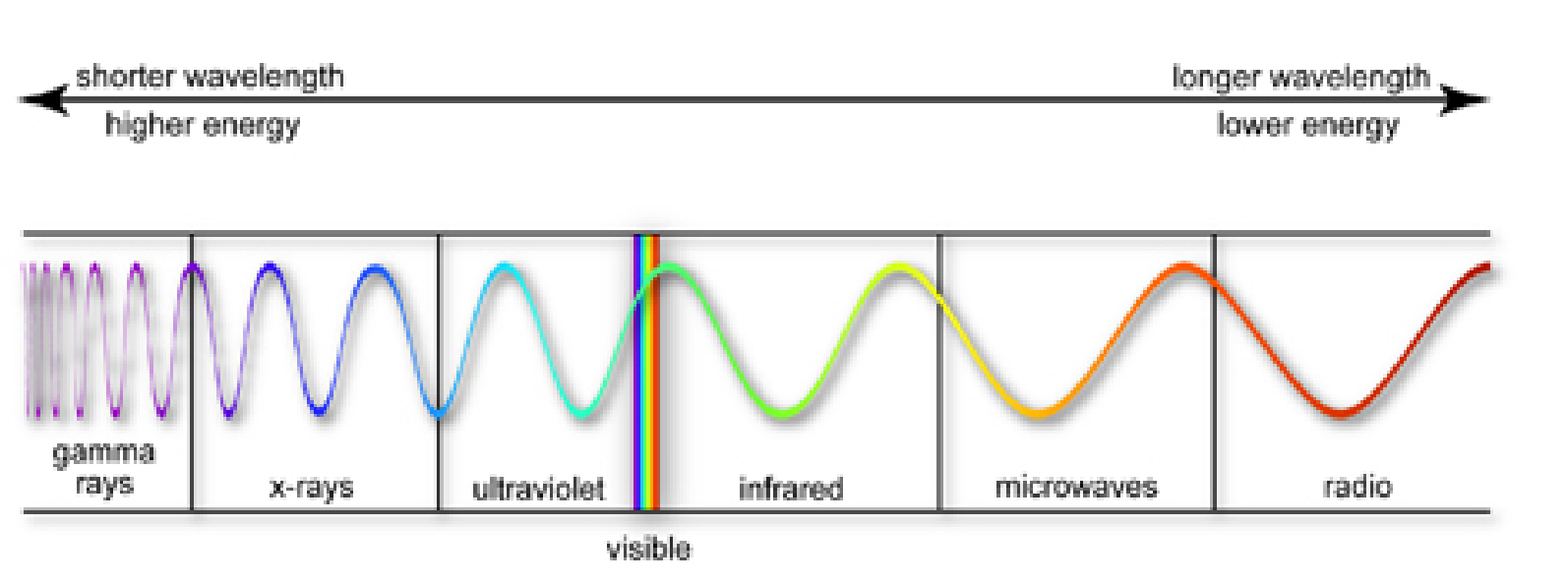
Ionizing radiation, radiation protection

Oldřich Ott, Petr Nádeníček

FAKULTNÍ NEMOCNICE BRNO

The Electromagnetic spectrum:



- x-rays wavelength 10 - 0,001 nm

Interaction of IR with matter:

photon

↓

electric interaction (Compton scattering, photoeffect, electron-positron couple)

↓

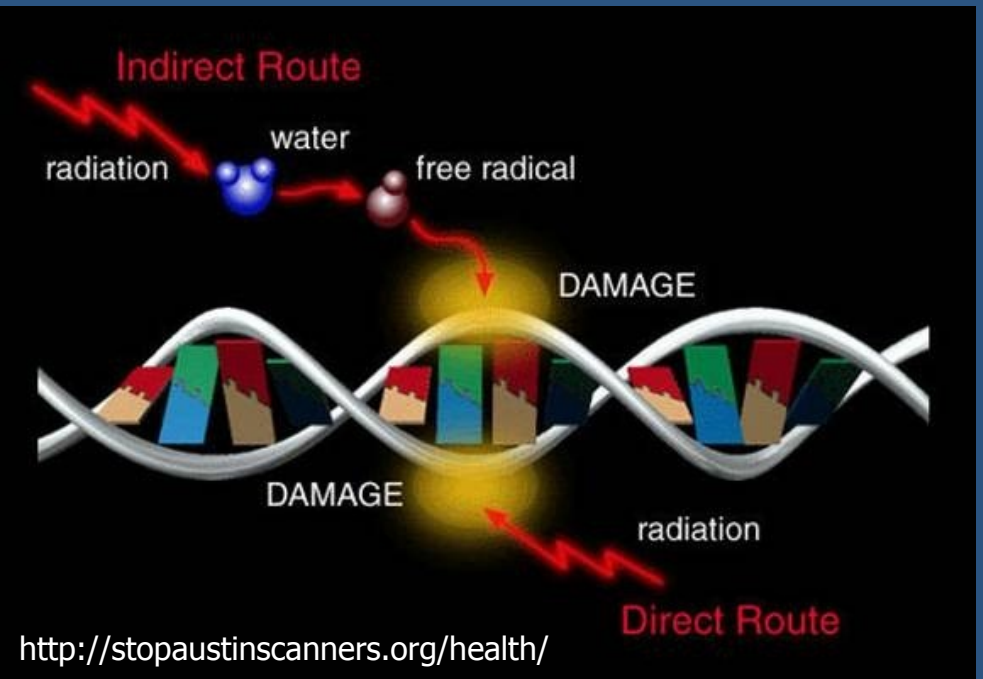
ionisation

↓

chemical changes

↓

biological effect



http://stopaustinscanners.org/health/

0,001 – 1 s, interaction of ions, radicals, excited atoms with biological organic molecules (DNA, proteins)

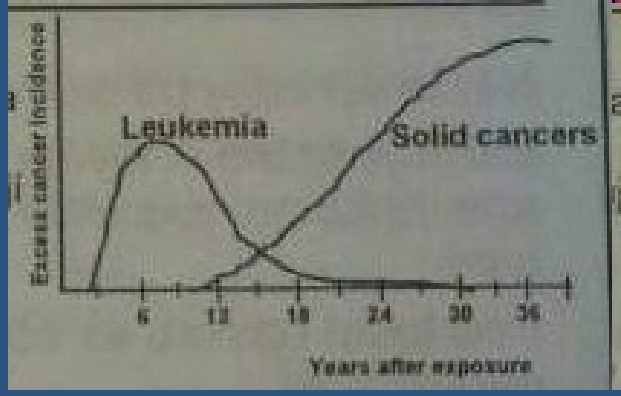
minutes – tens years, functional and morfological changes in cells, organs and whole organism

Biological effects of IR:

stochastic

deterministic

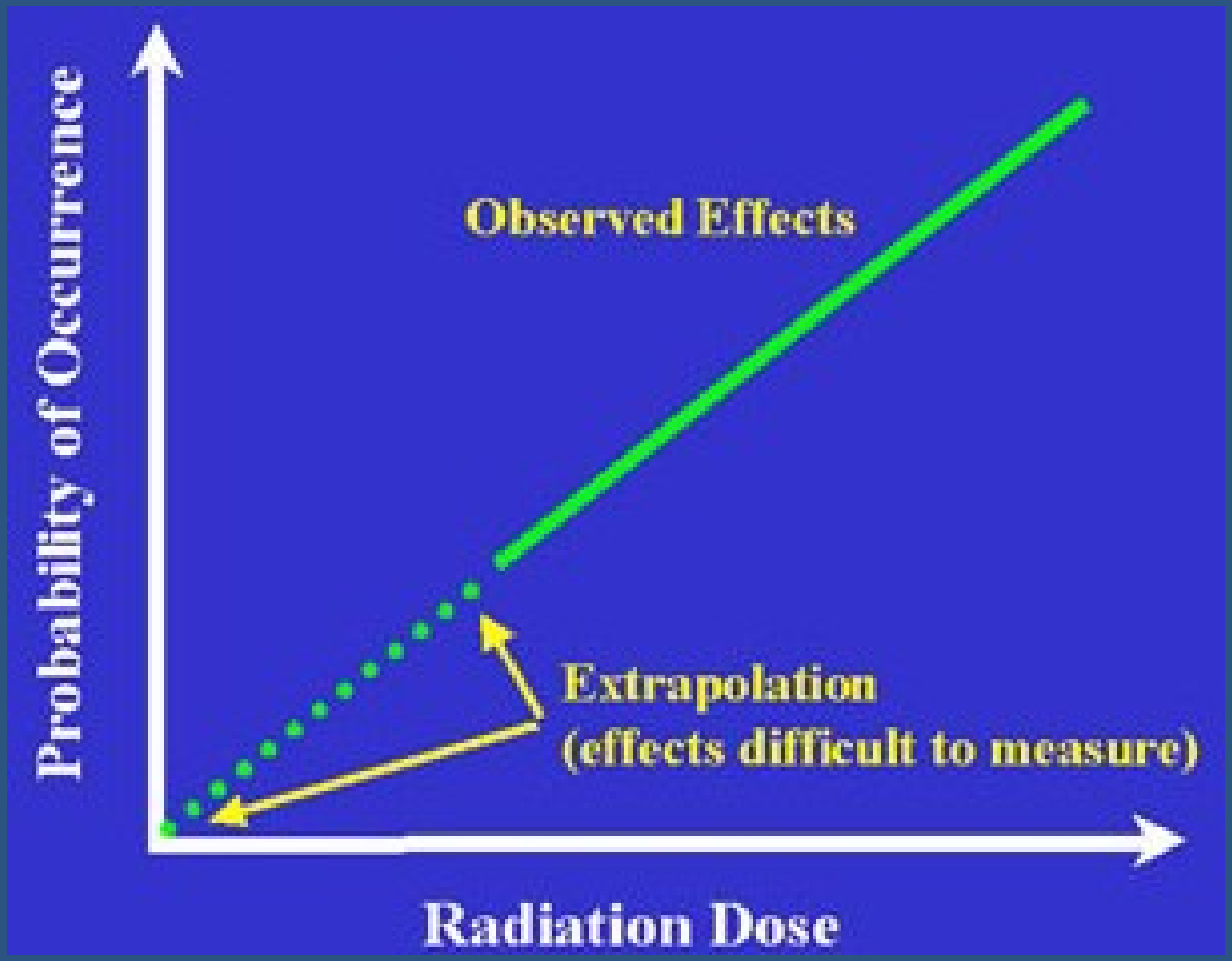
Stochastic effects:



- no threshold
- increasing D_{ef} – increasing probability of stochastic effects
- effect intesity do not dependent on the dose
- no effect immediately after irradiation (after several years)
- carcinoma + genetic effects
- lesion is not related to place of irradiation
- D_{ef} (Sv)

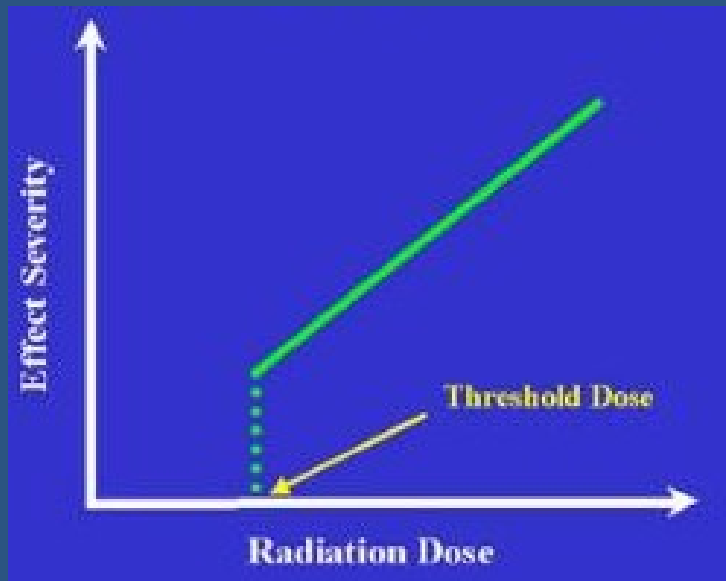
Latence: several years for cancer
100s years for genetic effects

Stochastic effects:



Deterministic effects:

- threshold
- lesion depends on absorbed dose
- local effects
- radiation damage is clinical provable
- example: cataract, erythema, infertility etc
- D_{ekv} (Sv)



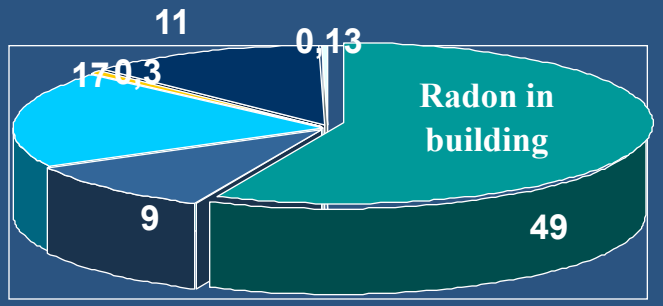
Embryo

- 2 weeks – „everything or nothing“
- 3.–8. w – organogenesis, risk of malformations
- 8.–15. w – risk of mental handicap
- after 15. w – the same resistance as born child

The highest radiosensitivity – 1. third of gravidity!

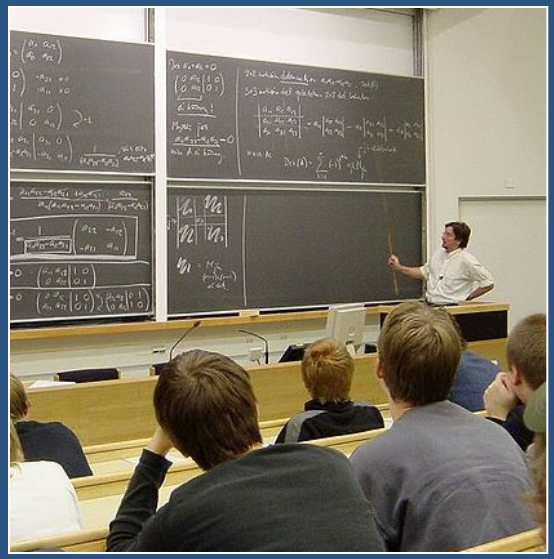
Ionizing radiation - etiology:

- natural : artificial = 5:1
- 54 % Radon (Rn)
- 16 % cosmic radiation
- 19 % gama radiation
- 11 % inner radiation
  - radionuclid ^{40}K, ^{14}C
- 93 % medical irradiation
- 1 % nuclear energy
- 2 % professional irradiation
- 2 % nuclear fall-out



- Radon in building
- Natural radionuclid in humans
- Gama from Earth surfice
- Nuclear fall-out
- Medical irradiation
- The rest

Limits:



- Radiation employee
- D_{ef} - 5 y - 100 mSv
- D_{ef} - 1 y - 50 mSv
- D_{ekv} – 1 y - lens - 150 mSv

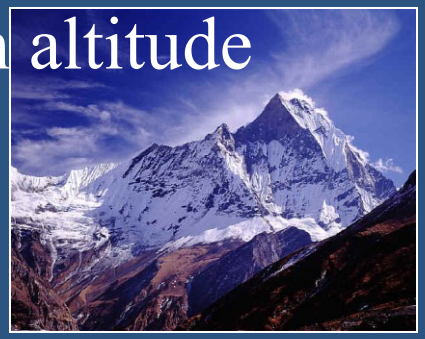
- Students
- 6 mSv
- 50 mSv

A pregnant woman – during whole pregnancy - 1 mSv

D_{ef} – 1 mSv

- **several years** – external irradiation from nature sources
- **several years** – internal irradiation from potassium in body
- **< 1 year** – internal irradiation from **Radon** in buildings

- **severals months** – external irradiation in high altitude

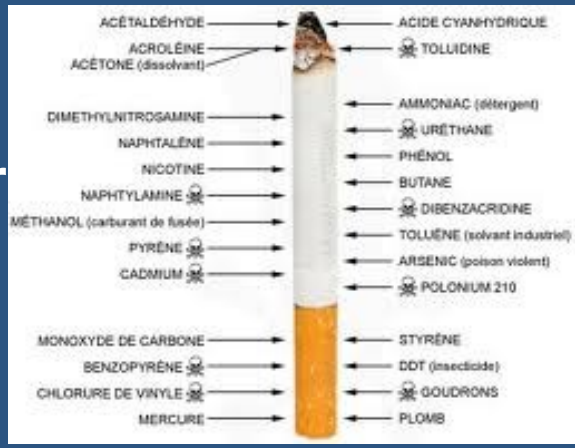


- **100-1000 hours** – external irradiation during long flight

1 mSv – 1 year limit for irradiation for person in population.

Probability of death – 50 mSv:

- irradiation of **50 mSv**
- 1 year work in **„industry"**
- smoke **10 packs of cigaret**
- 15 years in household with smoker
- drink **50 bottle of good wine**
- 1500 km tour on the **bicycle**
- 45 000 km travel by car



death probability - **1:10000**

Protection of patients:

- Was the examination done?
- Is it the best type of examination?
- Explanation of problem?
- Do you necessary need this examinaton?
- Do you need the examination now?

Thank you