

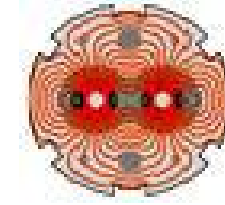
Personnel Protection in TCC2

Doris Forkel-Wirth (TIS-RP)

7 December 2001



Origin of Ionising Radiation

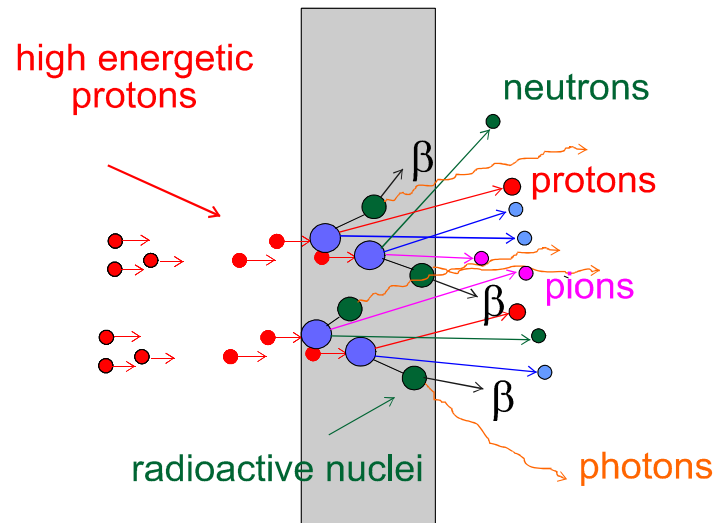


The operation of accelerators involves beam losses



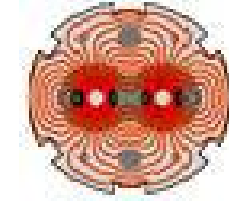
Stray radiation (hadrons, leptons, photons)

beam on





Origin of Ionising Radiation

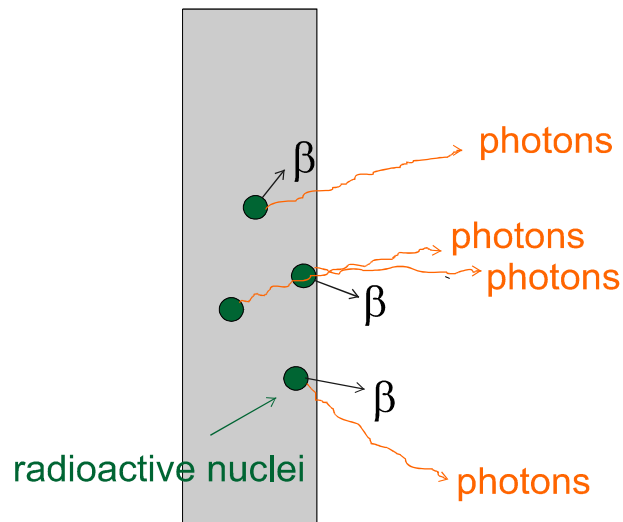


The operation of accelerators involves beam losses



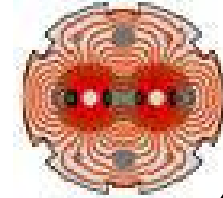
Induced radioactivity in accelerator components, air, water...

beam off





Absorbed Dose



ICRU definition:

The absorbed dose, D , is the quotient of dE by dm , where dE is the mean energy imparted by ionizing radiation to matter of mass dm , thus

$$D = dE/dm$$

Unit: J/kg or Gray
(Gy)

$$1 \text{ Gy} = 1 \text{ J/kg}$$

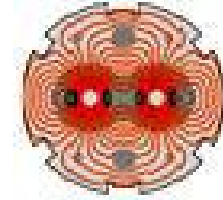
Reminder:

*4185 J heat 1 l of water by 1 K
but*

*3 mGy (gamma) result in 10 events per
cell*



Dose Equivalent



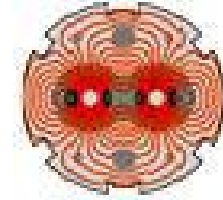
Describes the biological effectiveness of radiation

$$H_T = \sum_R w_R \cdot D_{T,R} \quad \text{Unit: Sievert (Sv)}$$

w_R :	photons:	1
	electrons, muons:	1
	neutrons:	
	< 10 keV:	5
	< 100 keV:	10
	< 2 MeV:	20
	< 20 MeV:	10
	> 20 MeV:	5
	alphas:	20



Effective Dose

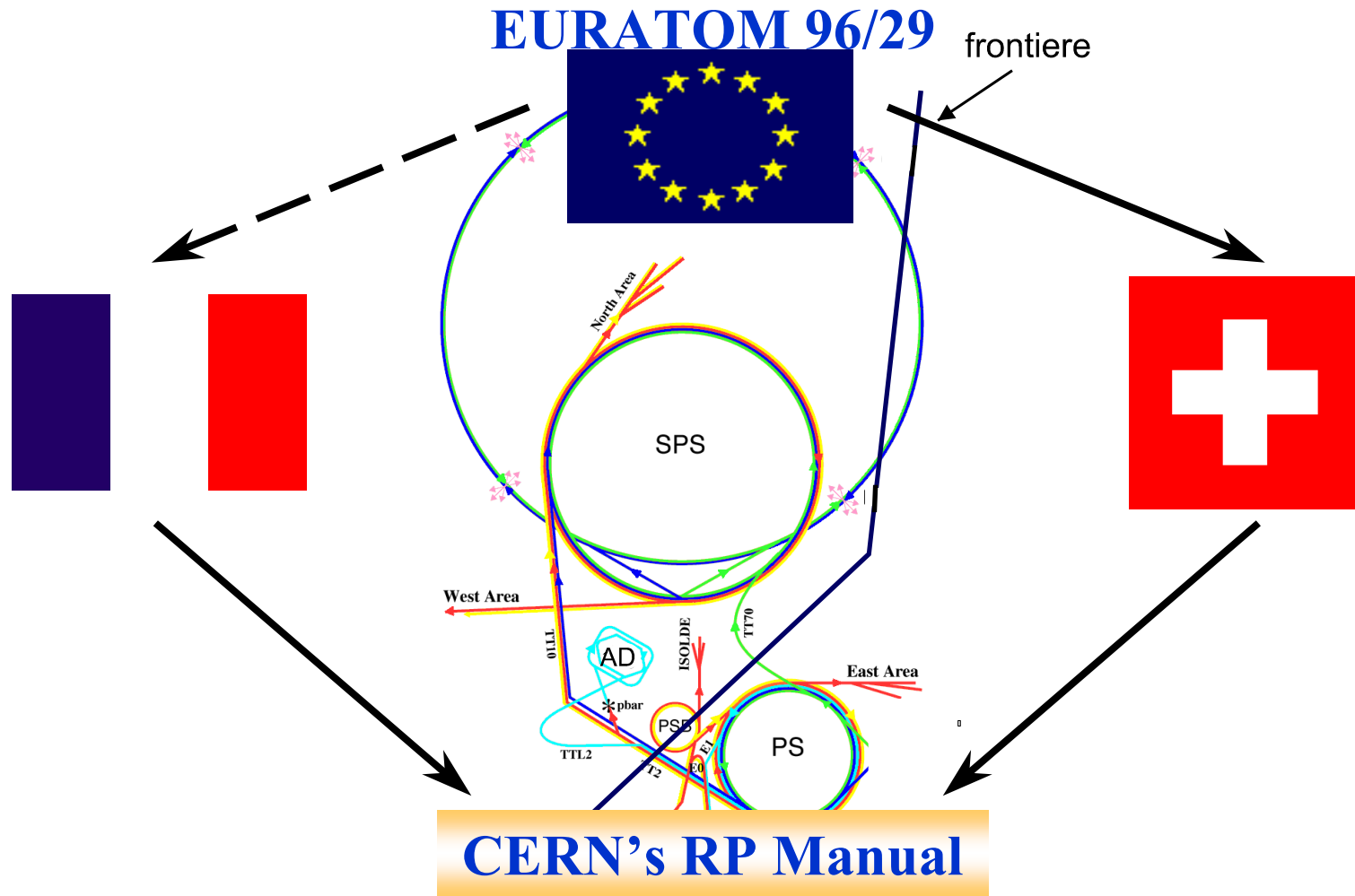
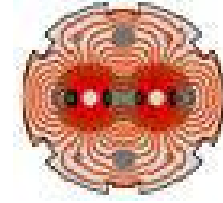


$$E = \sum_T w_T \cdot H_T = \sum_T w_T \sum_R w_R \cdot D_{T,R} \quad \text{Unit: Sievert (Sv)}$$

w_T	gonads:	0.2
	thyroids:	0.05
	skin:	0.01
	bone marrow (red):	0.12
	...	

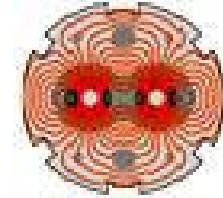


RP Legislation





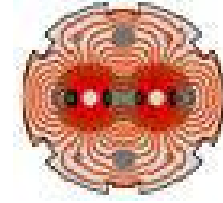
Dose Limits



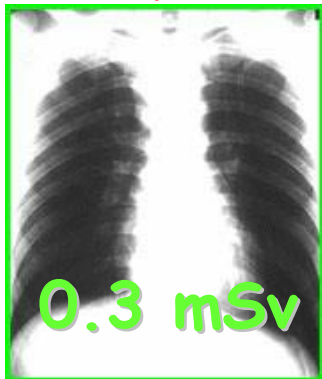
	<i>Limits per 12-months period (mSv)</i>		
	Public	Exposed Workers	
		B	A
EURATOM	< 1	< 6	< 20
Switzerland	< 1	< 20	
CERN	< 1	< 20	
France	< 5 1	< 5 6	< 50 20



Radiation Exposure



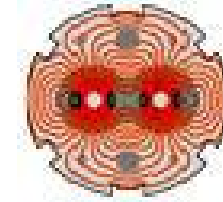
- Geneva area: 2 mSv/year
- Les Contamines: 4 mSv/year
- Chest X-ray: 0.3 mSv,
Computer tomography: 10 - 30 mSv
- Geneva - New York - Geneva: 30 μ Sv
- One month in outer space: 15 mSv



Thanks to M. Jonker / SL



Radiation Exposure Effects



• Lethal limits

- amoebas 3000 Sv
- escargot 200 Sv
- human 3 Sv (50% survival change)

• Non lethal direct effects:

- 700 mSv digestive problems
- 200 mSv bone marrow destruction
- Genetic effects

• Delayed effects:

- Cancer ... (400 mSv total dose during working live => 0.5 % chance to die on professional induced cancer)
- Unknown how effects scale to very low levels, due to built in repair mechanisms in human body

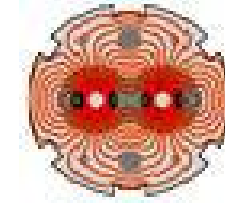
Note: the less primitive the live form, the less resistant it is against radiation.

Hence, intelligent live forms protect themselves against radiation.

Thanks to M. Jonker, SL

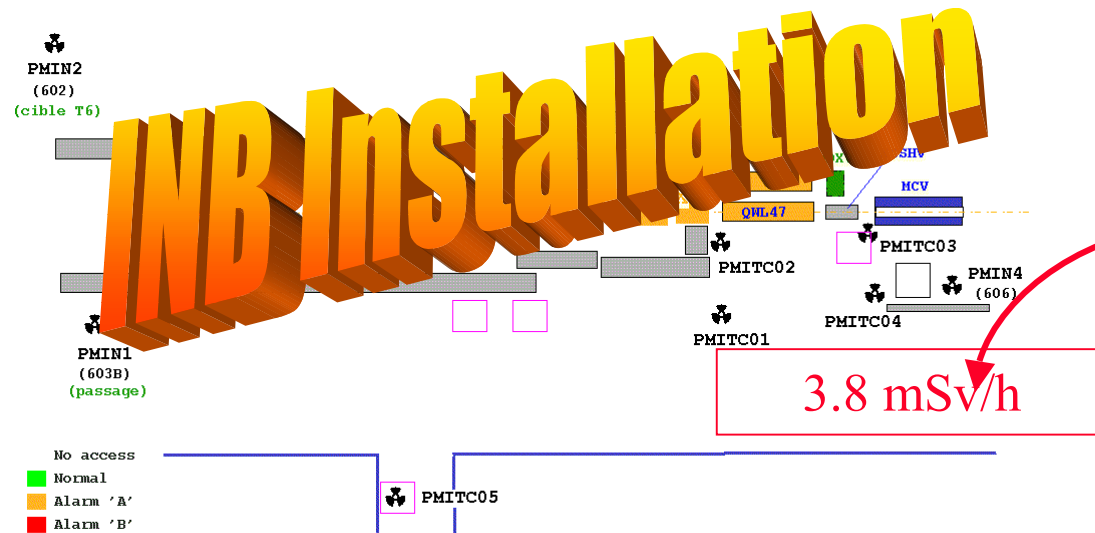


TCC2



ZONE TESTS EN TCC2

Access: some 100 microSv/h to some few mSv/h

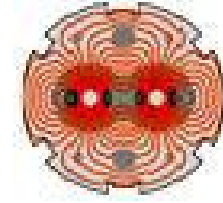


09/07/2001/jcg

Limited Stay Area, High Radiation Area



TCC2



Any person working TCC2 has to carry a **personal dosimeter and an operational dosimeter**

All work must be **authorized by the Divisional Radiation Safety Officer**

> **100 microSv/h**: All work must be planned

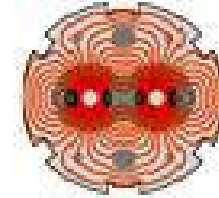
> **2 mSv/h**: close supervision by RP group
contract workers have to be on CDI

(J.O. Nr. 118 du 23 Mai 1998)

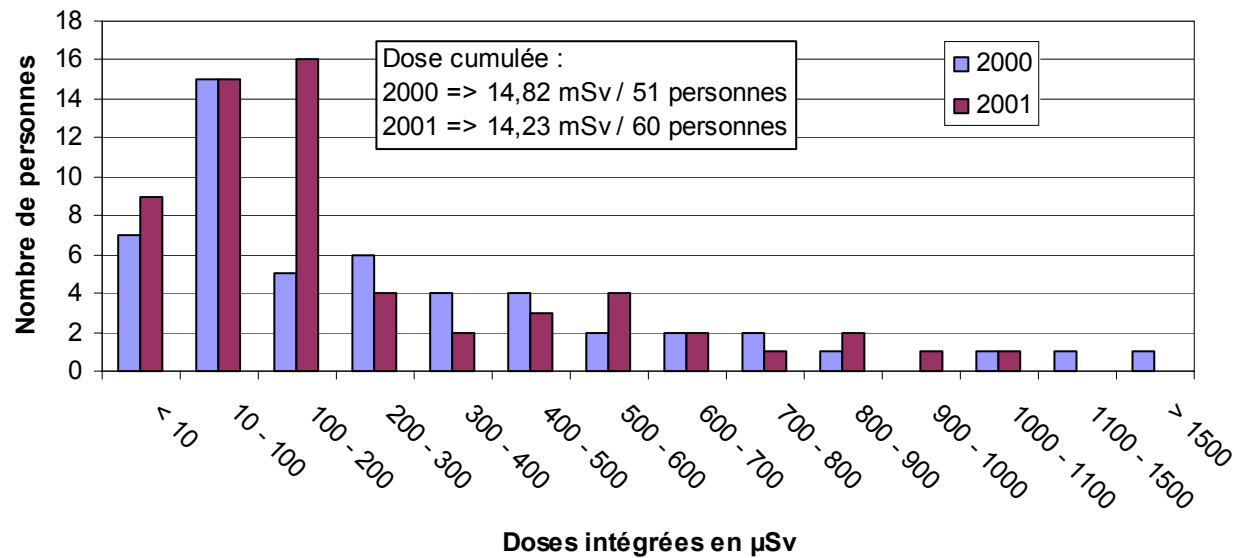
Tracing of all material leaving TCC2



Personnel doses

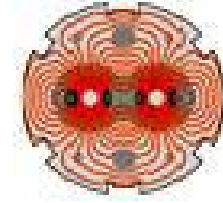


Répartition des doses pour les personnes intervenant sur la zone des tests "RADWG"





ALARA



Justification

Optimization

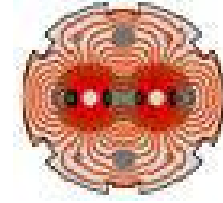
**TCC2: there is still room for improvement
(optimization)**

Ordonnance Suisse, Art. 6:

Le principe de l'optimisation est considéré comme respecté dans le cas des activités ne délivrant jamais une dose effective supérieure à 100 microSv par années aux personnes exposées aux rayonnements dans l'exercice de leur profession.....

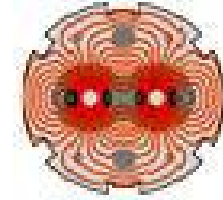


Access





Future



ALARA

Collaboration

RADWG, RSO-SL, TIS-RP-SL