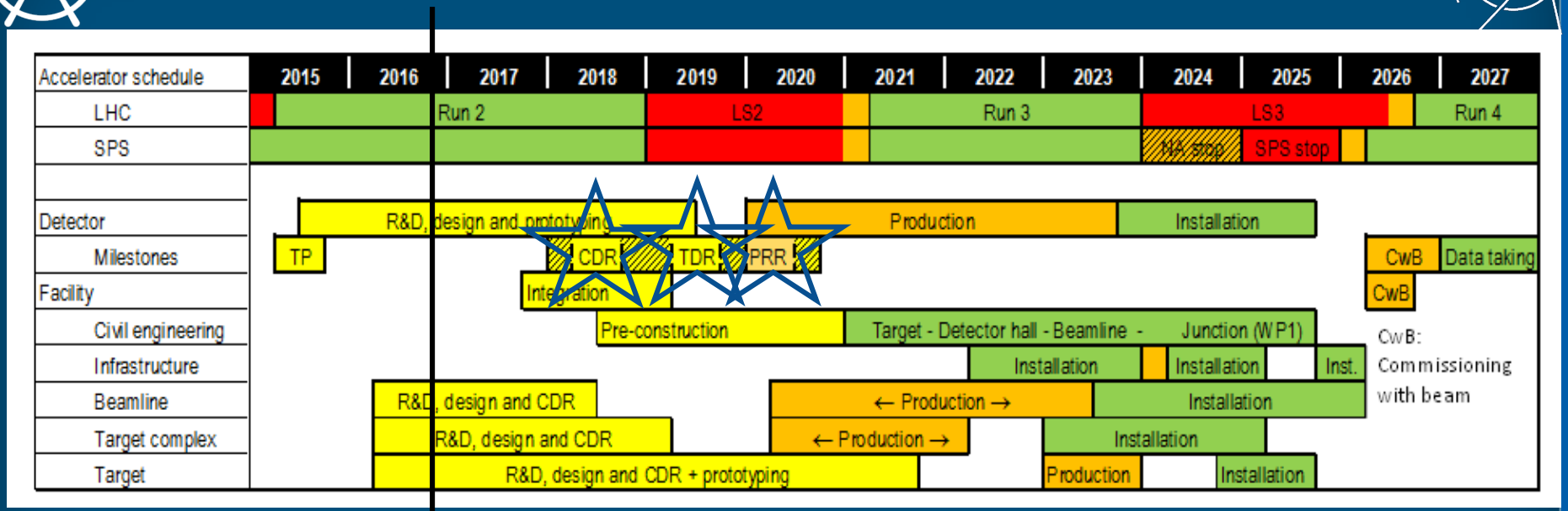
SHiP
Search for Hidden Particles

CDR planning

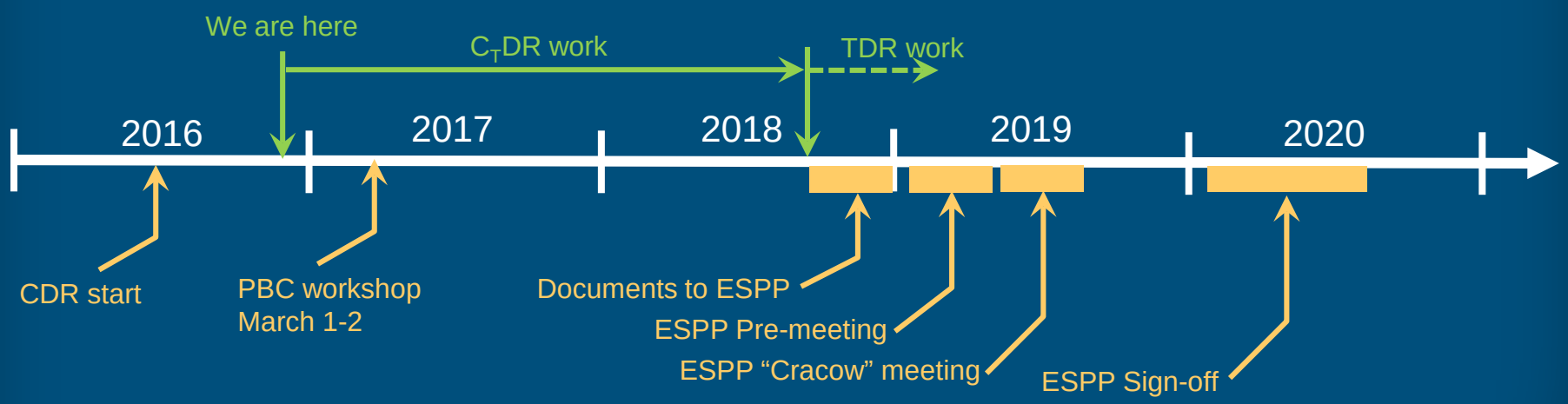
SHiP "TP version" → "Imperial version" → CDR version!

Richard Jacobsson

Global schedule



Reason for the "18-21 months to CDR":



→ Be reviewed by SPSC during CDR phase in order to transition to TDR

CDR planning

- Time line for the TDR phase is critical ➔ CDR is *ON* the path to TDR
- CDR phase products:
  - ➔ Notes, conference talks, publications (see Walter's talk) and CDR(eport) to ESPP panel
- CDR principal contents:
  - Updated motivation and physics programme
  - Updated detector description (assume shortish)
  - Updated performance
  - Updated project organization
  - Update cost and schedule (compiled together with BDF)
  - \+ comprehensive design of Beam Dump Facility (see Mike Lamont's talk)
- Complementary documents
  - Publications on physics and performance
  - Detailed detector description
  - Detailed planning
  - Preliminary Safety File
- Technology decisions (≠ engineering decisions)?
  - For some detectors we may arrive at CDR without making the choice
  - Not for critical items: muon shield, decay volume, (HS tracker)

CDR "progress tracking"

- A subject of interest/importance to everyone!

➔ Thursday "SHiP Joint Physics and Detector meeting" is THE forum

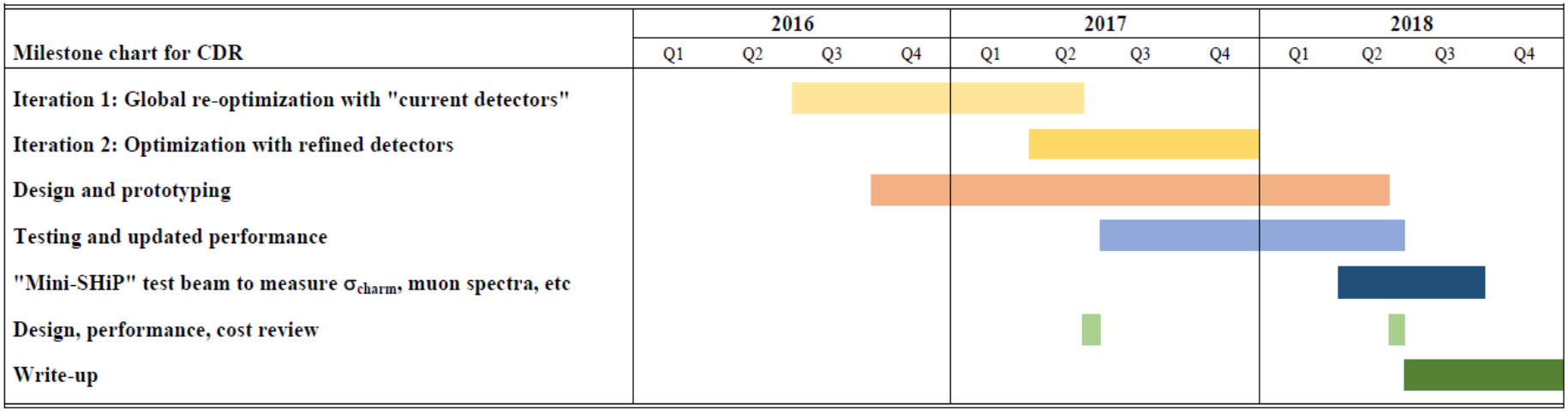
to discuss ideas and progress, and ask questions!

Essential to stay connected, coherent, consistent, etc etc

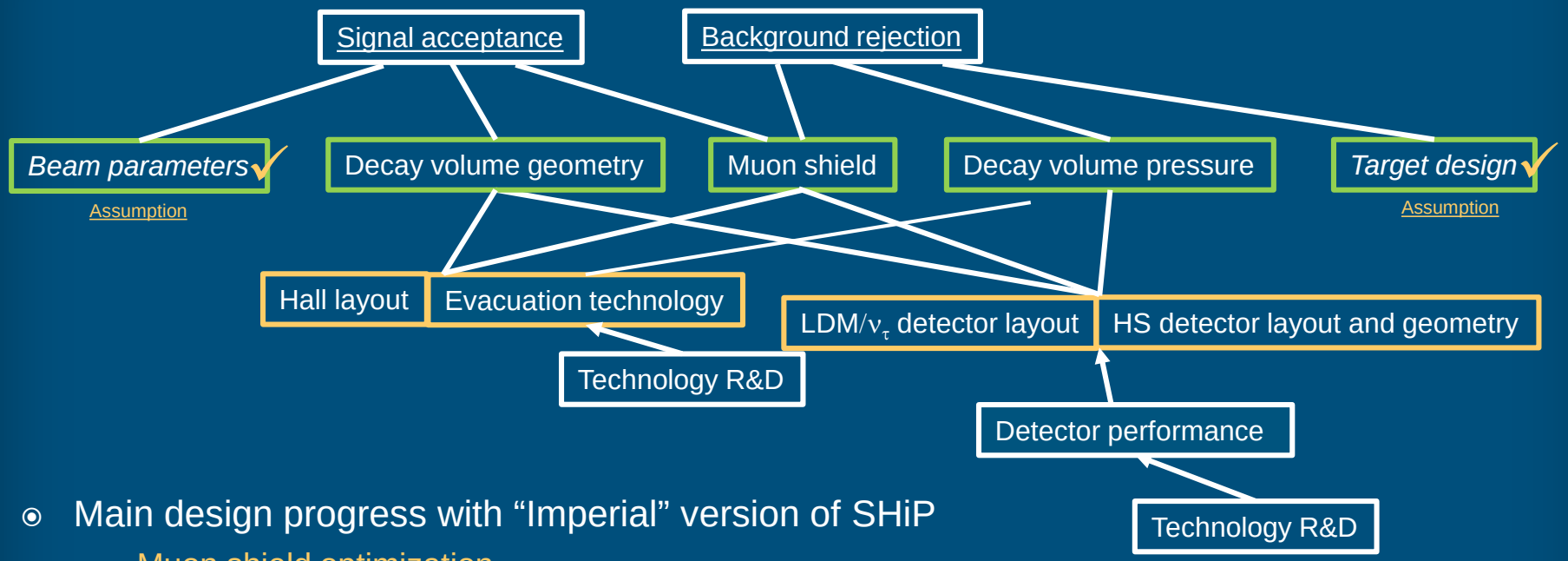
Please, join in! Suggestion for topic, ask Nico or me

- Formally we will setup a clear list of milestones (we do have one from TP review...):
  - Physics Planning Group
  - Technical Board (propose first meeting next Friday)

- CDR "Design" review of critical items (muon shield, decay volume, …)



Re-optimization – first iteration

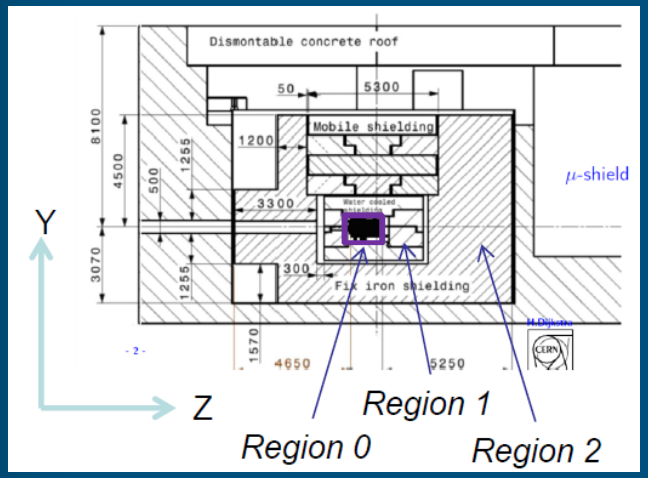


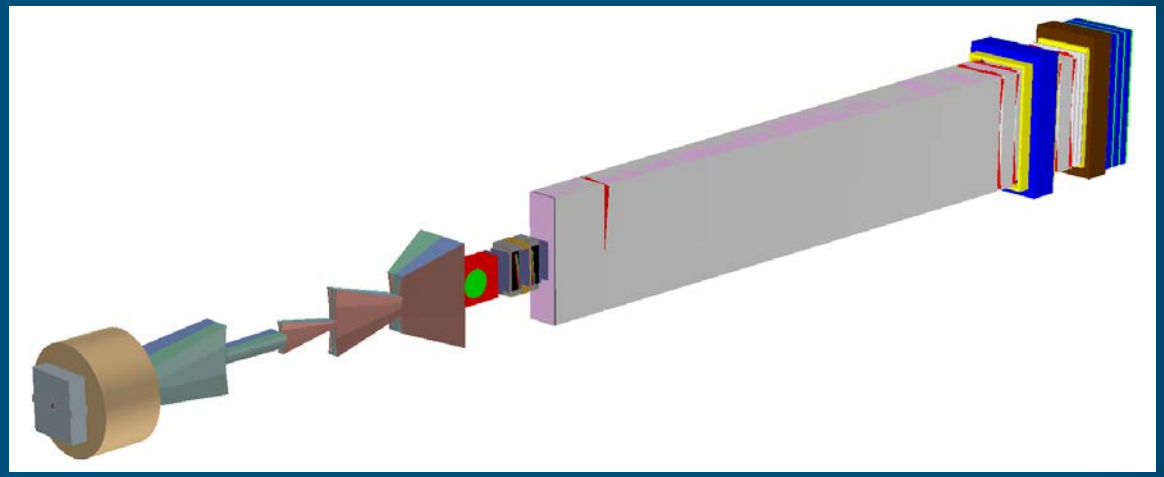
- Main design progress with "Imperial" version of SHiP
  - Muon shield optimization
  - Decay volume design
  - ➔ Freeze current design as first iteration (avoid moving target situation!)
- Next step for SHiP@Berlin / June2017 meeting
  - Update signal and background tables a la TP with current detector ideas
  - Refine detector requirements/specifications
  - Input to Beam Dump Facility (BDF) working group
  - Next iteration of global re-optimization (including evacuation or helium)

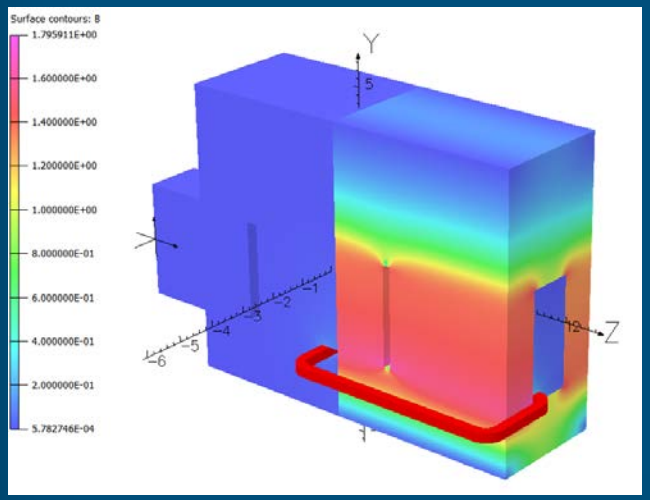
Magnetization of hadron stopper (reminder)

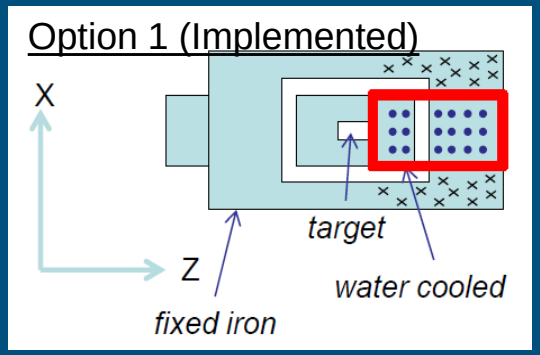
- Major advantages as shown by Hans
- Challenging but supported by BDF colleagues
- Proposed design by V. Bayliss (RAL)

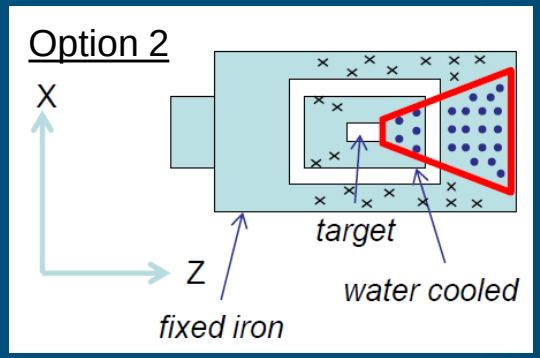
1. Field map
2. Cooling
3. Radiation hardness
4. No radiation leakage (integration)
5. Reliability (no access ever)











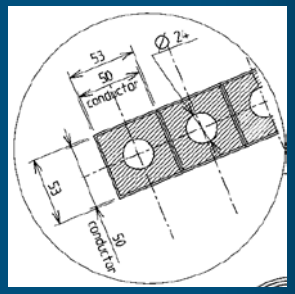
Magnetization of hadron stopper is baseline

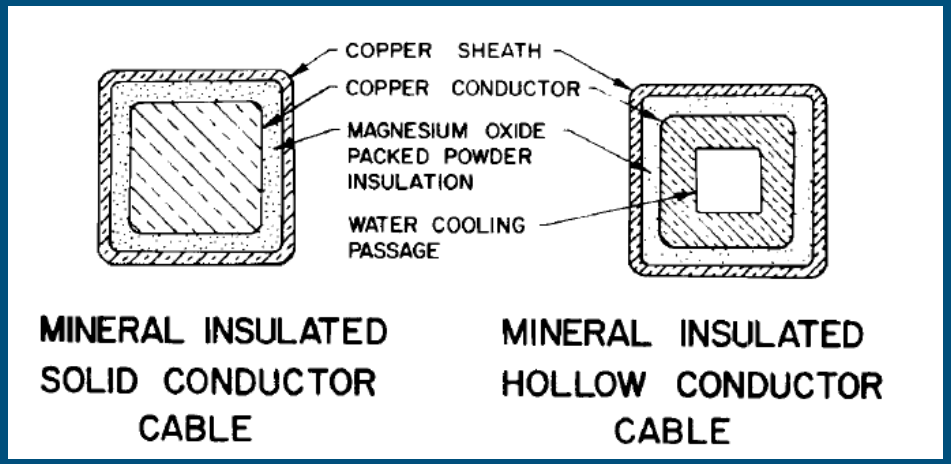
➔ Quantify advantages of option 2

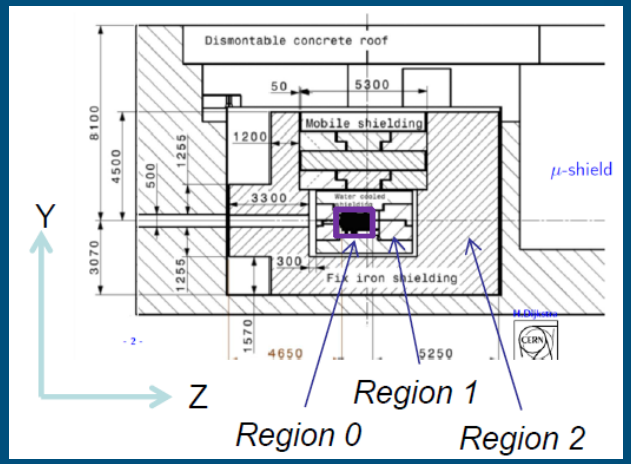
Magnetization of hadron stopper

- Cooling
  - Initial idea of heat conduction to surrounding shielding blocks for extraction by cooling system foreseen for the deposited beam energy not realistic with 50-100 kW dissipation
  - Perfect electrical insulation with perfect thermal conductivity, and stable thermal contact with surrounding shield and radiation hardness… Al_2O_3?

- Alternative
  - Cable-In-Conduit-Conductor (CICC) or MIC (Mineral Insulated Cable) with hollow conductor (e.g. LHCb 50x50 mm^2 Al-99.7 with 24mm bore for water cooling) with few bar pressurized cooling
  - Separate cooling closed cooling circuit – limited water quantity
  - Coil located as low as possible in shield to reduce radiation exposure







(Some) notes on subsystems

- Muon shield
  - CDR design with current knowledge of muon spectra?
  - Design work is of critical importance
  - Final CDR performance updated with 2018 test beam measurements
- Emulsion (spectrometer)
  - Decide on configuration, no magnet option for start-up looks attractive

    (if we can produce enough emulsion → other type of companies?)
- Upstream muon spectrometer
  - Straw tube option
  - Implement in simulation
- Decay volume
  - Two "compatible" vacuum designs
  - Update dimensions and geometry, and tolerance on flexing – reduce material further?
  - Focal point of pyramidal frustum
  - Verification of leak tightness and mechanical stability of welds
  - Design of front cap – material budget for simulation
  - End cap on hold waiting further specs for calorimeters
  - Further consolidate price tag (request offer?) – add features (flanges, access etc)
  - Discuss vacuum system with CERN experts

  ➔ Current conceptual design enough for now, hold of engineering design 6 months (detector integration)

  - Design structure for helium balloon/SBT?

(Some) notes on subsystems

- "VETO" systems (SBT, UVT, RPC, SVT, T1)
  - Drop (ab)use of "veto" concept
  - Background taggers provide information on activity which may be correlated in time/space
  - Effect of electromagnetic debris
  - Define requirements/specs a la Heiko with input from all background studies
  - ➔ Guide choice on technology (LiSci / PlasticSci) and integration in decay volume
  - RPC and SVT is not baseline currently
- Spectrometer magnet
  - Need a few people to refine design of magnet + costing
- Spectrometer Straw Tracker
  - Towards defining straw parameters and tracker configuration
  - Alignment technique
- Spectrometer Timing Detector
  - Two very valid options
  - In vacuum?
  - Refine efficiency, time resolution of MRPC option
  - Investigate timing calibration

(Some) notes on subsystems

- PID (calorimeters, MUONs, RICH)
  - Calorimeter requirements under study
  - Optimization work
  - Redundancy/flexibility not to be neglected
- DAQ
  - DAQ demonstrator for test beams?
  - Extend towards online framework for CDR/TDR
- Offline
  - Key to everything!
  - Update along with optimization work
  - Lose control without documentation….
  - On the way: ELOG
- Exchange with BDF WG
  - Slow extraction/spill non-uniformity
  - Target design
  - Magnetization of hadron stopper
  - Update of RP aspects
  - Integration (experimental area)
  - Civil engineering (muon shield area width, detector hall floor)

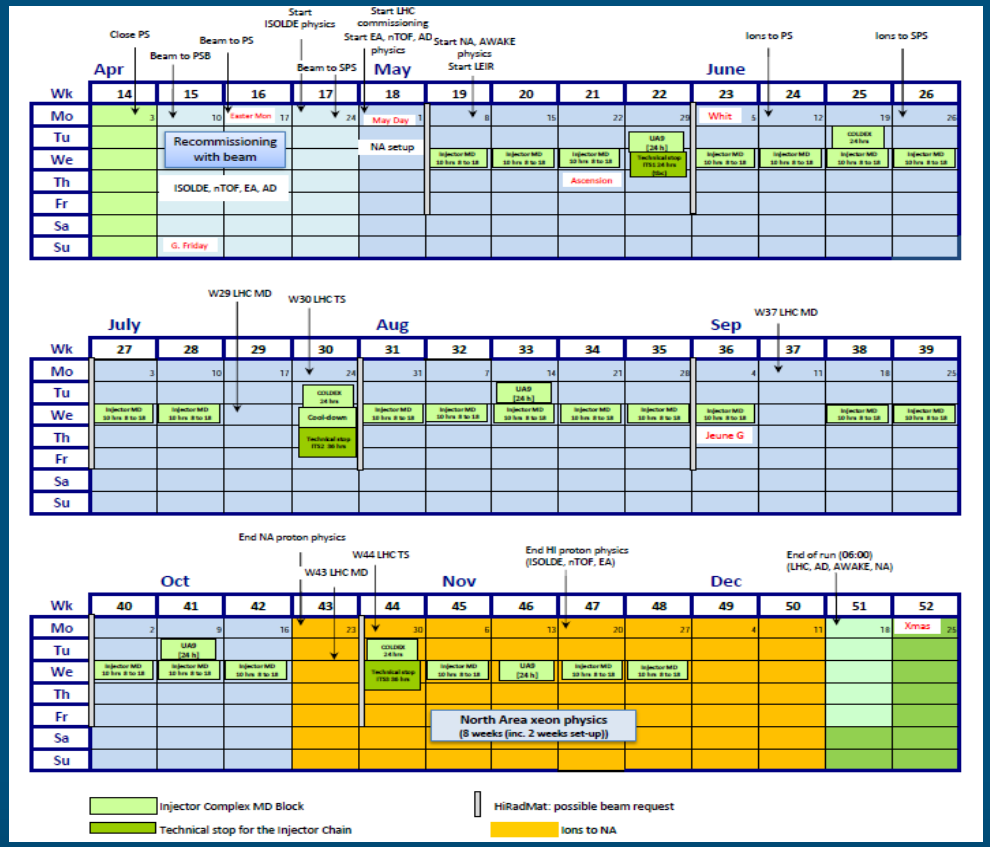
Test beam requests 2017

1. 2.5 weeks joint SHiP test beam for Straw Tracker, SBT, CALO on SPS (Sep-Oct)
2. 2 weeks emulsion test beam on PS (Sep-Oct)
3. 2 weeks joint SHiP/NA62 test beam for MUONs on PS (Oct)

➔ Opportunity for DAQ demonstrator?

- We are very likely to get the complete request approved

➔ It is critical that we make full use of it!



Project structure

- The project structure for the CDR phase is *subject to evolution*
- Several items still to be covered
- Main task of conveners: ensure consistent and complete CDR chapters

SHiP Project organization for Comprehensive Design Phase (v.2016-11-08)

Spokesperson	A. Golutvin (CERN, Imperial)	
Country Representative Board		
Chair:	E. van Herwijnen (CERN)	
Physics Planning Group (Members as defined in "Mandate" document)		
Chair:	**Physics Coordinator**	N. Serra (Zurich)
	CDR Conveners	
	Hidden sector signals and models	K. Petridis (Bristol)
	Hidden sector background and signal selection	M. Patel (Imperial)
	Tau neutrino and Light Dark Matter	A. Di Crescenzo (Naples)
Technical Board (Members as defined in "Mandate" document)		
Chair:	**Technical Coordinator/CERN Local Contact**	R. Jacobsson (CERN)
	CDR Conveners	(see Subsystems below)
Speakers and Publications board		
Chair:	W. Bonivento (Cagliari)	
EXSO/GLIMOS	R. Jacobsson (CERN)	

Project structures

Subsystems	CDR Conveners	Groups
Muon shield	M. Patel (Imperial)	
Emulsion"spectrometer / target"	G. De Lellis (Naples), M. Komatsu (Nagoya)	
Upstream muon spectrometer	C. Hagner (Hamburg)	
Muon spectrometer magnet		
Decay volume	A. Malinin(NRC KI), A. Prota (Naples)	
Surround background tagger (SBT/UVT)	H. Lacker (Berlin), I. Korolko (ITEP)	
Spectrometer Tracker (ST)	M. Ferro-luzzi (CERN)	
Spectrometer timing detector (STD)	P. Mermod (Geneva), B. Storaci (Zurich)	
HS Spectrometer magnet		
Calorimeters	W. Bonivento (Cagliari) (*see footnote)	
Muon detector (MUON)	G. Lafranchi (INFN-Lab. Naz. Frascati), Y. Kudenko (INR)	
Online	H. Dijkstra (CERN)	
Offline → Physics software; → Computing framework (need convener)	T. Ruf (CERN)	
Infrastructure	CERN	

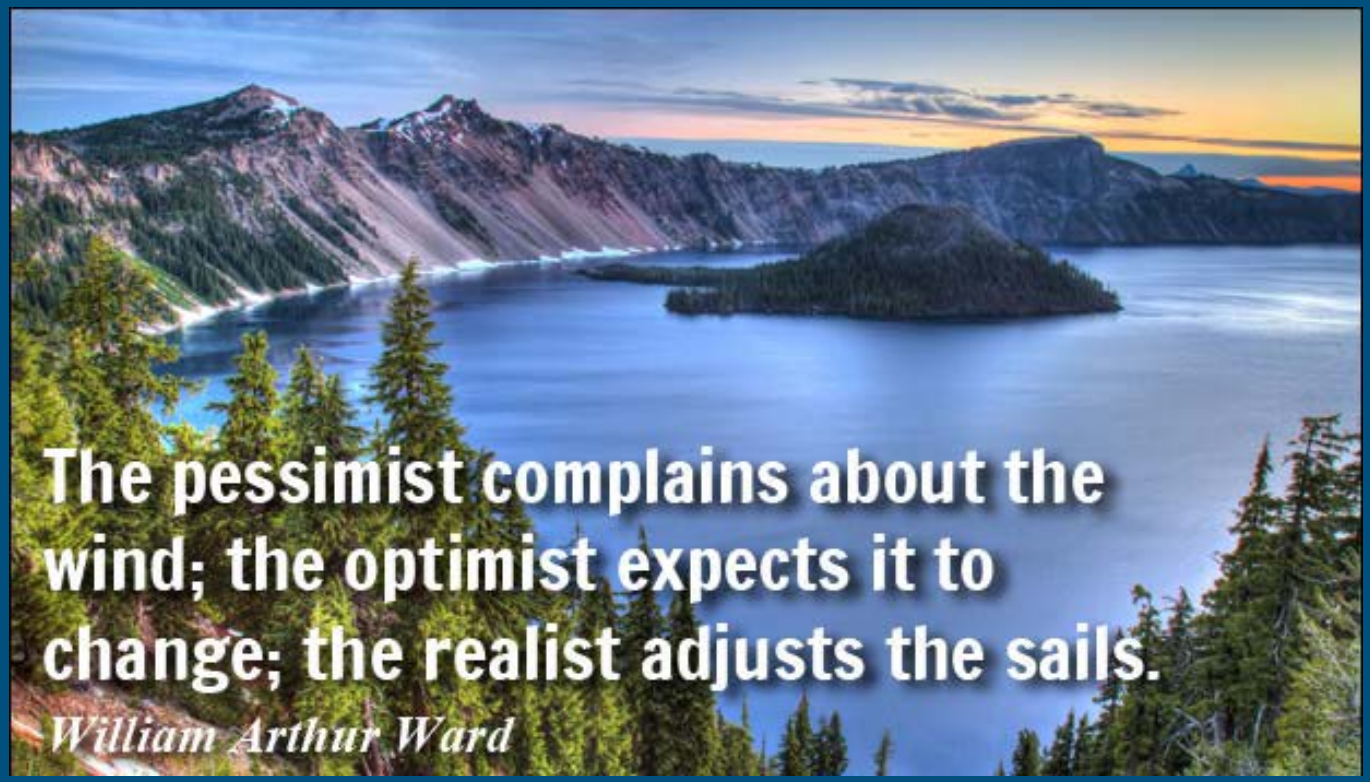
*The PID configuration and the detailed requirements is under study, including a preshower, electromagnetic and hadron calorimeter in association with the muon detector, and is open to interest from external groups

- There will also be an "Electronics coordinator" appointed at some stage
- Next step is to ask conveners to update group participation, search for new groups to cover all aspects

Conclusion I

- SHiP thrives on our motivation and commitment as a collaboration (compare TP)
  - ➔ Demonstrate a coherent and consistent effort
  - ➔ Need all of your help to attract more collaborators

- A lot of engineering effort (many of which are short well-define tasks)



Conclusion II

We have a SHiP-load of work to do in the coming months!