

Beam Interlock System @ FLASH

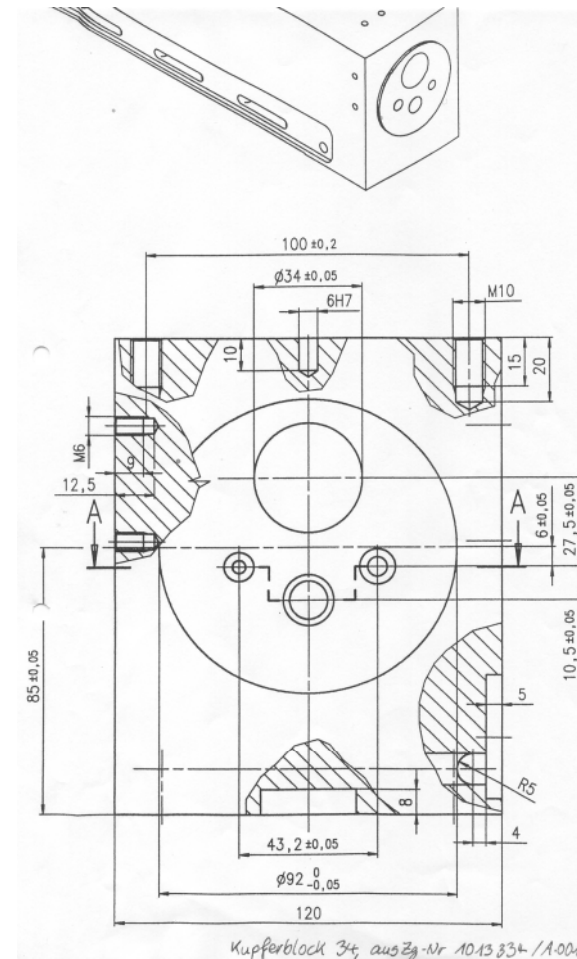
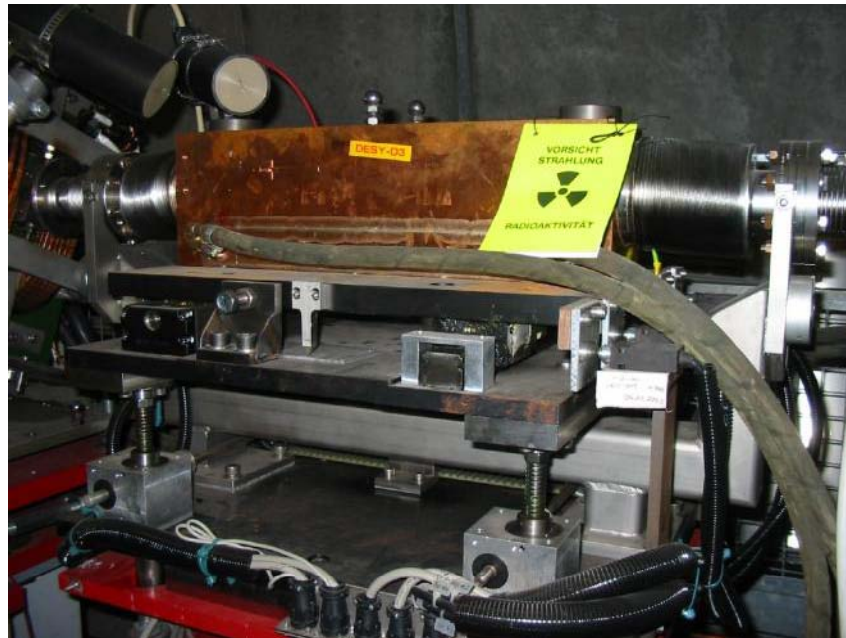
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Bedienung und Funktionen

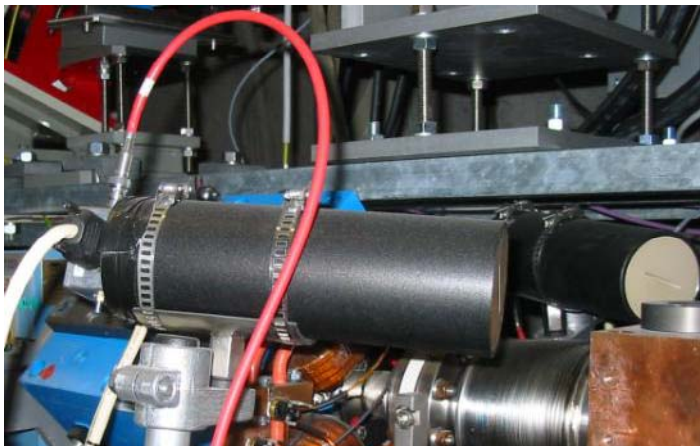
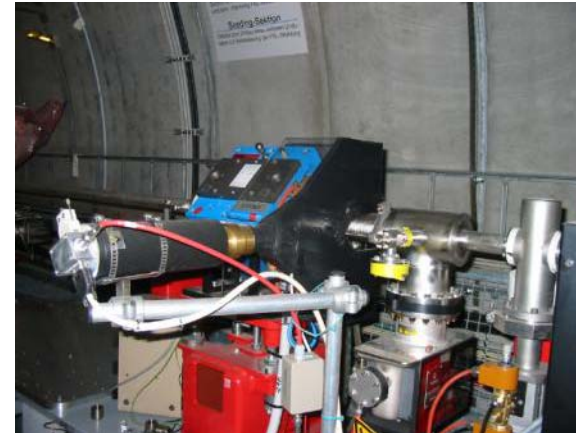
- **Aufgaben der Machine Protection**
- **Komponenten der Machine Protection**
- **Operation Modes und Beam Modes**
- **BIS special functions**
- **Laserinterlock**
- **Fragen und Antworten, auch zwischendurch!**

- **Beschleuniger schützen**
- **Operation modes ermitteln**
- **Erlaubte Strahlpulslänge managen**
- **Subsysteme überwachen**
- **Sicher abschalten im Fehlerfall**
- **Alarmer anzeigen**
- **Daten speichern in Histories**
- ...
- **Personensicherheit gehört nicht dazu!**

Fahrbare Kollimatoren mit 4 Aperturen



**Ca. 80 Photomultiplier
gibt es in FLASH**



4 Toroidpaare schützen den Beschleuniger

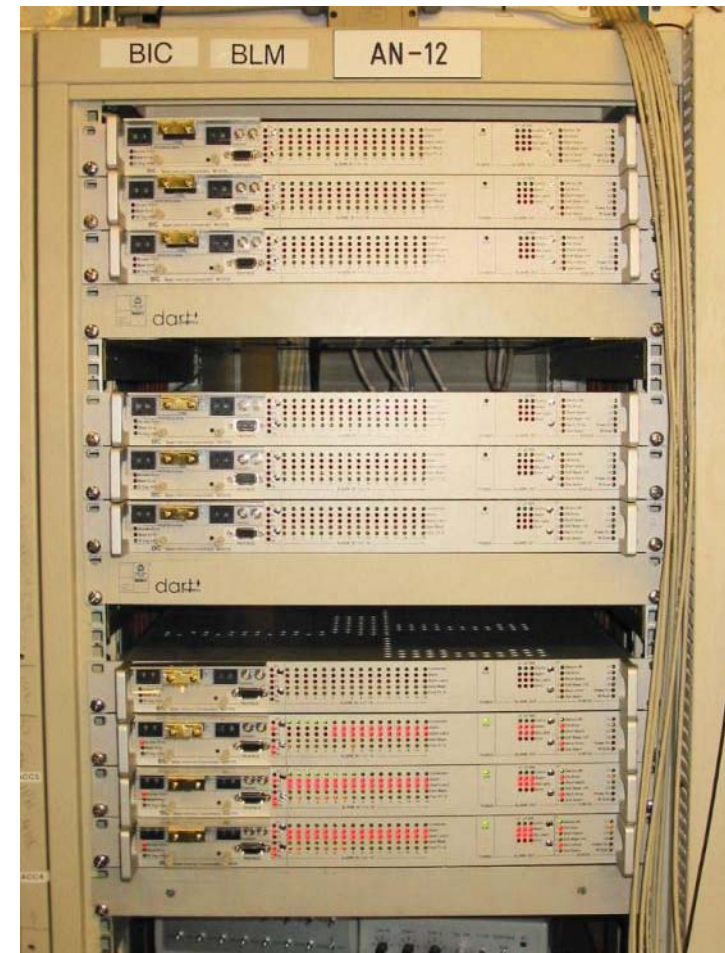


10 Beam Interlock Concentrators

sammeln Alarmsignale von

- BLMs
- Toroid Protection System
- Vacuum Fast Shutter
- Koppler-Interlock
- Quenchdetection

**...und schalten direkt
den Gun-Laser und
die ACC1-RF aus nach
ca. 2 Mikrosekunden**





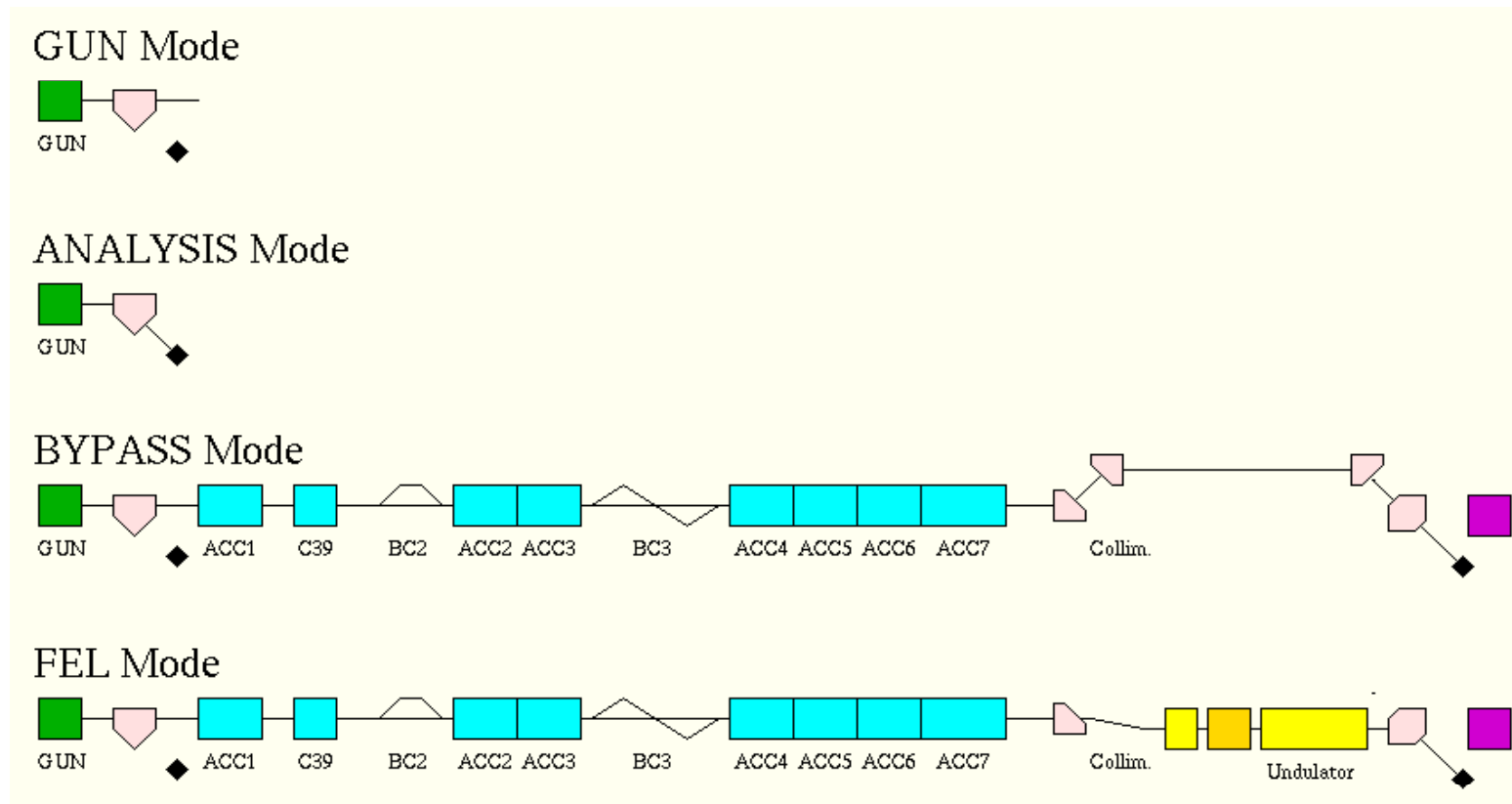
- Auslese und Steuerung der BICs
- Ermittlung der erlaubten Pulslänge für den Gunlaser
- Makropuls-synchrone Datenspeicherung via DOOCS
- Zykluszeit von etwa 1 Millisekunde
- SPS arbeitet unabhängig vom Kontrollsystem

SPS sammelt und verarbeitet über 300 Digitalsignale

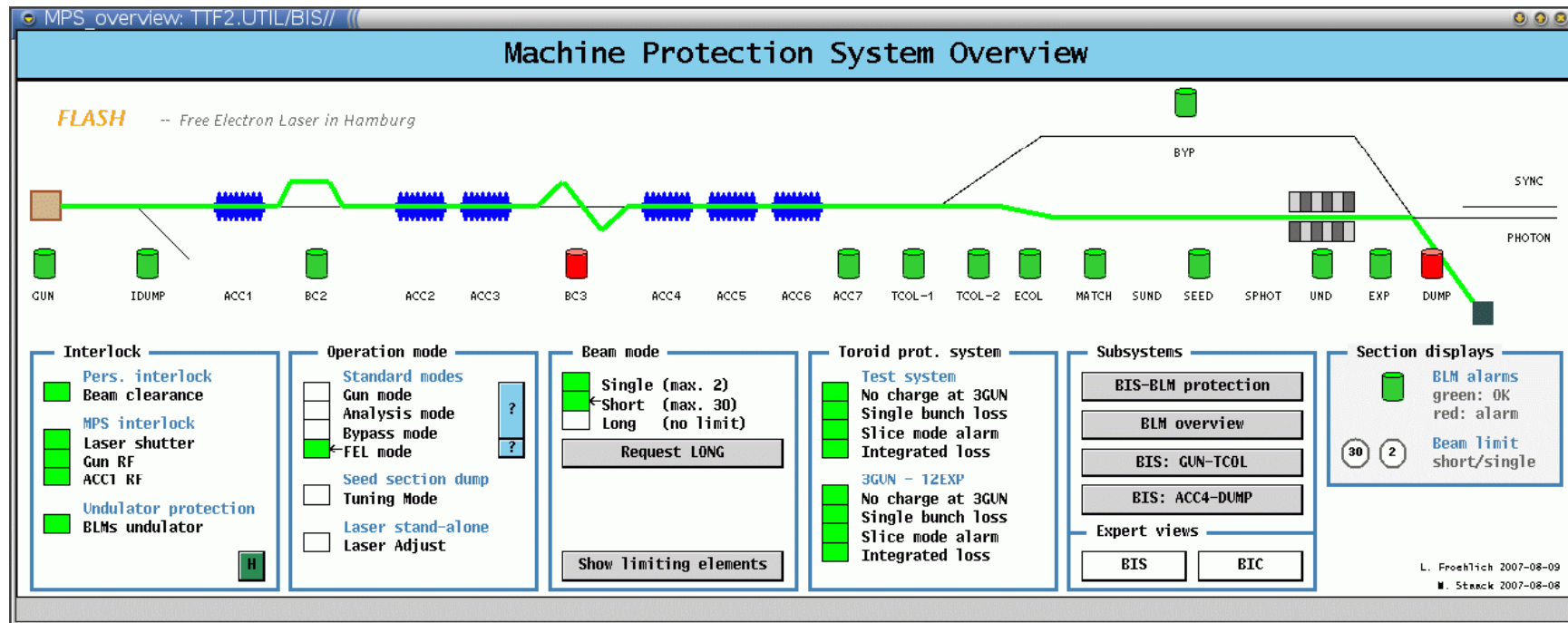
- Magnet-Powersupplies
- OTR-Schirme
- Kollimatoren
- Pneumatik-Mover
- Wasser-Durchflusswächter
- Pilotherme
- Vakuumschieber
- BLMs (Photomultiplier)
- Toroide
- RF
- ...



Die BIS-SPS ermittelt die Operation-Modes direkt aus den Machine settings (Vakuumschieber und Dipolmagnete):

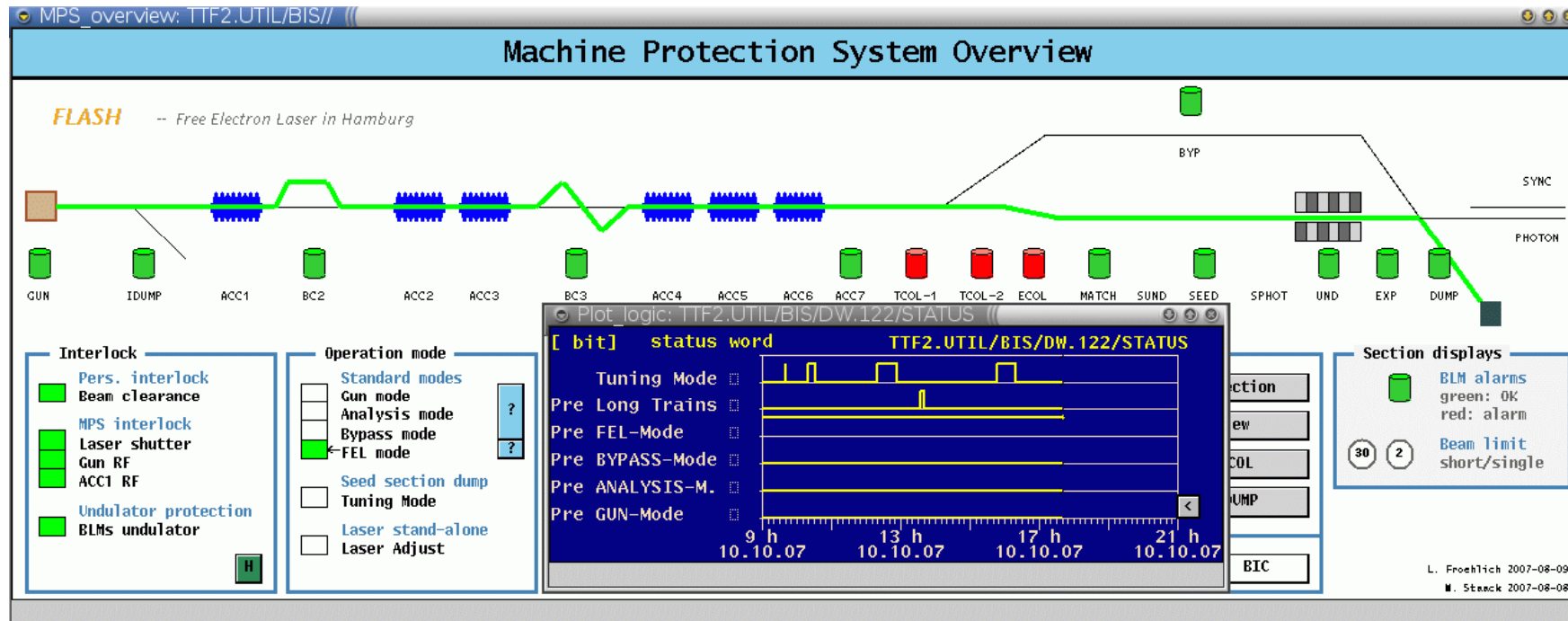


Derzeit befindet sich FLASH im FEL-Mode:



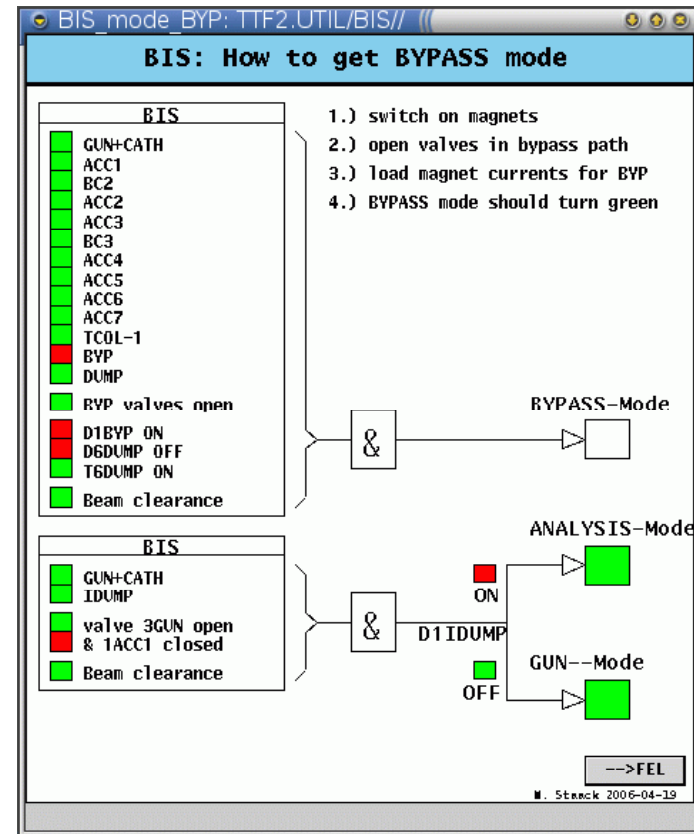
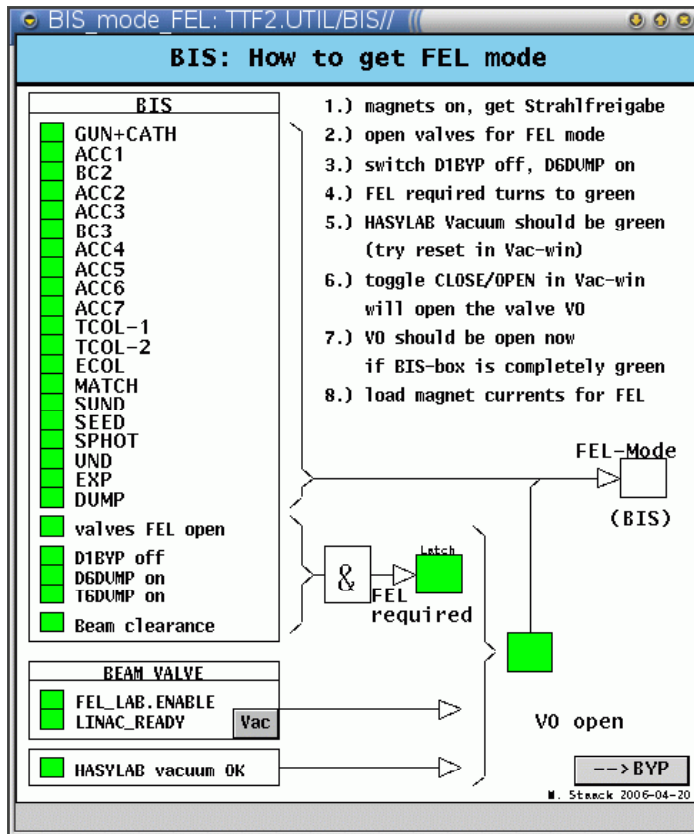
Klick auf den Operation mode → History plot...

FEL-Mode, zeitweise mit eingeschaltetem Tuning-Dump:



Klick auf die Fragezeichen bietet Hilfe...

...und der Operateur kann sehen, in welcher Sektion für den gewünschten Mode noch Fehler anstehen:



Zum Öffnen des HASYLAB-Ventils V0 muss derzeit noch im Vakuum-Panel mit einer Freigabe geklappert werden:

The screenshot displays the 'Machine Protection System Overview' interface, which is divided into several functional windows:

- Left Panel (under construction):** Shows status indicators for HASYLAB and V0, along with various dump and flow control elements like 4DUMP, 9DUMP, 12EXP, 13DUMP, and 13DUMP.
- Center Panel (BIS: How to get FEL mode):** Contains a list of BIS components (GUN+CATH, ACC1-7, TCOL-1/2, ECOL, MATCH, SUND, SEED, SPHOT, UND, EXP, DUMP) and a set of 8 numbered instructions for entering FEL mode. Below this is a logic diagram showing the 'FEL required' signal path leading to 'V0 open'.
- Right Panel (ve_main_FEL_win):** Features a control diagram for the V0 valve, including 'open', 'close', and 'Reset' buttons, and a logic diagram with 'S' and 'R' elements. It also shows 'control by HASY-Lab' and 'control by VAC' sections.
- Bottom Right Panel:** A 'Plot (logic)' window showing a timeline of system events from 9h to 21h, including EXT-ALARM, FEL-SKS-Way_OK, GP_OFF, WARNING, GP_RE_OK, GP_LI_OK, FREE, FEL-clearance, INT-ALARM, 15YNC-close, 15YNC-open, 1PHOTON-close, 1PHOTON-open, FEL-FAULT, and AVAIL.

Beam Modes werden aus den Machine settings ermittelt:

The image shows two screenshots from the FLASH control system. The top screenshot is the 'Machine Protection System Overview' window, which displays a schematic of the electron beam line with various components like GUN, IDUMP, ACC1, BC2, ACC2, ACC3, BC3, ACC4, ACC5, ACC6, ACC7, TCOL-1, TCOL-2, ECOL, MATCH, SUND, SEED, SPHOT, UND, EXP, and DUMP. Below the schematic are several control panels: Interlock (with items like Pers. interlock, Beam clearance, MPS interlock, Laser shutter, Gun RF, ACC1 RF, Undulator protection, BLMs undulator), Operation mode (Standard modes, Analysis mode, Bypass mode, FEL mode, Seed section dump, Tuning Mode, Laser stand-alone, Laser Adjust), Beam mode (Single, Short, Long), Toroid prot. system (Test system, No charge at 3GUN, Single bunch loss, Slice mode alarm, Integrated loss), Subsystems (BIS-BLM protection, BLM overview, BIS: GUN-TCOL, BIS: ACC4-DUMP, Expert views: BIS, BIC), and Section displays (BLM alarms, Beam limit short/single). The bottom screenshot is the 'BIS panel for operation ACC4-DUMP', which provides a detailed view of the beam line components and their status. It includes a schematic with labels like 1ACCB, 14Cr, 18ACC7, 3BYP, 9TCOL, 5ECOL, 7MATCH, 3SUND1, 2SUND3, 5, 8, 9, 14SEED, 21SEED, 4DUMP, 9DUMP, 13DUMP, and HASYLAB. Below the schematic are various status indicators and control buttons for different sections: ACC4/5, ACC6-TCOL1, I/ECOL, MATCH/SUND, SEED-UND, EXP, and DUMP. It also shows error messages like 'Errors: D1BYP', 'FEL-Mode: D6DUMP on, D1BYP off, Hasylab-V0 open', and 'Bypass-Mode: D1BYP on, D6DUMP off'. The bottom right corner of the BIS panel shows 'BIC Status' and 'BIS test win'.

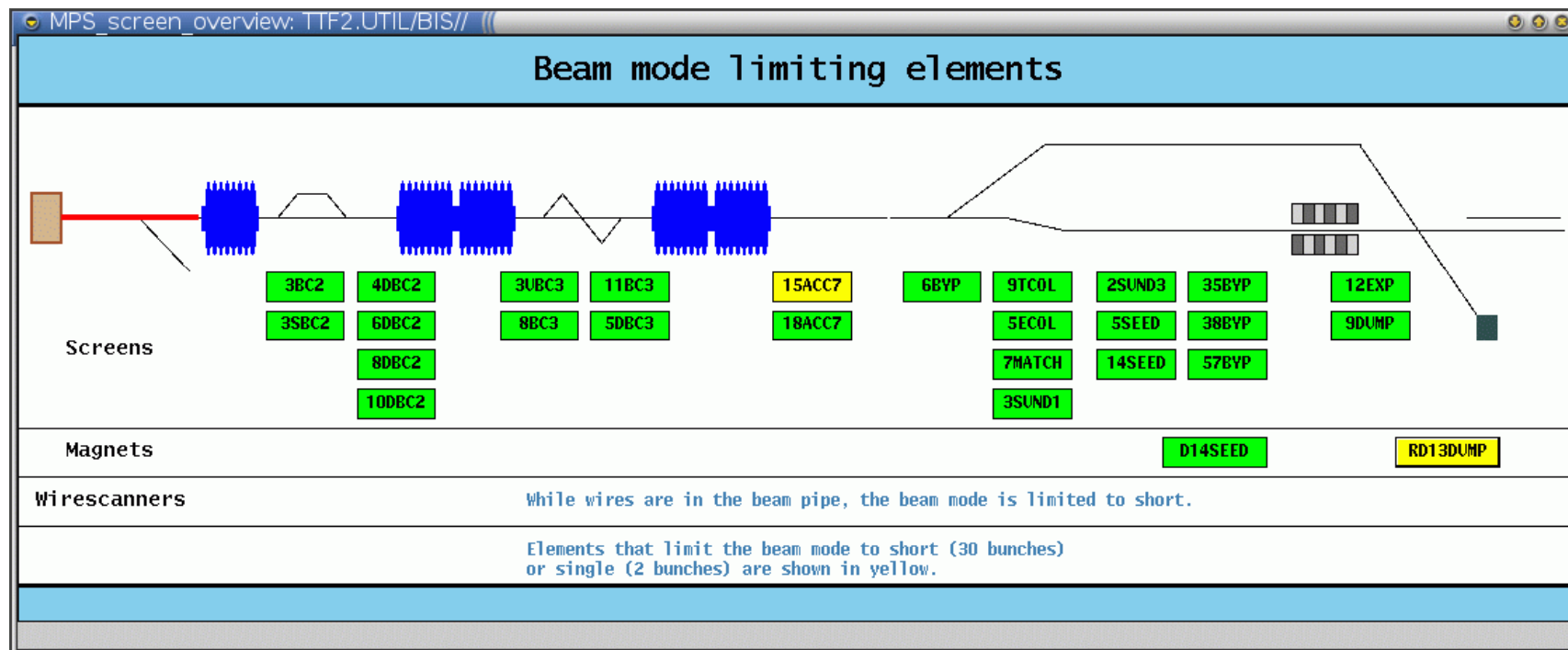
... hier gibt's grad mal keinen Strahl; das BIS zeigt an, woran's liegt:

Beam mode

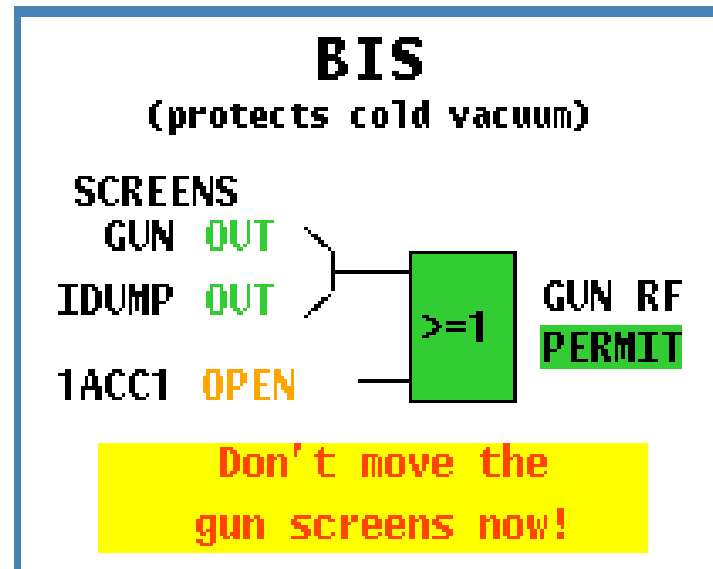
- Single (max. 2)
- Short (max. 30)
- Long (no limit)

Request LONG

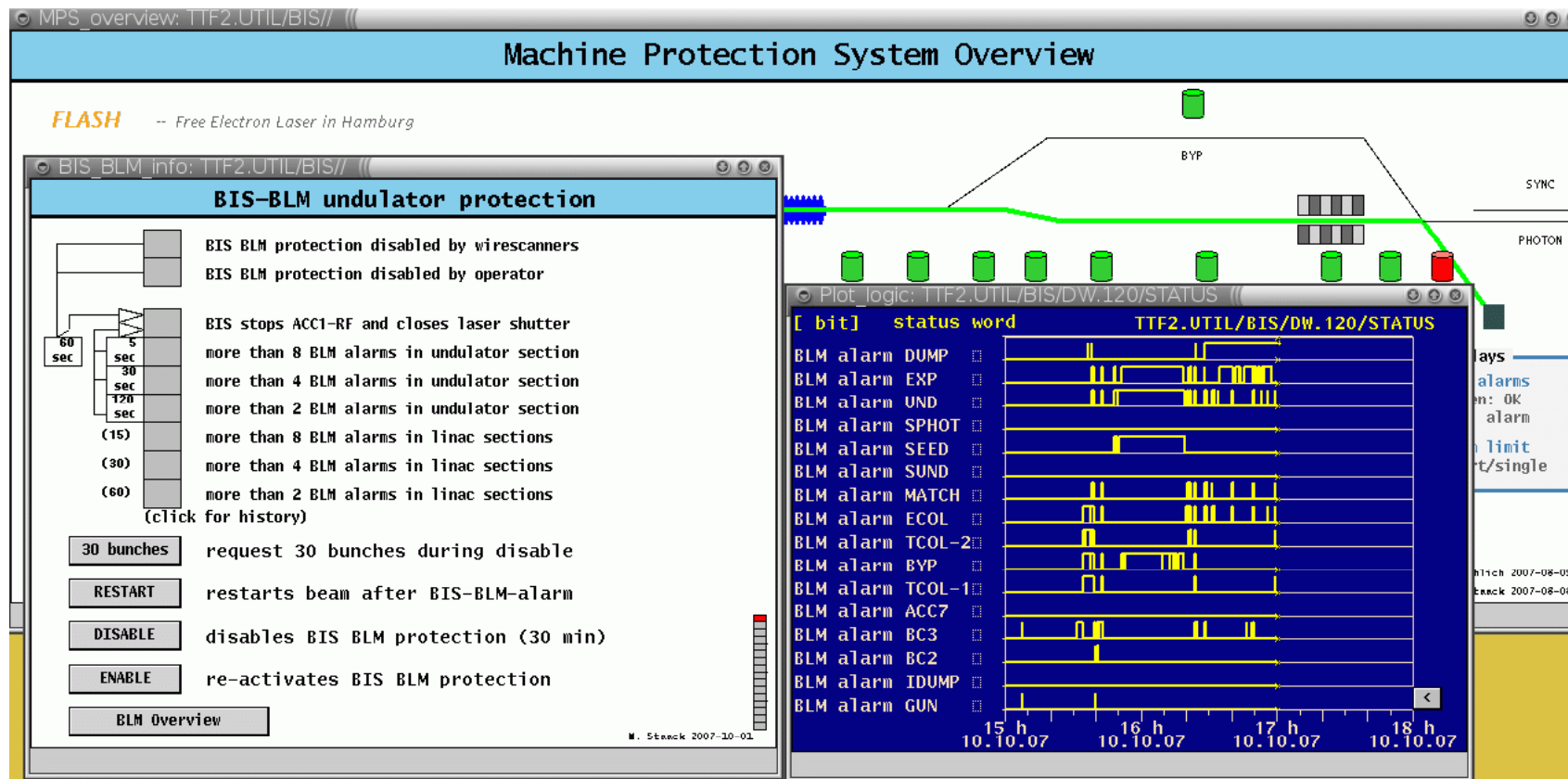
Show limiting elements



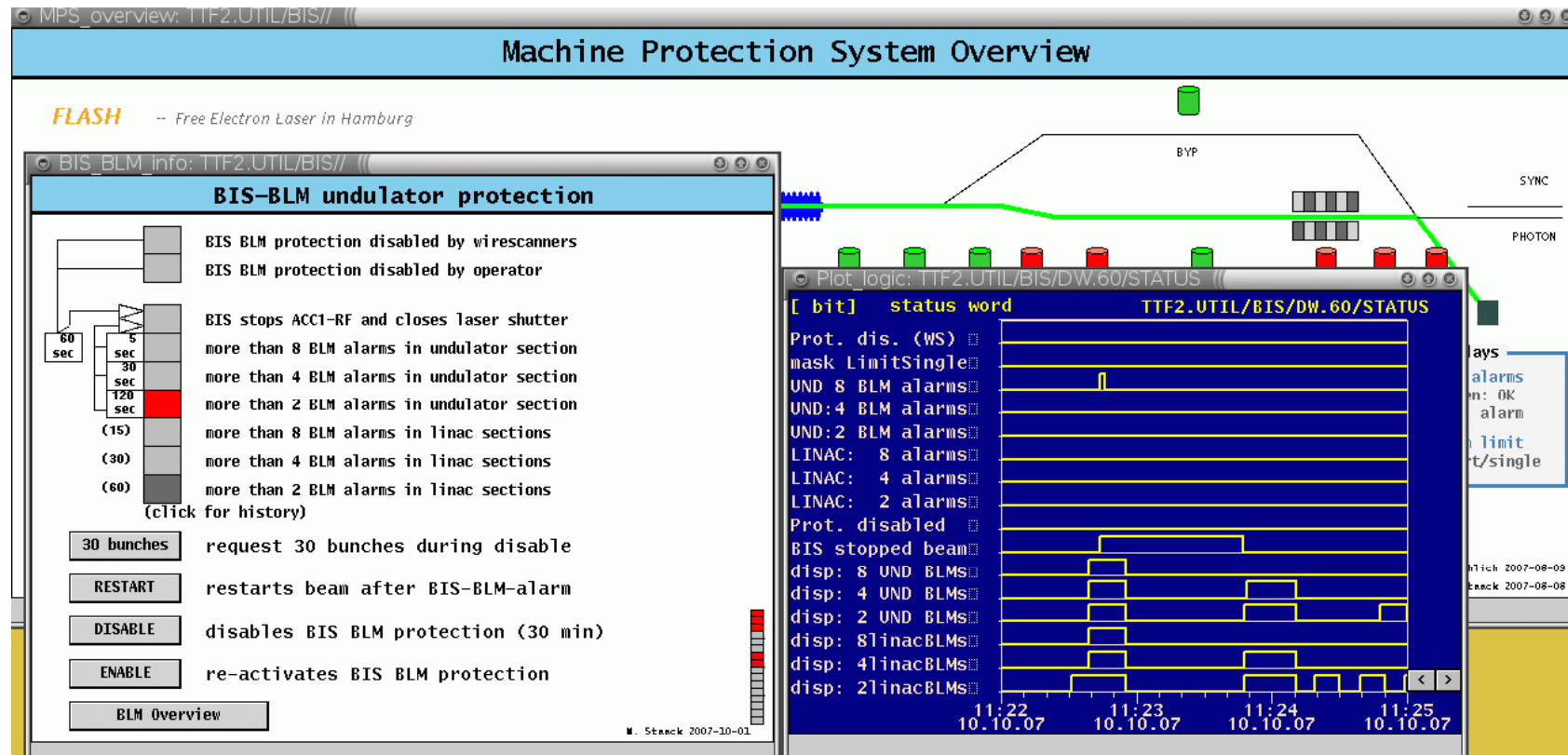
Das BIS schaltet die Gun-RF aus, wenn bei offenem Ventil zum Modul ACC1 Gun-Schirme gefahren werden – es wäre sonst durch Dunkelstrom das Vakuum in ACC1 in Gefahr:



Das BIS schützt die Undulatoren vor Aktivierung...



...bei zu vielen BLM-Alarmen wird abgeschaltet!



Hier sieht man, wer es denn war...

MPS Overview: TTF2.UTIL/BIS//

Machine Protection System Overview

FLASH -- Free Electron Laser in Hamburg

BIS-BLM undulator protection

BIS BLM protection disabled by wire scanners
BIS BLM protection disabled by operator

BIS stops ACC1-RF and closes laser shutter

- more than 8 BLM alarms in undulator section
- more than 4 BLM alarms in undulator section
- more than 2 BLM alarms in undulator section
- more than 8 BLM alarms in linac sections
- more than 4 BLM alarms in linac sections
- more than 2 BLM alarms in linac sections

(click for history)

30 bunches request 30 bunches during disable

RESTART restarts beam after BIS-BLM-alarm

DISABLE disables BIS BLM protection (30 min)

ENABLE re-activates BIS BLM protection

BLM Overview

BLM overview: TTF2.DIAG/BLM.ALARM//

Beam Loss Monitors

1GUN	11BC3	8.1TCOL	2.1BYP	6.1DUMP
17ACC1	14BC3	8.2TCOL	2.2BYP	6.2DUMP
1BC2	2DBC3	2.1ECOL	15.1BYP	13.1DUMP
2BC2	2ACC7	2.2ECOL	15.2BYP	13.2DUMP
3BC2	10ACC7	3.1ECOL	36BYP	
4BC2		3.2ECOL	59BYP	
4DBC2		7MATCH	74BYP	
8DBC2		17SEED	92BYP	
12DBC2		2EXP	1.1DUMP	
2UBC3		10EXP	1.2DUMP	
1BC3	2.1TCOL			
5BC3	2.2TCOL			

Inj .. Acc5 Acc6 .. Dump

22L. SEED	UND1	UND2	UND3	UND4	UND5	UND6	Undulator
22R. SEED	1R	3R	1R	3R	1R	3R	

Undulator HV

Last, but not least:

Laserinterlock

- Managt das Türinterlock
- Überwacht Wasserdurchfluss
- Checkt Laser-Temperaturen
- Überwacht den VME-Rechner
- Schaltet ab im Fehlerfall

