Photon reflectivity from Al vacuum chamber of DAΦNE

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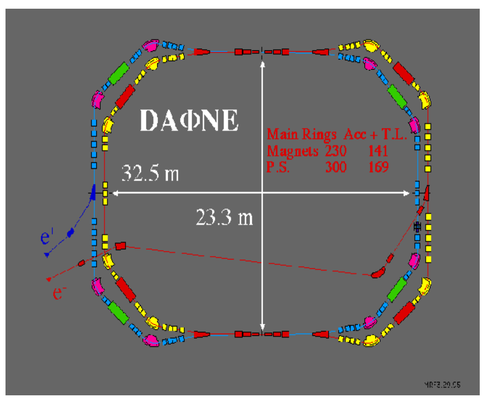
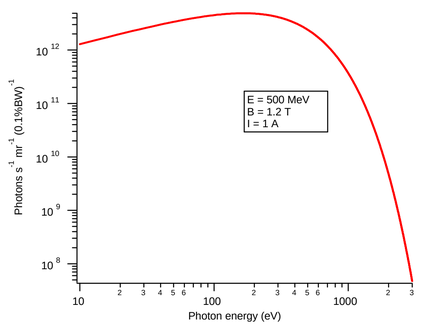


DaΦne is an electron-positron collider with 1.02 GeV center of mass energy. For each circulating beam the maximum design current is 5A at an average dynamic pressure of 1 nTorr.
The simulations predict severe e-cloud induced beam instabilities in the positron ring for the design parameters. Such calculations did not include the use of realistic parameters, such as chamber geometry, measured secondary electron yield, reflectivity and photon yield of the vacuum chambers walls, etc.

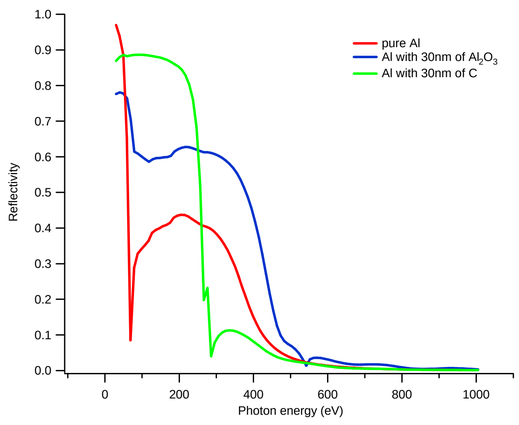
DaΦne spectral brilliance



The synchrotron photon flux at the bending magnet of DaΦne has been calculated assuming an electron energy of 500MeV, bending magnet field 1.2T and a beam current 1A.

Reflectivity simulations

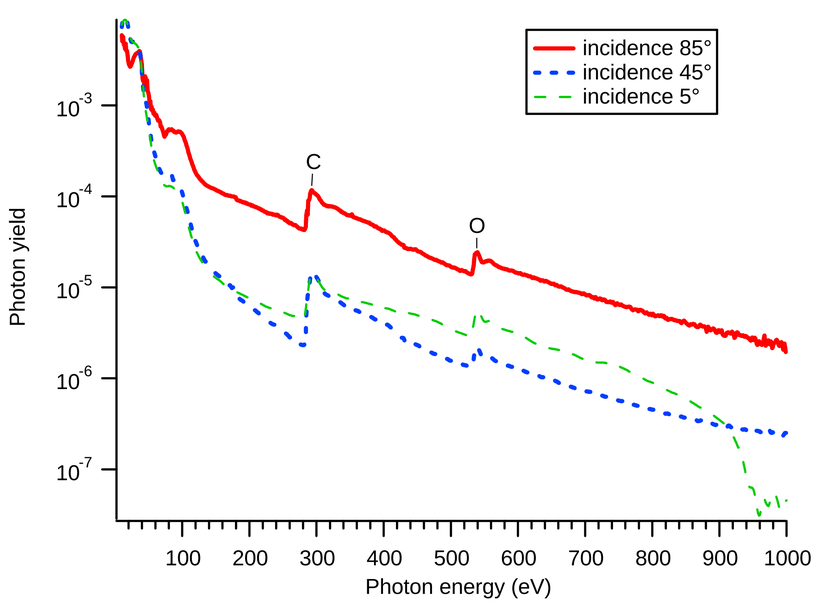
The reflectivity has been simulated, usingg the online software of Berkeley Lab. (http://wwwcxro.lbl.gov/optical\textunderscore~constants/), considering an Al substrate covered by a 30nm thick contaminant layer. The contaminant chosen are carbon (in no particular form) and aluminium oxyde.



Photon yield measurements

$$PY = \frac{\text{N. emitted electrons}}{\text{N. incident photons}} = \frac{n_e(E)}{n_p(E)}$$

The number of incident photons $n_p(E)$ is given by the photodiode current; the total number of emitted electrons $n_e(E)$ is given by the measure of the drain current of the sample.



The total photon yield is obtained by integration of the values measured with monochormatic light. For all the three incidence angle the value is **PY** ~ **0.2**.

Conclusions

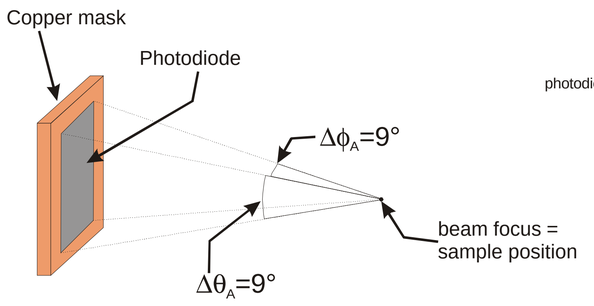
With these measurements we gave quantitative extimations of the reflectivity and photon yield of the vacuum chamber walls material of DaΦne.

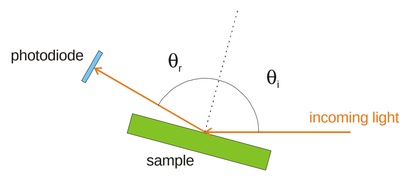
These values are very usefull to make realistic simulations of the e-cluod build upand therefore to prevent beam instabilities.

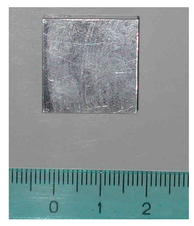
Reflectivity measurements

The sample used is made of the same aluminium alloy (Al 5083) and prepared in the same way used for the vacuum chamber walls of DaΦne. The sample has 0.2μm surface roughness and it has not been cleaned before measuring.

The light detector is an absolute photodiode mounted on a two rotation axes goniometer: with this configuration the detector can be placed in every point over the sample. The diode collects light in a solid angle 9°×9°.

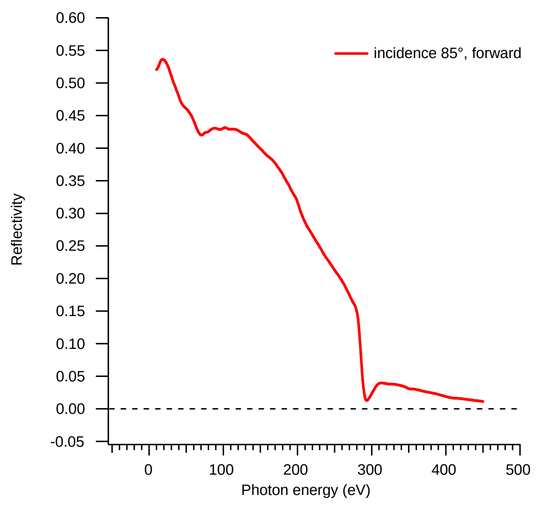


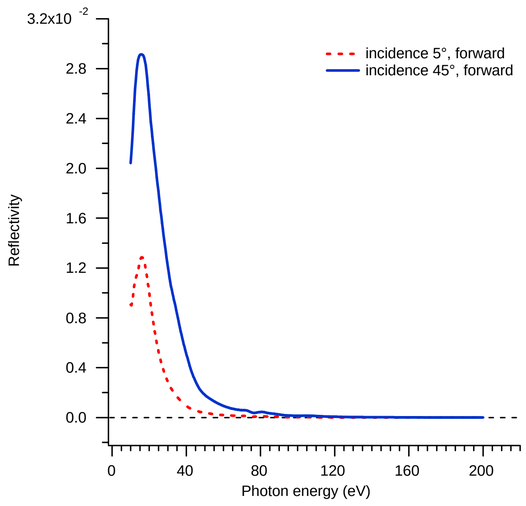




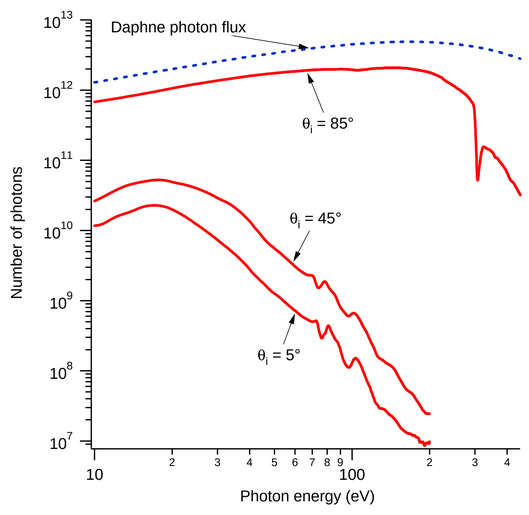
Sample size:
20mm × 20mm × 7mm

The reflectivity was measured in forward direction (θ-2θ geometry, specular reflected light) at three different incidence angles using monochromatic light from 10eV to 1000eV.

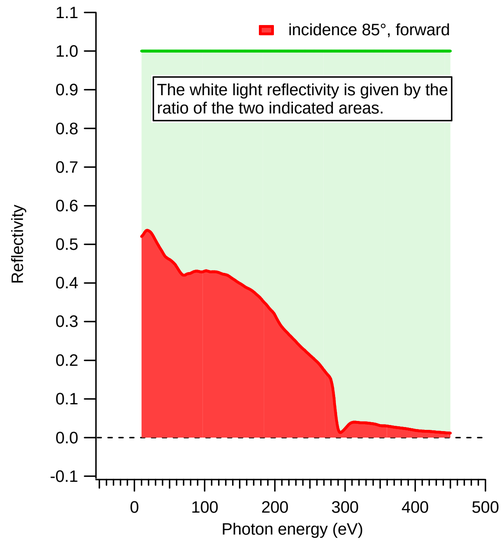




It is possible to calculate the number of photons produced by the electron beam in DaΦne and reflected by the Al vacuum chamber walls.



From the reflectivity measurements made with monochromatic light, it is possible to estimate the reflectivity of the white light (all photon energies).



Incidence angle	Integrated reflectivity
85°	24%
45°	0.3%
5°	0.1%