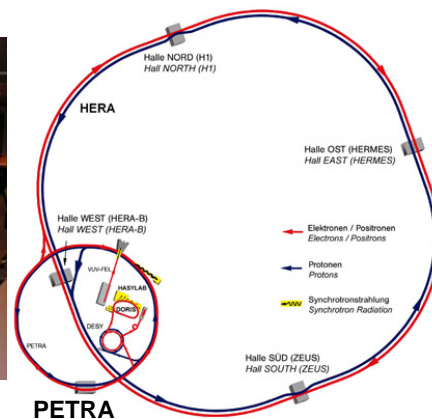# The Users Perspective
on control systems
(some truisms)

Heiko Ehrlichmann, DESY

My Perspective as a
Control System User

-> ***beam operation*** of particle accelerators

● PETRA II

HERA

Halle NORD (H1)
Hall NORTH (H1)

Halle OST (HERMES)
Hall EAST (HERMES)

Halle WEST (HERA-B)
Hall WEST (HERA-B)

Elektronen / Positronen
Electrons / Positrons

Protonen
Protons

Synchrotronstrahlung
Synchrotron Radiation

Halle SÜD (ZEUS)
Hall SOUTH (ZEUS)

PETRA

Some General Remarks

- (un) fortunately the control system is able to <u>compensate deficits</u> of both hardware and operation
  -> central role in accelerator operation

- the operation concept and the control system are (and should be) strongly linked
  (from design to routine operation)

- controls should always fit to the user capabilities
  (and not the opposite way around)

  => no universal panacea for control systems,
  always specific solutions required
  (depending on the specific constraints)

Some Questions
### for control system experts

concerning

1. online information
2. offline information
3. operation panels
4. automated procedures
5. failure recognition + alarm panel
6. remote operation

with some subjective answers

1. Online Information at the console

- *how much information is necessary ?*
- *how much is enough ?*
  -> well selected information (situation dependent)

- *how important is the way of presentation ?*
  -> important !
    - homogenous display / layout
    - suggestive graphical presentation   i.e. orbit (position vs. phi)
    - well defined colours, large fonts
    - no overlapping windows
  => *cockpit concept* (automated configuration)

  + clear presentation of the actual machine status
    (control room + world outside)

Example 1

3
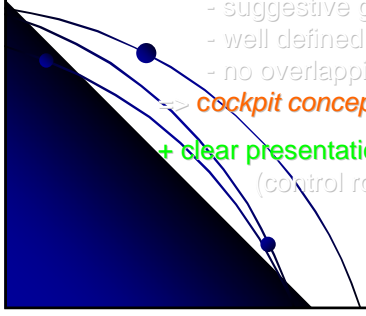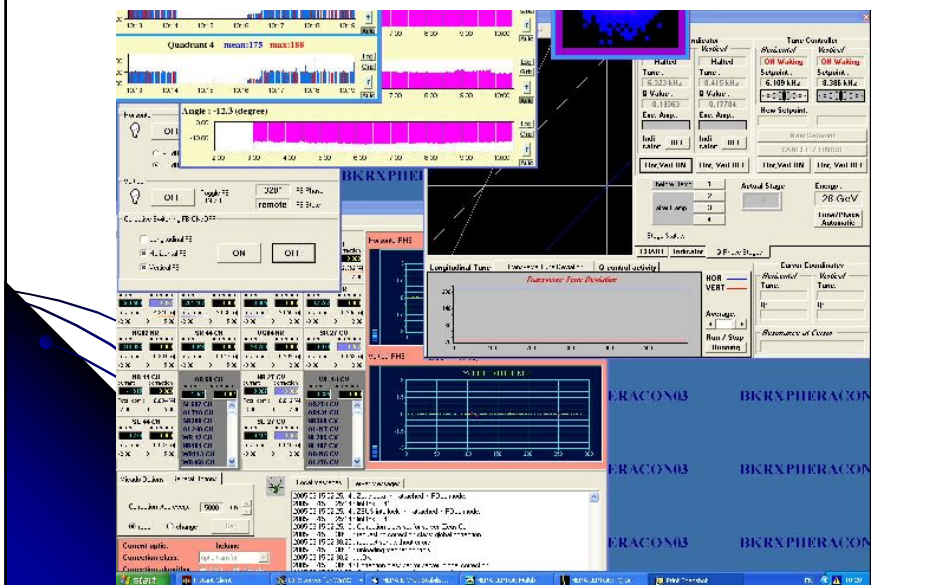
Example 2
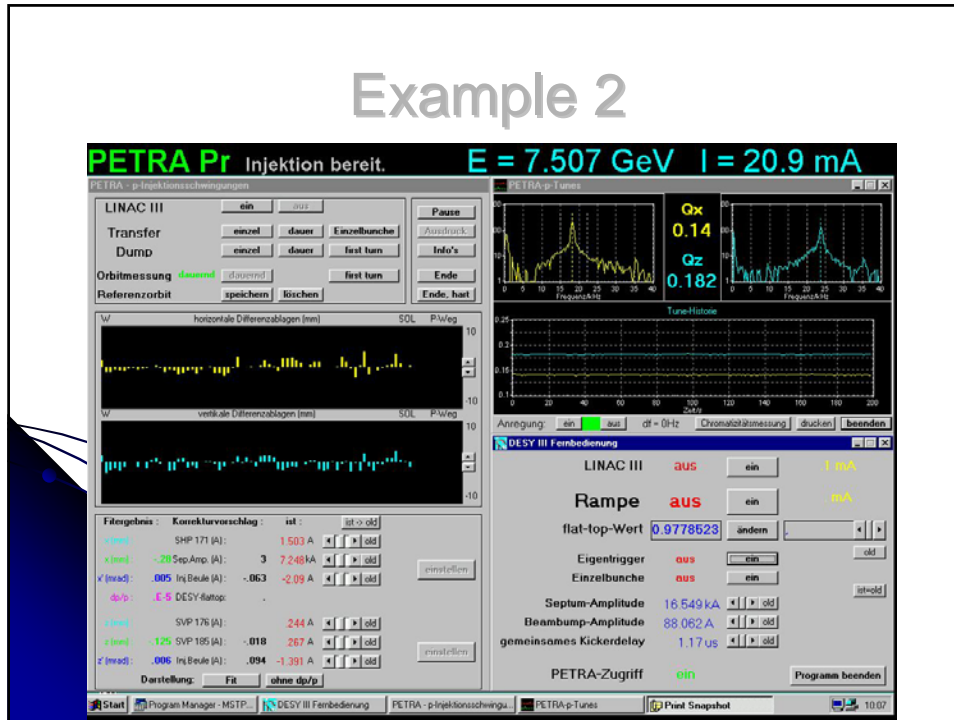
2. Offline Information

- *how much archiving is necessary ?*
- *how much is possible ?*
  -> data selection is unavoidable
  but when ? - "now" -> triggered system
  - "later" -> exhumation
  - "never" -> data graveyard

- *how important is an easy archive access ?*
  usable **archive viewer** at the console is **essential**

- *do we need special post mortem diagnostics ?*
  yes -> "flight recorder"
  + fast data access at the console -> **viewer**

- *how important is an integrated logbook ?*
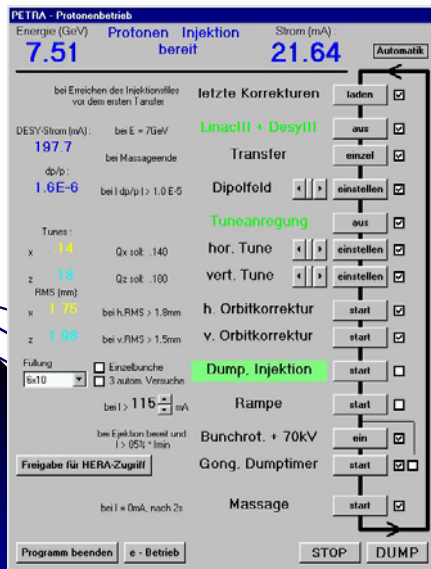 *(15 years of experience with e-logbooks at DESY …)*
  -> **in vogue**

3. Operation Panels at the console

- *how many knobs are necessary ?*
- *how many are enough ?*
  - -> access possibility to **all** components and functions
  - -> but: **selected** knobs for standard operation

- *how important is the way of presentation ?*
  - -> important !
    - graphical operating, avoiding keyboards
    - homogenous display / layout
    - suggestive graphical presentation
    - well defined colours, large fonts
    - no overlapping windows
  - -> **cockpit concept** (automated configuration)

- *how important are ergonomics ?*
  - *... (are you driving a car ?)*

4. Automation

- *are automated procedures useful ?*
  - -> *yes !*

- *how high should be the degree of automation ?*
  - -> depending on the level of complexity and routine
  - -> high complexity -> automation very helpful
  - -> routine operation -> automation reasonable
  - but : it could become **dangerous** -> operators get used to it ....
    - -> is one single knob ("beam on") desirable?

- *how important is the transparency of automated actions ?*
  - -> **essential** for complex procedures

- *how important is an "automatic off" option ?*
  - *... (do you like MS products ?)*

Example: PETRA *Autopilot*

PETRA - Protonenbetrieb

Energie (GeV)	Protonen Injektion	Strom (mA)
7.51	bereit	21.64	Automatik

bei Erreichen des Injektionfiles vor dem ersten Transfer — letzte Korrekturen — laden ☑

DESY-Strom (mA): bei E = 7GeV — LinacIII + DesyIII — aus ☑
197.7

dp/p : — bei Massaeende — Transfer — einzel ☑
1.6E-6 — bei I dp/p I > 1.0 E-5 — Dipolfeld ◄ ► einstellen ☑

Tuneanregung — aus ☑

Tunes: — Qx soll .140 — hor. Tune ◄ ► einstellen ☑
x 14
z 18 — Qz soll .180 — vert. Tune ◄ ► einstellen ☑

RMS [mm] : — bei h.RMS > 1.8mm — h. Orbitkorrektur — start ☑
x 1.75
z 1.98 — bei v.RMS > 1.5mm — v. Orbitkorrektur — start ☑

Füllung — ☐ Einzelbunche ☐ 3 autom. Versuche — Dump, Injektion — start ☐
6x10

bei I > 115 mA — Rampe — start ☐

bei Ejektion bereit und I > 95% * Imin — Bunchrot. + 70kV — ein ☑

Freigabe für HERA-Zugriff — Gong, Dumptimer — start ☑☐

bei I = 0mA, nach 2s — Massage — start ☑

Programm beenden | e - Betrieb | STOP | DUMP

- all essential information and knobs within one single window
- knob arrangement
  -> procedure map
- remote control of other console applications
  ("top" instead of "middle" layer)
- 1Hz logic, based on the actual machine situation
  -> proposal for next action
- automation option for each single step

=> *assistance* for the crew
=> *full automation* possible
=> but *no paternalism !*

9 years of stable operation

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5. Failure Recognition + Alarm Panel

- *how important is a failure recognition system ?*
  -> **essential**, especially at high degrees of automation
  -> **fast** guidance to the source of trouble

- *how reliable it must be ?*
  -> **as high as possible**
    -> detection of **any** condition blocking beam operation
    -> monitoring of **all** components and subsystems
    -> **no** false alarms

- *when it should be implemented ?*
  ... *(when do you want to have help?)*

6. Remote Accelerator Operation

- *is remote operation necessary ?*
  - -> *no*

- *is it desirable ?*
  - -> could be a very **powerful** feature

- *can remote operation affect the operation reliability ?*
  - -> *yes !*
    - -> net access security   -> your business
    - -> unintentional operation
      - -> traceability really important
        - -> permission / prohibition possibilities

- *how sophisticated should / could it be ?*
  - simply remote console access ? (VNC, Timbuktu ...)
  - virtual control rooms, videoconference...   -> GAN

Summarising Questions

- *is a good information presentation part of a good control system ?*

- *are ergonomics and traceability part of a good control system ?*

- *is operation assistance part of a good control system ?*

-> *yes*

-> *it's a major part of the job*

The Last *General* *Question*

looking at the past decades:

- the physics or principles of particle accelerators are unchanged
- the machine complexity is increasing roughly linearly with time
- the computing power is increasing exponentially

-> where is the impact on control systems ?
-> where is the next step of innovation ?

- *can we (users) expect a new generation of accelerator controls ?*