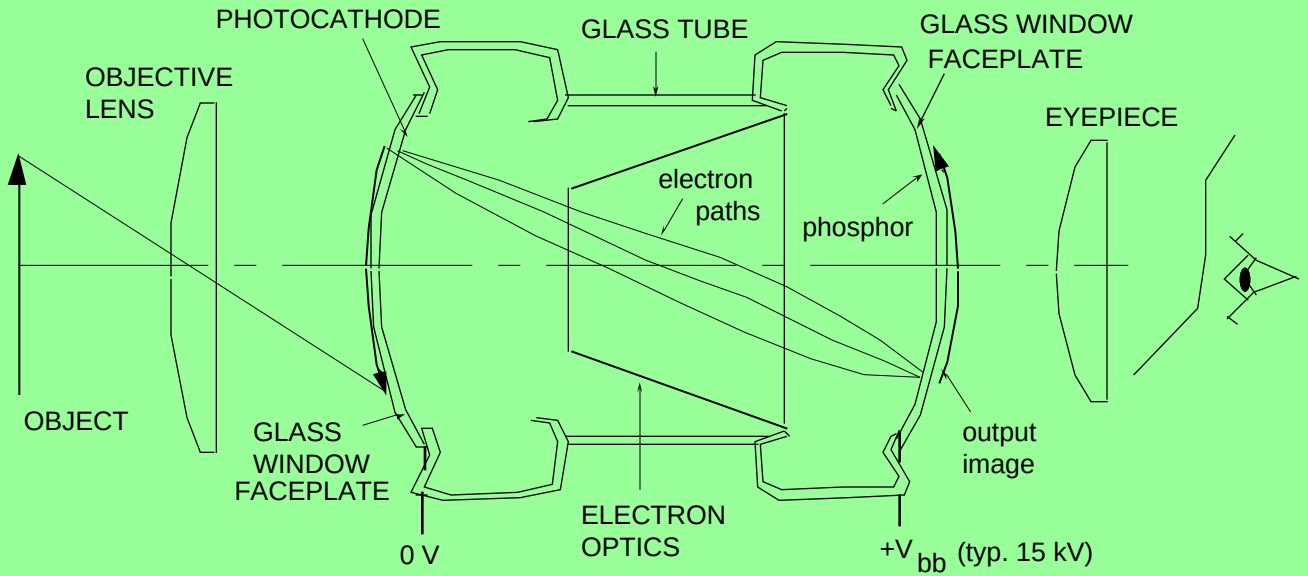
Basic functions

- *photoelectronic conversion* of image by a photocathode
- *conjugation* by an electron optics
- *power gain* of the electron image
- *luminescent conversion* of electron image at the *phosphor*



from:"Photodetectors", by S.Donati, Prentice Hall 2000

Classification

near-infrared viewers

1st, 2nd, 3rd generation types

for radiology

- in visible (IMAGE INTENSIFIERS or IIT)
  or infrared, UV (IMAGE CONVERTERS or ICT) and X-rays
- ELECTROSTATIC or MAGNETIC focalization
- electron ENERGY or electron NUMBER amplification
- special functions can be included: gate, zoom, sweep

hand-held night visors and LLLTV

bulky, for astronomy

with MCPs

fast (ns) shutters

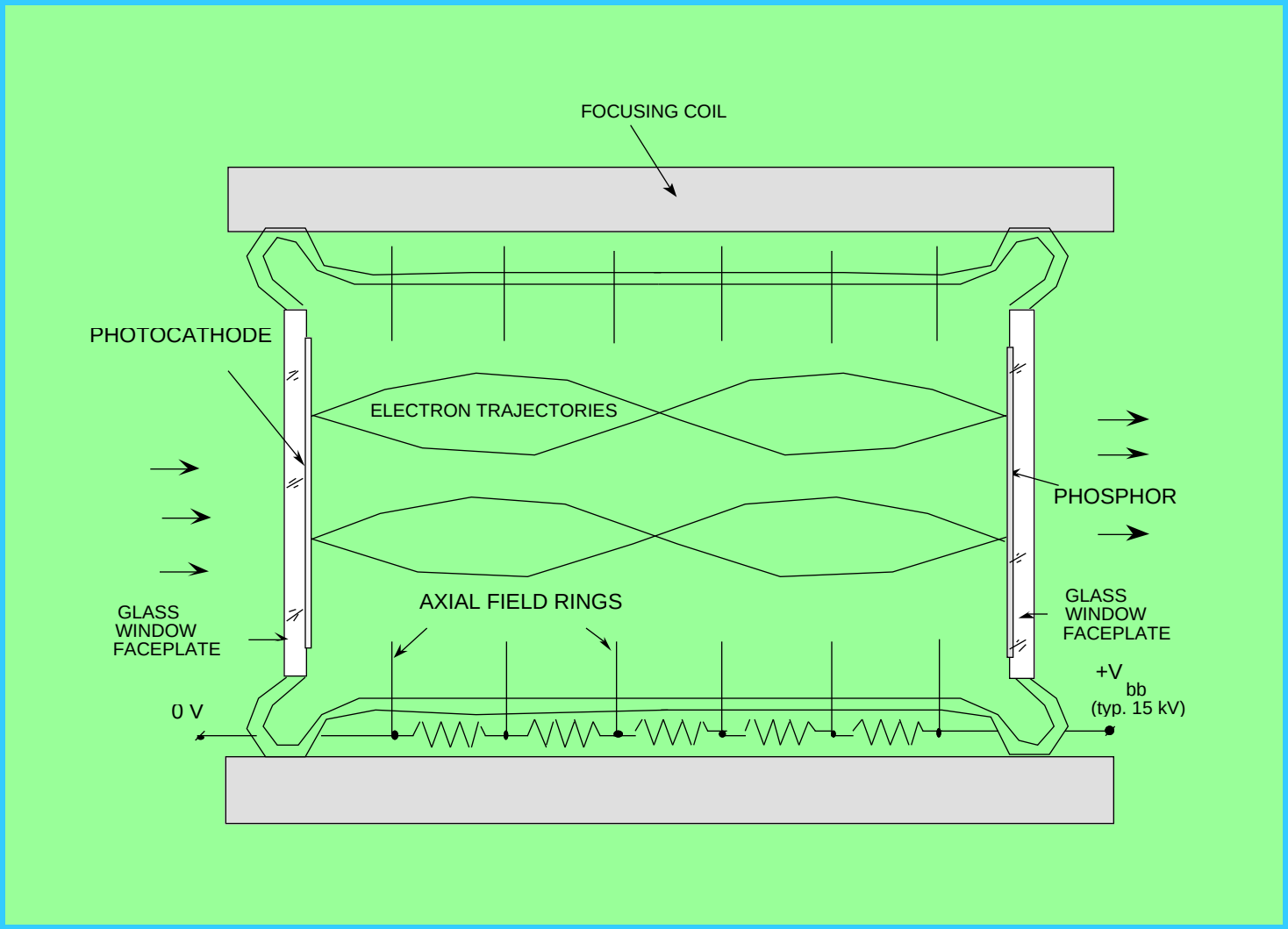
streak cameras

from:"Photodetectors", by S.Donati, Prentice Hall 2000

Typical ICTs

from:"Photodetectors", by S.Donati, Prentice Hall 2000

Magnetic focussing ICT



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ICT gain

By a simple photon-energy balance, *irradiance* at phosphor is written as:

$$E_u(x',y') = (h\nu/e)\,\kappa V_{el}\,J'(x',y') = (e/h\nu)\,\kappa V_{el}\,\sigma E_i(x,y)$$

where σ is spectral sensitivity (typ.10-50 mA/W) and κ=n/V is phosphor yield (typ. 30-60 photons per keV), and unity magnification is assumed.

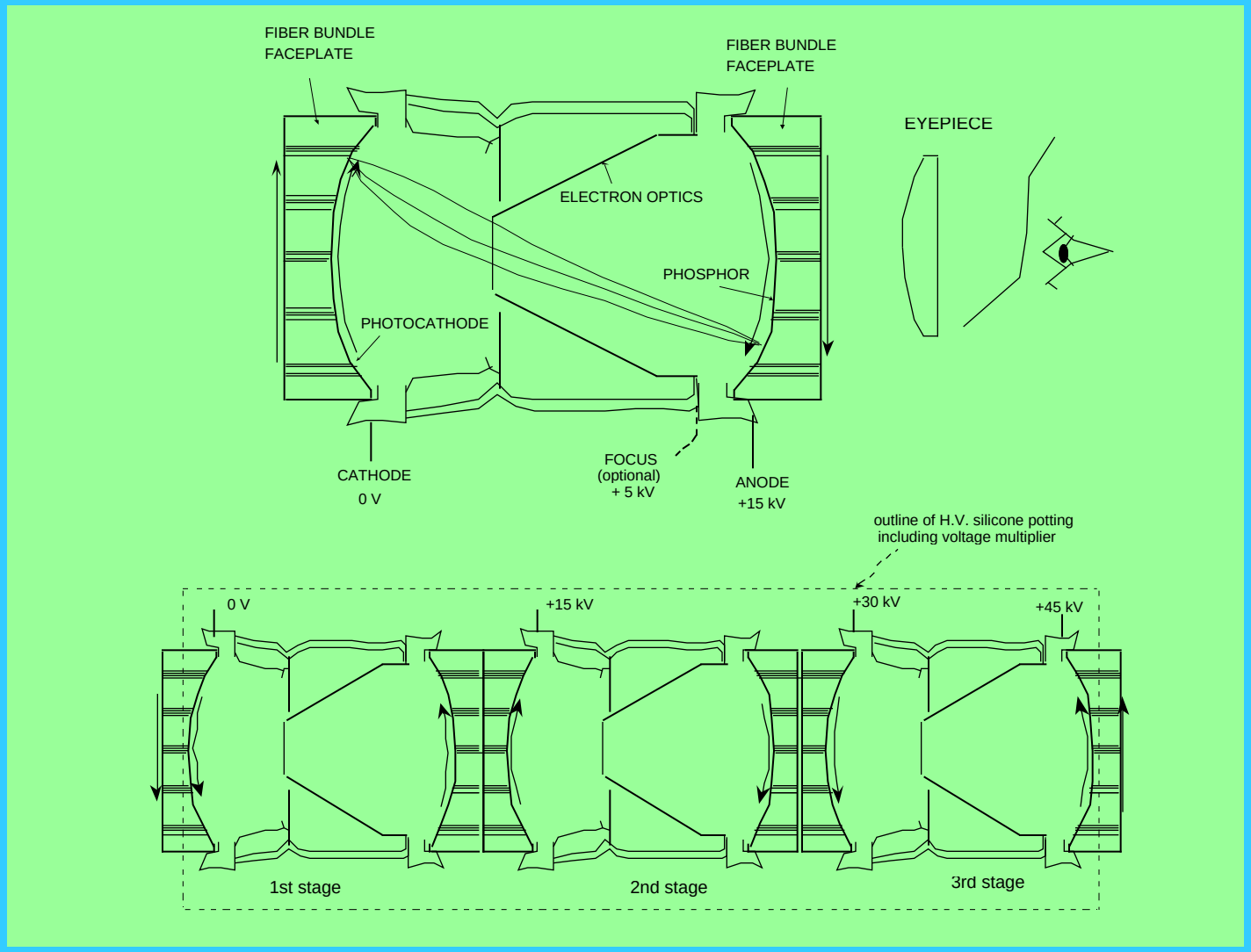
The radiant gain $G=E_u/E_i$ of the ICT then follows as:

$$G = (h\nu/e)\,\kappa V_{el}\,\sigma = \kappa V_{el}\,\eta$$

example: with a typ. V_{el}=10 keV and η =0.1, gain is G=30-60.
By cascading two or more stages, total gain is the product of stage gains and with 3 stages we can get a gain $G=10^5$, enough to view single photoelectrons.

from:"Photodetectors", by S.Donati, Prentice Hall 2000

1st generation, fiberoptic faceplate ICT



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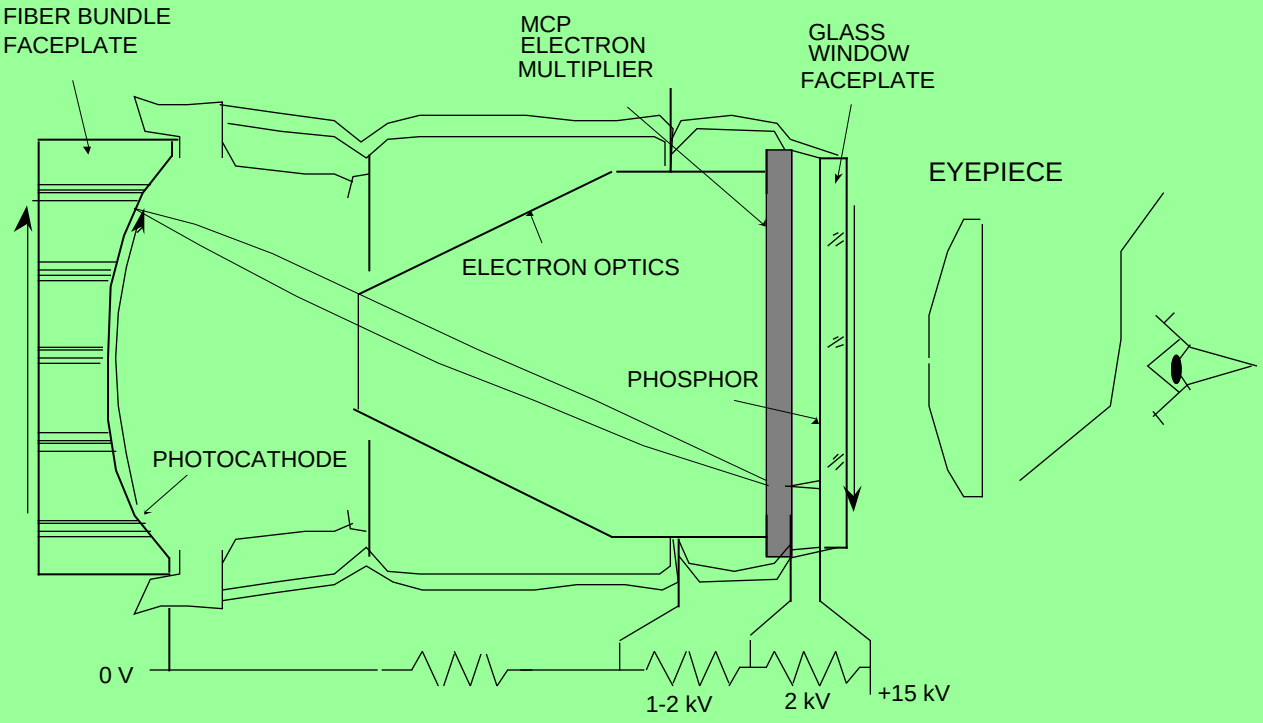
2nd generation ICT with M CP



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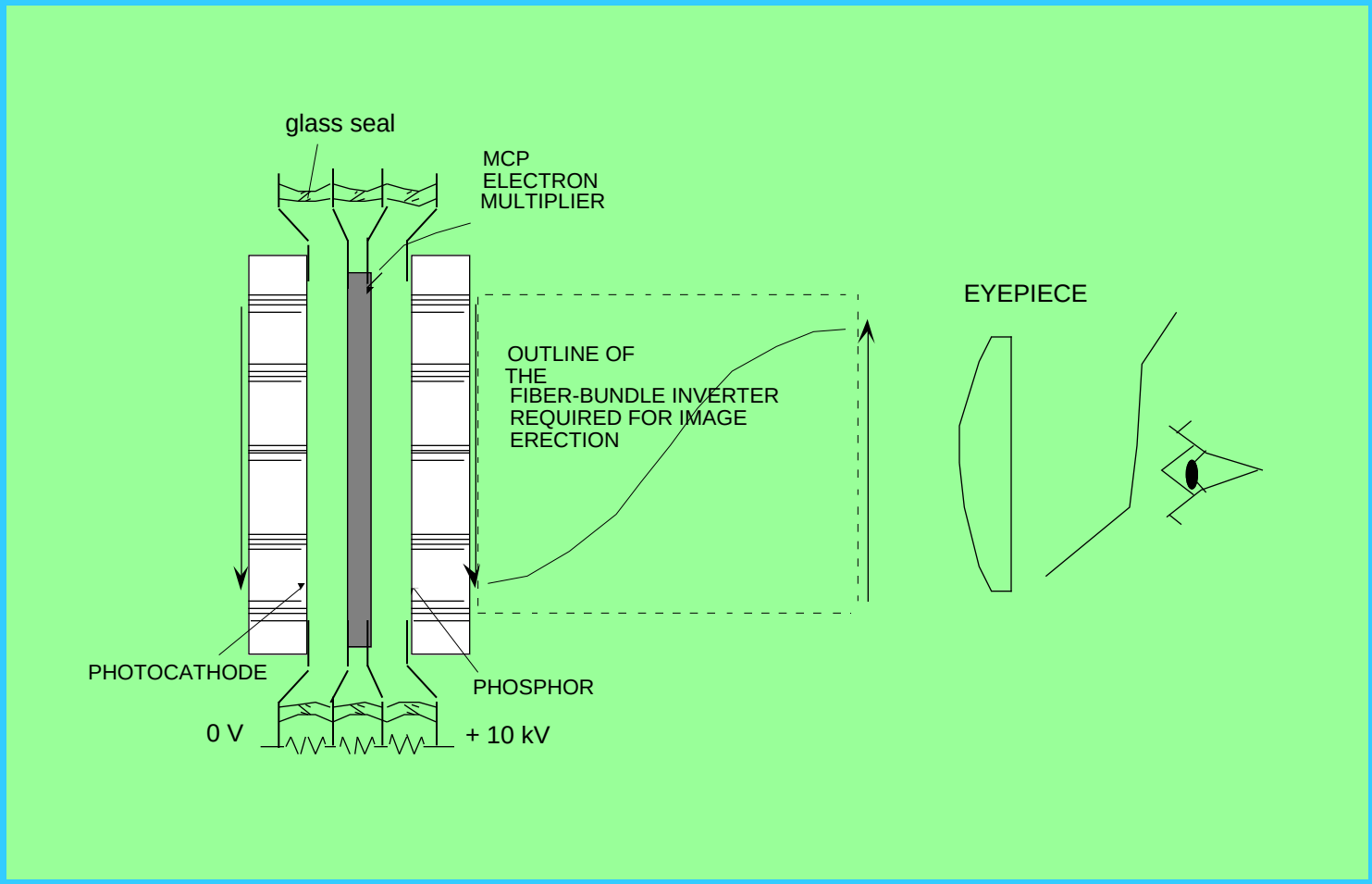
3rd generation ICT



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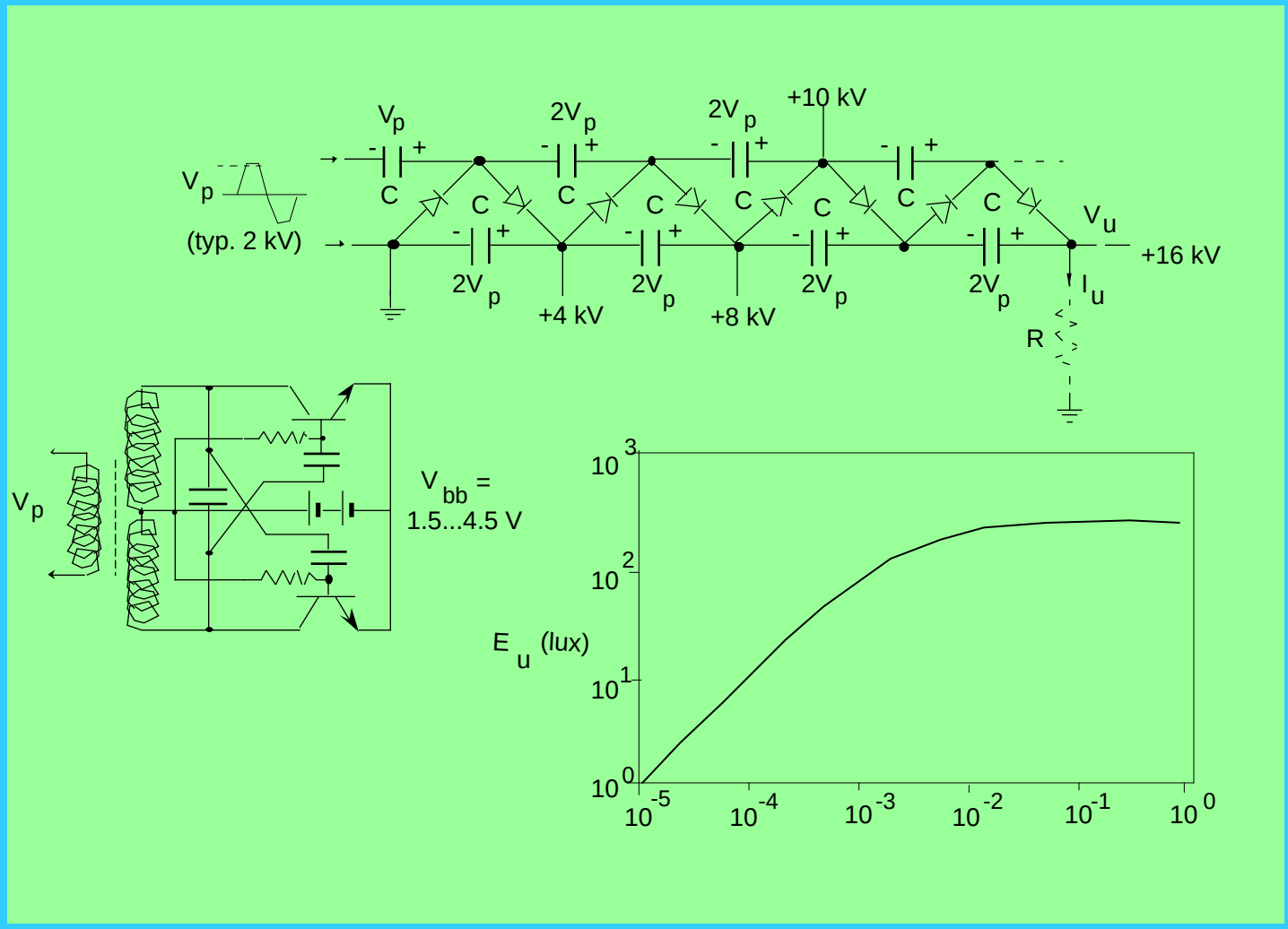
Multiplying chain for ICTs



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ICT parameteres

Spectral response : all transmission PhC available, with preference of S-20 and S-1

Display characteristics : phosphor P-20 is preferred, has medium persistence (0.35 ms), good yield(κ=80 ph /keV)

Radiant gain $G=E_u/E_i$: reference source is the 2850 K lamp (as representative of artificial illuminance and of residual illuminance of natural scenes at dark

Response dynamic range : ratio of max. to min. reproduced illuminance, is given by $E_{sat}/G_{ICT}EBI$, where E_{sat}=screen saturation level, G_{ICT}=gain and EBI=equivalent background illuminance (typ. 10^{-7} to 10^{-4} lux)

Linearity : $E_u=KE_i$ can reach a conformity better than 1% for an individual pixel, but from pixel to pixel K may vary over ±10%, because of PhC and PS disuniformity

Spatial resolution : is described by the MTF; total limiting resolution is about 50 cycles/mm.

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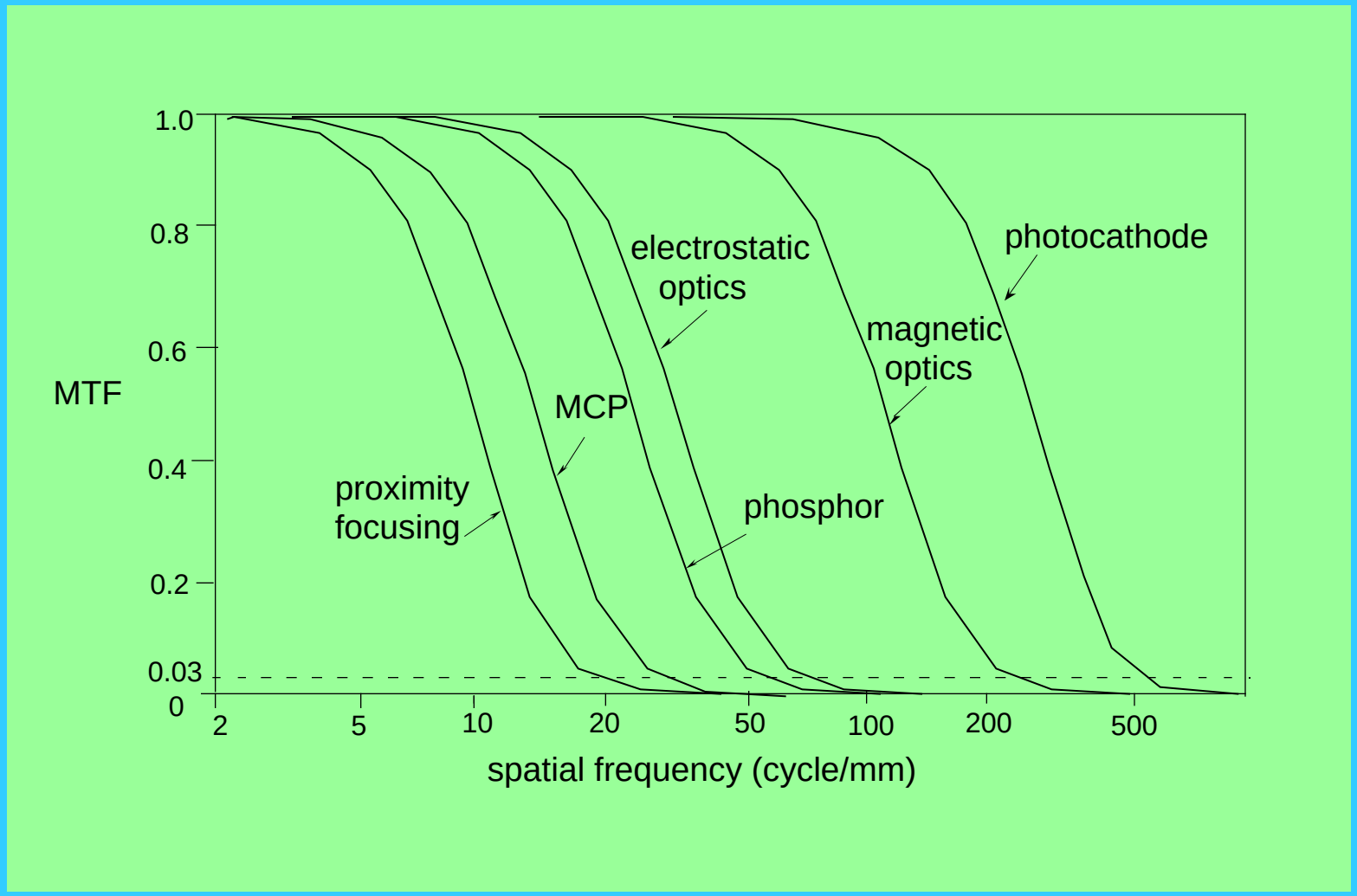
ICT resolution: MTF contributions



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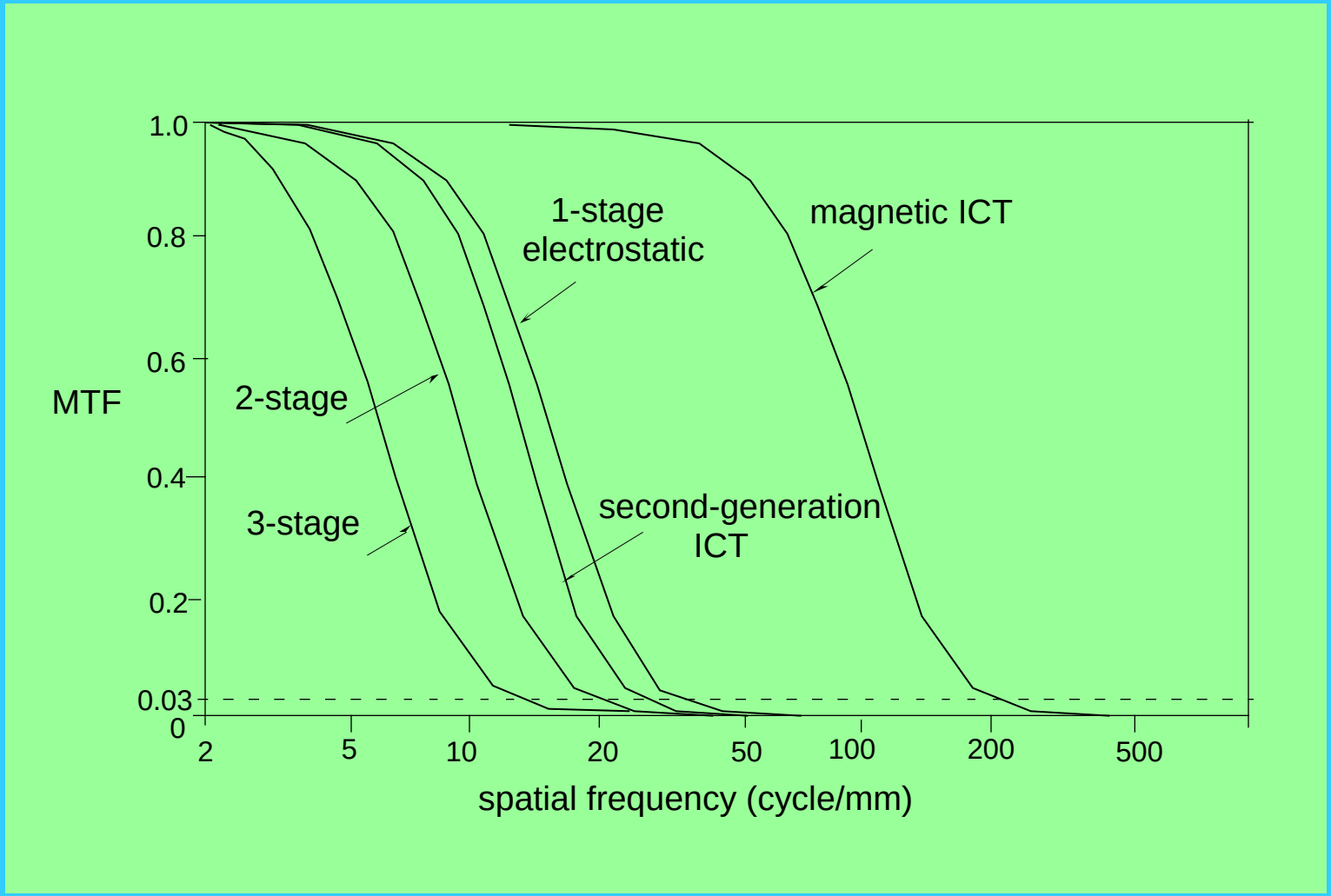
ICT resolution: stages and types



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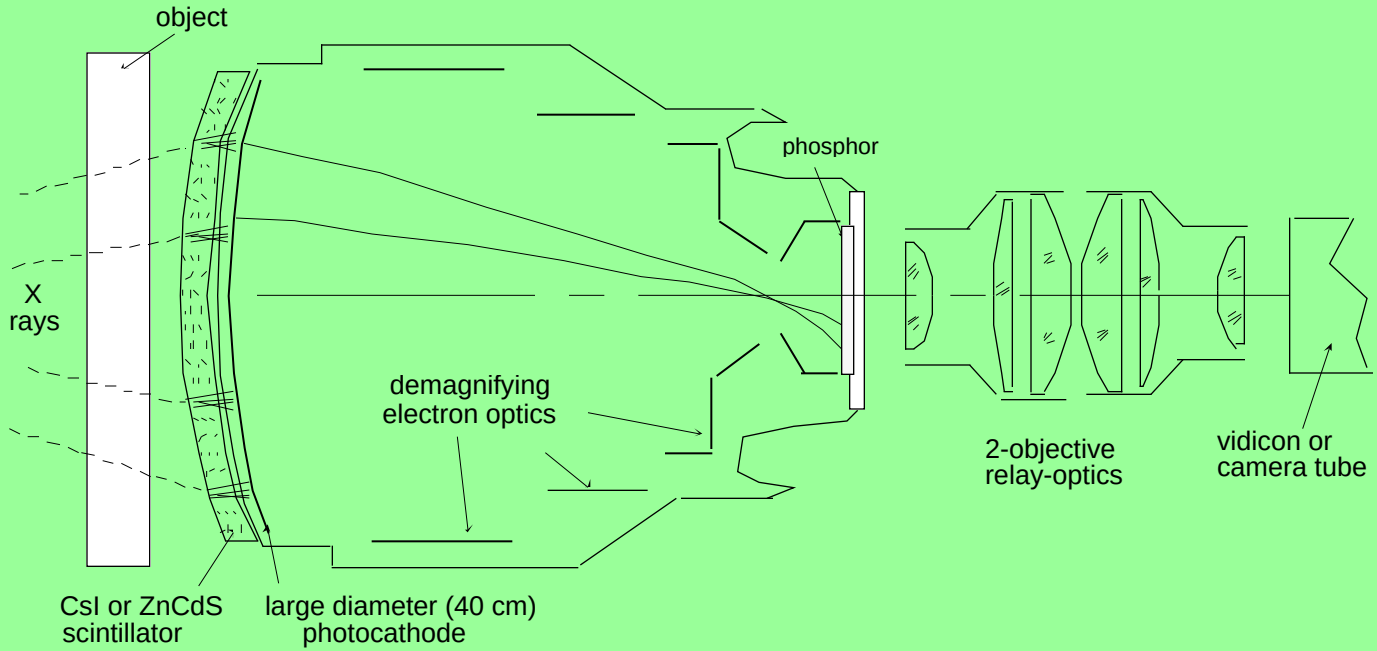
X-ray ICT



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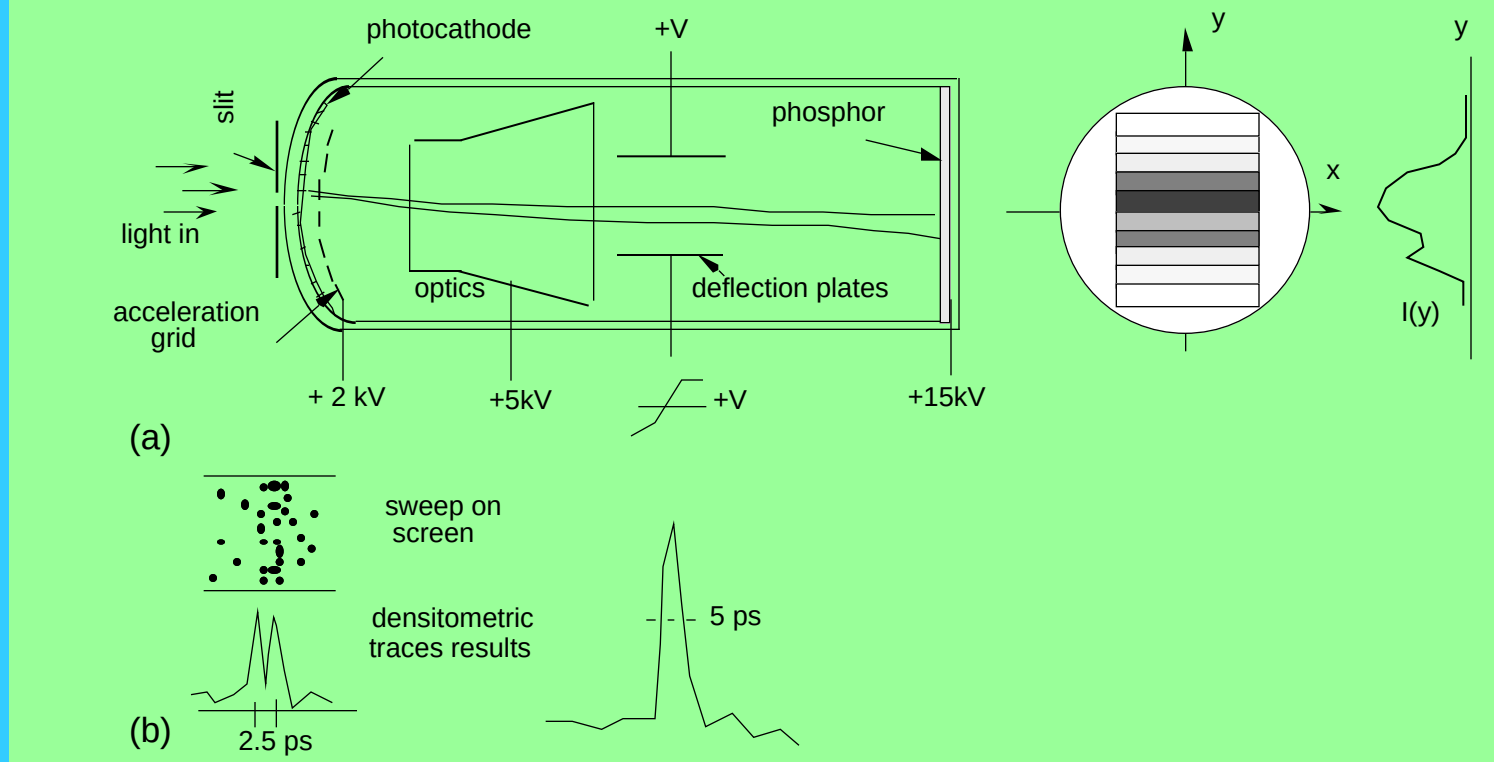
Streak-camera



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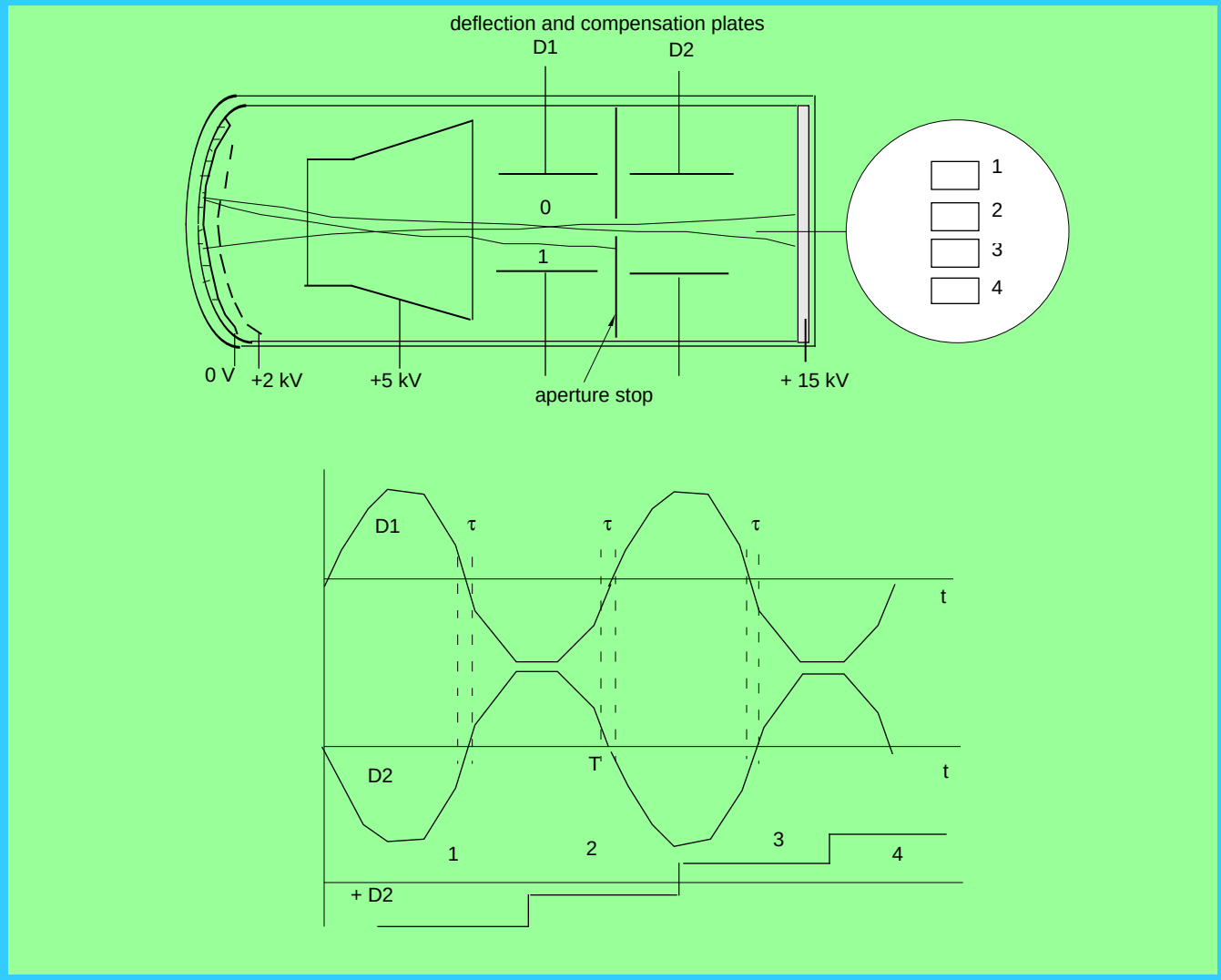
Multiple-frame, ultrafast photography ICT



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