Premature Dumps in 2011

M.Albert LHC Beam Operation Workshop December 2011

Acknowledgements: A.Macpherson, G.Papotti, M.Zerlauth

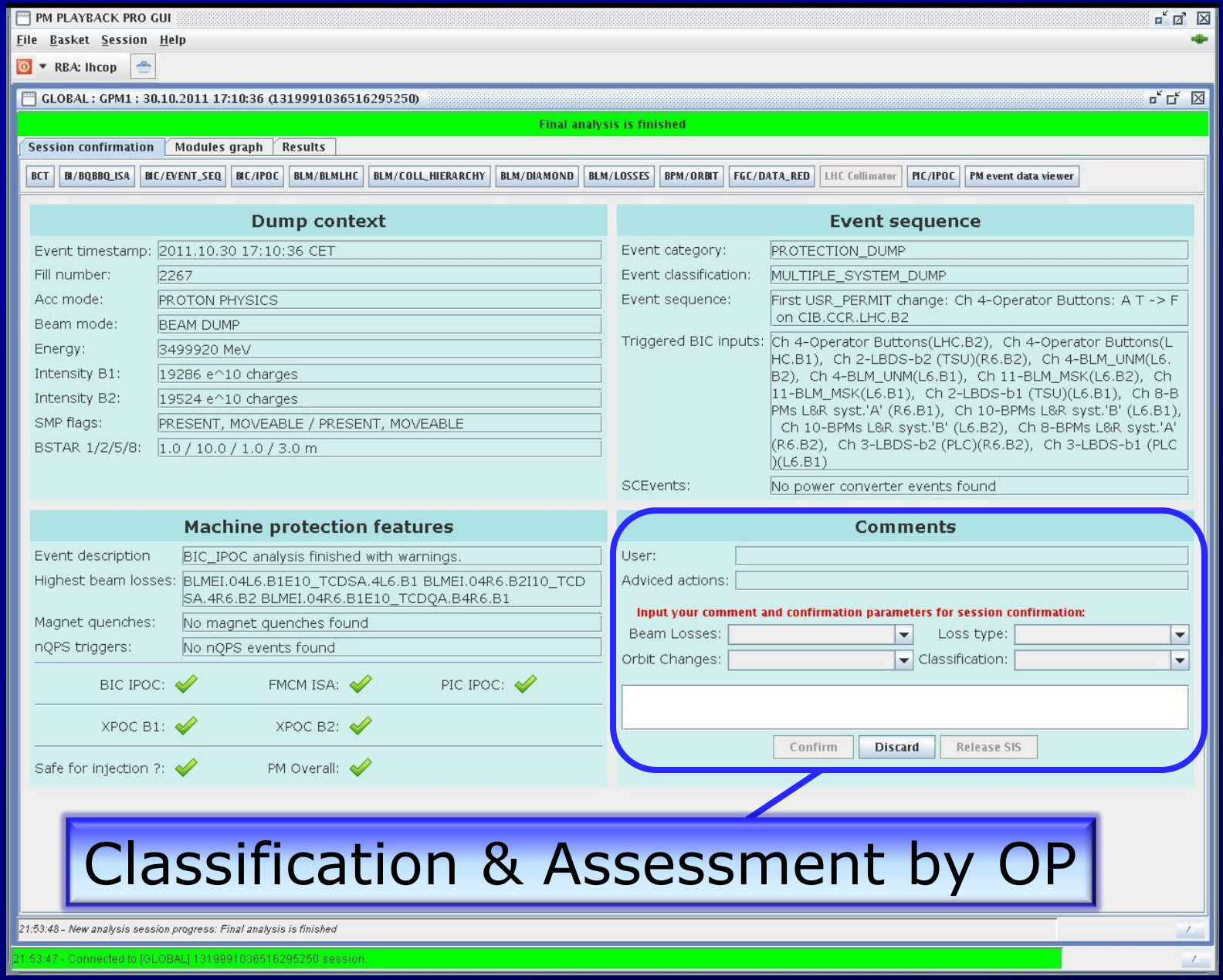
Outline

- Introduction
- Data extraction
- Dump statistics by mode
- Dump causes
- Dumps in STABLE BEAMS
- Summary

Introduction

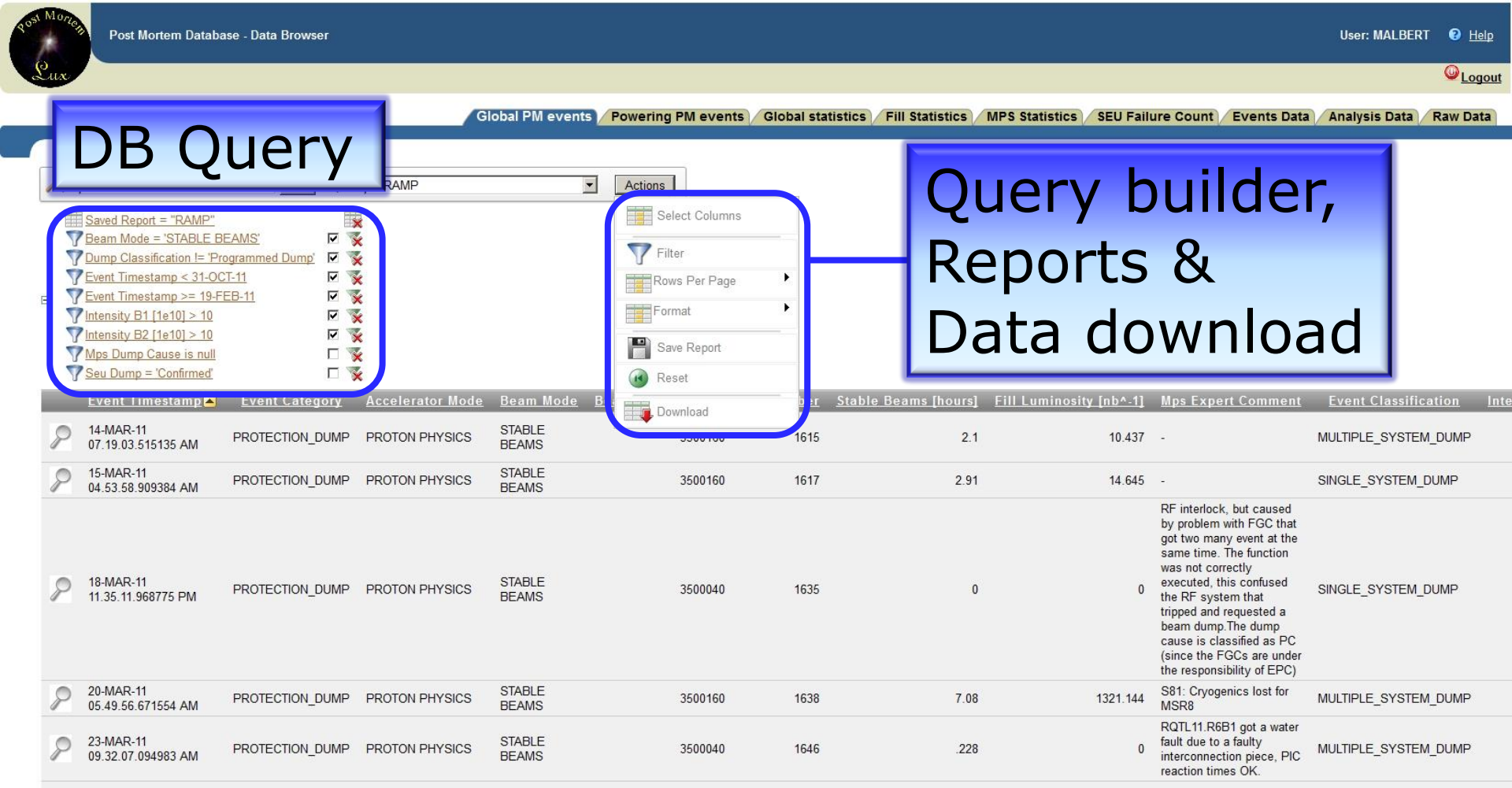
- Every dump generating PM data is assessed by shift crew using PM Online tool.
- All beam dump characteristics are collected and stored in the PM Database.
- Dumps at 3.5 TeV are systematically reanalyzed by MPS experts.
  (M. Zerlauth, R. Schmidt, J. Wenninger)
- Analysis of PM data for p+ run:
  - 19/02 (first beam) – 30/10/2011 (last dump)
  - I_{B1} > 1e12 and I_{B2} > 1e12 (exclude probes, MPS tests)

PM Online Tool



Classification & Assessment by OP

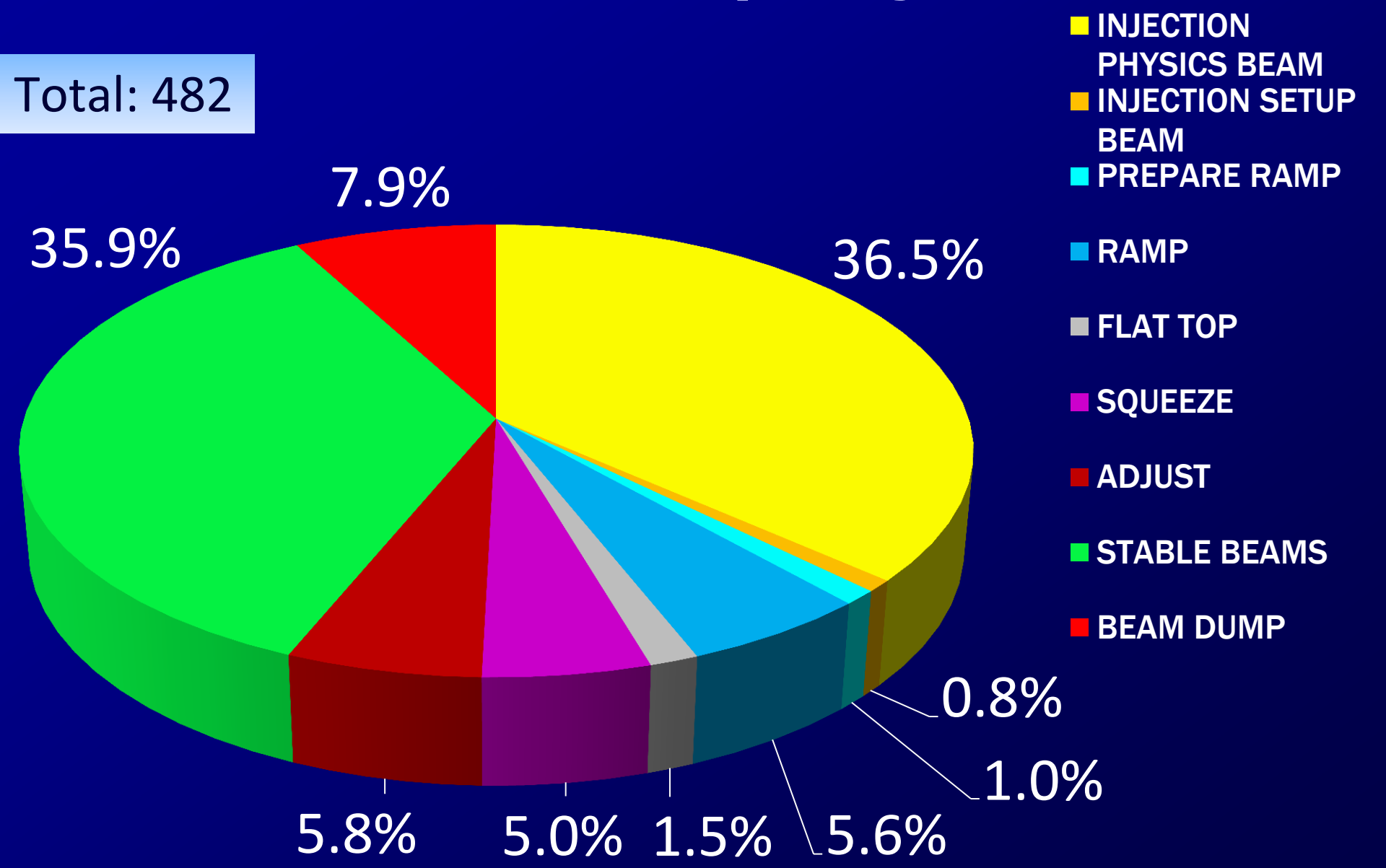
LHC Post Mortem Database



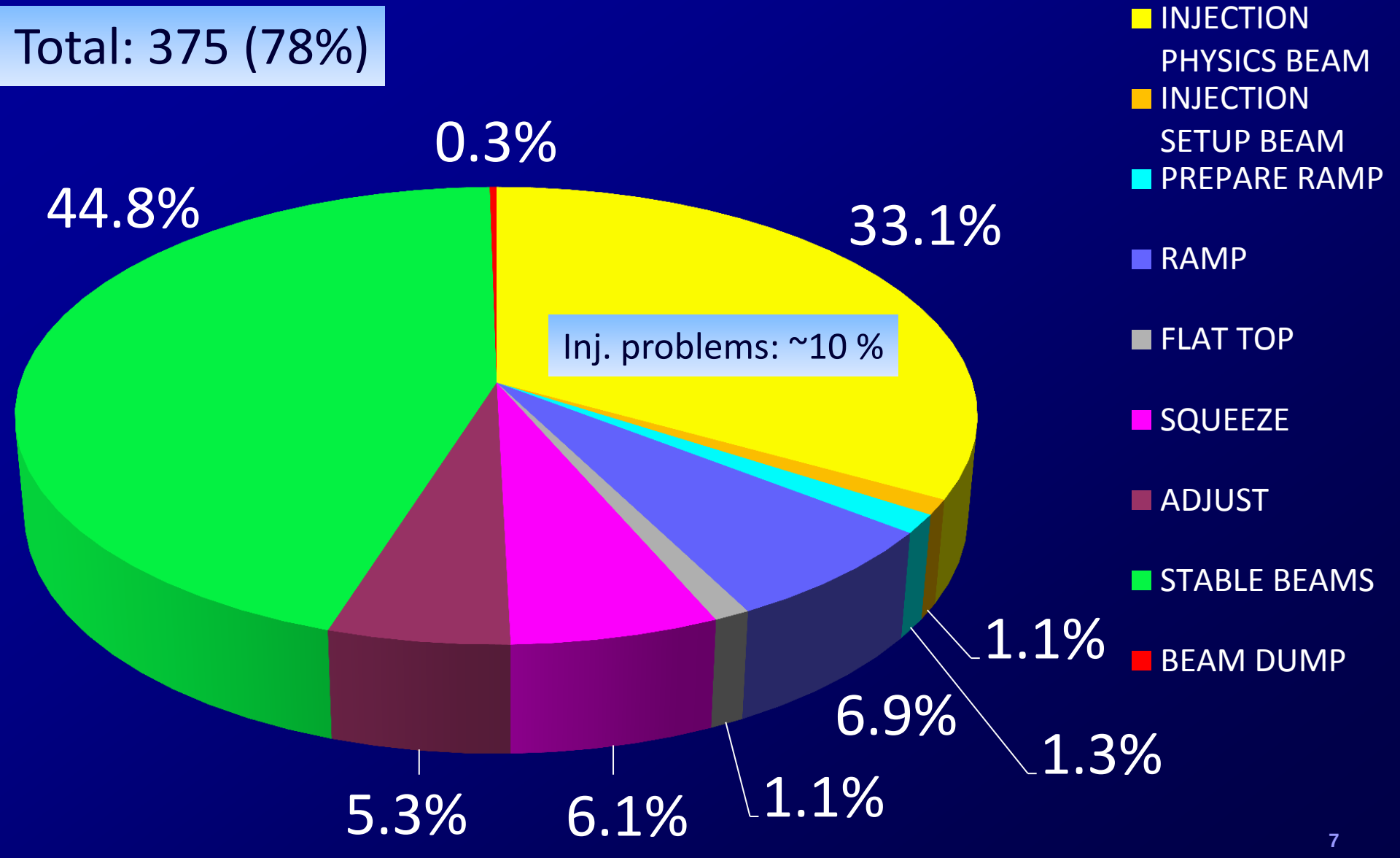
Event Timestamp	Event Category	Accelerator Mode	Beam Mode	B	er	Stable Beams [hours]	Fill Luminosity [nb^-1]	Mps Expert Comment	Event Classification	Inte
14-MAR-11 07.19.03.515135 AM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS		1615	2.1	10.437	-	MULTIPLE_SYSTEM_DUMP	
15-MAR-11 04.53.58.909384 AM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS	3500160	1617	2.91	14.645	-	SINGLE_SYSTEM_DUMP	
18-MAR-11 11.35.11.968775 PM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS	3500040	1635	0	0	RF interlock, but caused by problem with FGC that got two many event at the same time. The function was not correctly executed, this confused the RF system that tripped and requested a beam dump.The dump cause is classified as PC (since the FGCs are under the responsibility of EPC)	SINGLE_SYSTEM_DUMP	
20-MAR-11 05.49.56.671554 AM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS	3500160	1638	7.08	1321.144	S81: Cryogenics lost for MSR8	MULTIPLE_SYSTEM_DUMP	
23-MAR-11 09.32.07.094983 AM	PROTECTION_DUMP	PROTON PHYSICS	STABLE BEAMS	3500040	1646	.228	0	RQTL11.R6B1 got a water fault due to a faulty interconnection piece, PIC reaction times OK.	MULTIPLE_SYSTEM_DUMP	

All beam dumps by mode

Total: 482

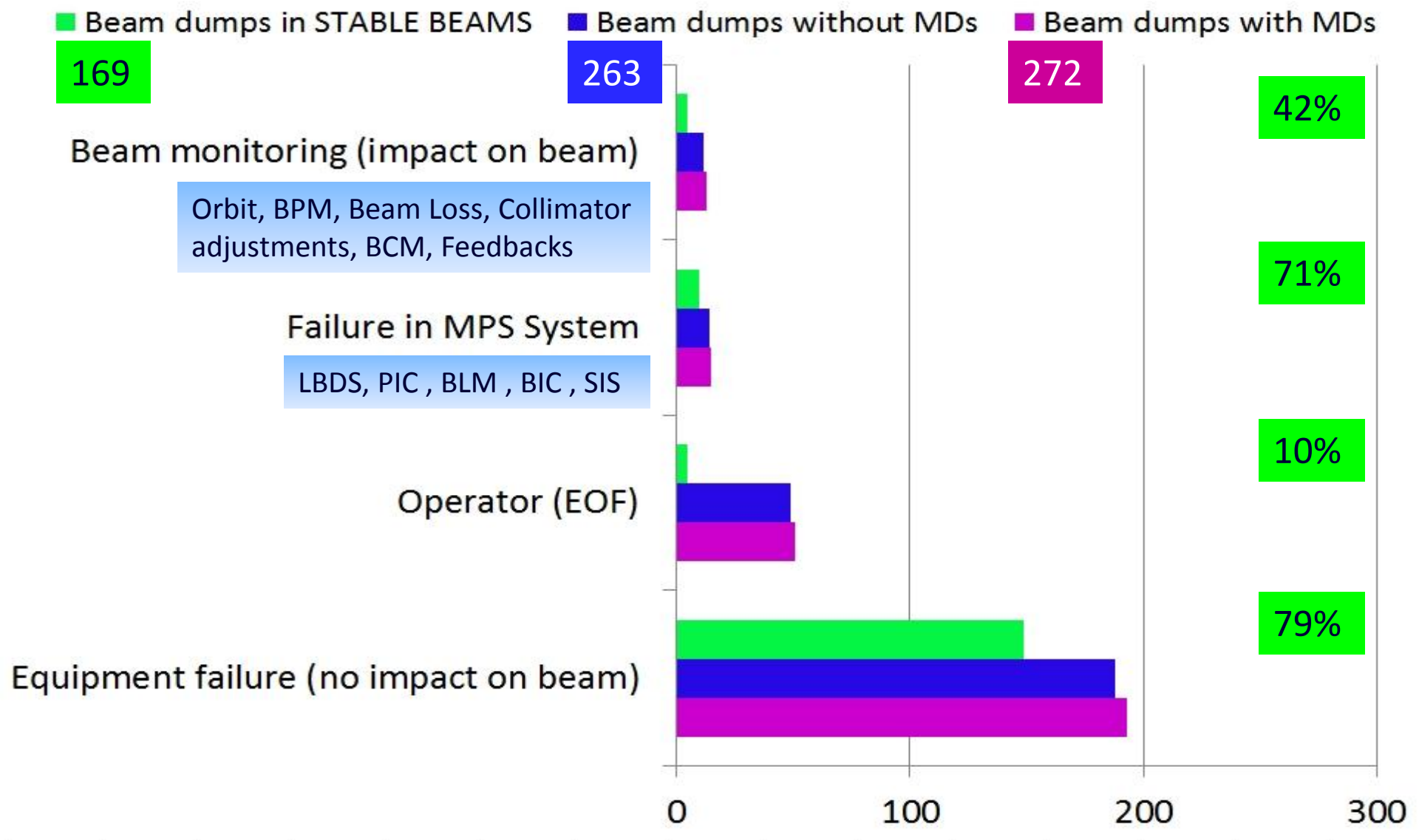


Non-programmed dumps by mode

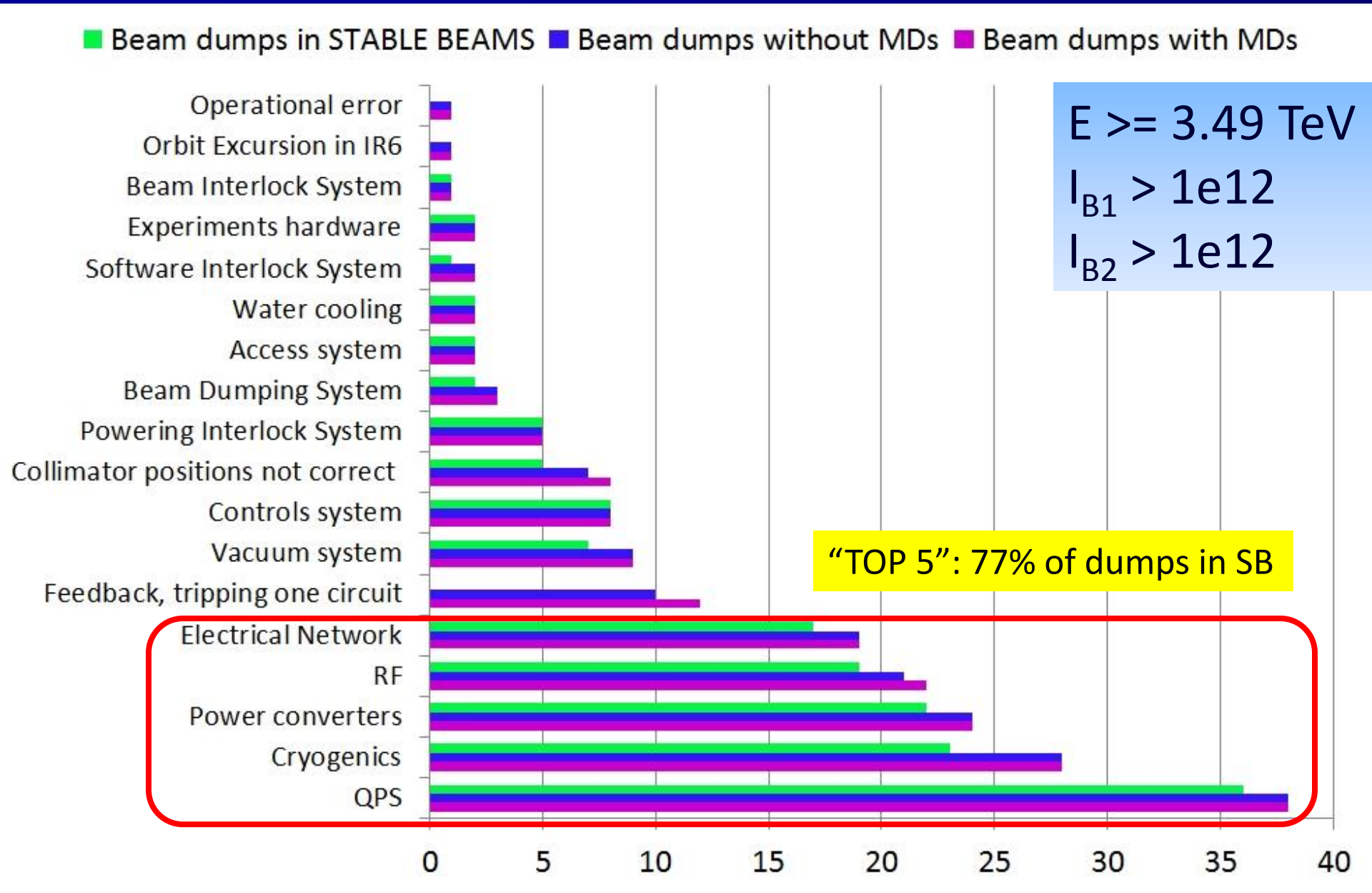


Beam dump causes

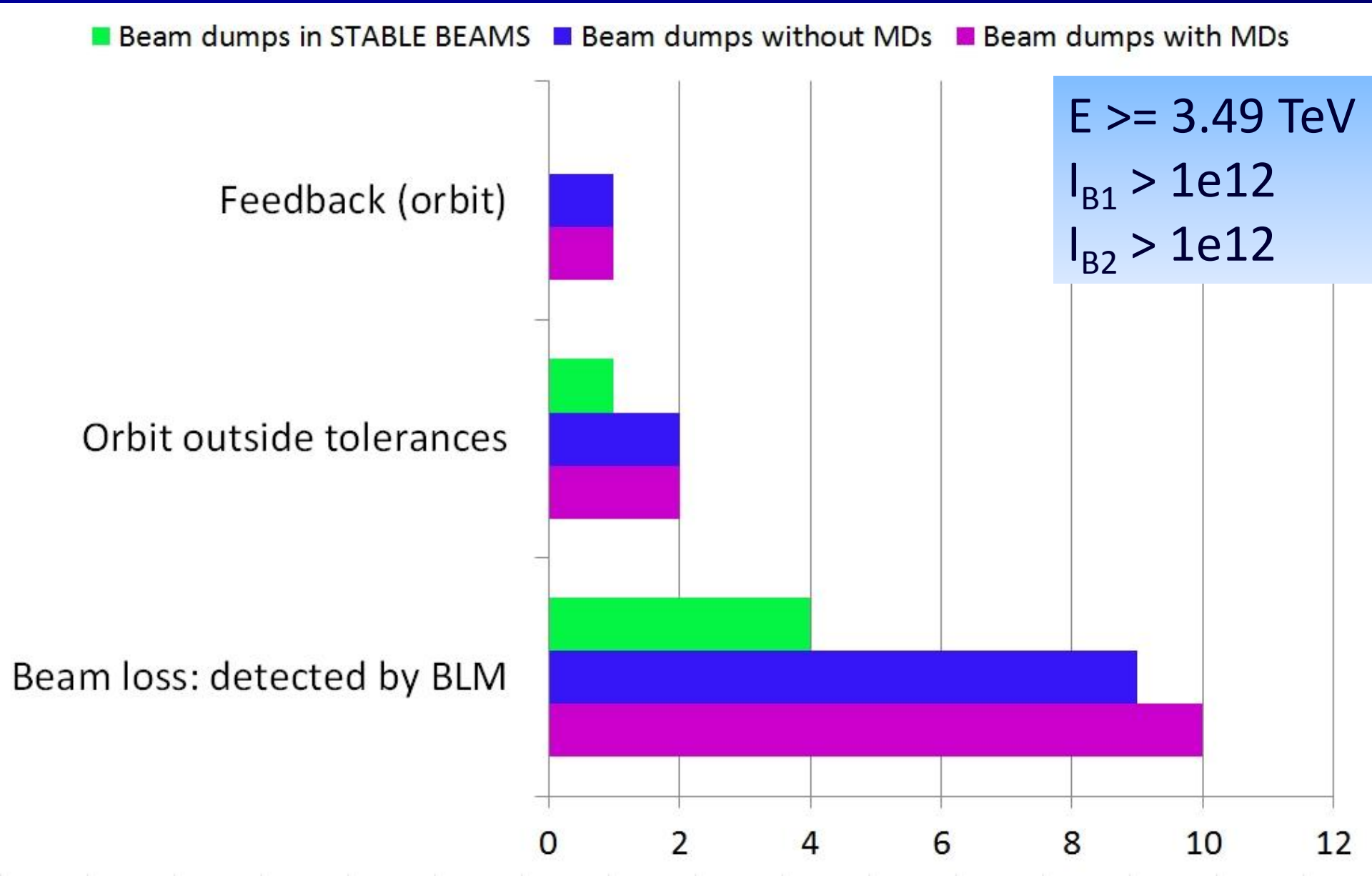
E >= 3.49 TeV
I_{B1} > 1e12
I_{B2} > 1e12



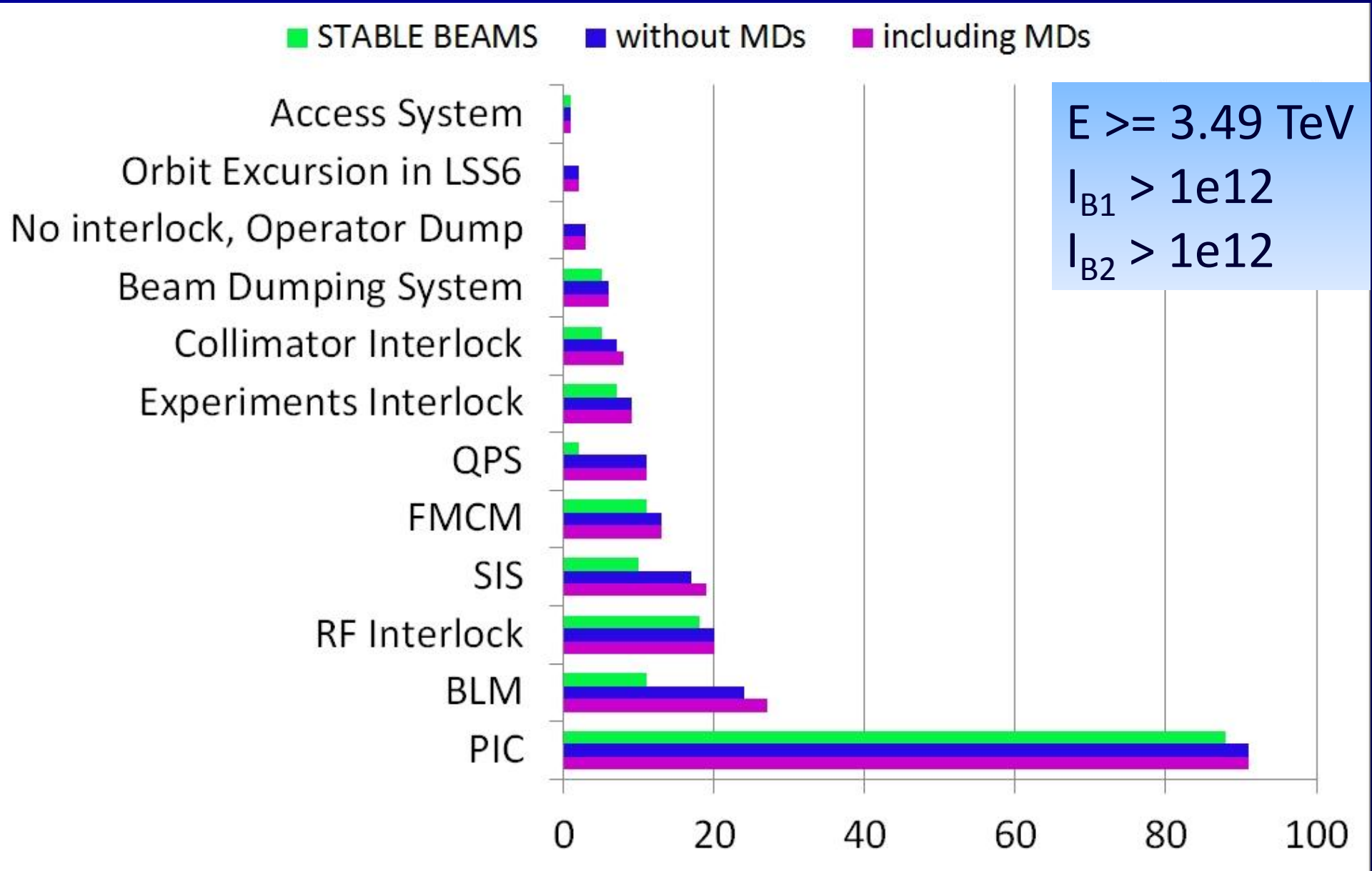
Beam dump causes by equipment



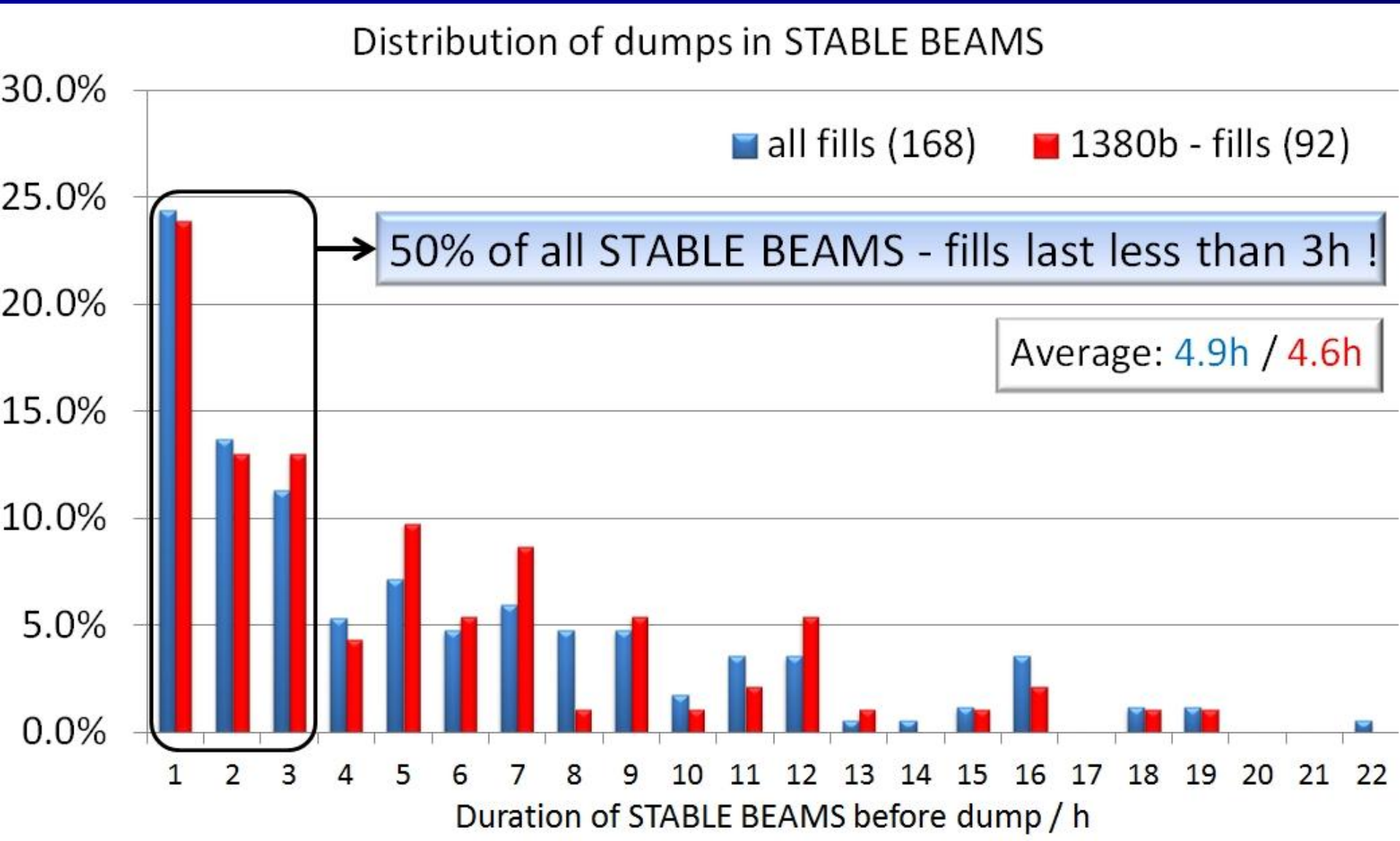
Beam dump causes by beam monitoring



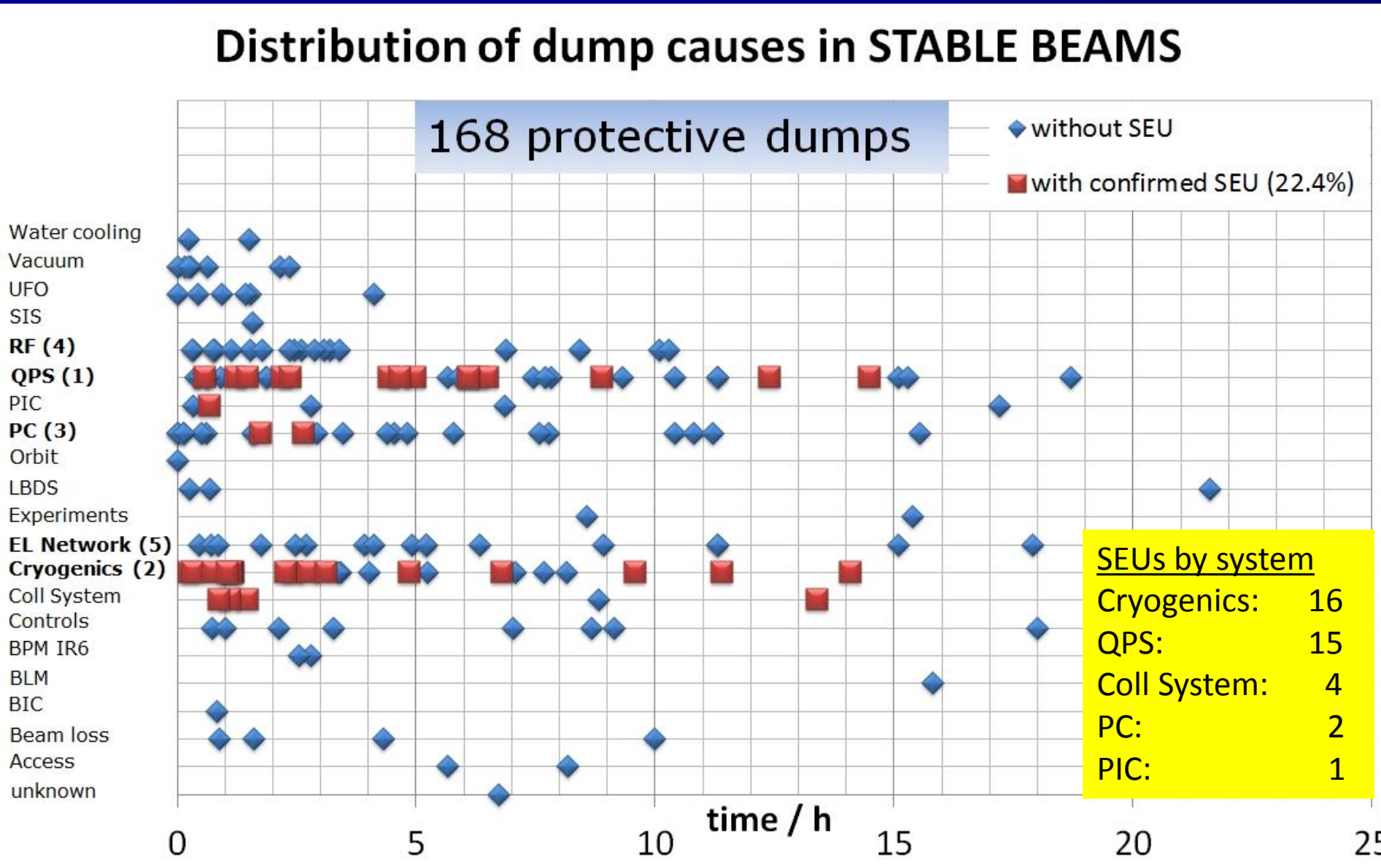
Systems which saved us…



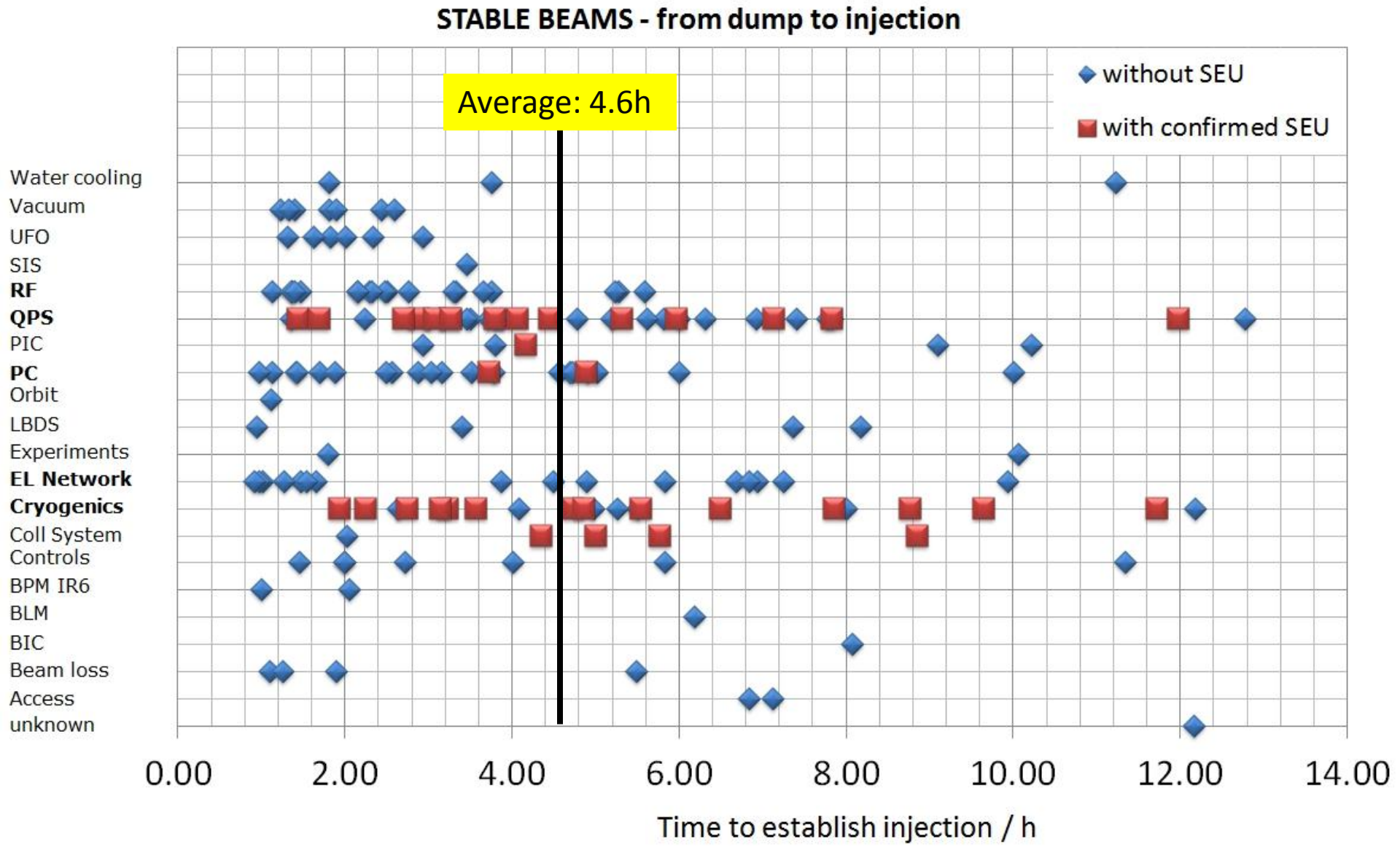
STABLE BEAMS – often short !



Dumps in STABLE BEAMS



Recovery after dump in SB



Proposals for improvements

- PM Online tool should offer re-editing (correction of wrongly assessed dumps)
- Include injection scheme in PM-Database
- Do we need to add more categories for dump classification?
  "Other" used for 11% of non-programmed dumps
- Should we also systematically analyse dumps at injection energy ?

Summary

- Beam dump causes due to equipment failures clearly dominate.
- 50% of all fills & “1380b – fills” last < 3h
- Average fill duration: ~5h
- 22% of STABLE BEAMS - fills were dumped by SEU effects, mainly on cryogenics and QPS equipment
- The average time from a beam dump in STABLE BEAMS to the next injection is ~4.5h.