ILC Laser-wire R&D status

- Reaching high luminosities
- Laser-wire principle
- The PETRA laser-wire
- The ATF laser-wire
- Laser R&D

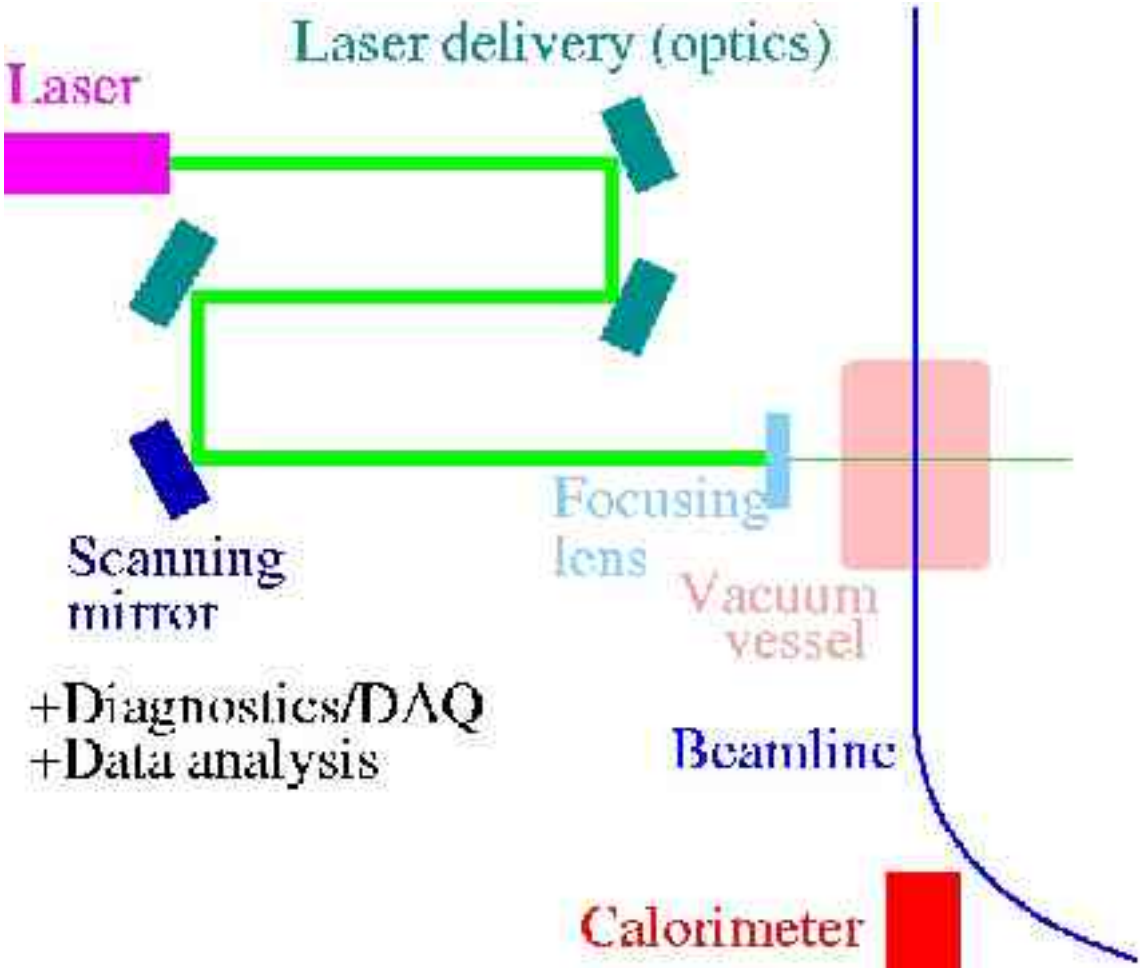
Nicolas Delerue, University of Oxford
http://www-pnp.physics.ox.ac.uk/~delerue/

Reaching a high luminosity

- The luminosity goals set for the ILC require very high beam densities => very small beams
- Device used in the past to tune accelerators beam size are too fragile or too imprecise to be used with the ILC's high power beams
- R&D is ongoing to prove that a laser swiped across the accelerator beam can provide the necessary resolution => Laser-wire
- Idea pioneered at SLC and at the ATF DR

Laser-wire principle: Compton interactions

- Laser pulses are sent across the electrons' path
- Compton photons are produced
- By varying the vertical position at which the laser pulse interacts with the electrons one can probe different parts of the bunch and thus measure the beam size and its profile

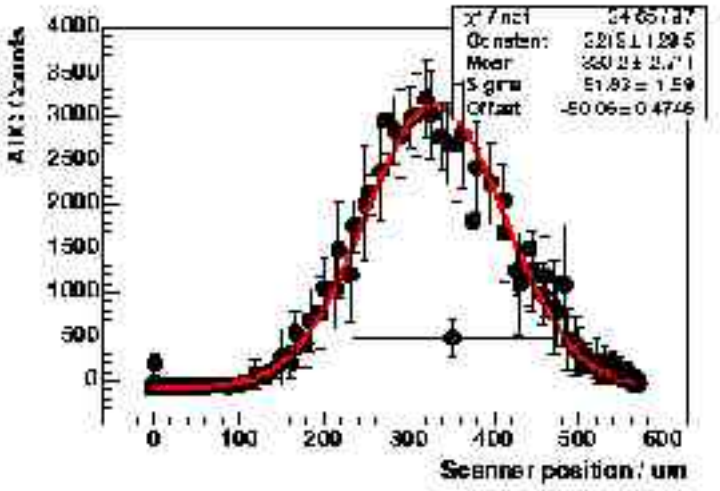


Challenges for the ILC laser-wire

- Need laser pulses of ~10MW at the ILC repetition rate (~3000 bunch/train@5Hz) => that's a lot of power!
- Need to transport the laser pulses from their source to the laser-wire IP without distorting them => this could be 100's of meters.
- Need to change the laser pulses vertical offset between two trains => that is less than 300ns.
- Need to focus the laser pulses to a size smaller than the electron beam => In the BDS that is less than 1 micrometer!
- Need to extract the photons from the beam-line and measure their energy accurately
- Prototypes are being tested at PETRA and the ATF extraction line.

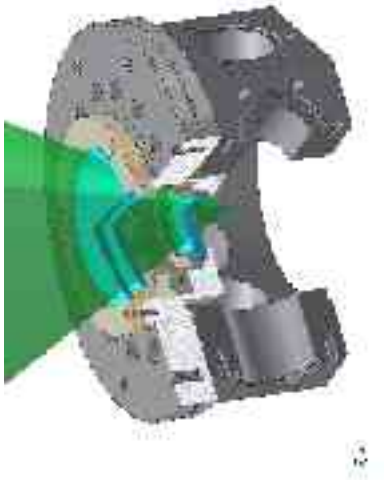
The PETRA laser-wire

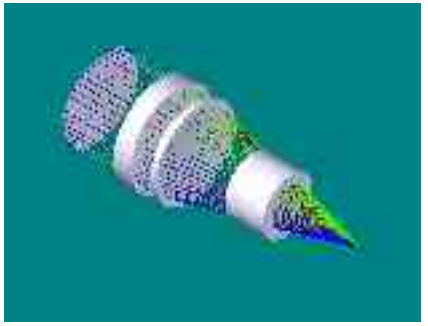
- Collaboration
  DESY/CERN/UK/SLAC
- Working prototype
- Identified several issues:
  - Laser reliability
  - Photons extraction issues
  - DAQ
- Laser upgraded (EuroTeV)
- 2nd dimension scan. added this year



The ATF extraction line laser-wire

- Collaboration KEK/UK/SLAC
- Goal: achieve a resolution of ~1 micrometer
- Infrastructures installed last September
- Trying to have the two beams aligned vertically
  => need more diagnostic tools
- First scan expected by the end of the year





Lessons from the current laser-wire R&D

- Focusing the laser light below 1 micrometer will be difficult => need to use UV pulses?
- Time & spatial alignment of the laser with the electrons is difficult
- The laser delivery line may affect the quality of the laser pulse
- Laser quality & reliability is critical... (see next talk)