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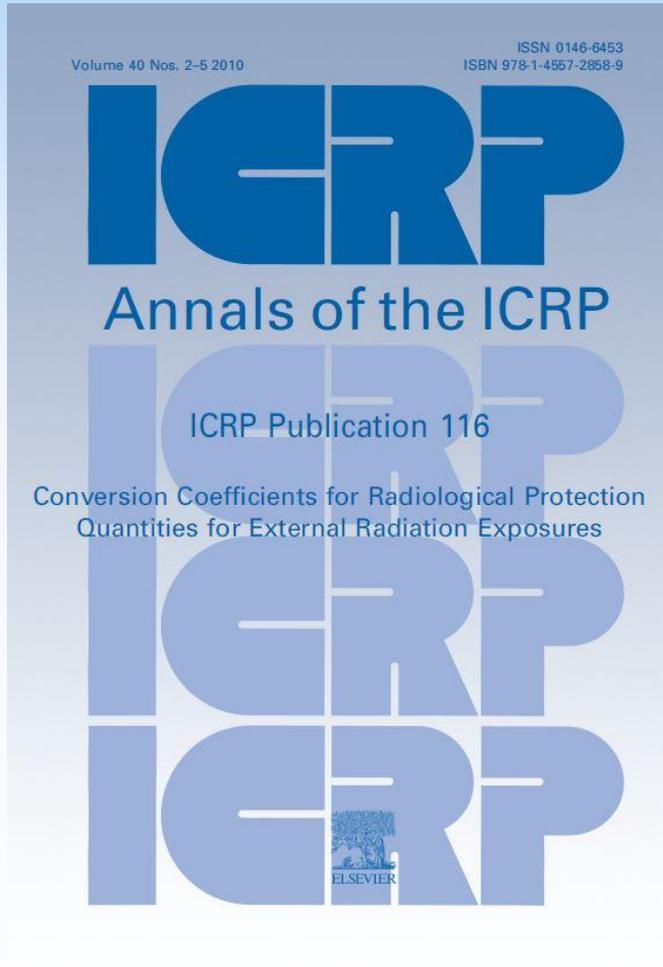
Dosimetric models of the eye and eye lens and their use in assessing dose coefficients for ocular exposures

ICRP 2013

2nd International Symposium on the System of Radiological Protection

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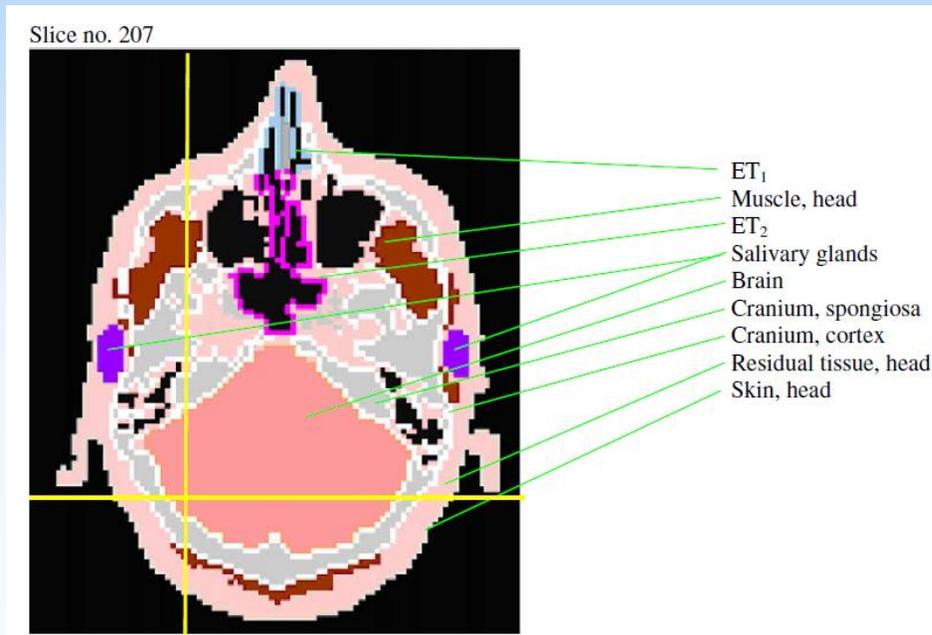
ICRP Publication 116



ICRP Publication 116 (201) from Committee 2

- " The first major revision of reference conversion coefficients for external exposures since ICRP Publication 74 (1996)*
- " Utilizes the Reference Adult Male and Adult Female computational phantoms of ICRP Publication 110 (2009)*
- " Provides both organ equivalent and whole-body effective dose per particle fluence for a broad range of particles and energies...*
 - " Photons*
 - " Neutrons*
 - " Electrons & Positrons*
 - " Protons*
 - " Muons & Pions*
 - " Helium Ions*

ICRP Publication 116



As is the case for all voxel phantoms, there can be limitations in dose assessment due to limited tissue region resolution

“ **2.1 x 2.1 x 8.0 mm³ Male**

“ **1.8 x 1.8 x 4.8 mm³ Female**

Consequently, additional supplemental models are required for dose assessment :

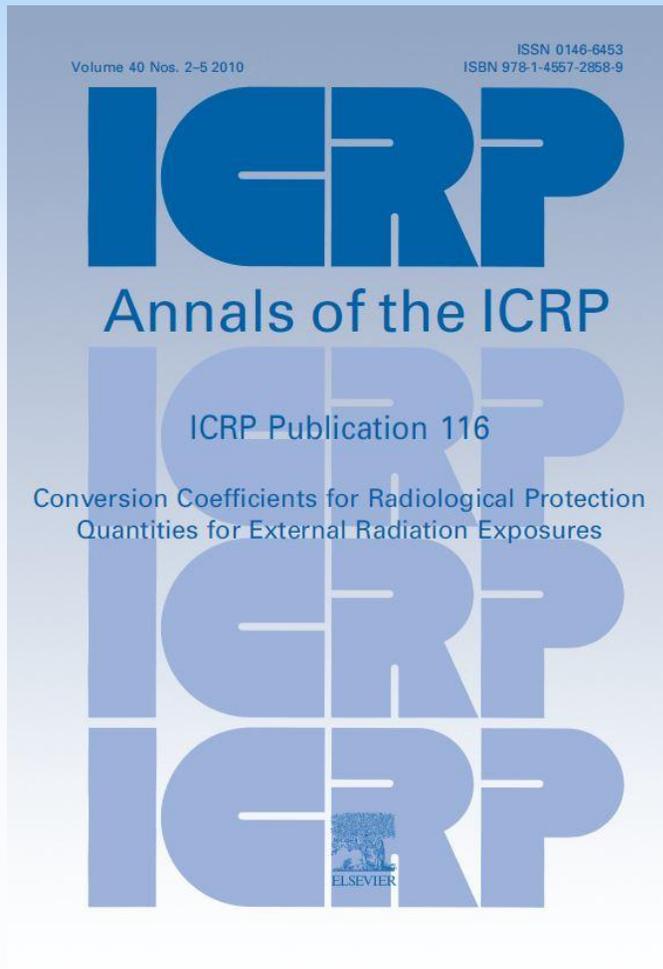
“ **Alimentary and respiratory tracts** – ICRP 66 and ICRP 100

“ **Skeletal spongiosa** – Annex D and E of ICRP 116

“ **Skin** – Annex G of ICRP 116

“ **Eye Lens** – Annex F of ICRP 116

ICRP Publication 116 – Annex F



ICRP Publication 116 (201) from Committee 2

- “ *Special consideration of absorbed dose to the eye lens is discussed separately in Annex F of this report*
- “ *This annex provides values of absorbed dose per particle fluence for the following ...*
 - “ **Photons** – 10 keV to 10 GeV under AP, PA, LAT, ROT, and ISO geometry
 - “ **Electrons** – 10 keV to 10 GeV under AP, PA, and ISO geometry
 - “ **Neutrons** – Thermal to 10 GeV under AP, PA, LAT, ROT, and ISO geometry

Stylized Eye Model of Behrens et al. 2009

Phys. Med. Biol. 54 (2009) 4069–4087

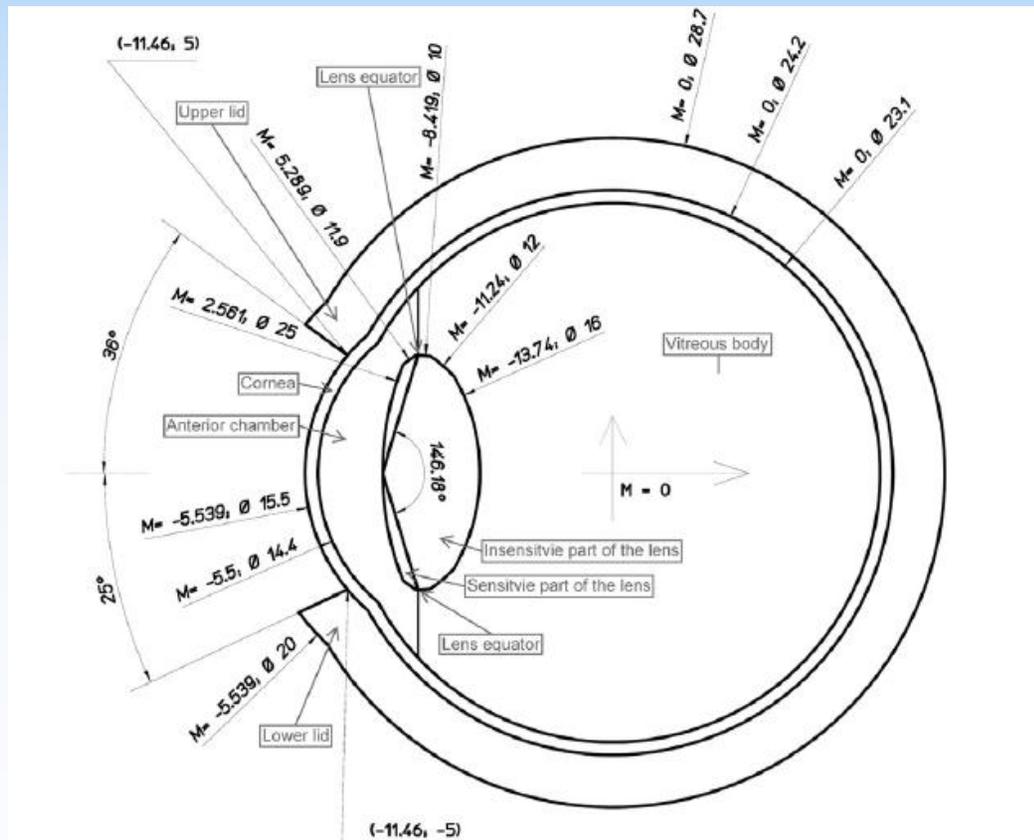
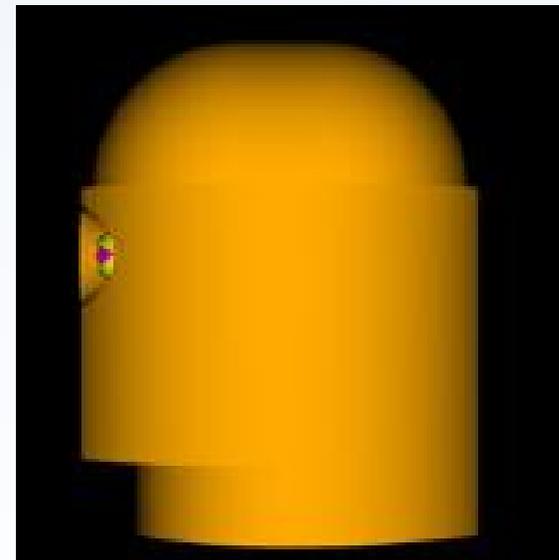
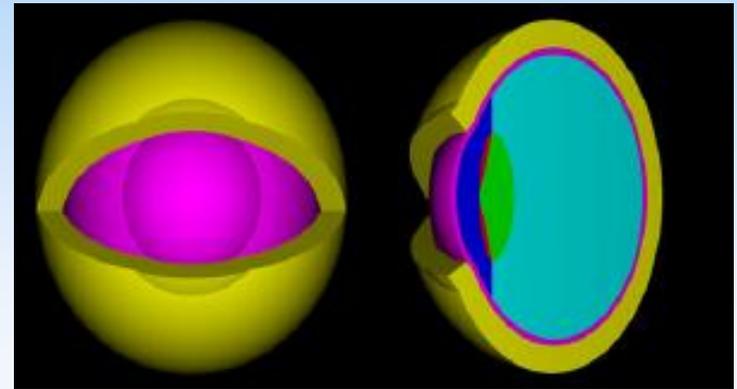


Fig. F.1. The detailed stylised eye model adapted by Behrens et al. (2009), as simulated in the Monte Carlo calculations. All dimensions are given in mm. M denotes the x -position of the centres of the spheres and Ø denotes the corresponding diameters.



Data Taken from Charles & Brown (1975)

Dimensions of the Human Eye Relevant to Radiation Protection

M. W. CHARLES, PH.D.

Central Electricity Generating Board, Berkeley Nuclear Laboratories,
Berkeley, Gloucestershire

and

NICHOLAS BROWN, F.R.C.S.

Institute of Ophthalmology, Judd Street, London

PHYS. MED. BIOL., 1975, VOL. 20, NO. 2, 202–218. © 1975

This study provided important information on ...

- “ Ocular Dimensions – thicknesses, depths, and angular extent*
- “ Location of the target cells - radiogenic cataract induction*

Data Taken from Charles & Brown (1975)

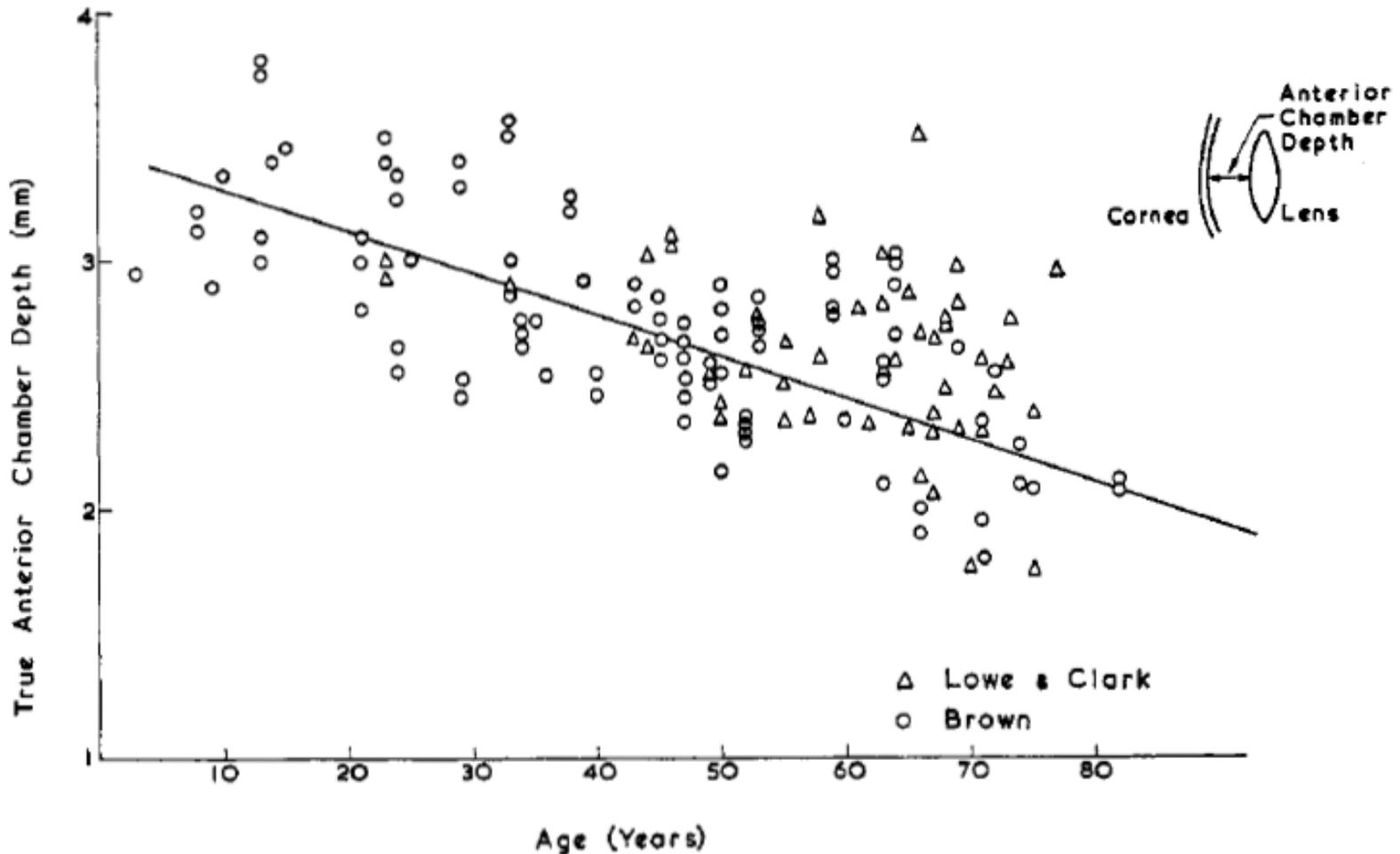


Fig. 5. Anterior chamber depth as a function of age.

Data Taken from Charles & Brown (1975)

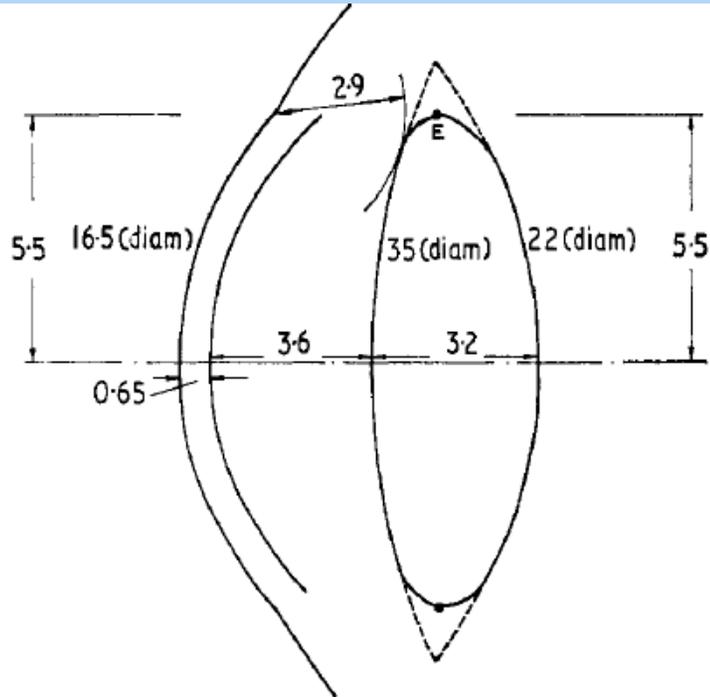


Fig. 9. Deep lying lens (young myope).

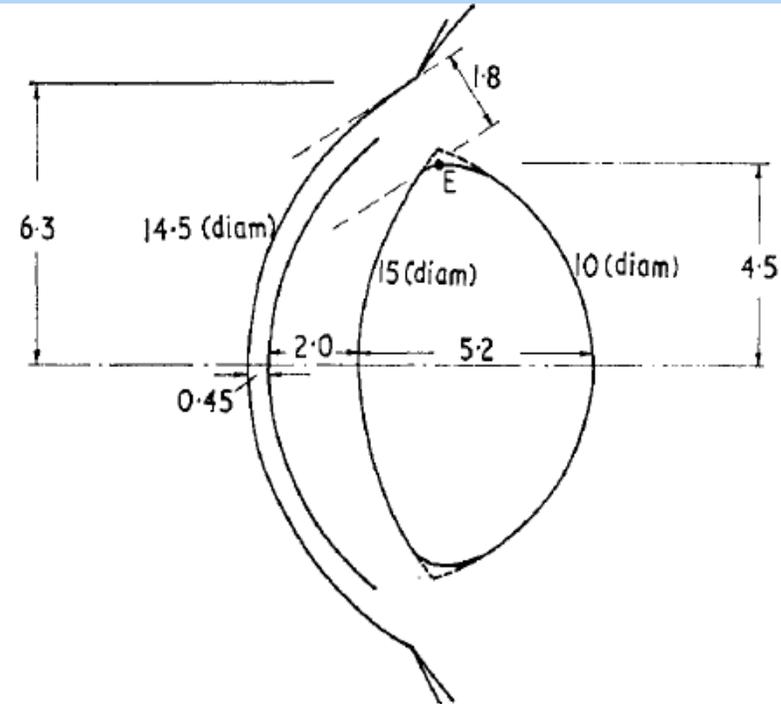


Fig. 10. Shallow lying lens (old hypermetrope).

Note – Report provides dimensional data on the extremes of ocular anatomy

Data Taken from Charles & Brown (1975)

“The lens is biconvex in shape and the rounded junction of the two surfaces is called the equator”

Statement by Sowby in 1973 and Justification for this study

“The equatorial portion of the anterior epithelium of the lens was the anatomical region generally considered to be the most radiosensitive part of the lens as related to the susceptibility to the induction of lens opacities. ICRP Committee 1 did not have data on the depth of this part of the lens, and it was thought that such information might in any case fall within the domain of the Task Group on Reference Man”

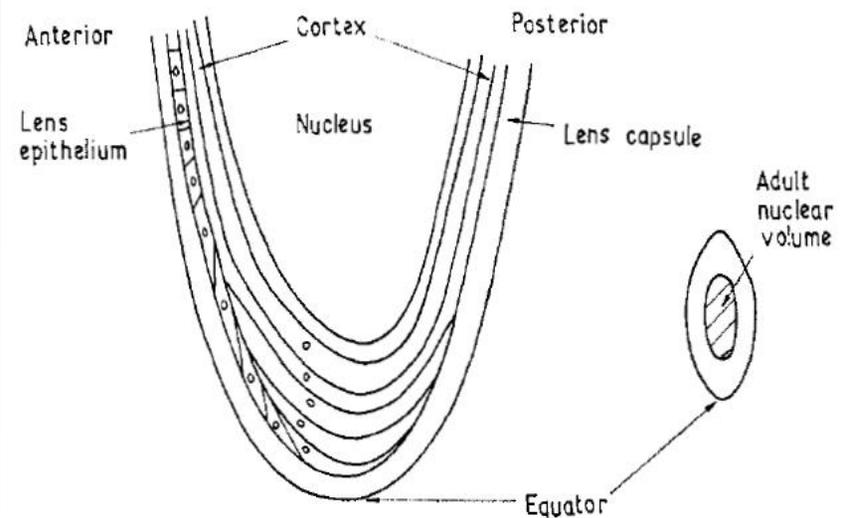
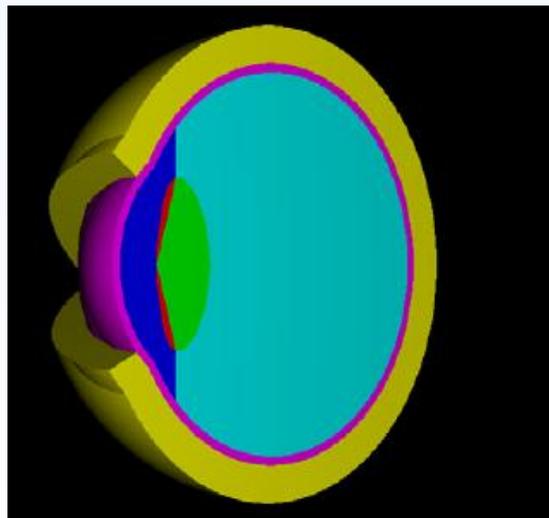
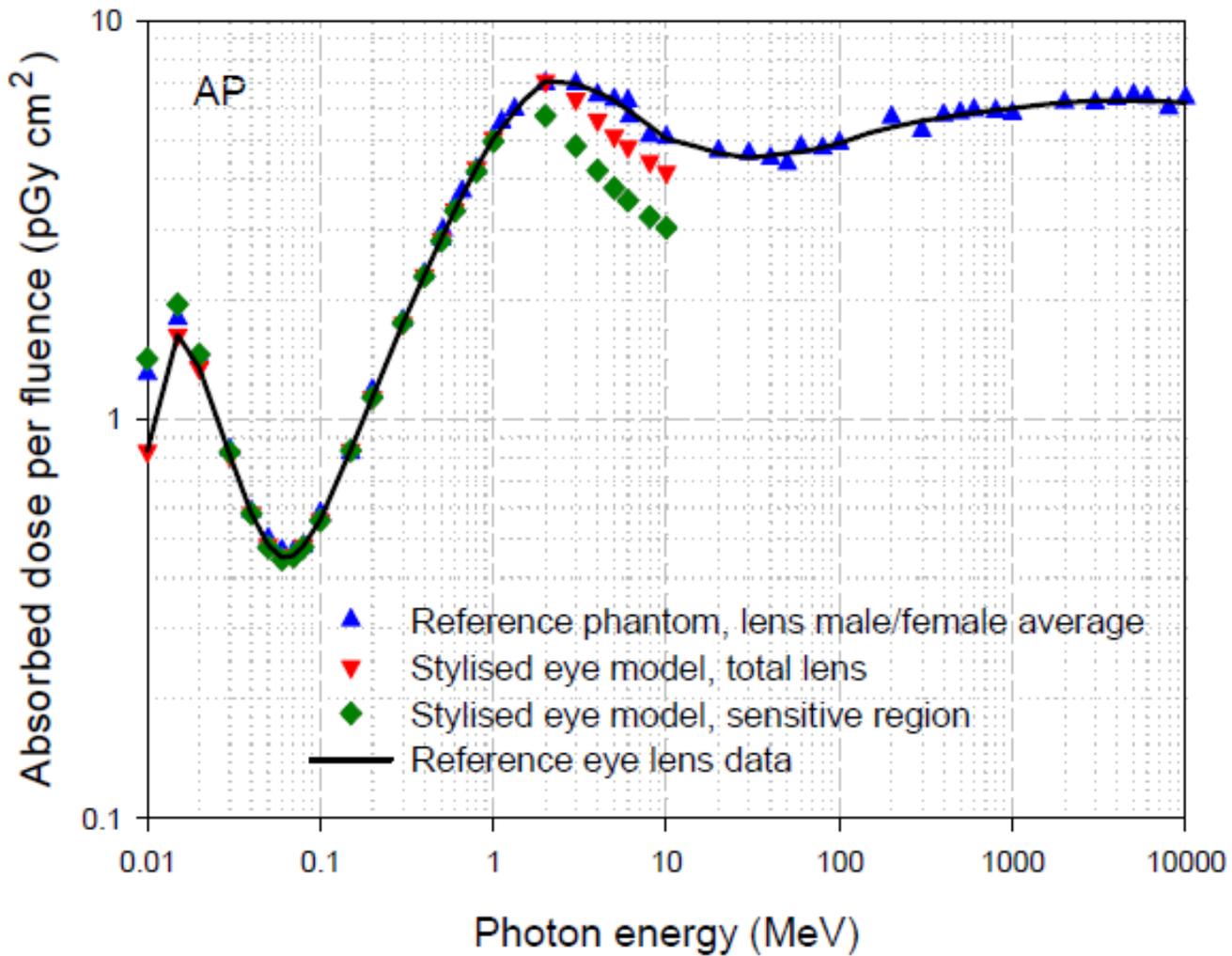
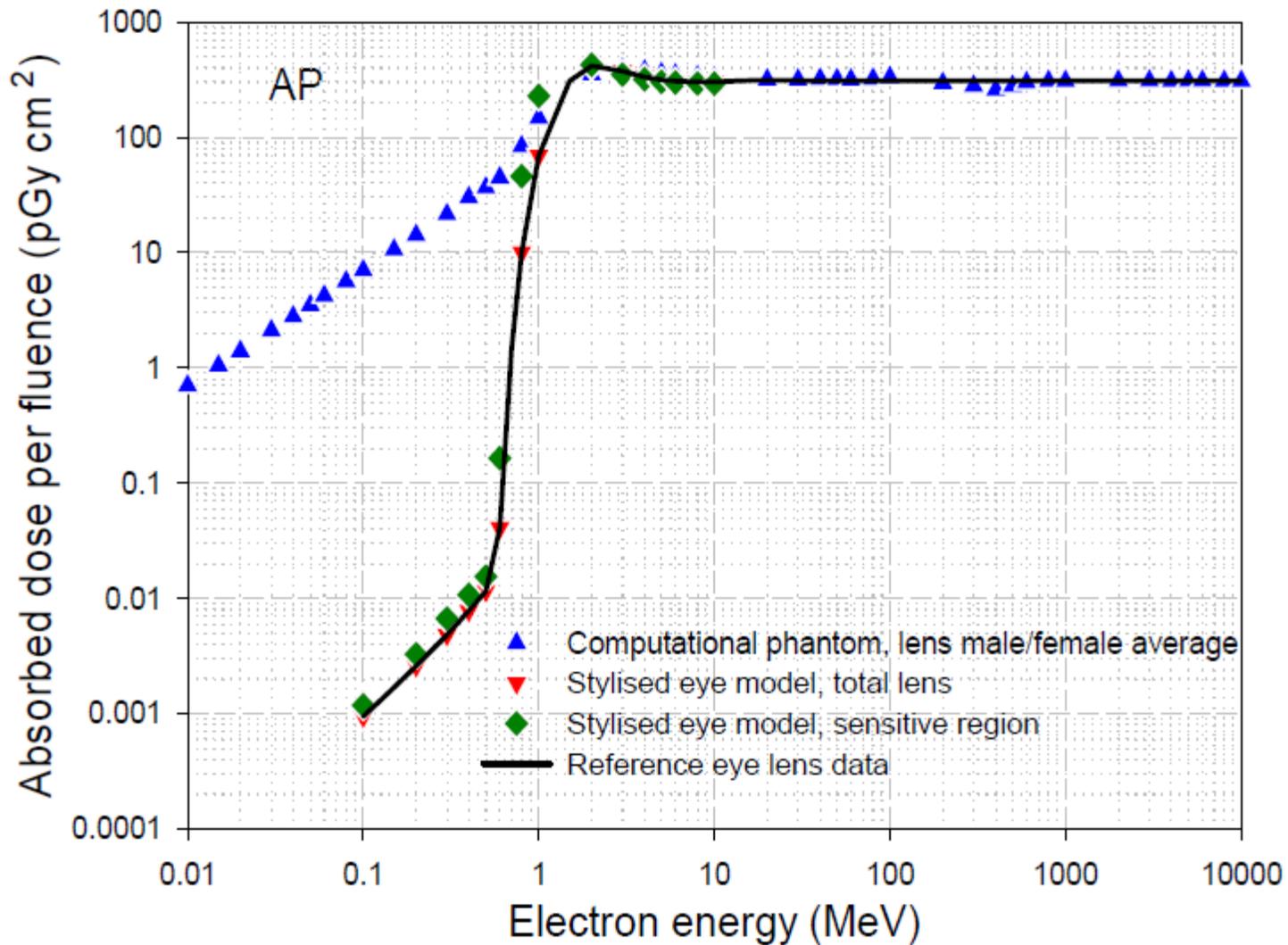


Fig. 2. Transverse section of the lens.

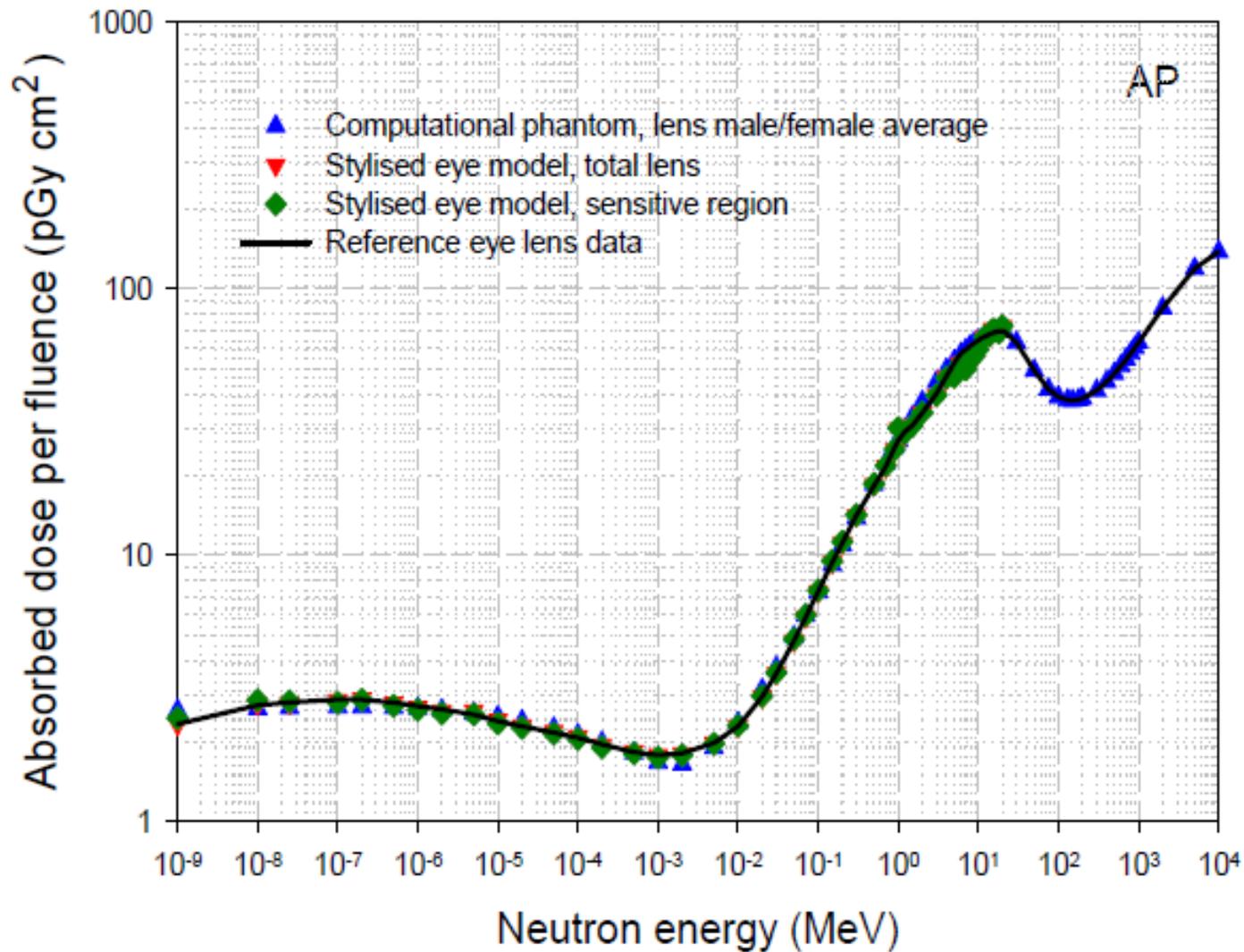
ICRP Publication 116 – Annex F



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Conclusions from Annex F

Reference Dose Coefficients for External Exposures

- “ **For photons**, dose coefficients from the stylized eye model were adopted as reference values at energies < 2 MeV for AP, PA, LAT, and ROT geometries.
- “ **For electrons**, dose coefficients from the stylized eye model were adopted as reference values at energies < 10 MeV for AP geometry. For ISO geometry and at energies < 1 MeV, the values for AP geometry were adopted as conservative estimates.
- “ **For neutrons**, dose coefficients from the stylized eye model were adopted as reference values at energies < 4 MeV.
- “ For all other conditions (particle, energy, geometry), reference values are taken as the average of values from the male and female voxel phantoms

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