The ILC beam dumps
BCD/ACD

Beam dumps meeting, RAL
30th November 2005

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The ILC dumps

• The ILC beam dumps are a major issue in the design and costing of the project.
• Perhaps as many as 6 full power (18MW) dumps, with $\gamma$ dumps, may be needed.
• Solid dumps have been ruled out due to power loads (see the work done for TESLA), and traditional thinking indicates a pressurised water dump may be appropriate.
Why 6 dumps?

R. Appleby, RAL dumps meeting,
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The water-based dump

- Water-system
- Air treatment
- Water-dump vessel
- Dump shielding
- Emergency/comm. beam tilted ≈15 mrad
- Spent beam, tilted ≈15 mrad
- Exhaust / chimney?
- Normal cooling water
- Hall basin

Figure: Schmitz, DESY
The gas dump

One atomic noble gas core (Ar, Xe) is surrounded by solid material (Fe)

gas core acts as scattering target (only small amount of energy deposition) and distributes energy longitudinally over ~ 1km into surrounding material.

Figure: Leuschner, DESY

R. Appleby, RAL dumps meeting, 30/11/05
The hybrid dump

• The hybrid uses a shorter gas dump as a passive beam expander, in front of a water-based dump

• The idea, which arose out of discussion with target people, is very attractive
  – Water dump window problems eased
  – Beam expander failure unlikely
  – Other benefits e.g. reduced neutron flux coming back from the water dump
The ILC BCD (baseline configuration document)

- Written recently (editors: Appleby and Walz)
- Baseline configuration is a pressurised water-based dump
  - Extensively studied for TESLA
    - See, for example, Bialowons et al TESLA note 2001-04 or the TESLA TDR (2001)
    - Used at 2MW (800kW) at the SLC
The ILC BCD: dump quantity

- The beamstrahlung dump is crossing angle dependent
  - Common with charged beam for 20mrad
  - Separate with charged beam for 20mrad
- This dump should be rated to around 1MW
- Together with tune-up dumps (which may be full power?), there are 6 dumps in total (for 2 IRs), would be good to reduce this
The ILC BCD: dump details

- The water flow is sufficient to avoid boiling
- The vacuum/water boundary is a thin window, with cyclic stress limited by controlling delta-T of the water per pulse
- Nominal beam size is allowed to grow in the extraction line to avoid window damage
- Nominal beam sweeping prevents boiling
- Water system: 2 closed loop, inner loop at 10bar, volume of around 18m$^3$
- Total size: 25m longitudinally, 15m transversely
The ILC BCD: required R+D

- The BCD document lists the required R+D for the water-based dump (this is not an exhaustive list and we may have missed something!)
  - Window survivability
  - Prototype of window and beam test (with the correct energy density)
  - Pressure wave formation
The ILC ACD
(alternate configuration document)

• Alternative configuration is a Noble gas based dump
  – 1km of Ar(?) with a cooled Fe jacket
  – Acts as scattering target, to blow the beam up
  – Exploit pressure profile to tune the profile of the deposited energy
  – Issues include heating of the gas, activation and ionisation effects
The ILC ACD: required R+D

- The required R+D for a gas dump again is not exhaustive and we may (certainly!) have missed something
  - Study of gas heating, including ionisation effects
  - Study of activation effects
  - A gas dump window
  - A prototype would certainly be required
The ILC ACD: alternatives

- The use of the gas dump as a passive beam expander, followed by a water dump, has been recently proposed.
- This hybrid dump is attractive, but requires further study and development of the idea.
- Other ideas are rotating solid dump immersed in water, or a liquid metal dump.
Summary

• The ILC BCD/ACD dump section has been written since Snowmass
  – BCD consists of a pressured water dump, rated to 20MW, with 6 in total for 2 IRs
  – ACD consists of the gas based dump, or hybrid dump, or some alternative
What are pro/cons of:
a) separate full power tune-up beam dumps, as in baseline (six full power beam dumps in total);
b) eliminating the tune-up beam dump, and using main dumps for tune-up mode as well.

- What is the amount of cost reduction?
- What is impact on ILC availability due to elimination of "tune-up" mode (cannot simultaneously access detector and tune the linac?)?
- What is technical feasibility of beam dump design, with windows on both sides?
- What is feasibility from optics point of view?
- What are conventional facility implications, e.g. do we need to widen the tunnel?
- Would it improve the ILC availability if the tune-up dump would be kept but with reduced power rating, e.g. to "keep-alive" intensity?
- Would it be possible to dump "keep-alive" beam intensity to the main dump in tune-up mode and have people accessing detector?
Question on separate tune-up dump