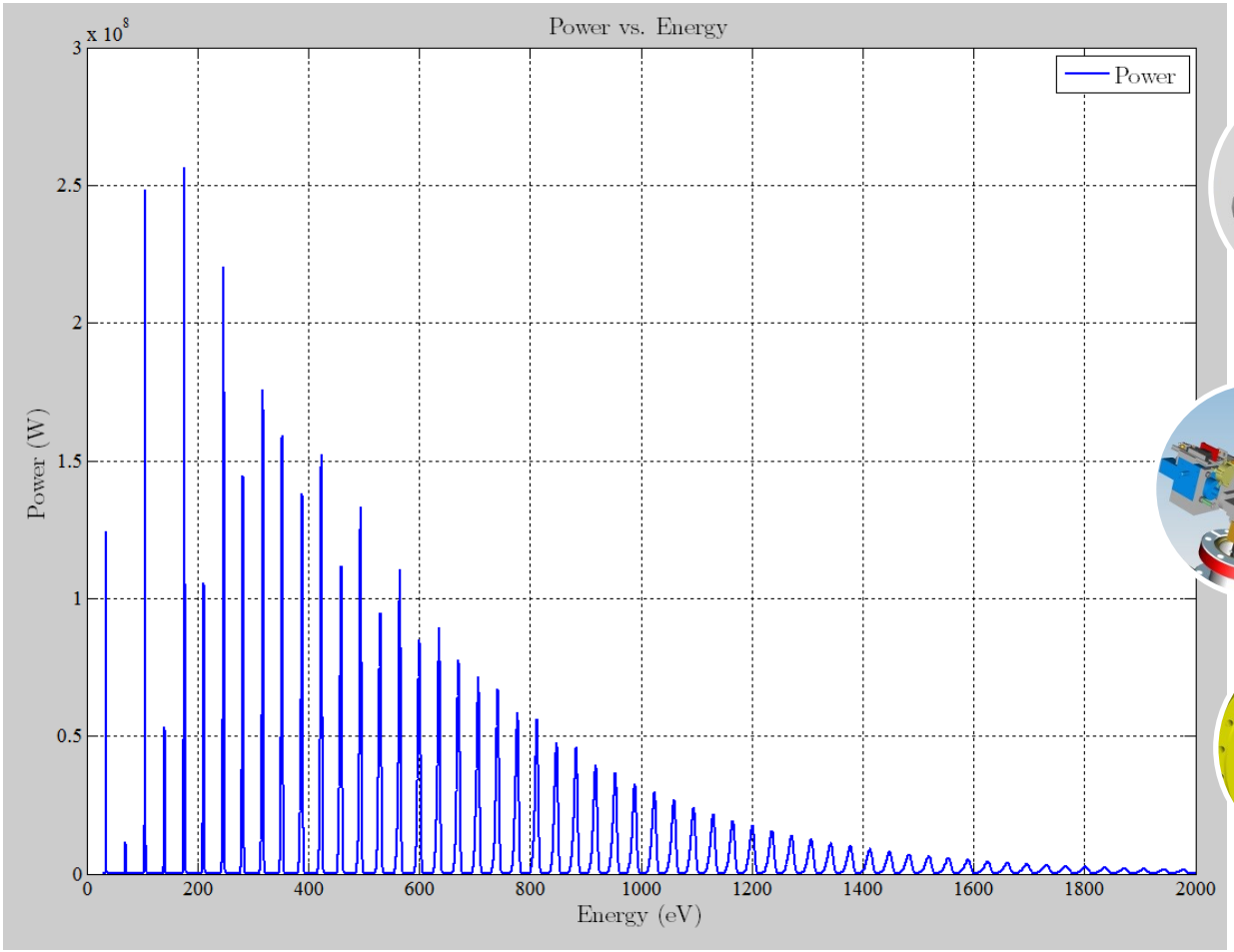

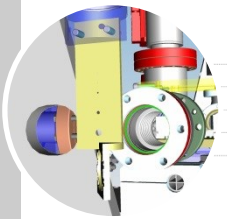

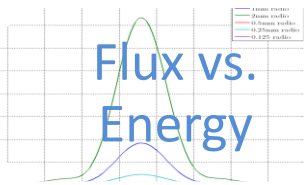

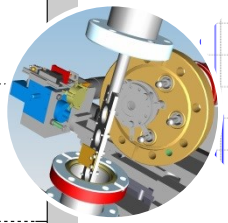

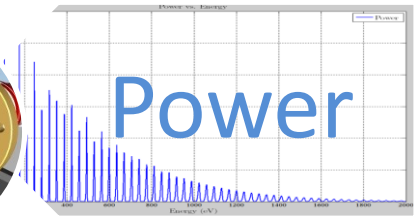

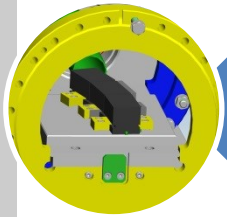

Mirrors

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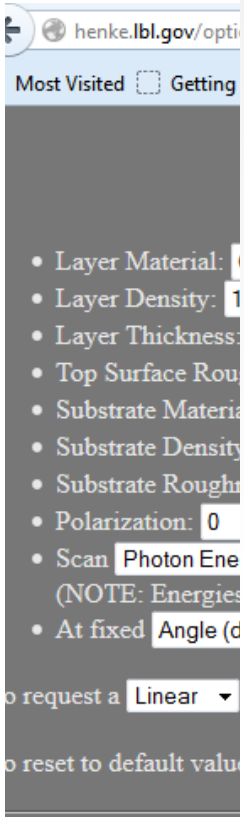

CXRO
THE CENTER FOR X-RAY OPTICS

BERKELEY LAB

The Center for X-Ray Optics is a multi-disciplined research group within Lawrence Berkeley National Laboratory's (LBNL) Materials Sciences Division (MSD). Notice to users.

X-Ray Interactions With Matter

Introduction

Access the atomic scattering factor files.

Look up x-ray properties of the elements.

The index of refraction for a compound material.

The x-ray attenuation length of a solid.

X-ray transmission

- Of a solid.
- Of a gas.

X-ray reflectivity

- Of a thick mirror.
- Of a single layer.
- Of a bilayer.
- Of a multilayer.

The diffraction efficiency of a transmission grating.

Related calculations:

- Synchrotron bend magnet radiation.

Other x-ray web resources.

X-ray Data Booklet

Reference

B.L. Henke, E.M. Gullikson, and J.C. Davis. *X-ray interactions: photoabsorption, scattering, transmission, and reflection at E=50-30000 eV, Z=1-92*, Atomic Data and Nuclear Data Tables Vol. **54** (no.2), 181-342 (July 1993).

By Eric Gullikson. Please send me your comments.

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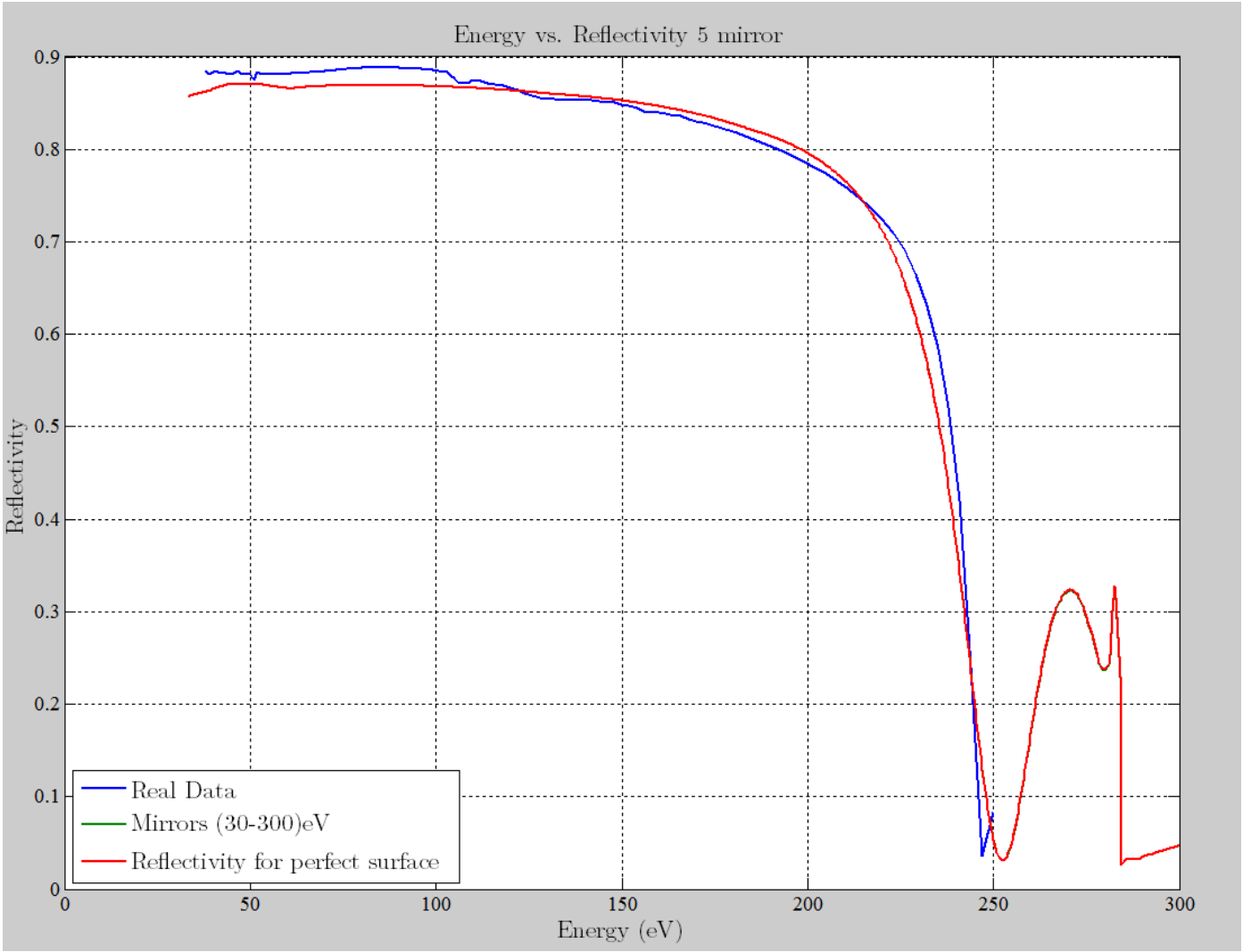
Results & Plots



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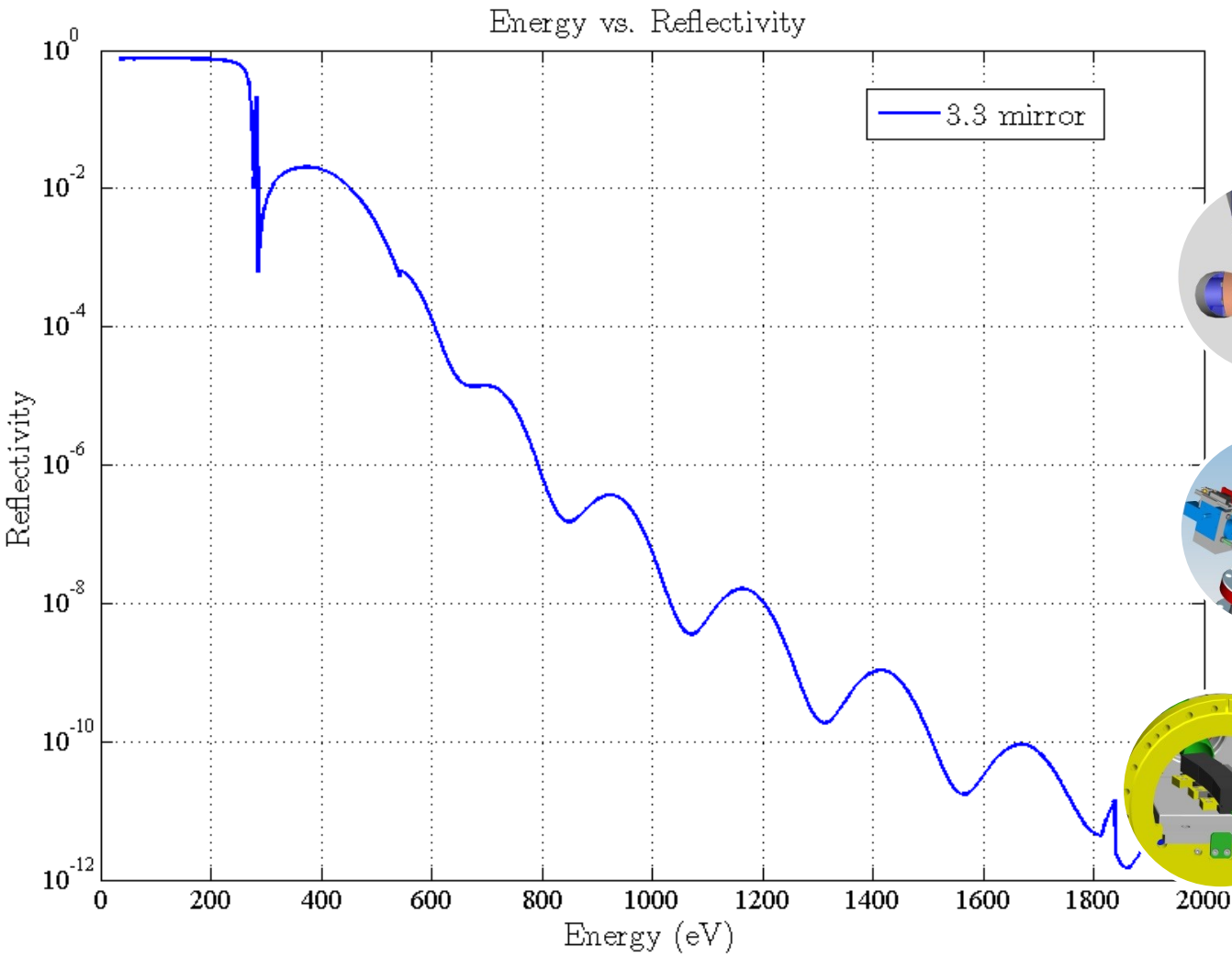

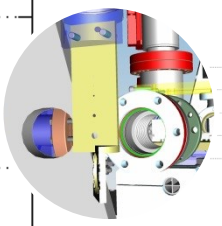

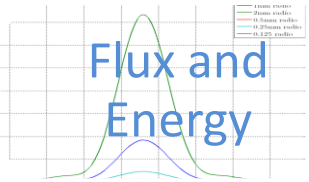

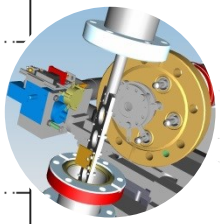

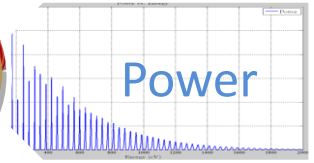

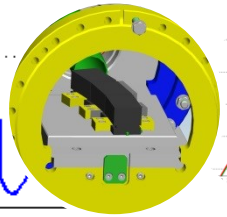

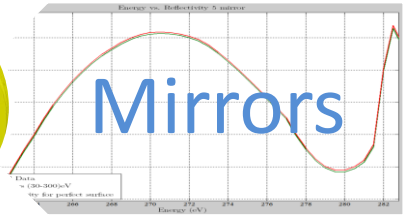

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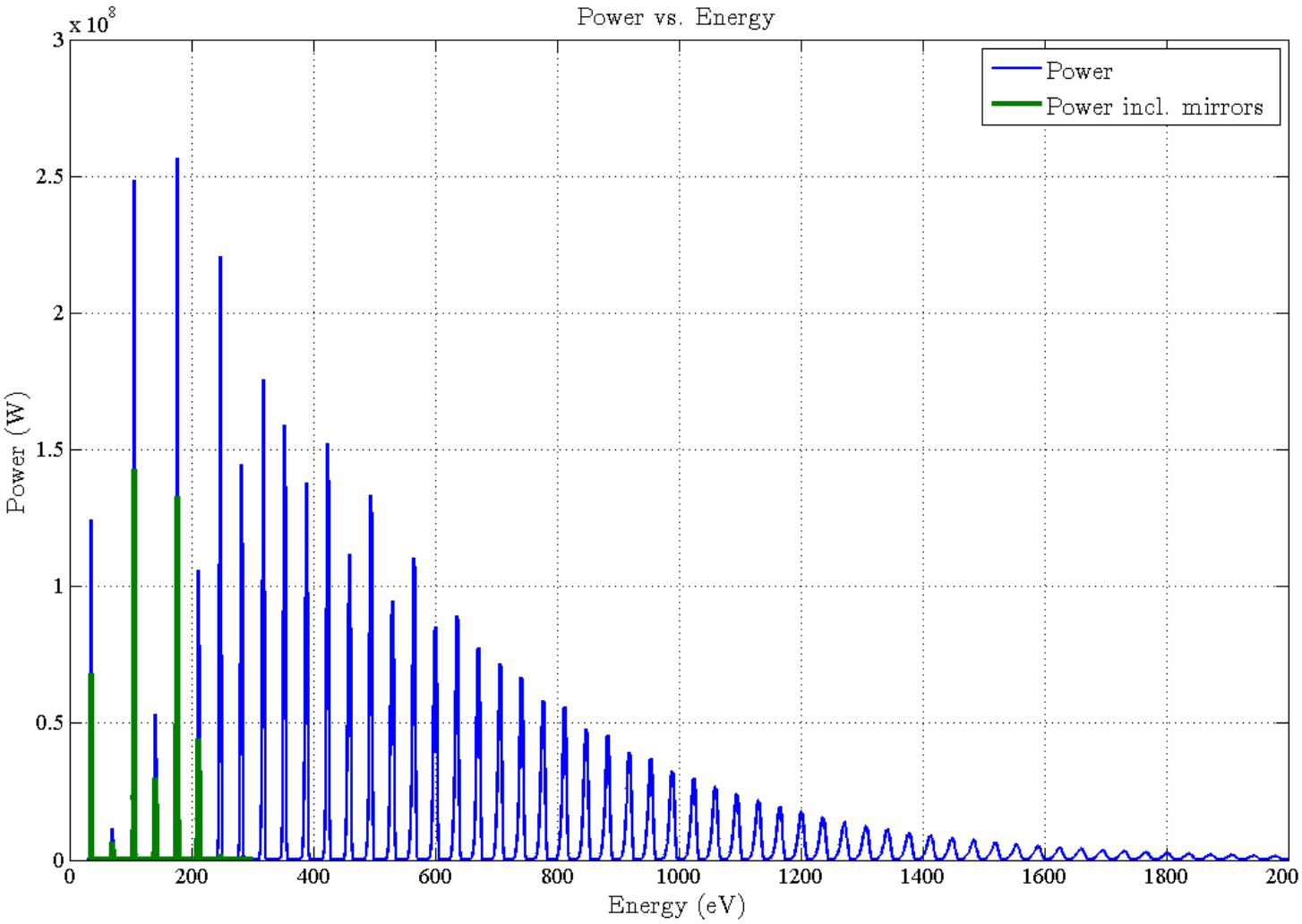

Thanks for your attention!

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