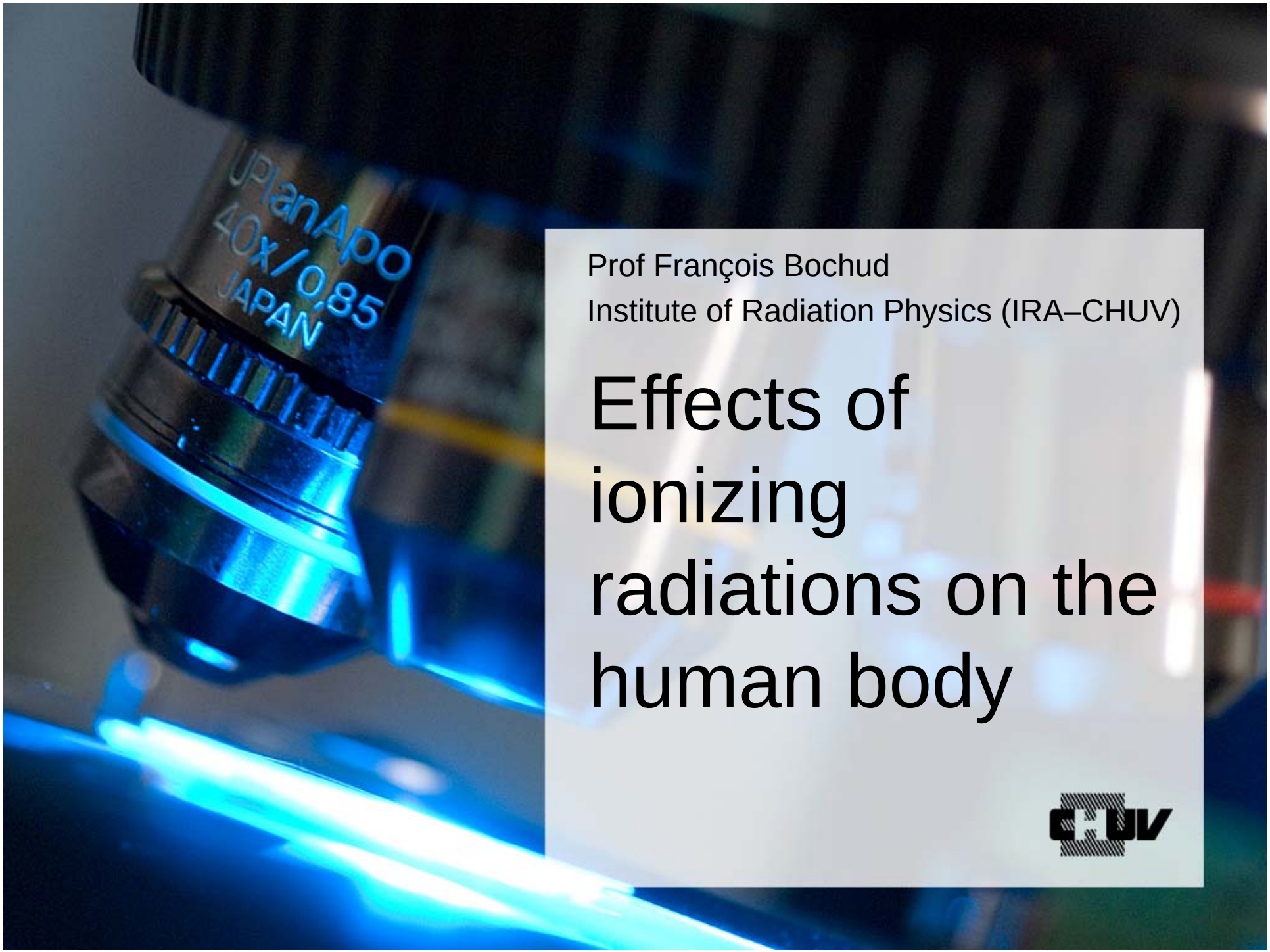
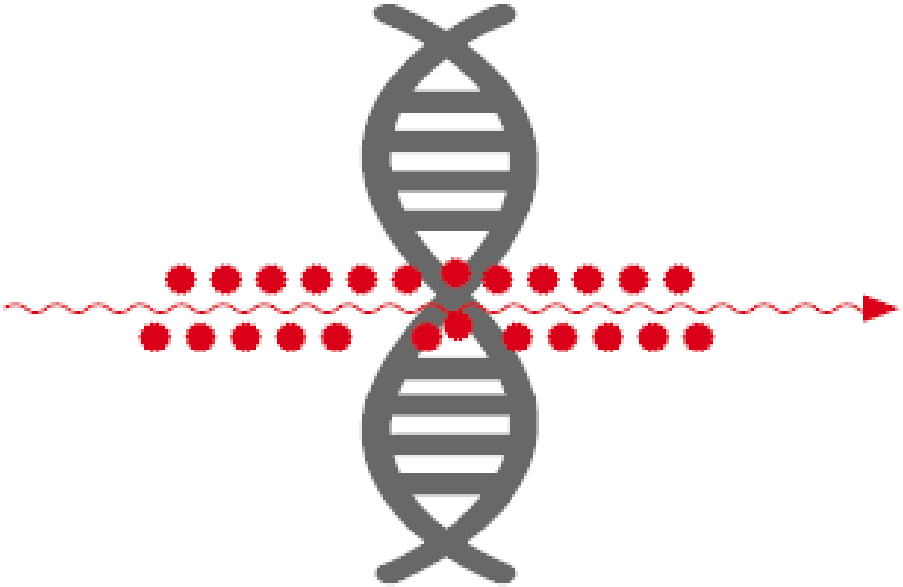


Prof François Bochud
Institute of Radiation Physics (IRA–CHUV)

Effects of ionizing radiations on the human body

Radiations can damage living organisms



At high doses, life is threatened in the short term

Table 3.3: Range of doses associated with specific radiation induced syndromes and death in human beings exposed to acute low LET uniform whole body radiation.

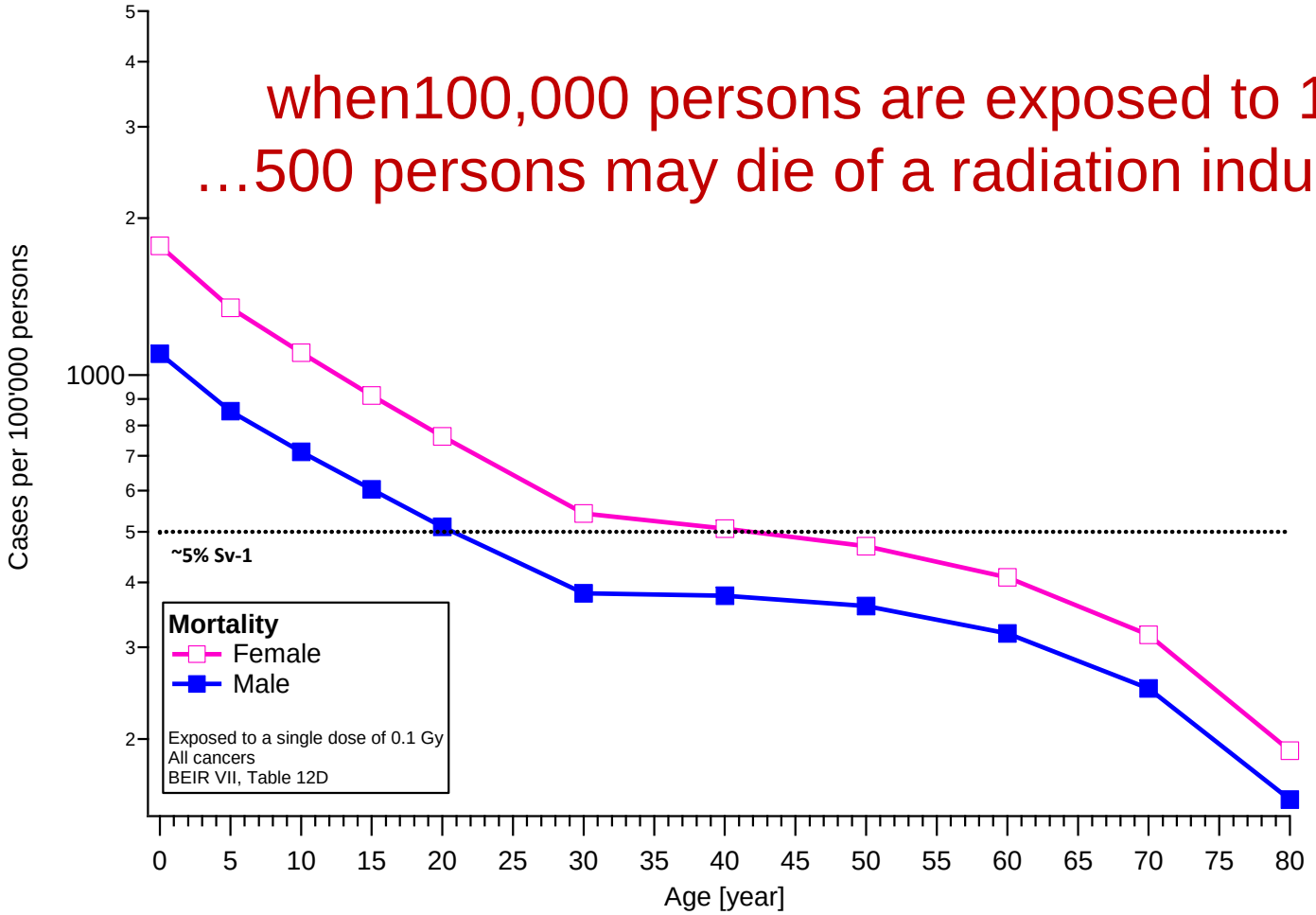
Whole body absorbed dose[a] Gy	Principal effect contributing to death	Time of death after exposure (days)
3-5	Damage to bone marrow ($LD_{50/60}$)	30-60
5-15	Damage to the gastrointestinal tract	7-20
5-15	Damage to the lungs and kidney	60-150
>15	Damage to nervous system	<5, dose-dependent

5 Gy is about 5,000 mSv

ICRP 107 (2009)

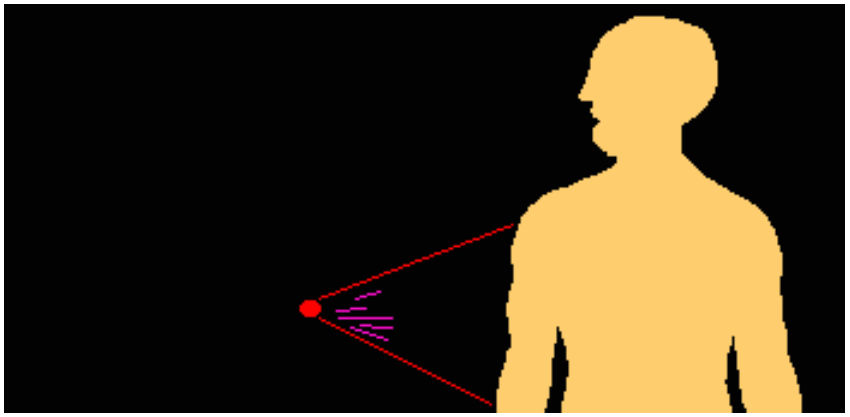
At low doses, risks of cancer and heritable effects increase

when100,000 persons are exposed to 100 mSv
…500 persons may die of a radiation induced cancer



BEIR VII (2005)

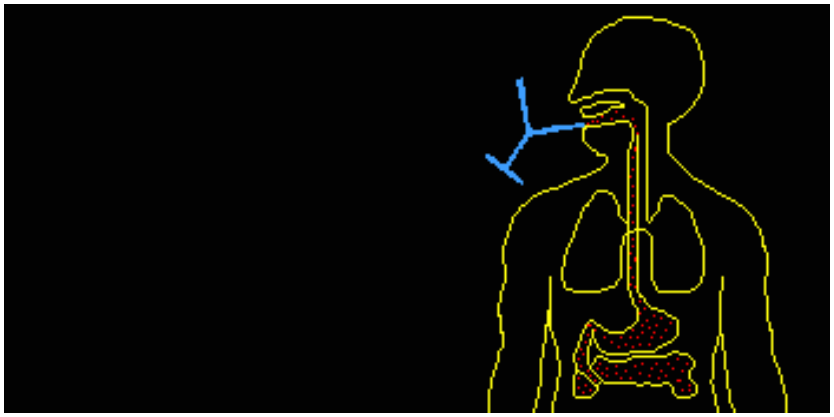
External irradiation



The source does not need to be in physical contact

The person is **not radioactive**

Internal contamination

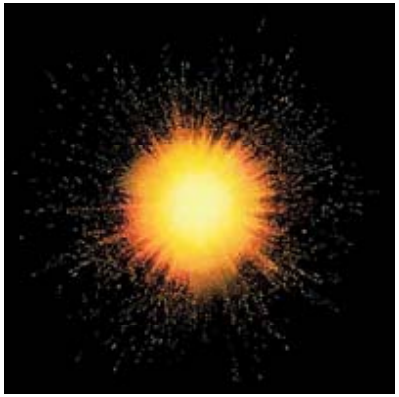


The source is in physical contact

The person is **radioactive**

… but usually not dangerous for nearby people

Radiations are everywhere

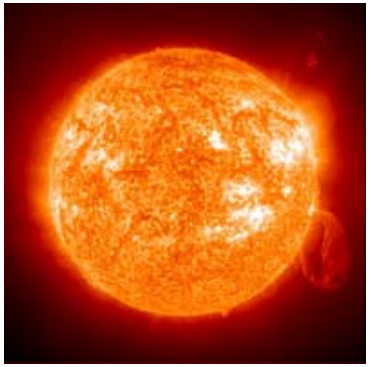


Big Bang

hydrogen
helium

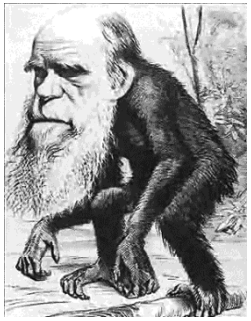
Stars,
super novae

all other
elements

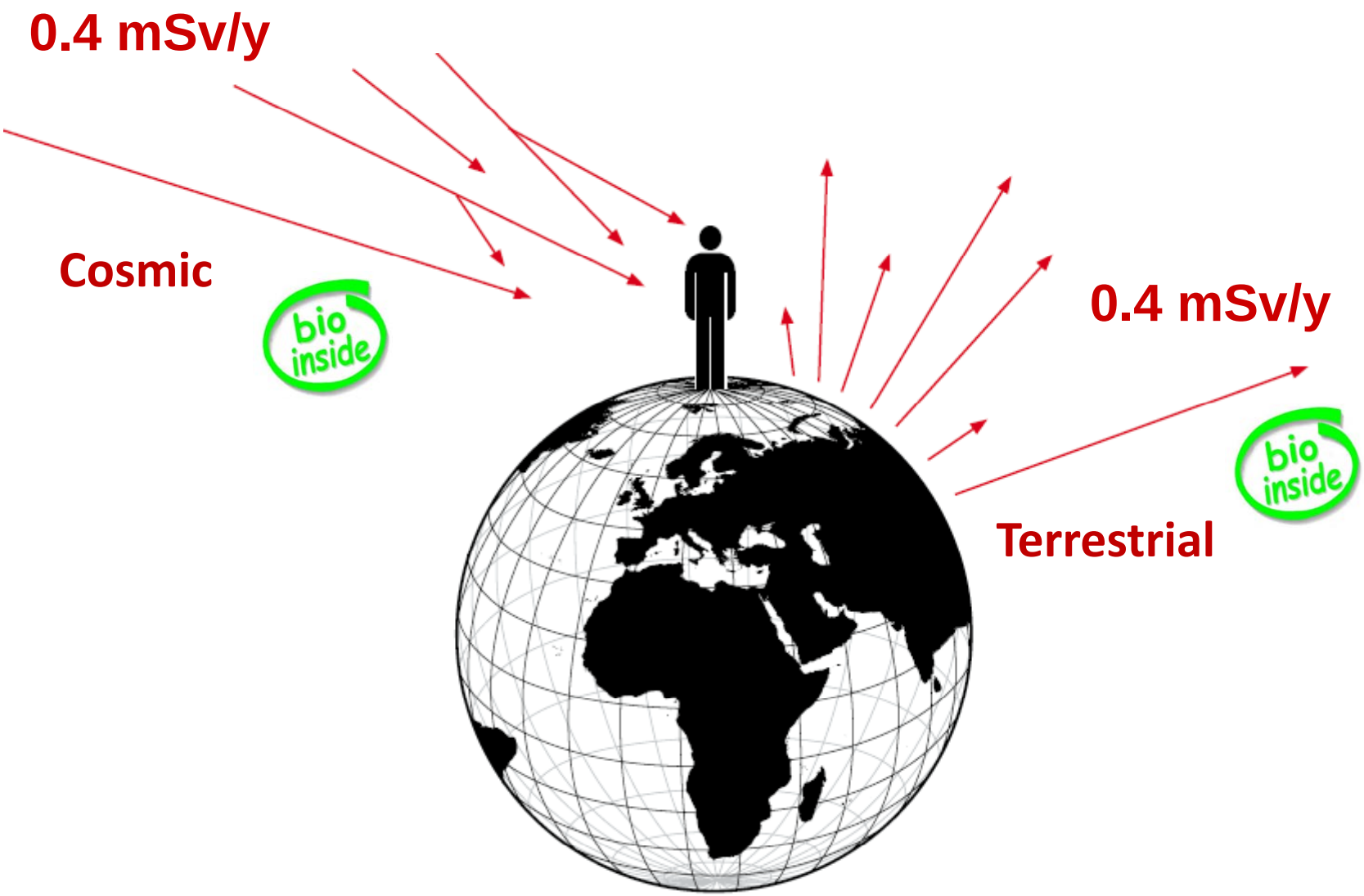


solar
system

Beginning of life
(~3.5 billion years)

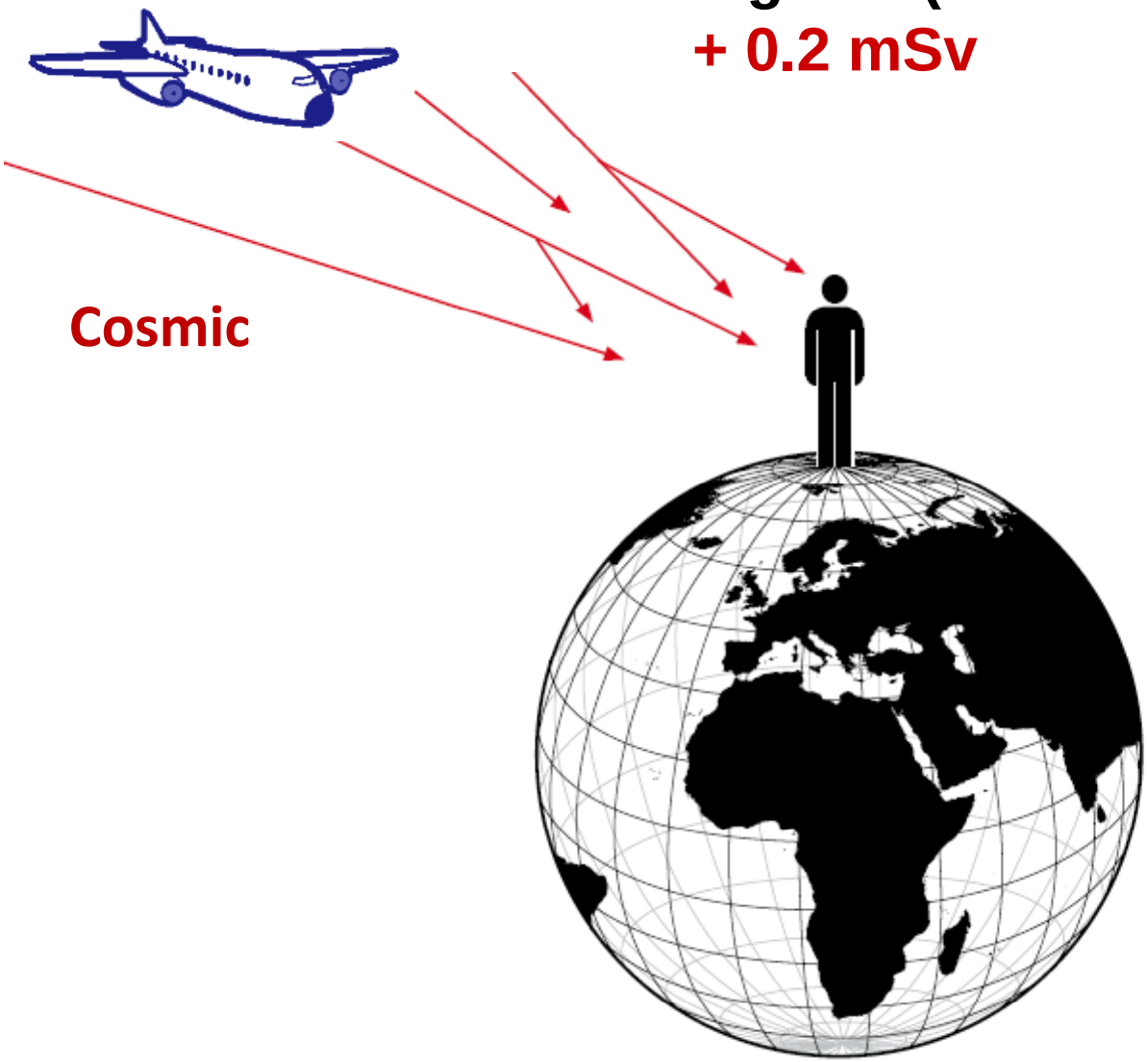


Man separates from
Chimpanzee
(~6 million years)


0.4 mSv/y
Cosmic
bio inside
0.4 mSv/y
bio inside
Terrestrial

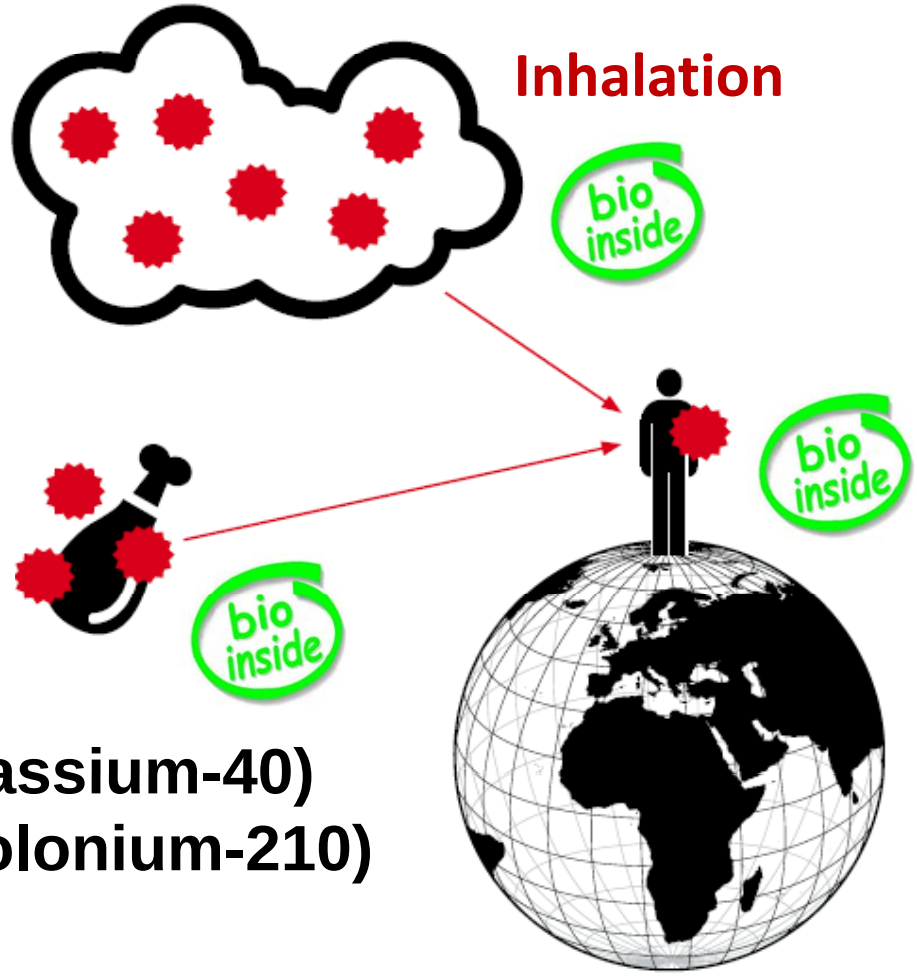
Zurich – Los Angeles (back and forth)

+ 0.2 mSv



radon-222 in dwellings

1.6 mSv/y

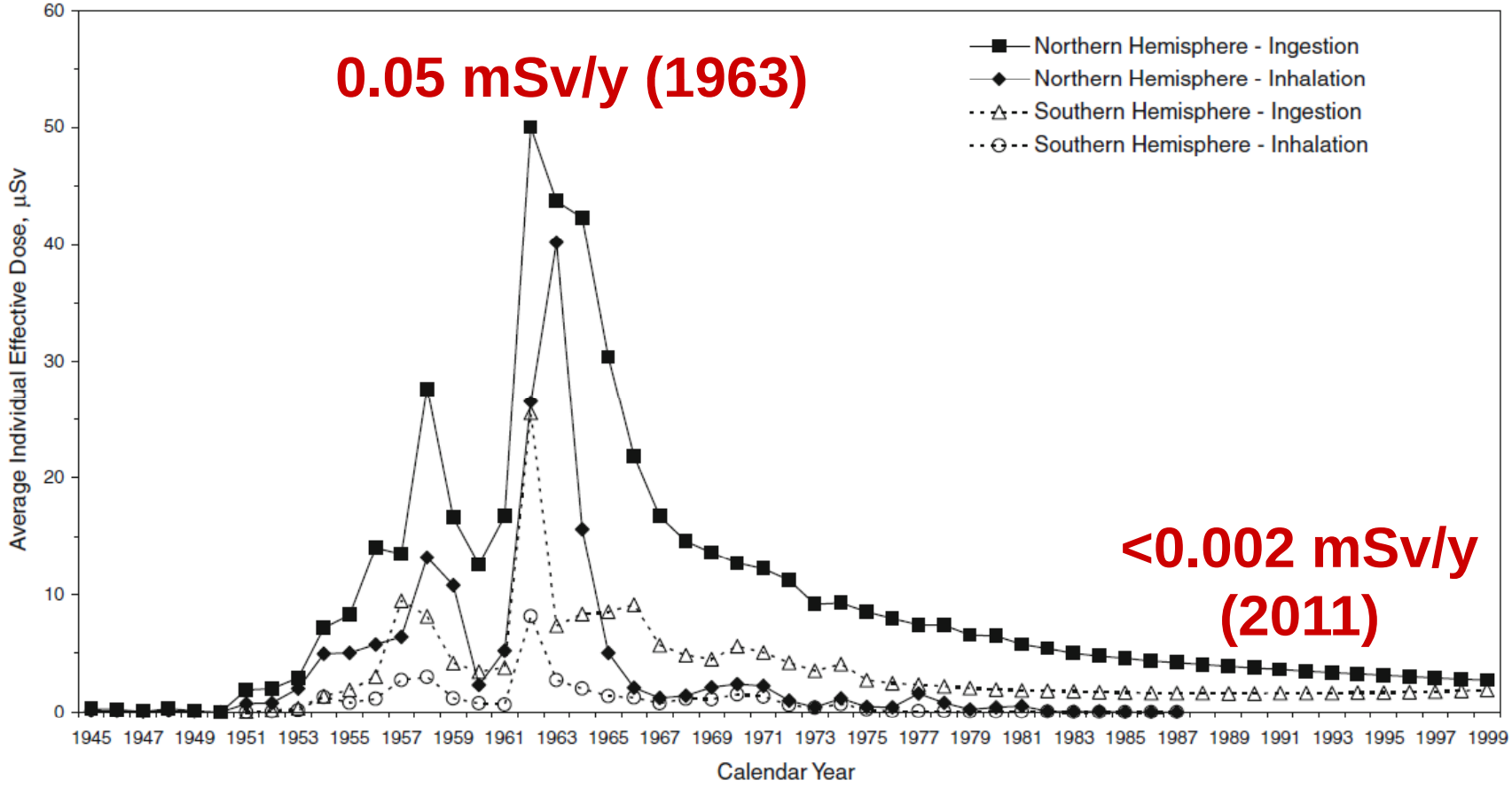


our composition (potassium-40)

our food (plomb-210, polonium-210)

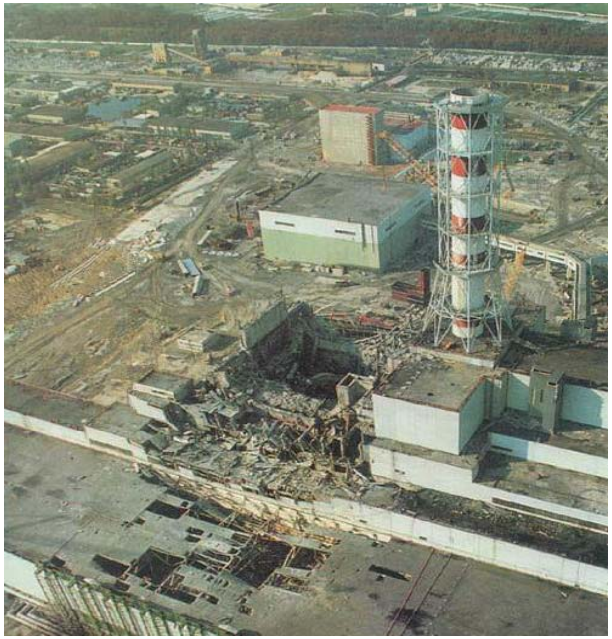
0.4 mSv/y

- **528 nuclear bomb tests between 1945 et 1981**
- **radioactive contamination of food and organisms**



Radiat Environ Biophys (2010) 49:213–227

UNIL | Université de Lausanne



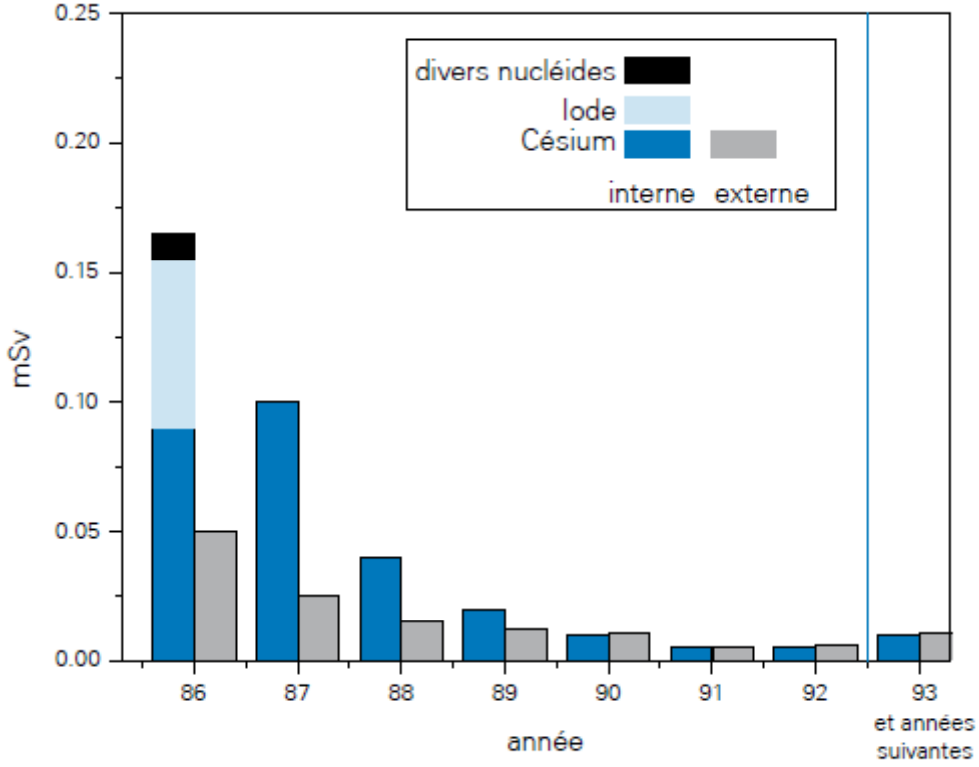


Figure 6: Doses moyennes supplémentaires en mSv reçues par la population suisse à la suite de l'accident de Tchernobyl, pour les années 1986 et suivantes.

Chernobyl

All Europe contaminated in 1986

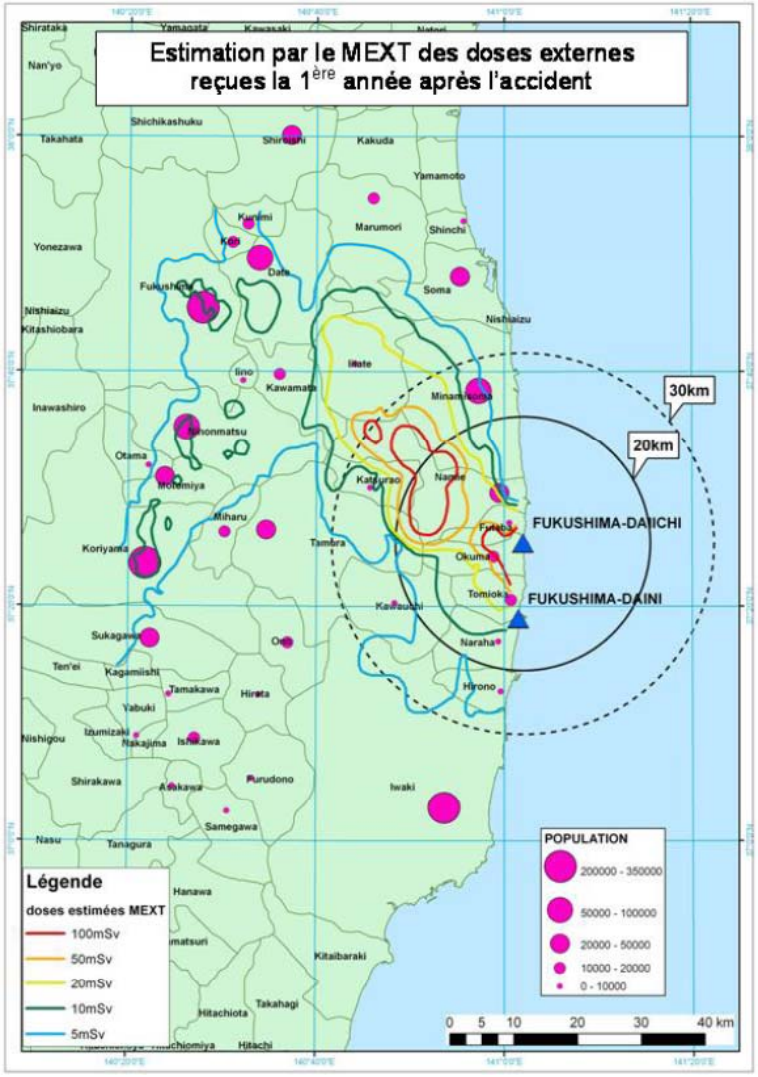
Swiss average: **0.5 mSv**
Swiss maximum: **5 mSv**
(<0.01 mSv/y now)

"20 ans après Tchernobyl, les conséquences en Suisse", Rapport OFSP (2006)

Fukushima

North Eastern Japan contaminated in March 2011

IRSN 16.05.2011, Rapport DRPH/2011-10

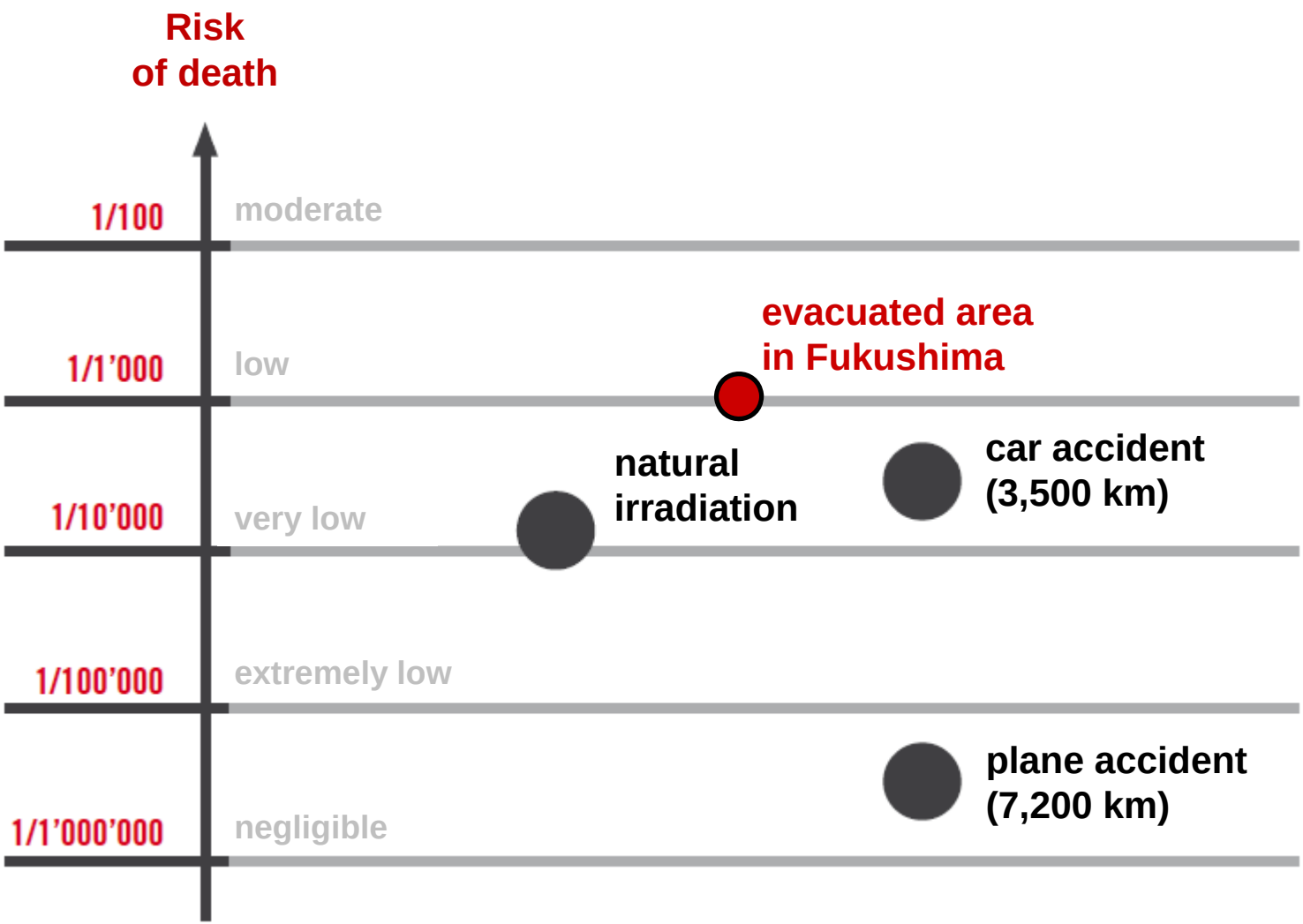


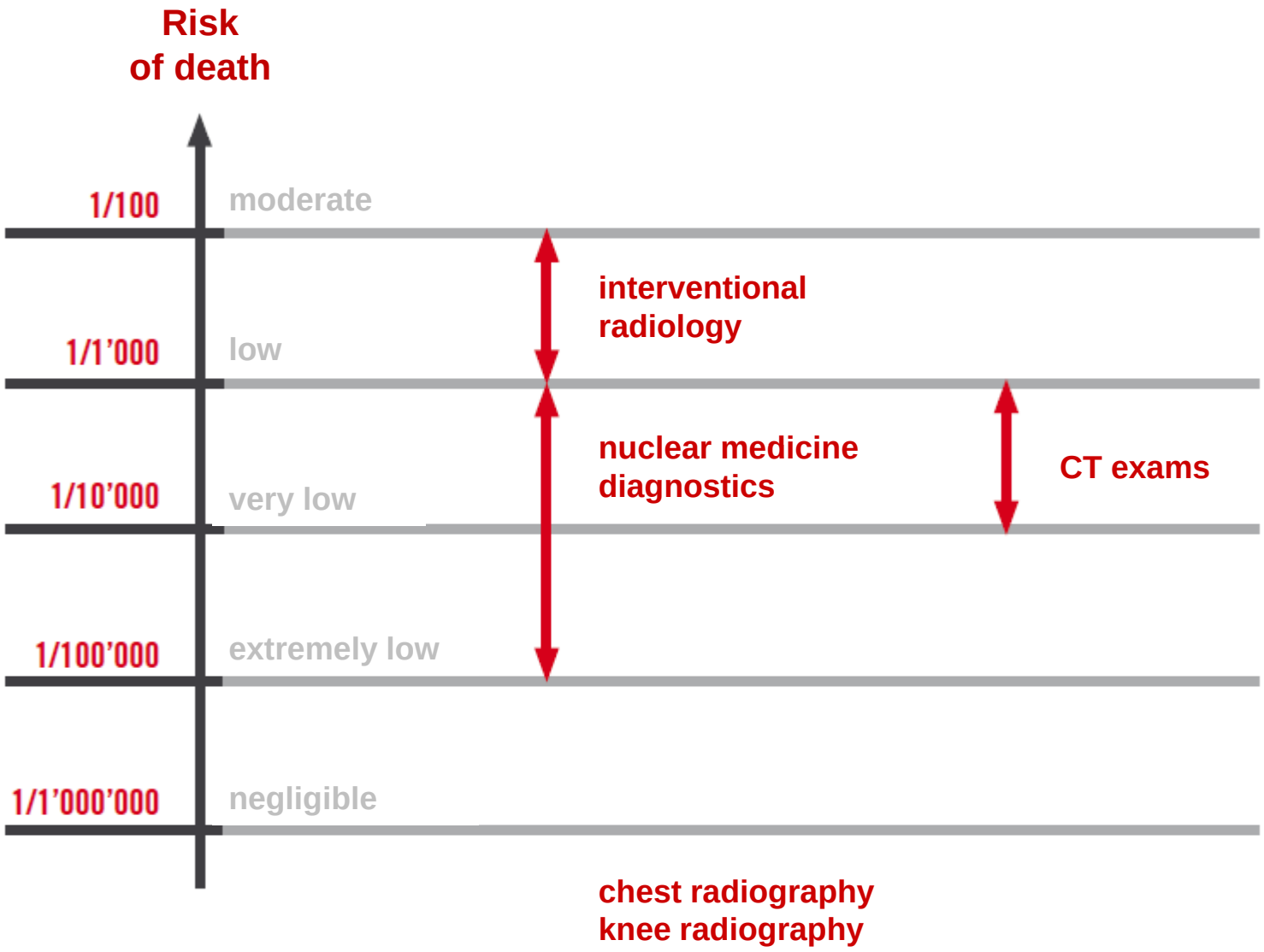
More than 20 mSv in the first year: evacuated

medical radiology

in 2008, the
"average Swiss"
received **1.2 mSv/an**

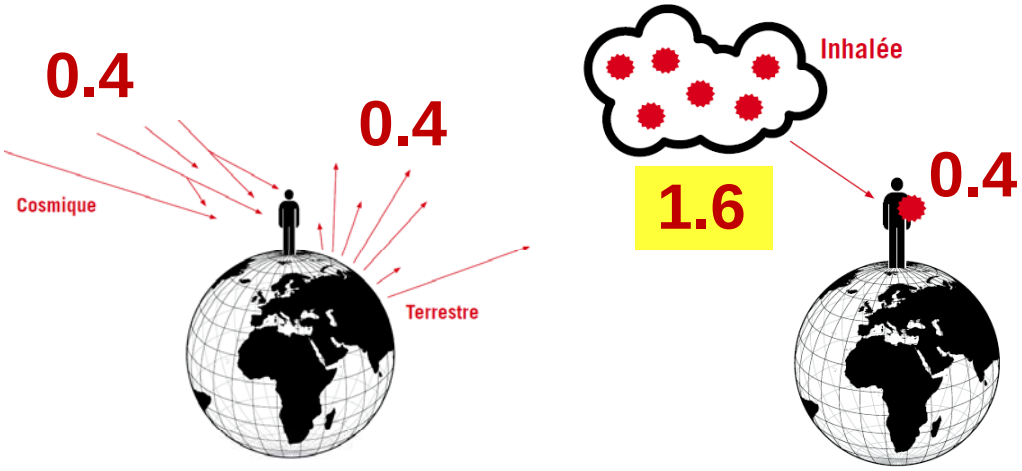
(large variations)
(in doses)
(in ages)


Risk
of death
1/100
moderate
1/1'000
low
evacuated area
in Fukushima
1/10'000
very low
natural
irradiation
car accident
(3,500 km)
1/100'000
extremely low
plane accident
(7,200 km)
1/1'000'000
negligible


Risk
of death
1/100
moderate
1/1'000
low
1/10'000
very low
1/100'000
extremely low
1/1'000'000
negligible
interventional
radiology
nuclear medicine
diagnostics
CT exams
chest radiography
knee radiography

Conclusion

- **High doses** of radiation have early effects
- **Low doses** of radiation can cause **cancer**
- Radiations are **omnipresent**
  - The main component of the dose is natural with **2.8 mSv/y**
  - Radon gas is the highest contribution



1.2

UNIL | Université de Lausanne