Operations & Availability

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Global Group 3

Tuesday (8/16): Availabilty & Recovery Room: *Erickson*, Chair: *E Elsen*

16:00 - 16:15 Benchmarking Availabilty code, S Schaetzel

16:15 - 16:55 Availability simulations, T Himel

16:55 - 17:30 Sources & Tunnels, Discussion

Wednesday (8/17): ILC Commissioning Room: *Erickson* , Chair: *T Himel*

16:00 - 16:30 ILC commissioning from a HERA perspective, F Willeke

16:30 - 16:45 ILC commissioning Schedule, J Sheppard

16:45 - 16:55 ILC commissioning ideas from the TESLA TDR, K Floettmann

16:55 - 17:30 Requirements, Discussion

Thursday (8/18): Protection Systems Room: *Erickson* , Chair: *T Himel*

16:00 - 16:35 Fast MPS for ILC, P Tenenbaum

moved to next week

16:35 - 16:55 Dump layout, Discussion

16:55 - 17:20 Requirements for MPS & PPS, Discussion

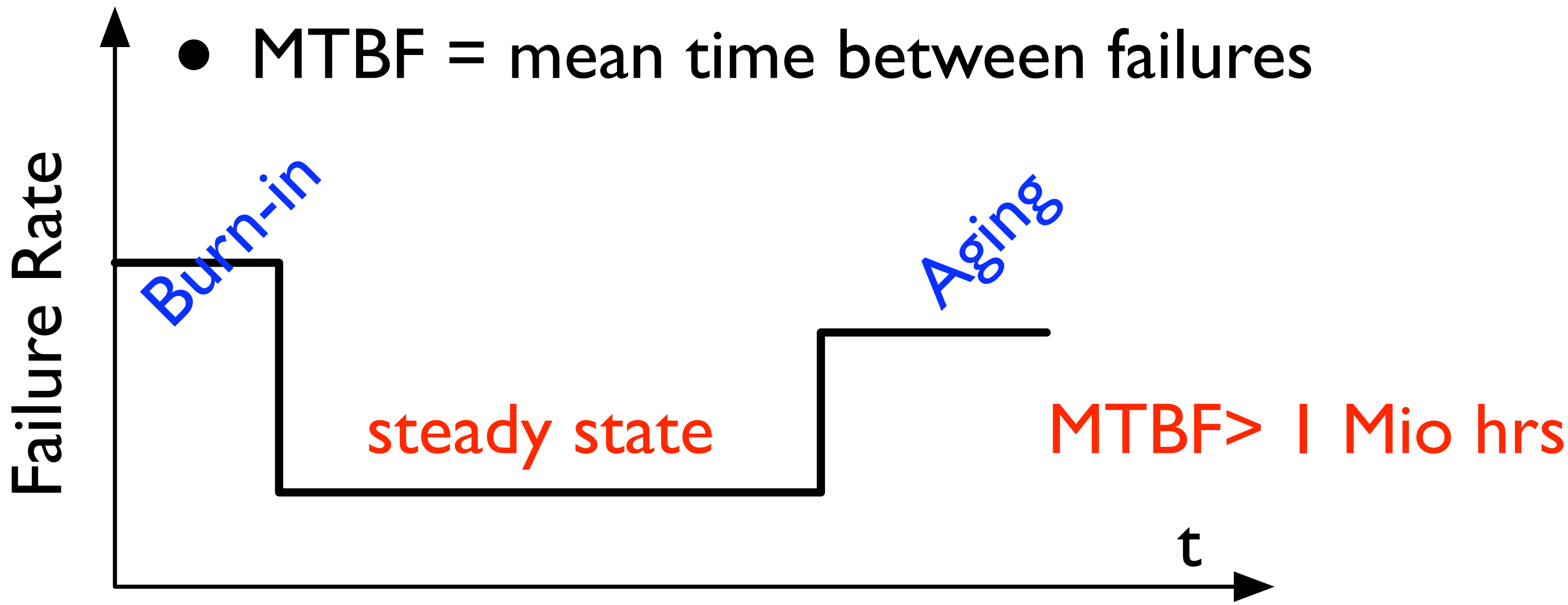
17:20 - 17:30 EMI for detectors & diagnostics, C Damerell & Discussion.

Availability for Luminosity

- Why is it a concern when we have operated 30 km long accelerators before?
- HERA has been operating for more than 13 years: mixed cold and warm components
  - η_{max} = 40 - 60%
    and similar numbers for other large colliders
  - understanding and improvement?

Deriving Availability from first Principles

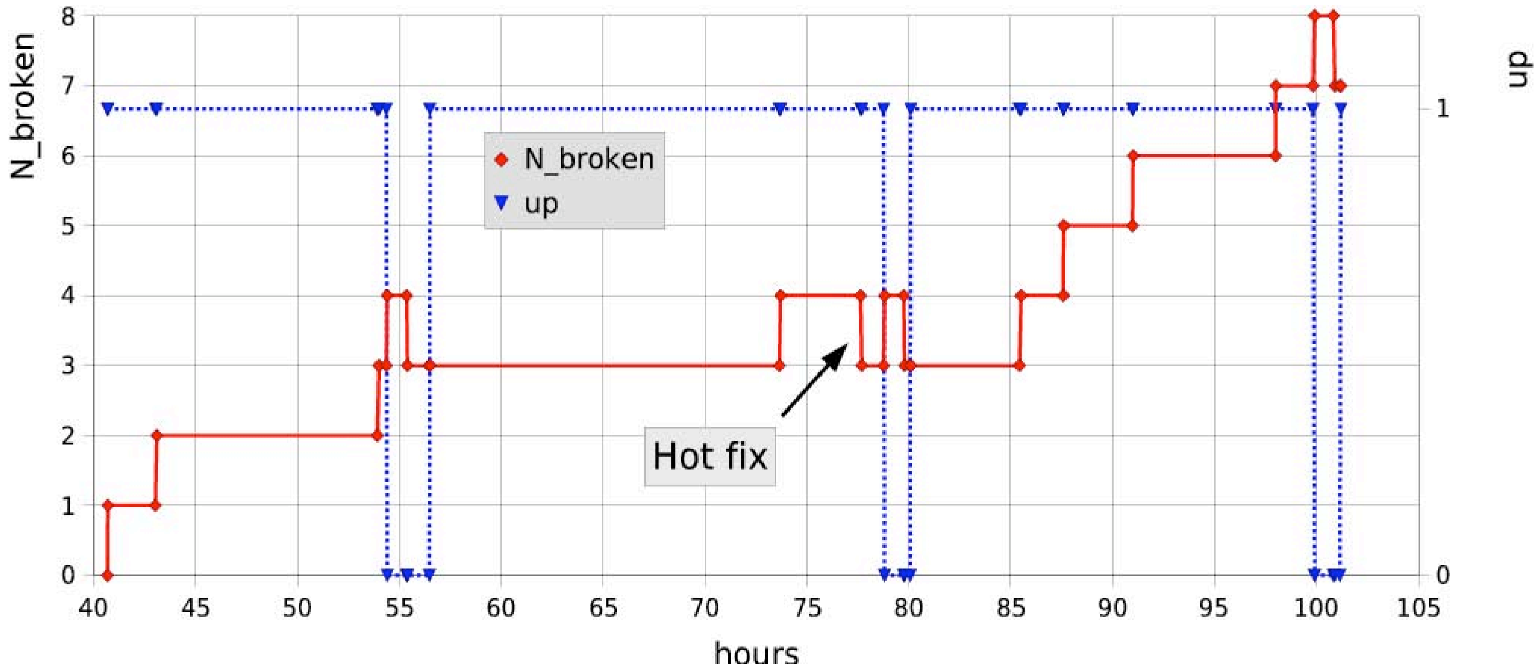
- Number of components is sufficiently large to justify stochastic approach:
  - MTBF = mean time between failures



Consequence of Failure

- Repair
  - time of repair can be optimized
- Time to Recovery
  - Assume mean time to recovery MTTR proportional to down time

Example run


N_broken
up
hours
N_broken
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Hot fix
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1

ILC Availability Simulation

- T. Himel’s code originally developed for USLCTOS
  - MTBF of many components (magnets, couplers, modulators…
  - MTTR for each
  - access restrictions for repair
  - tuning
  - many previously “lumped” systems now described by individual components

Result of Simulation

	% time integrating Luminosity	
ILC1	2 tunnels, conventional e+, nominal MTBF	67.5%
ILC2	ILC1 but Table A MTBF	80.0%

Table A
Assume that MTBF for selected components can be improved by factors 2-20.

Needed Improvements

Device	Improvement factor A for 2 tunnel conventional e+ source	Nominal MTBF (hours)
magnets - water cooled	**20**	1,000,000
power supply controllers	**10**	100,000
flow switches	**10**	250,000
water instrumention near pump	**10**	30,000
power supplies	**5**	200,000
kicker pulser	**5**	100,000
coupler interlock sensors	**5**	1,000,000
collimators and beam stoppers	**5**	100,000
all electronics modules	**3**	100,000
AC breakers < 500 kW		360,000
vacuum valve controllers		190,000
regional MPS system		5,000
power supply - corrector		400,000
vacuum valves		1,000,000
water pumps		120,000
modulator		50,000
klystron - linac		40,000
coupler interlock electronics		1,000,000
linac energy overhead		3%

HERA benchmarking under study (S Schaetzel)

Undulator Source

- positrons are made from ~150 GeV electrons
- requires keep-alive beam to continue
  - tuning and
  - machine development
    while electrons are down

Source Comparison

ILC2	2 tunnel, conventional e+, table A MTBF	80.0%
ILC3	ILC2 but with undulator	68.6%
ILC4	ILC3 but with keep-alive source*	78.0%

*Source intensity must be such that beam is detectable by diagnostics (BPMs etc.)

1 vs 2 Tunnels

- a second tunnel may be used to access on hot-fix components
- klystrons, modulators, electronics can be placed in second tunnel
- for single tunnel: consider robotic repair

Tunnel Scenarios

ILC8	1 tunnel, undulator e+, keep-alive 2	64.2%
ILC10	ILC8 and robotic repair	68.1%
ILC11	2 tunnel, support tunnel only accessible with RF off, keep-alive	72.3%
ILC12	2 tunnel, keep-alive source 2	78.3%

Needed MTBFs Improvements

Device	**Improvement factor A for 2 tunnel conventional e+ source**	**Improvement factor B for 1 tunnel undulator e+ source, 6% energy overhead**	**Improvement factor C for 1 tunnel undulator e+ source, 3% energy overhead**	**Nominal MTBF (hours)**
magnets - water cooled	**20**	20	20	1,000,000
power supply controllers	**10**	**50**	50	100,000
flow switches	**10**	10	10	250,000
water instrumention near pump	**10**	10	**30**	30,000
power supplies	**5**	5	5	200,000
kicker pulser	**5**	5	5	100,000
coupler interlock sensors	**5**	5	5	1,000,000
collimators and beam stoppers	**5**	5	5	100,000
all electronics modules	**3**	**10**	10	100,000
AC breakers < 500 kW		**10**	10	360,000
vacuum valve controllers		**5**	5	190,000
regional MPS system		**5**	5	5,000
power supply - corrector		**3**	3	400,000
vacuum valves		**3**	3	1,000,000
water pumps		**3**	3	120,000
modulator			**3**	50,000
klystron - linac			**5**	40,000
coupler interlock electronics			**5**	1,000,000
linac energy overhead		**3%**		3%

Commissioning

- Lessons from
  - HERA: F Willeke
  - SLC and beyond: J Sheppard
- Ideas for ILC (TESLA-Report 2002-09)
- to be done:
  - impact on tunnel/DR/source layout (next week)

Some lessons

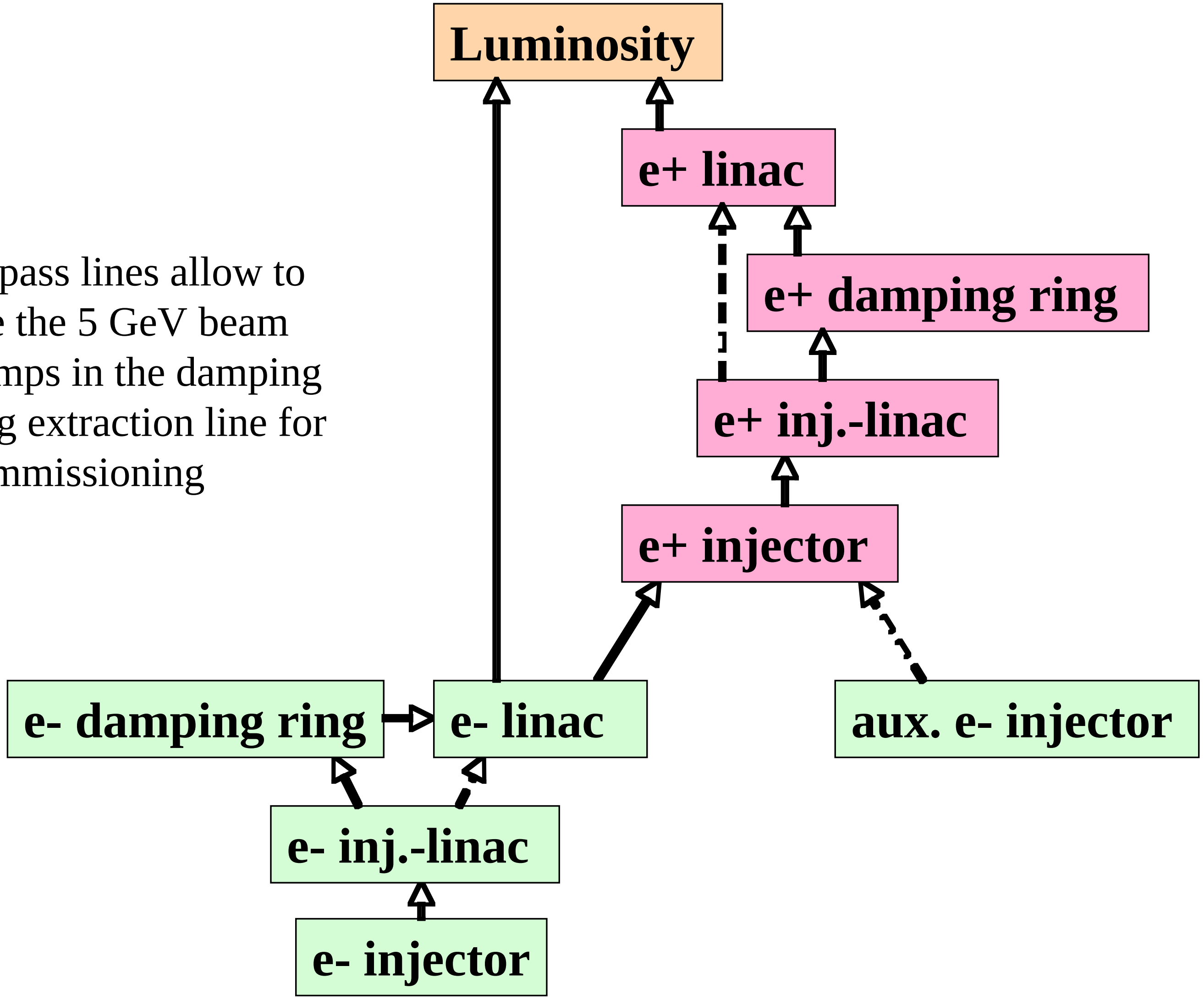
- Don’t be cheap on low cost items; beware of trivial systems
- Minimise active components in accelerator tunnel
- Failing interlocks: Have remotely controllable trip levels

Some lessons cont'd

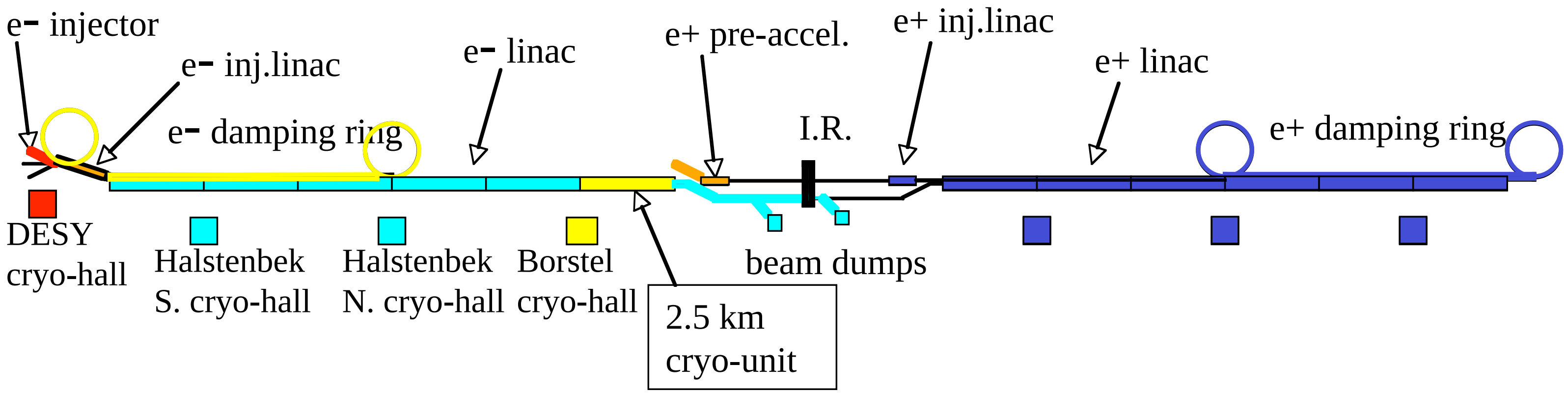
- Attempt phased commissioning
- Have e- source to commission e+ system. (Damping ring polarity should be reversible in ~1 shift
- control system must be capable of recording synchronized data of many systems

Example Injector linac

Bypass lines allow to use the 5 GeV beam dumps in the damping ring extraction line for commissioning



Plans for TESLA Commissioning



Phase 1: electron injector (500 MeV)

Phase 2: electron inj.-linac (5 GeV)
+ auxiliary electron injector
+ positron pre-accelerator

Phase 3: electron damping ring
+ 2.5 km cryogenic unit

Phase 4: electron linac

Phase 5: all the rest

To come in week 2

- Effect of 1 vs 2 tunnels and DR location on phased commissioning
- Method of energy upgrade will affect commissioning
- etc.

Protection Systems

- Machine Protection Systems
- Person Protection Systems

deferred to next week

Summary - so far…

- Undulator source
  Loss in availability can be mitigated by keep-alive source with sufficient intensity (BPMs)
- Tunnels - one or two?
  Gain in Lumi-availability with second tunnel depends on position of klystrons, modulators annd electronics
- Commissioning
  - Scenarios for several tunnel/DR/source configurations to be developed
  - Don't be cheap - have diagnostics
- MPS & PPS to come next week

to come…

Tuesday: Availability and recovery

1. How hard will it be to make the ILC
2. What needs to be done to attain hi
3. How does the type of e+ source (
4. Is an e+ keep-alive source neede
5. How does the tunnel configuratio
   use of robot arms for repairs) affe
6. Is it important to have many PP
   be in one zone while beam is ir
7. How does the time to recover
8. Are there other driving needs
9. What design features lead to
   a. Should temperatures be kep
   b. Should magnets be left on
   c. Should there be a very qu
   compensate for persistent
   d. Should there be enough
   field probes in each magnet?)

Wednesday: Commissioning

1. How much time can be saved by phasing commissioning (e.g. commissioning the injector while building the damping rings and then commissioning a damping ring� while building the main linac or doing e- before e+)?
2. How is phased commissioning affected by tunnel layout decisions: 1 vs 2 and DR in high or low energy end of linac tunnel?
3. Is an e- source needed to commission positron system?
4. Is a non-undulator e+ source needed to commission the positron system?
5. Is a non-undulator e+ sourced useful for the first few years of luminosity running?
6. How large a dynamic range on diagnostics (both intensity and beam size) is needed for commissioning?
7. How does the method of phasing the energy upgrade affect the commissioning?
8. Is an automated/remote alignment system needed?

Thursday: MPS and PPS

1. Where are collimation sections and sacrificial collimators needed?
2. Where are abort and or tune-up dumps needed?
3. Do we need to use pilot bunches for MPS?
4. How many PPS zones are needed and where are tune-up dumps between them needed?
5. How much shielding is needed between zones and around dumps?
6. Should we be able to access one IR while beam is in the other? What are the consequences?

and more…