The M2 Beam Line

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with help from

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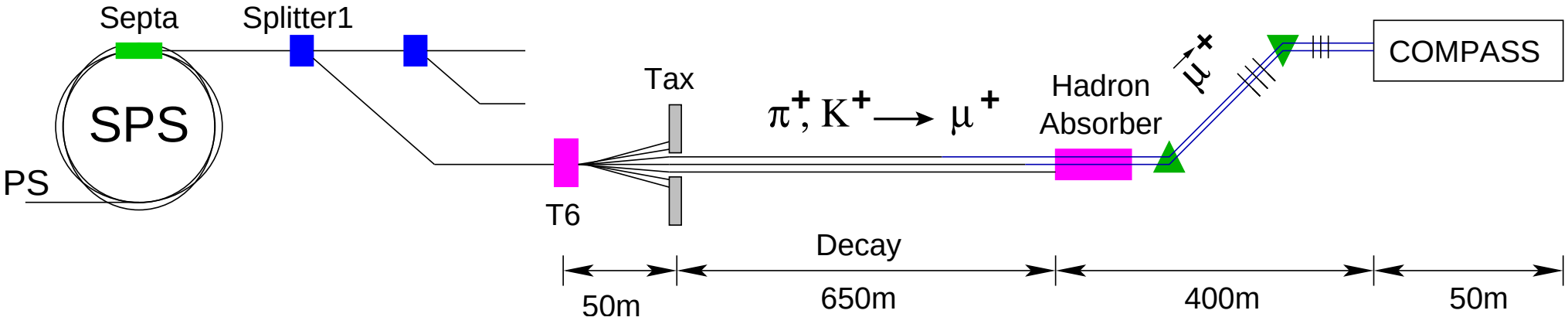
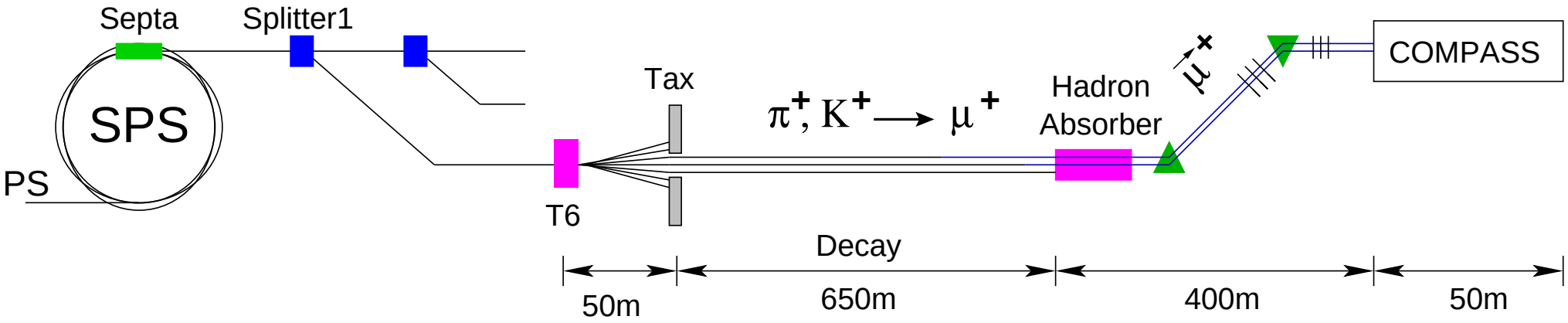
- From SPS protons to muons in COMPASS
- Consequences and limitations for 10 times more muons
  - In the muon part of the beam line
  - In the proton and hadron part of the beam line
- Summary/ Questions

From Protons in the SPS to Muons in COMPASS



- Beam extraction from SPS to the north (TT20) is done with three septa
  - One electro–static septum
  - Two magneto–static septa
- The extracted beam is then shared between the three main experimental halls: EHN1 (test-beam), EHN2 (Na58), EHN3 (Na48) by the means of splitter magnets
- SPS intensity: $190 \cdot 10^{11}$ protons about $125 \cdot 10^{11}$ for T6 = COMPASS

From Protons in the SPS to Muons in COMPASS



- T6 contains a set of air cooled beryllium targets with different lengths (4, 10 and 50 cm $= 5/4\,\lambda_I$)
- Tax1 and 2 are movable 3.2 m absorbers
  - Remove all unwanted particles
  - Block all hadrons in case of access
  - With bend1 and Collimator1/3 selection of momentum
- Beam momentum station around bend 6

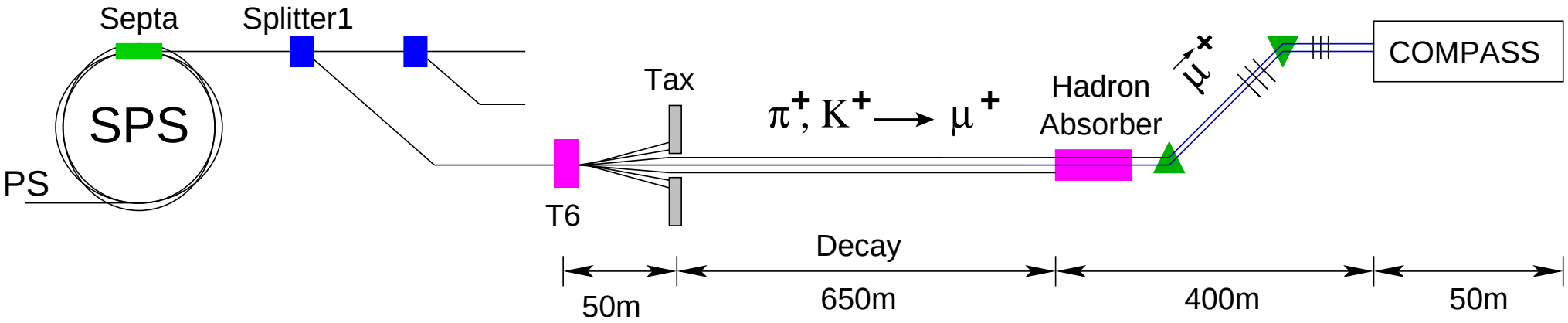
The High Intensity Scenario

What kind of limits will we meet if we would increase

the muon intensity to $2 \cdot 10^9$ per spill?

Let's start at the end, assuming that producing this muon flux is no problem

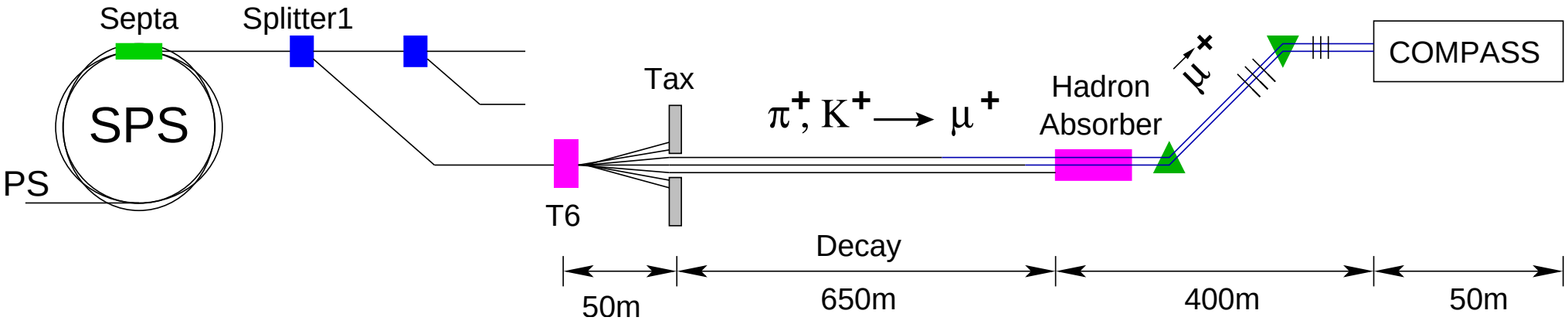
1st Limit: Radio protection (legal limit)



- Radiation level at the CERN fence 700 m after Bend 6. Two components:
  - Direct beam component passing 500 m of earth
  - Halo component missing bend 6 (33 mrad)
  - Limits: 10 μSv/a integral, 0.5 μSv/h peak $\Rightarrow$ to be measured this year
- Radiation levels in TT20

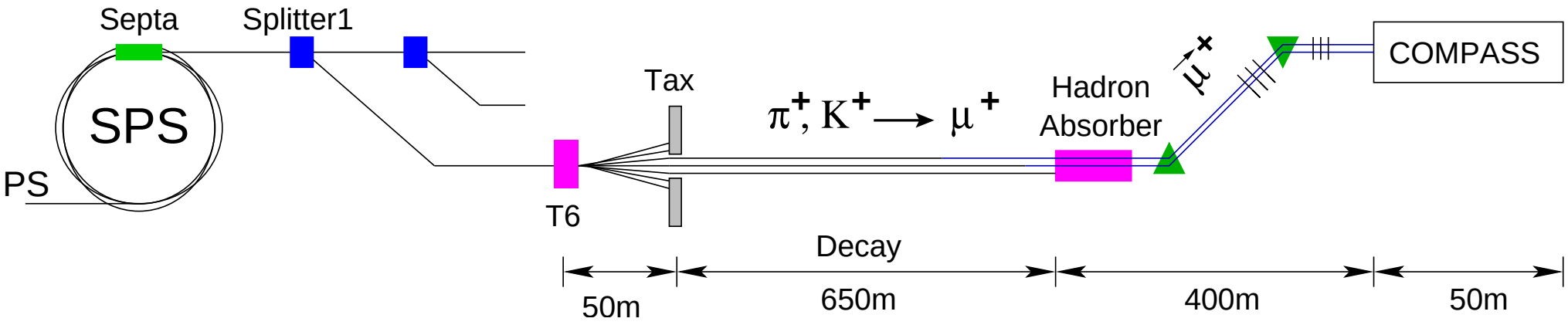
$\Rightarrow$ Beam line study needed (beam losses, possible accidents,...)
no manpower from SC before September

2nd Limit: Beam Halo



- Today we have about 25 % of the muon intensity as halo (outside a 4 cm diameter region around the beam).
- Halo Sources are believed to be:
  - Scraper 4 & 5 which define p_μ and Δp_μ
  - Halo π can produce halo μ
  - Where does the halo component parallel to the beam come from?
- Halo studies needed (both MC and Measurement). Was already done when upgrading M2 for SMC. More beam diagnostics? More MIBs (1 MIB = 500 kCHF)?

3rd Limit: Beam Momentum Measurement



- Single strip rates: now 1 MHz
- Time window to scifi: 4 ns $\Rightarrow$ now 15 % double hits
- Time information not enough to connect momentum and track $\Rightarrow$ beam tracking needed (would be also helpful for beam diagnosis).

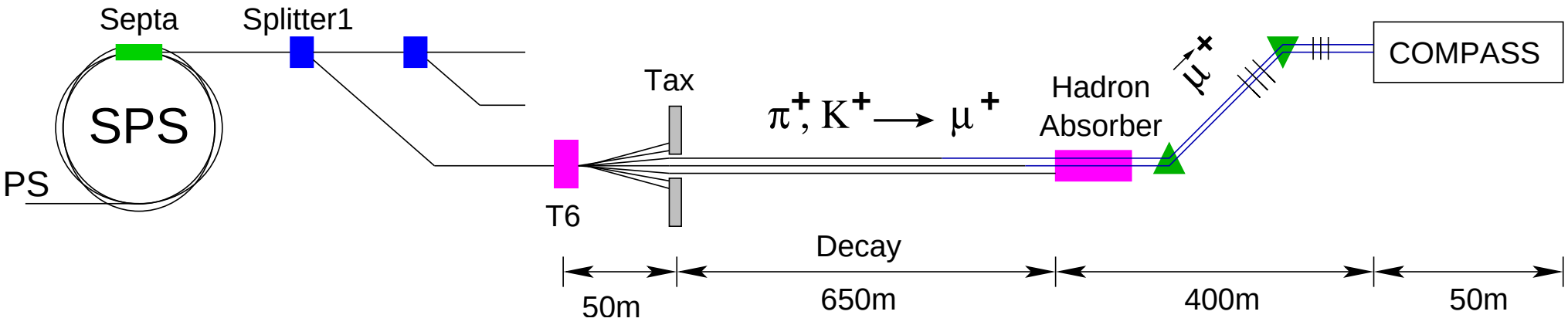
The High Intensity Scenario

What kind of limits will we meet if we would increase

the muon intensity to $2 \cdot 10^9$ per spill?

Let's move to the proton/ hadron section of the beam line. Here I have to make an assumption to estimate the necessary increase on the proton flux. In a very optimistic scenario with e.g. $E_\mu \leq 100\,\text{GeV}$ $600 \cdot 10^{11}$ protons/spill (5 times todays flux) could be sufficient.

4th Limit: Proton Rate on T6 and Tax

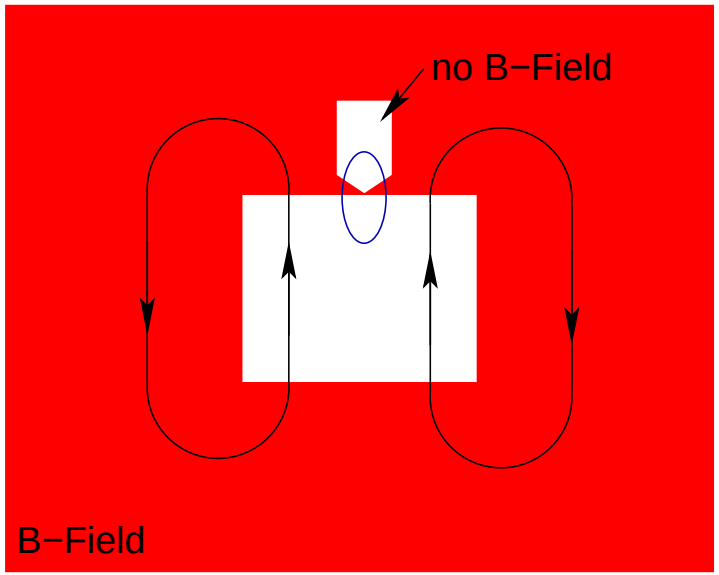


- For the moment T6 is believed to impose the strictest limit on the proton flux: built for $100 \cdot 10^{11}$ protons/spill
- The tax system has also to be able to absorb the full beam
- It is excluded that these systems can handle a 5 times higher beam intensity
- Calculation of the limits should be done (Lau)

4th Limit: Proton Rate on T6 and Tax

5th Limit: Splitter Magnets

Splitter Magnet

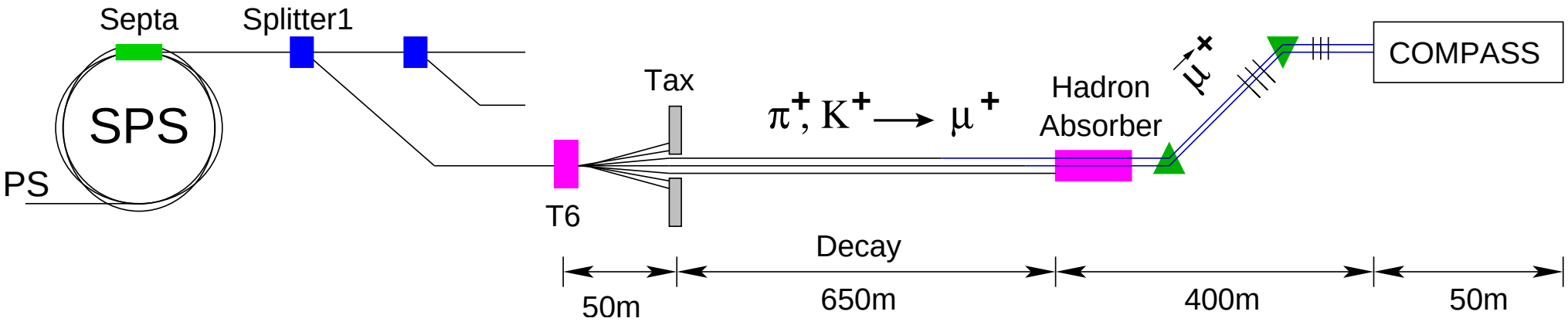


- The splitter magnets cause a beam loss of 10 % $\Rightarrow$ radiation
  - Corrosion/ destruction of cables and vacuum elements
  - Decrease of maintainability
- Problems if almost all beam goes to T6:
  - The aperture of splitter not big enough $\Rightarrow$ new beam optics?
  - Instable beam for the other targets

- Improvement of beam diagnostics (e.g. more beam loss monitors)
- Exchange of splitters?

5th Limit: Splitter Magnets

6th Limit: Septa



- Also for the Septa nobody knows how far they can work as they have never been operated at higher intensities than today.

6th Limit: Septa

Summary

- Increasing the muon intensity is not for free. There are two levels:
  1. In a very optimistic scenario with $E_\mu \leq 100\,\text{GeV}$ an increase by a factor of 2 might be possible without major changes in the hadron/ proton section.
  2. A higher increase would cause major change of the TT20
- In all cases work has to be invested in the study of the beam line (MC and measurement) and on the radiation protection sector
- We must decide now, which way to go (option 1 or 2) and what should be the prepared for the "Vilar paper". Time is short and there is not much manpower (Lau, ...?)
- Input needed from physics working groups to nail down the wanted beam parameter.
- More issues and requests towards the beam: Improve focus, ...
- No "show–stopper" identified yet