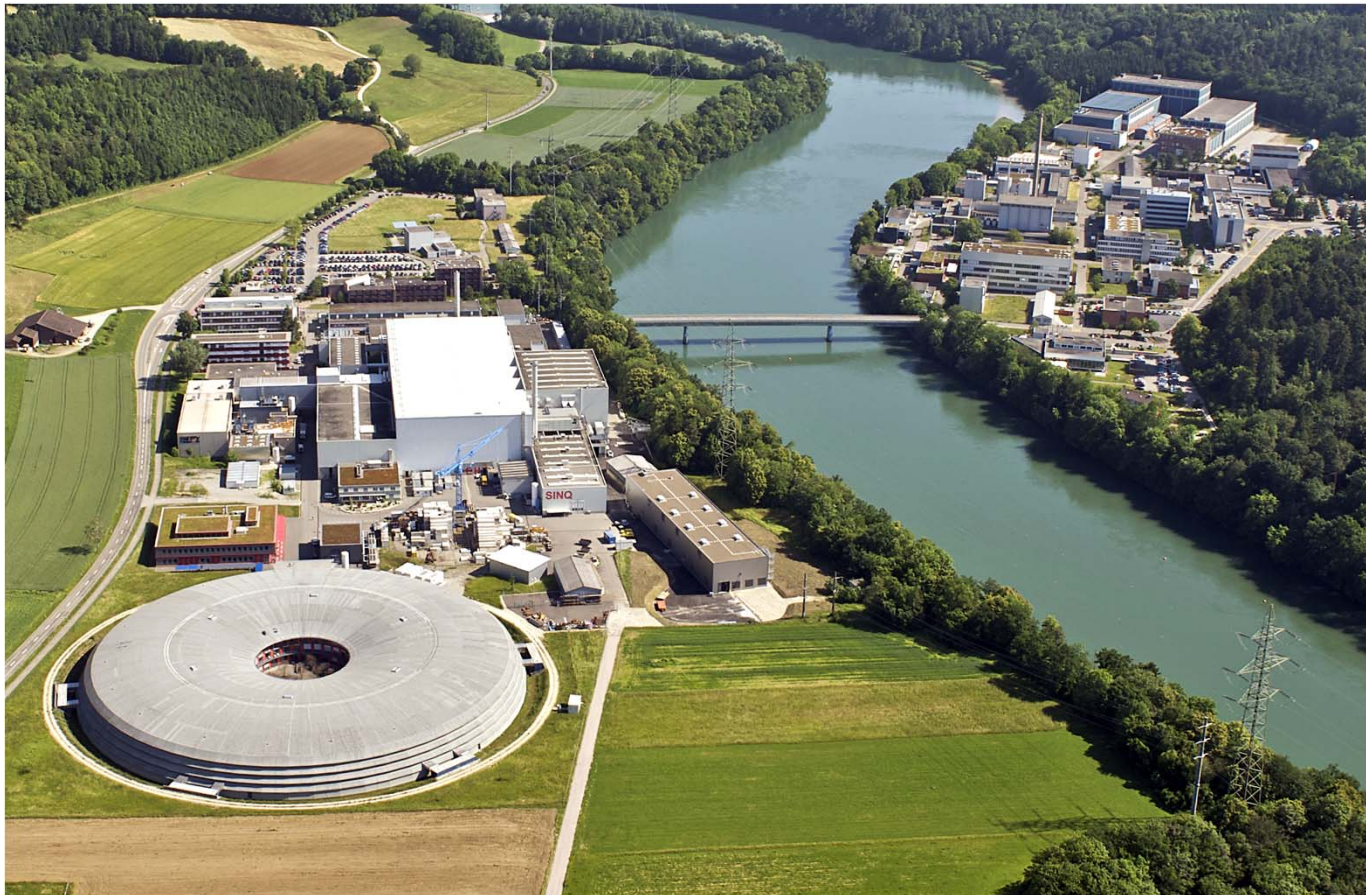


Evaluation of STPA in the Safety Analysis of the Gantry 2 Proton Radiation Therapy System

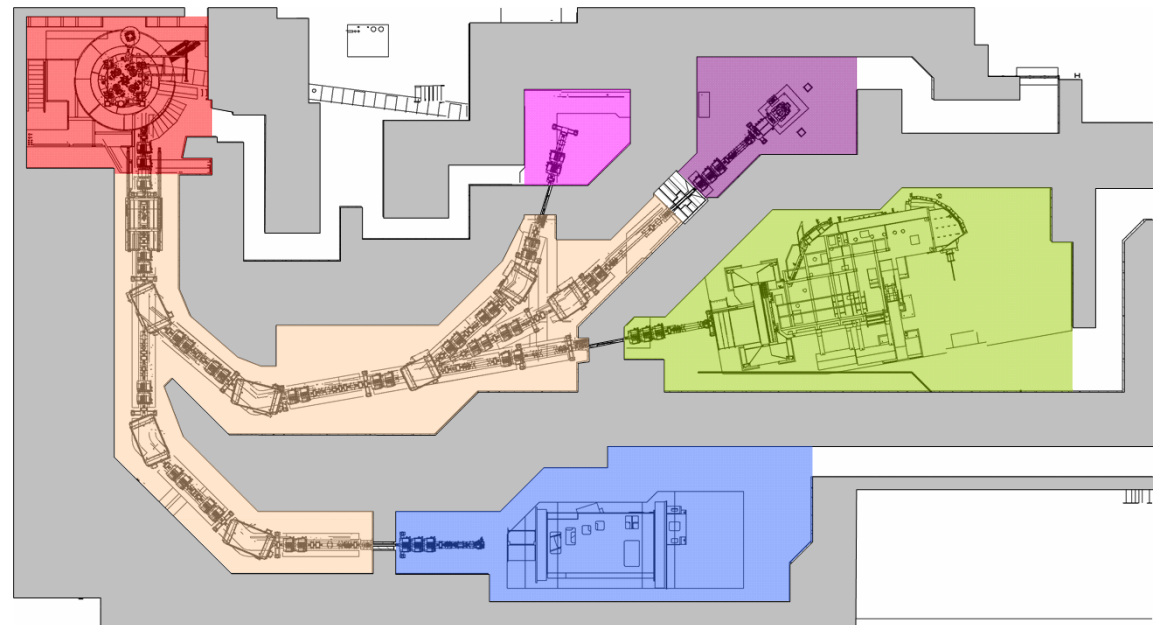
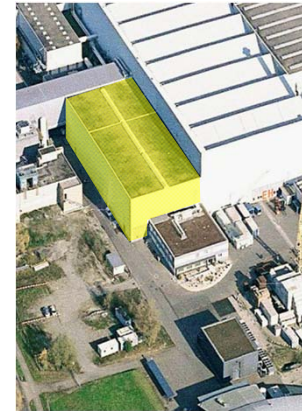


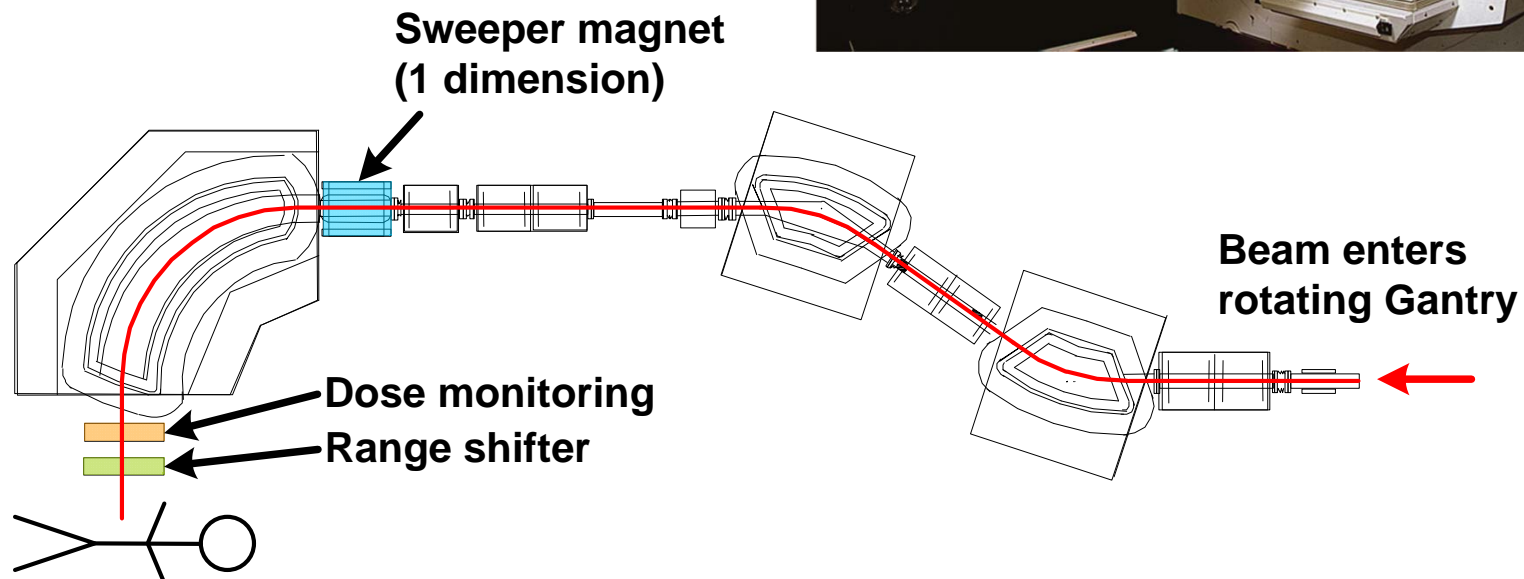
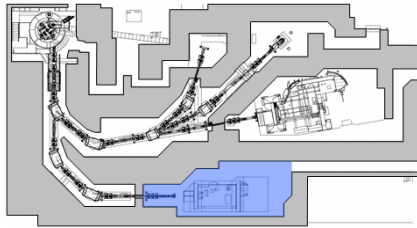
Martin Rejzek, Paul Scherrer Institute, Switzerland

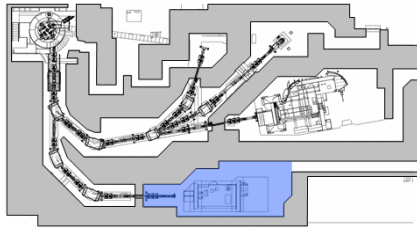
- Proton Therapy at the Paul Scherrer Institute, Switzerland
- Evaluation of STPA for the Advanced Scanning Technique
 - Scope of the Project
 - Examples
- Conclusions

Proton Therapy at the Paul Scherrer Institute, Switzerland

- 250 MeV Proton accelerator (superconducting cyclotron)
- Beamlines to 4 user areas
- OPTIS
- Gantry 1
- Gantry 2
- Experimental area

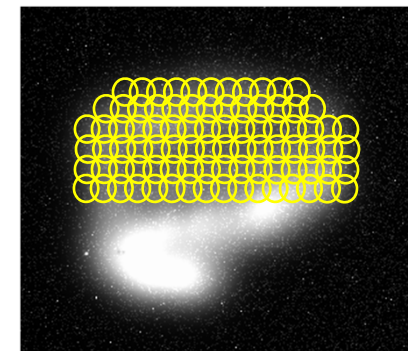


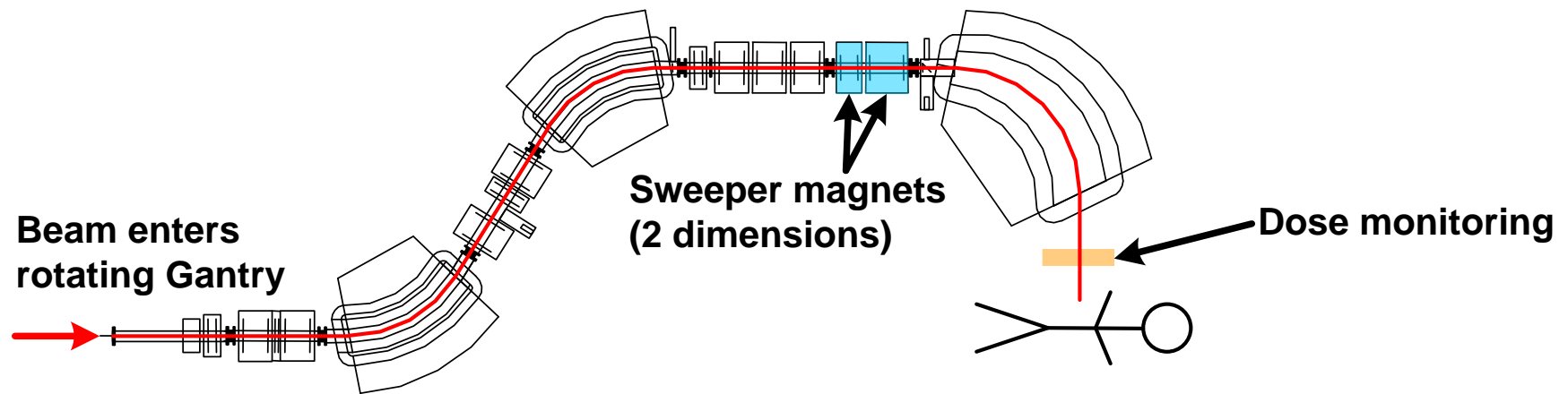
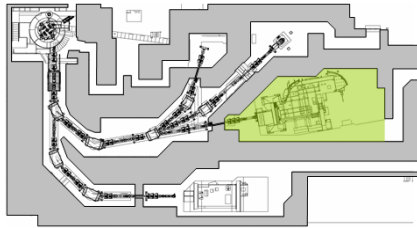


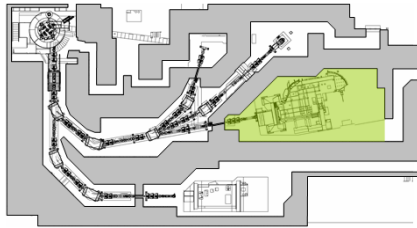


Elements of spot scanning:

- Beam on/off 50 μ s
 - Sweeper magnet 5 ms/step
 - Range shifter 30 ms
 - Patient table 1 cm/s
-
- 10'000 spots to treat 1 liter volume

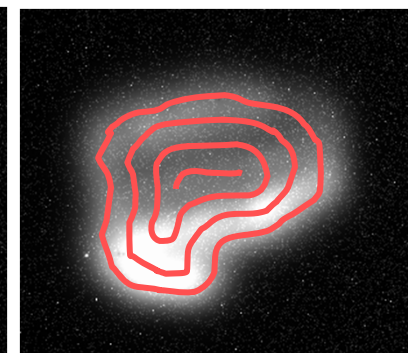
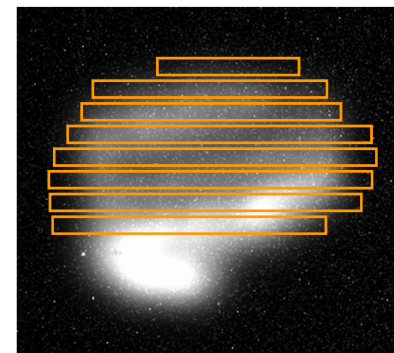
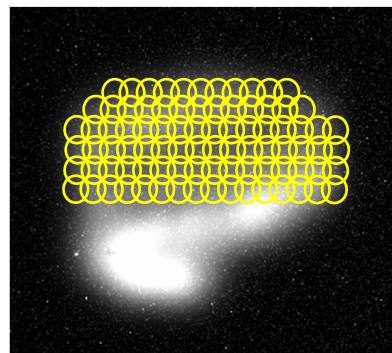






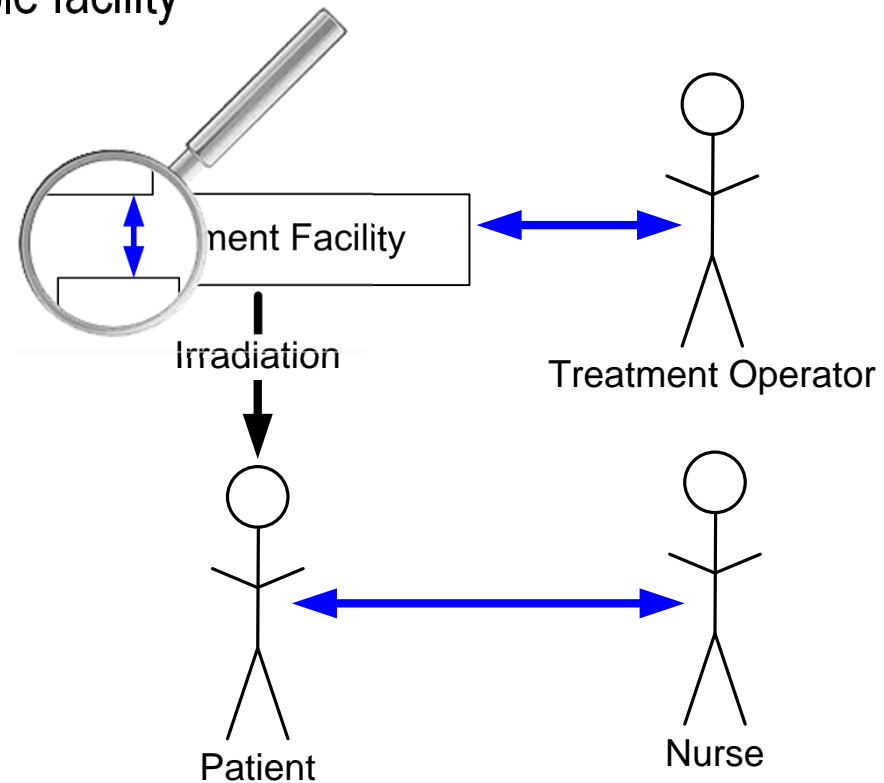
Advanced scanning:

- Increased speed
- Increased flexibility
- New treatment modalities



Evaluation of STPA for the Advanced Scanning Technique

- Safety analysis done with classical methods
- Evaluation of STPA as supplementary method for advanced scanning
 - explored different approaches
 - considered different parts of whole facility
- Few examples:
 - 1) STPA during workshops
 - 2) How to model controllers that can insert „veto“
 - 3) What is the reference for inadequate timing and the „Thomas process“



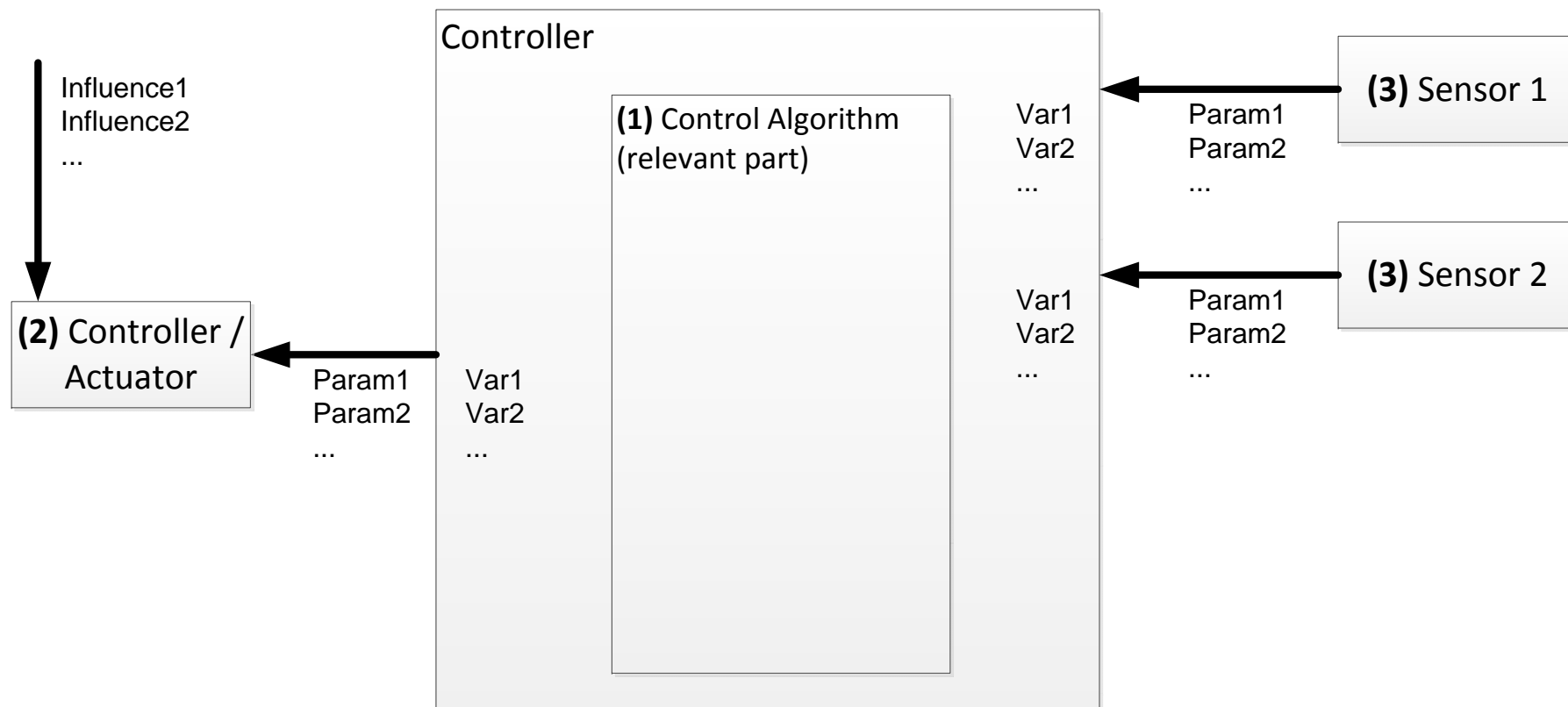
Evaluation of STPA for the Advanced Scanning Technique

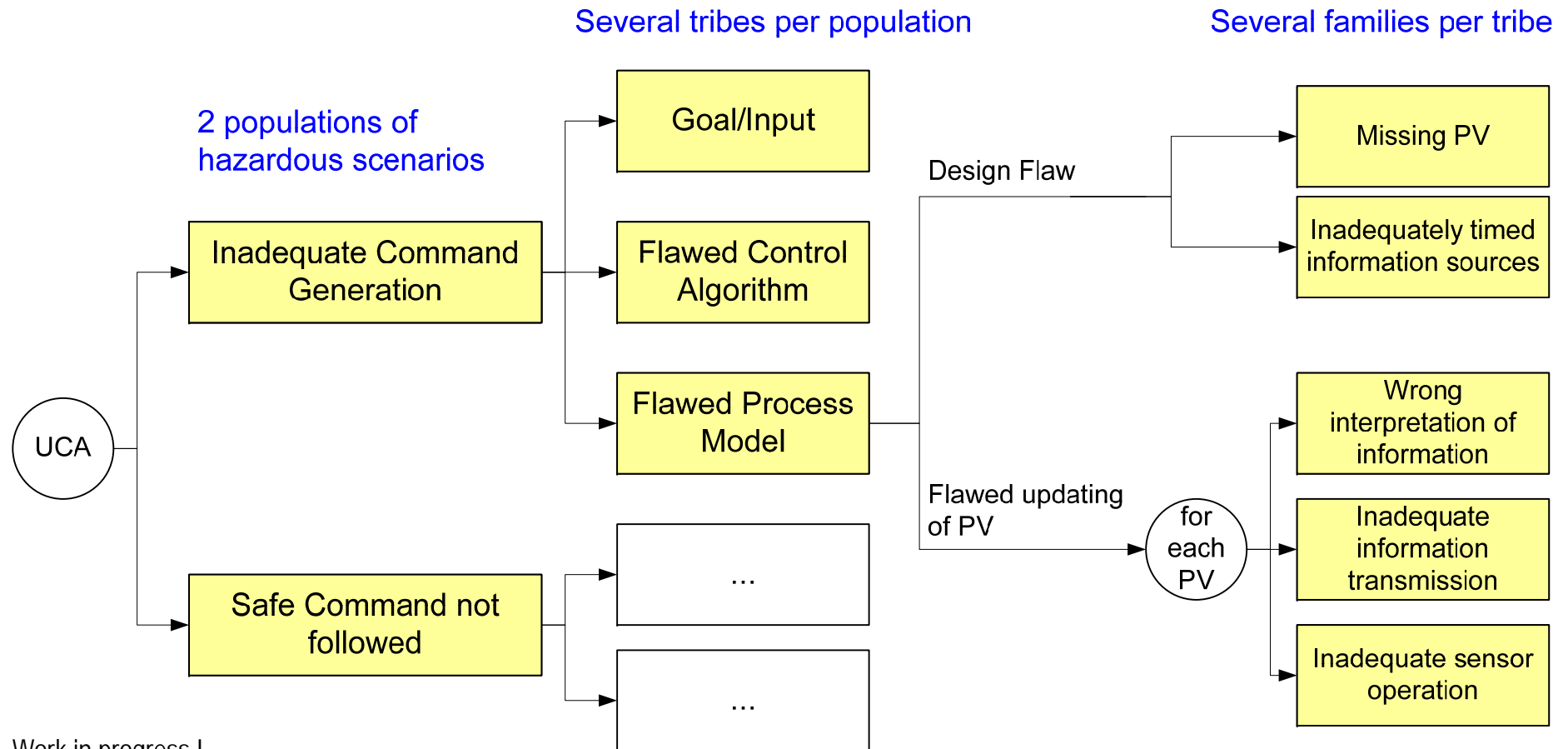
1) Performing STPA during workshops

- Performing STPA analysis during workshop with engineers
 - Preparation: Hierarchical control structure / high-level hazards
 - Table with guidewords

Nr	Hazard	Potential problem	Additional condition for hazardous state		
Control command:					
Not provided / Not followed					
Given when not expected					
Expected but too early					
Expected but too late					
Stopped too soon					
Applied too long					

- Performing STPA analysis during workshop with engineers
 - Preparation: Hierarchical control structure / high-level hazards
 - Table with guidewords
 - Reduced process loop





Work in progress !

UCA = Unsafe Control Action

PV = Process Variable

Evaluation of STPA for the Advanced Scanning Technique

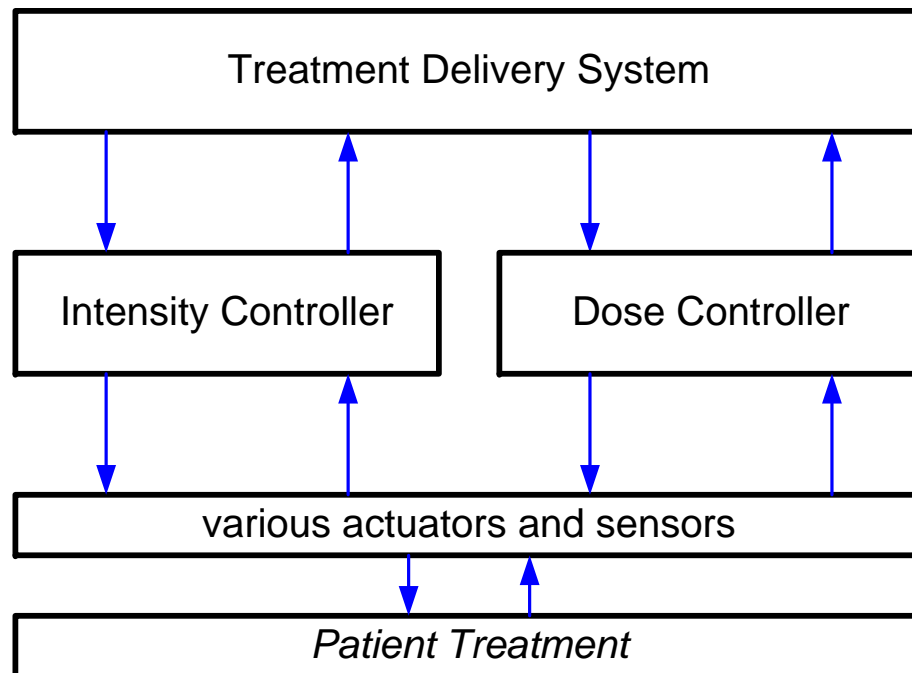
2) How to model controllers which can insert “veto”

Typical Situation:

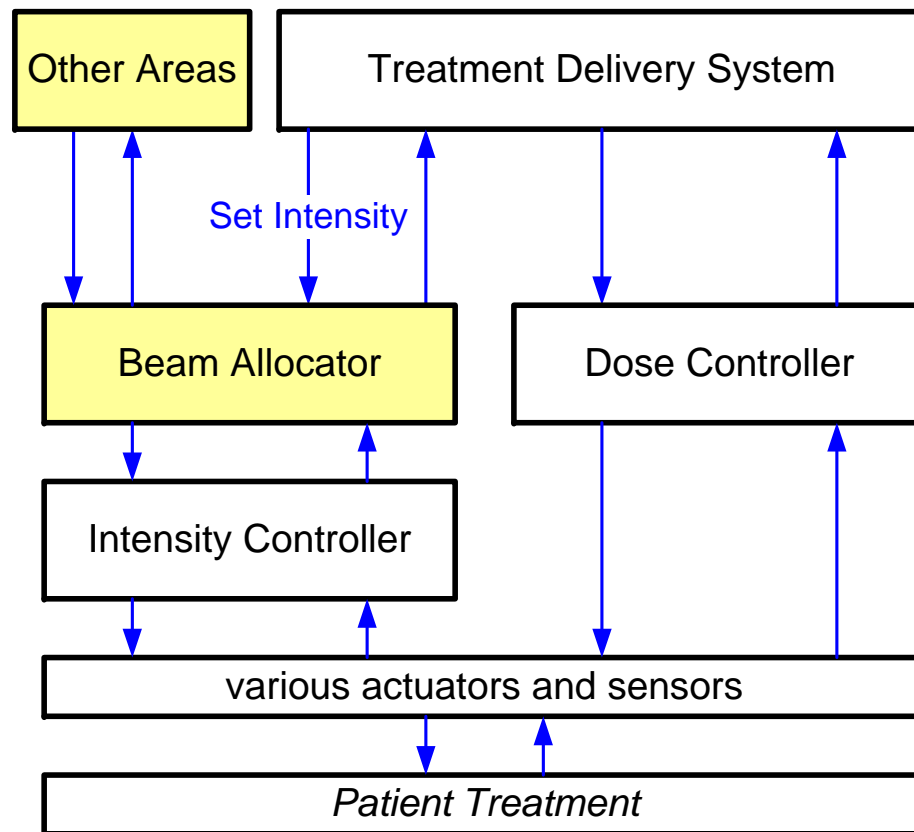
- One Treatment Delivery System (TDS)

In Proton Therapy:

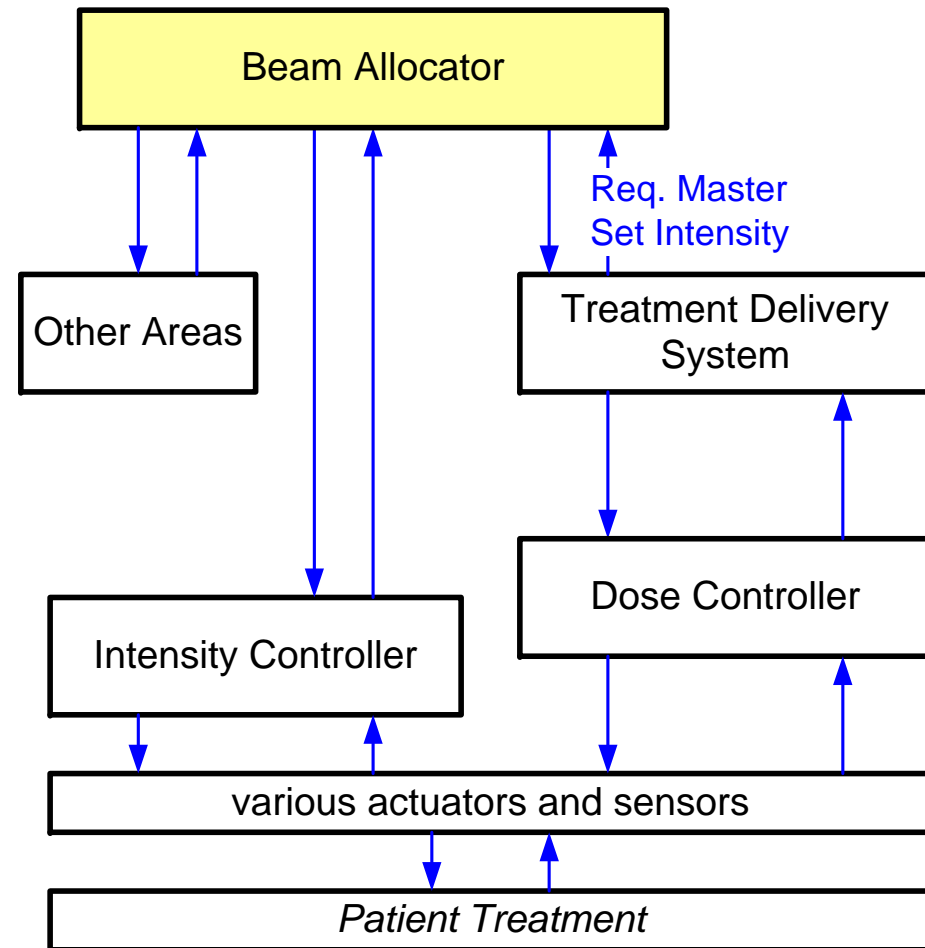
- One source of beam for all treatment areas



First approach:

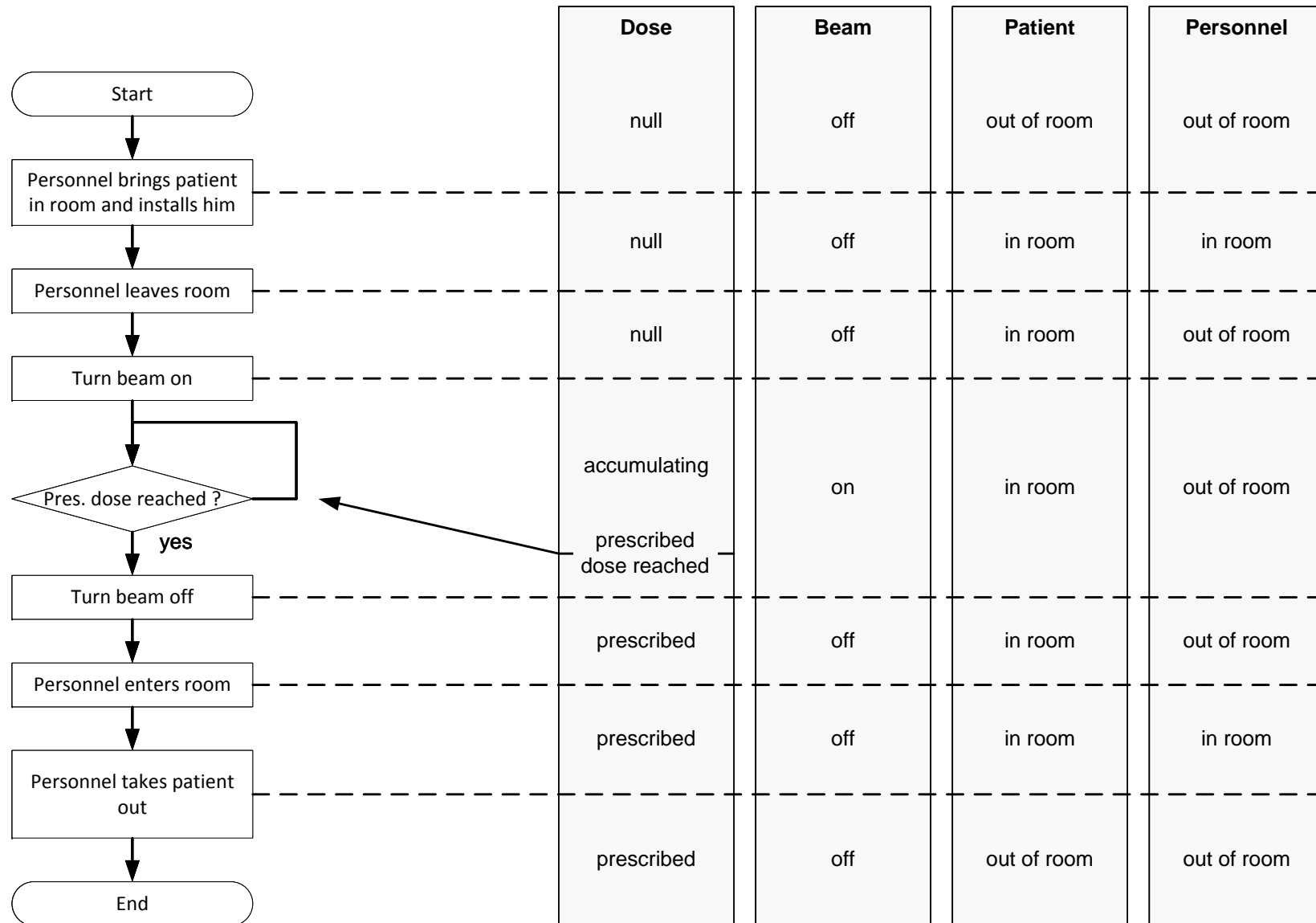


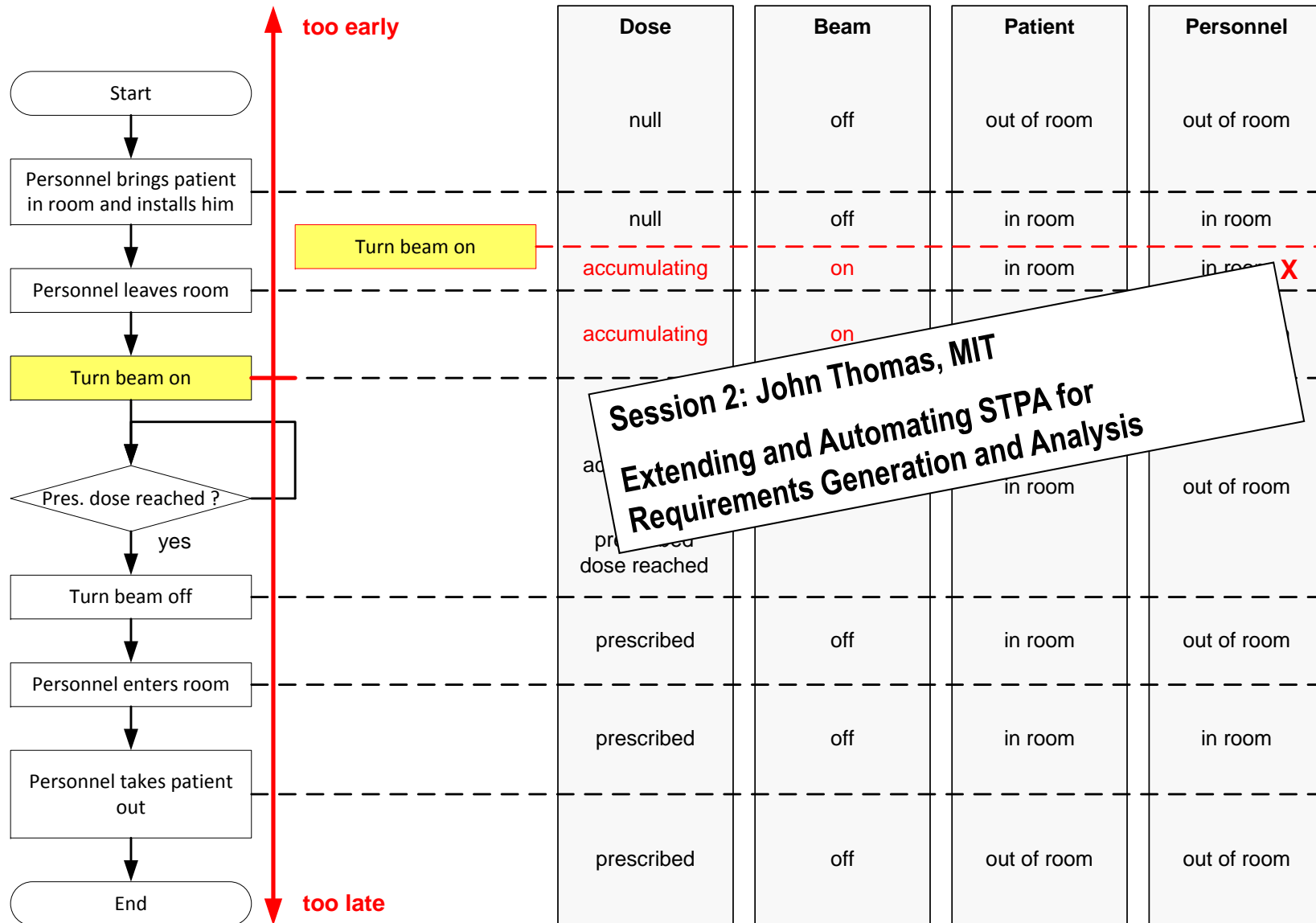
Second approach:



Evaluation of STPA for the Advanced Scanning Technique

3) What is the reference for inadequate timing





Session 2: John Thomas, MIT
Extending and Automating STPA for
Requirements Generation and Analysis

- STPA is a very useful method
 - Results achievable in straitforward way and rather short time
 - Feasible to perform with non safety experts
 - Discussion points raised for components not yet developed
- Next steps
 - Finish this project
 - Compare Results with those of existing safety analysis
 - hopefully continue with STPA method

Acknowledgments

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[Paul Scherrer Institute, CH](#)

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