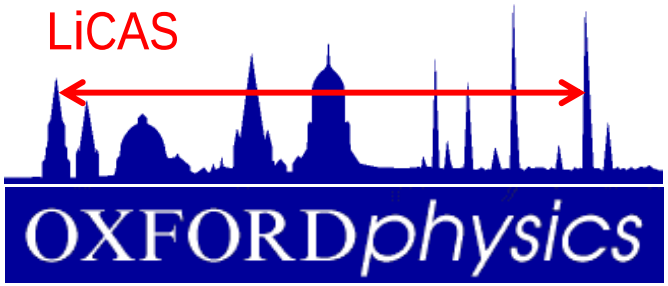
Survey and Alignment of the ILC

Status of the LiCAS RTRS Project

Warsaw University



LiCAS People

DESY

- Johannes Prenting
- Markus Schloesser
- Ernst-Otto Saemann
- Daniel Kaempnter

Project & Masters Students

Robert Apsimon
Peter Baker
Ken Chuang
Thomas Zlosnik
Simon Wilshin
Chris Glassman
James Robinson
Pauline Sliwa
Anna Lewis

Edward Botcherby

John Nixon

Warsaw

Gregorz Grzelak

Brtek
Szczygiel
student

Alumni

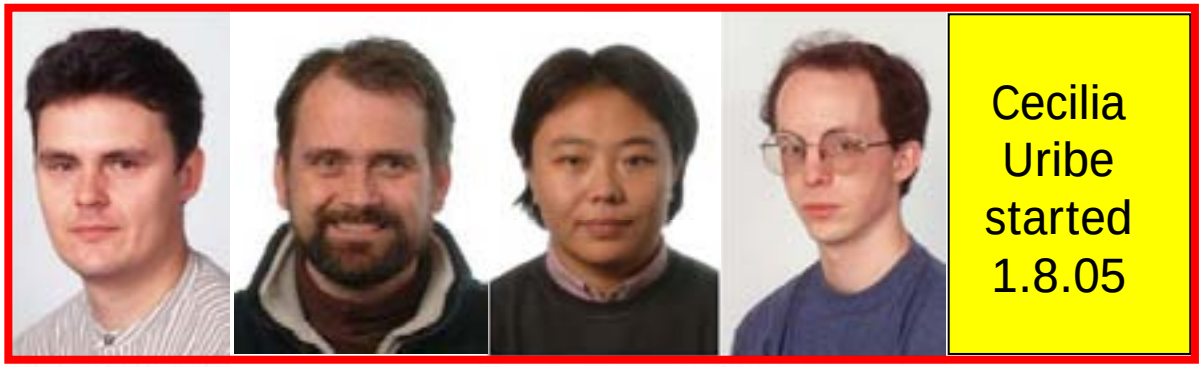
David
Howell

Roman Walczak

Colin Perry

Wing Law

LiCAS People (JAI @ Oxford)



academic

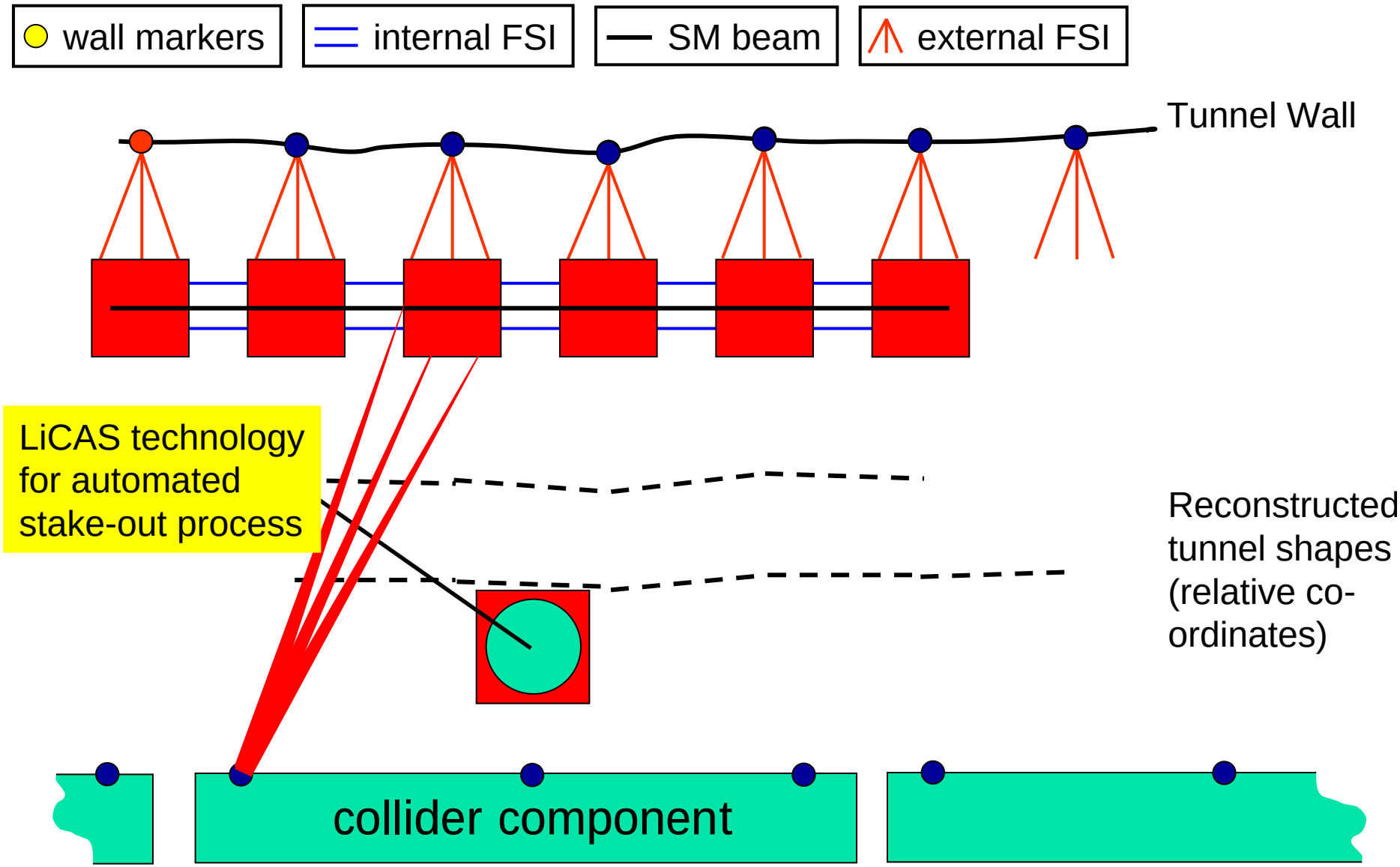
electronic & DAQ

mechanic

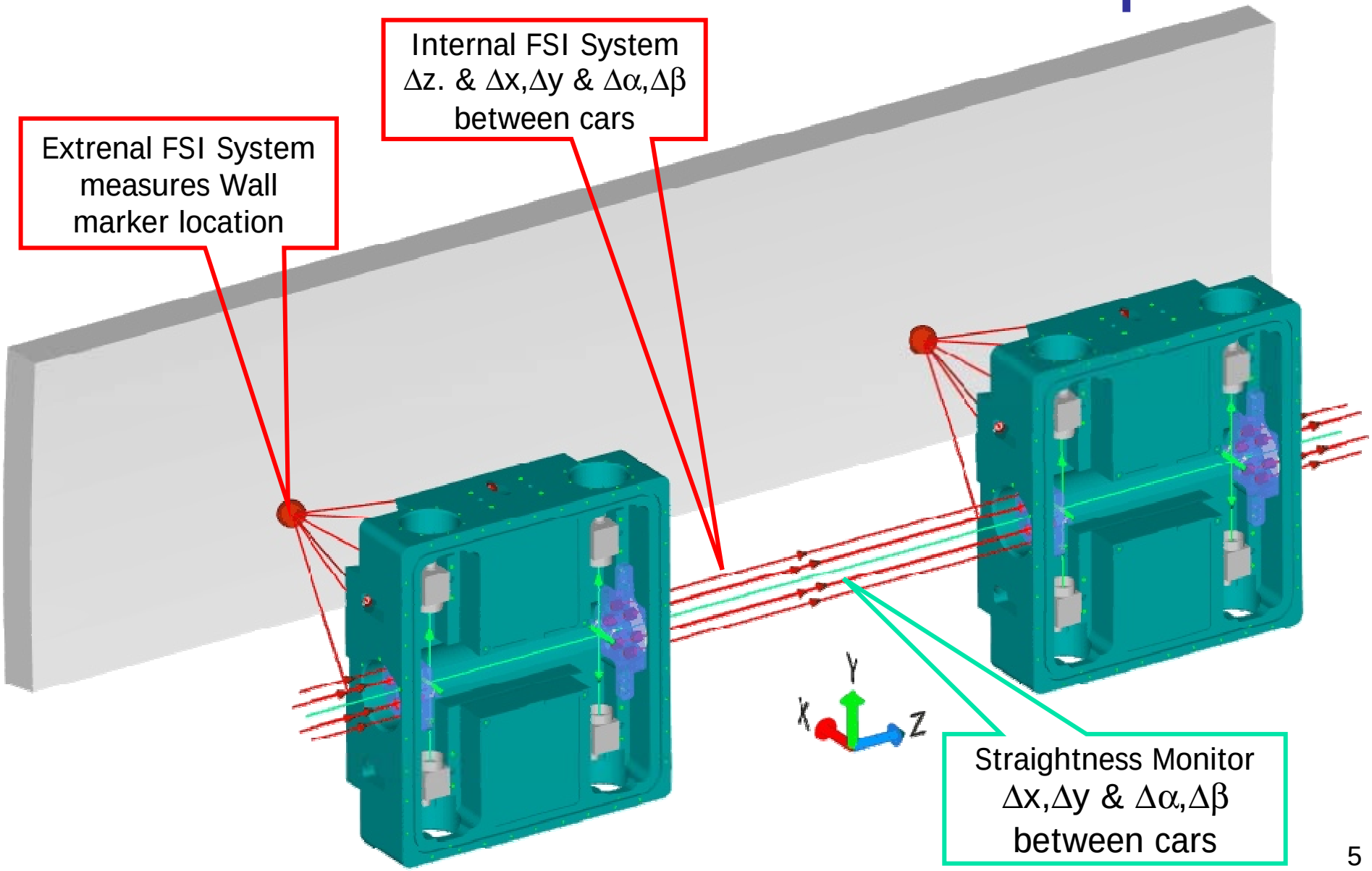
optic

student*ic* (PhD)

RTRS concept



LiCAS Measurement Principle

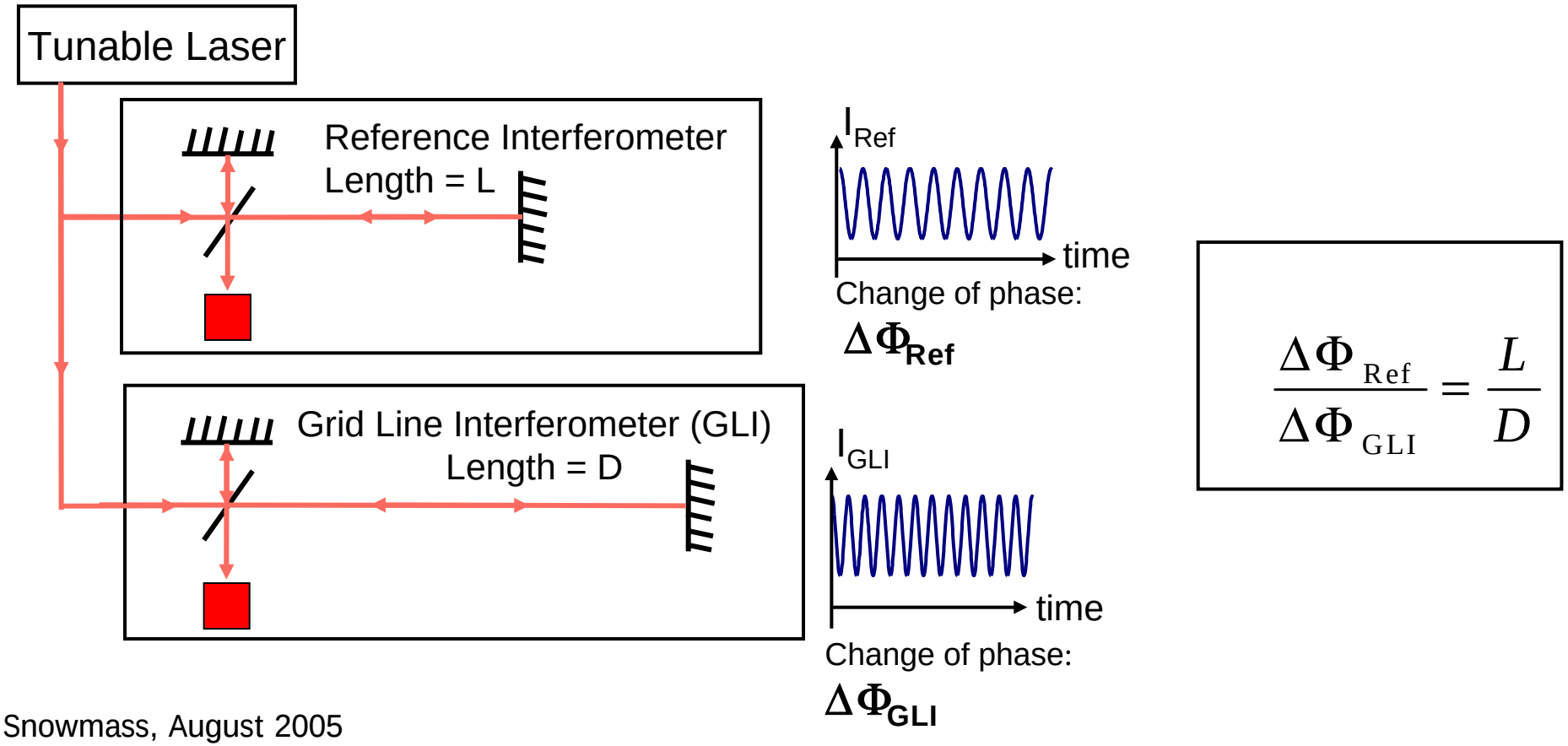


FSI

Frequency Scanning Interferometry
=
Absolute distance measurement system

FSI Principle

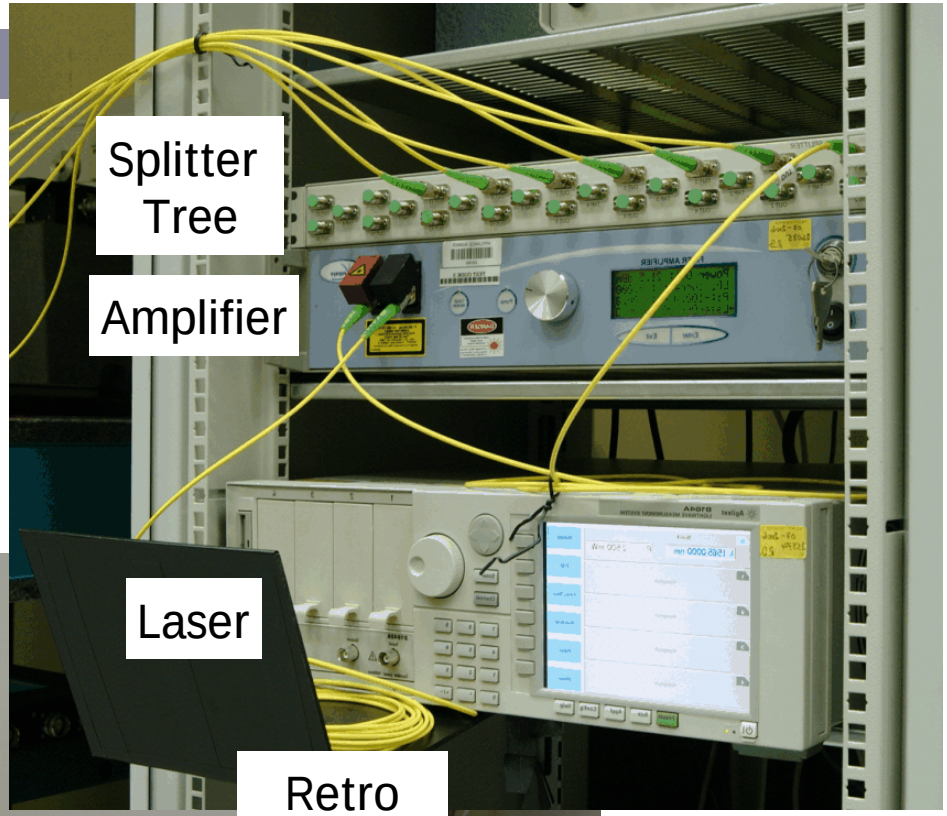
- Interferometric length measurement system
- Originally developed at Oxford for online alignment of ATLAS SCT tracker
- Measurement precision aprox. 1μm over 5m
- Two lasers with opposite tuning directions can reduce drift sensitivity (not shown)

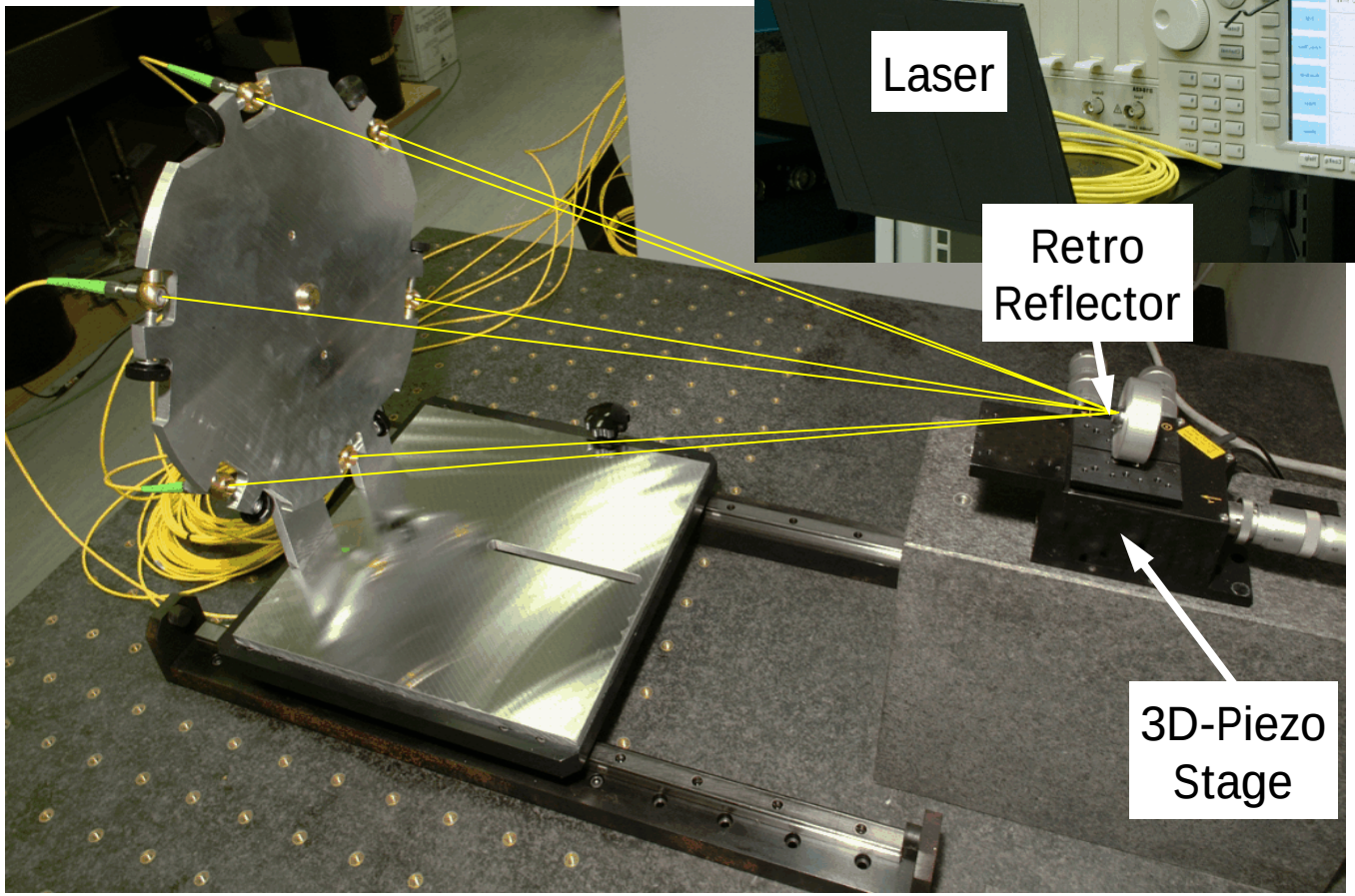


$$\frac{\Delta\Phi_{Ref}}{\Delta\Phi_{GLI}} = \frac{L}{D}$$

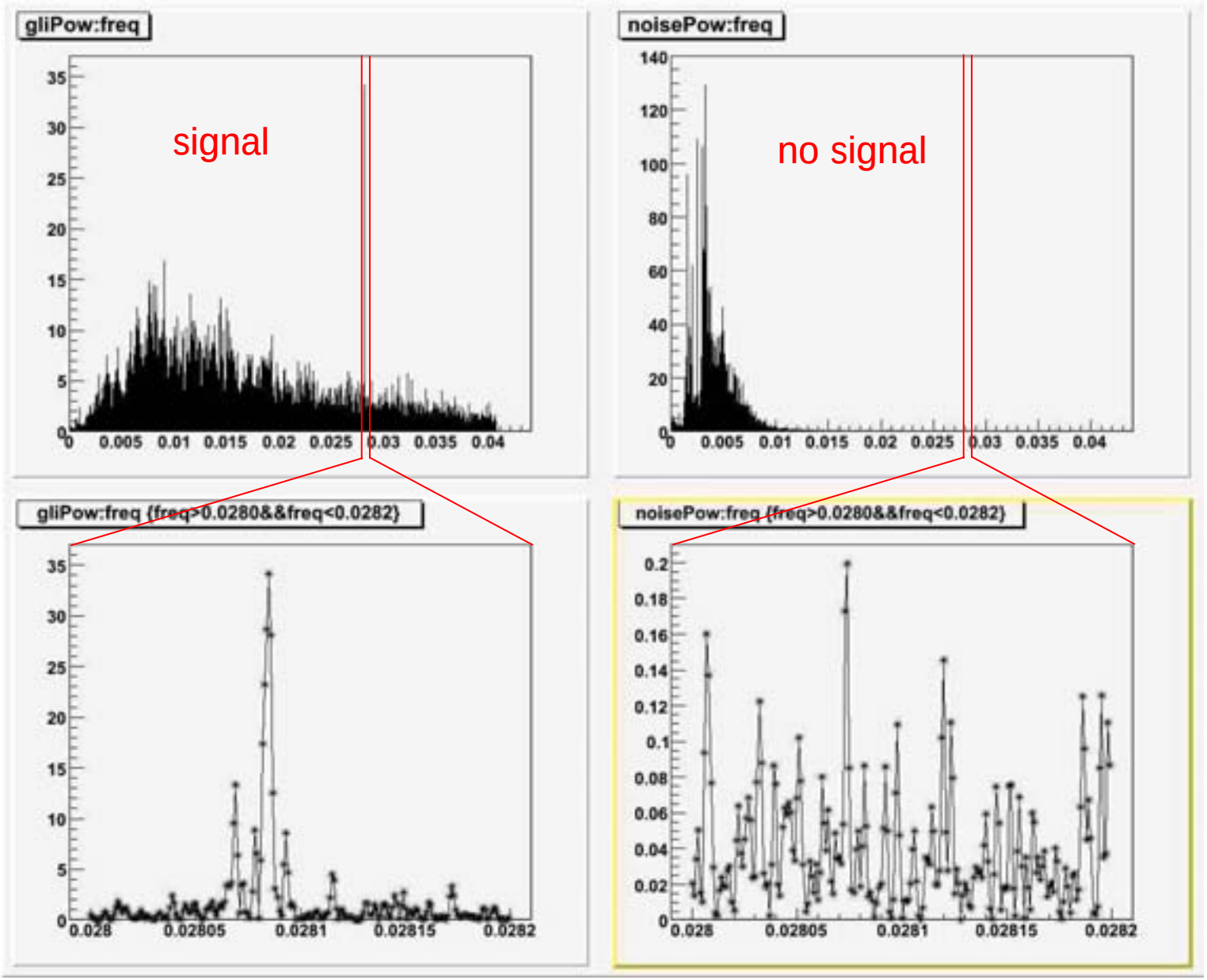
FSI

- 6-line FSI system for 3D wall marker measurement now works without collimation optics in 50x50x50 mm^3 dynamic volume thanks too ...





FSI spectral analysis (10^{-9} of 1 mW returned light power)

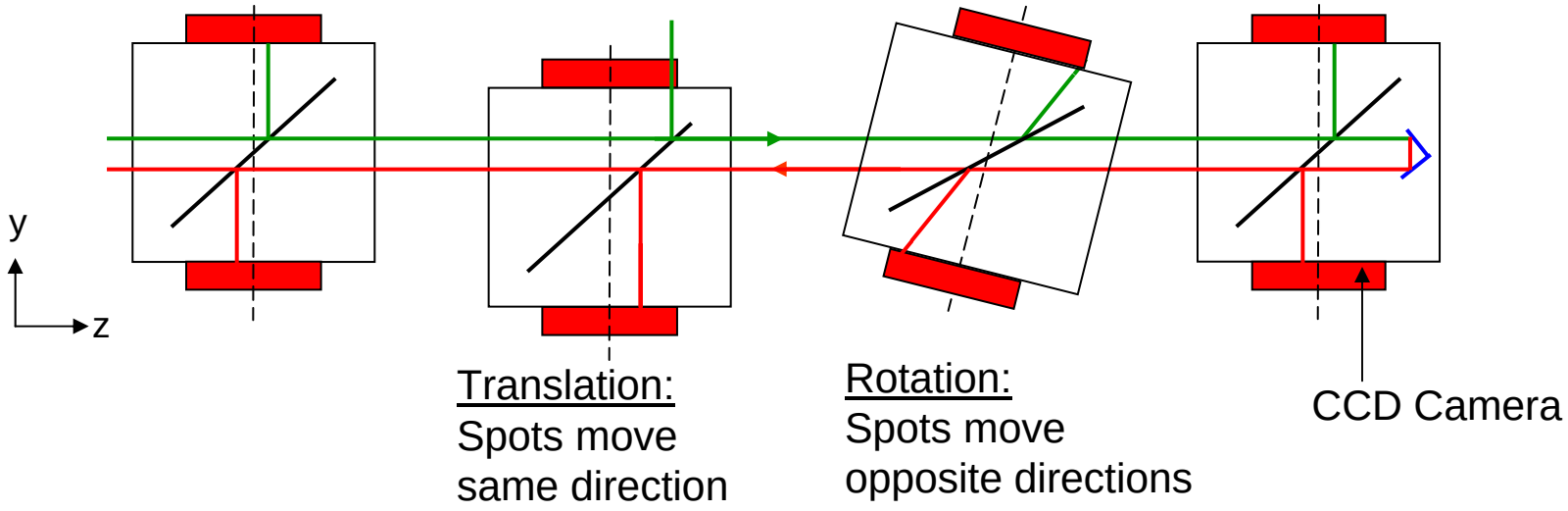


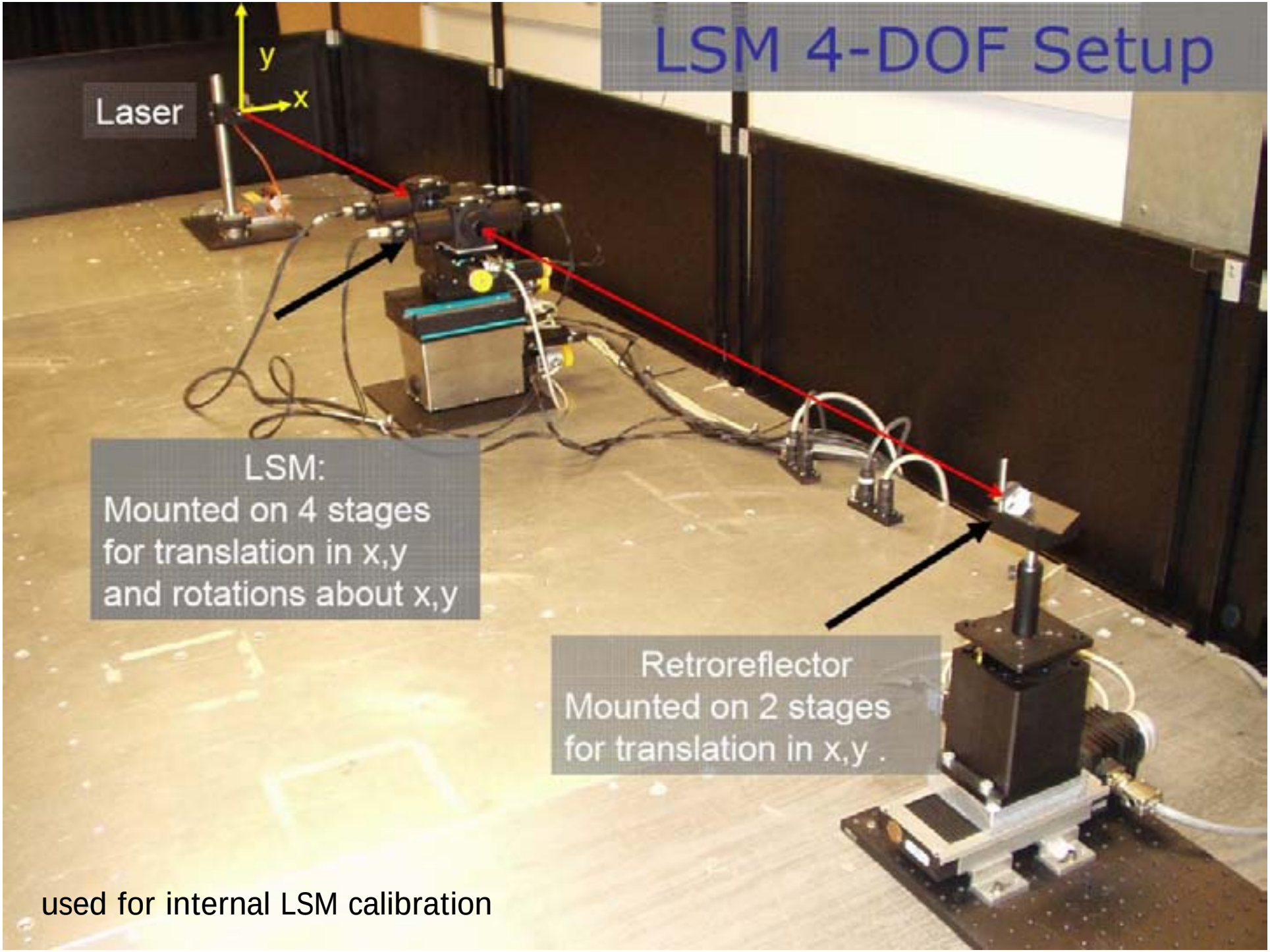
LSM

(Laser Straightness Monitors)

LSM Principle

- Used to measure carriage transverse translations and rotations
- Aprox. 1μm precision over length of train





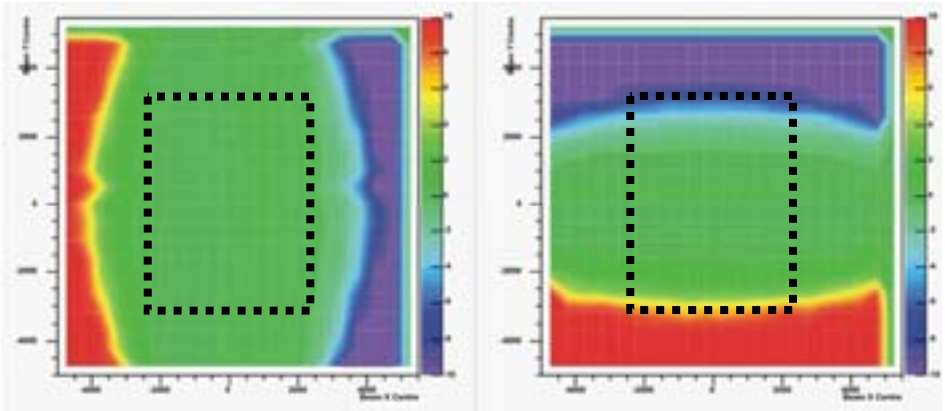
used for internal LSM calibration

LSM fitting and beam finding (Sony)

Narrow (σ=1.5mm) beam fitting

Errors up to 10 microns for

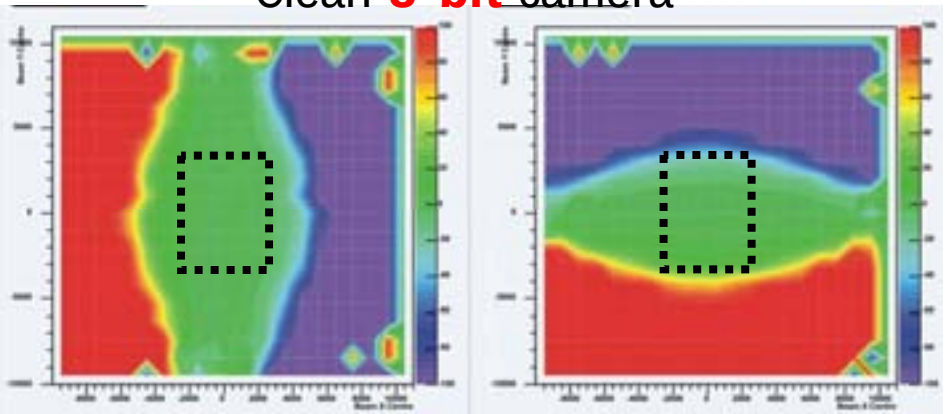
Clean camera, **10-bit**



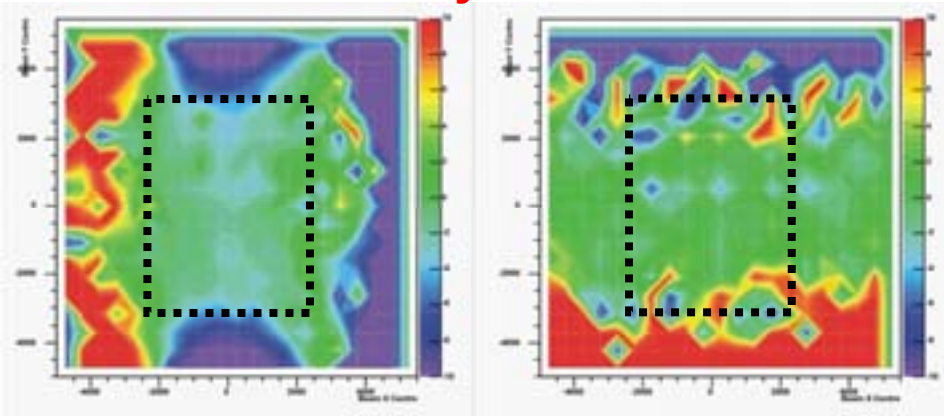
Wide (σ=2.5mm) beam finding

Errors up to 100 microns for

Clean **8-bit** camera

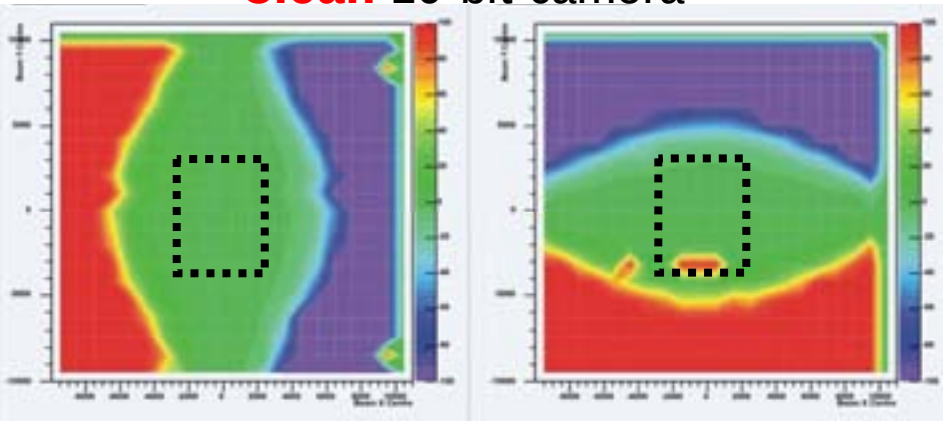


realistic "**dusty**" 10 bit camera



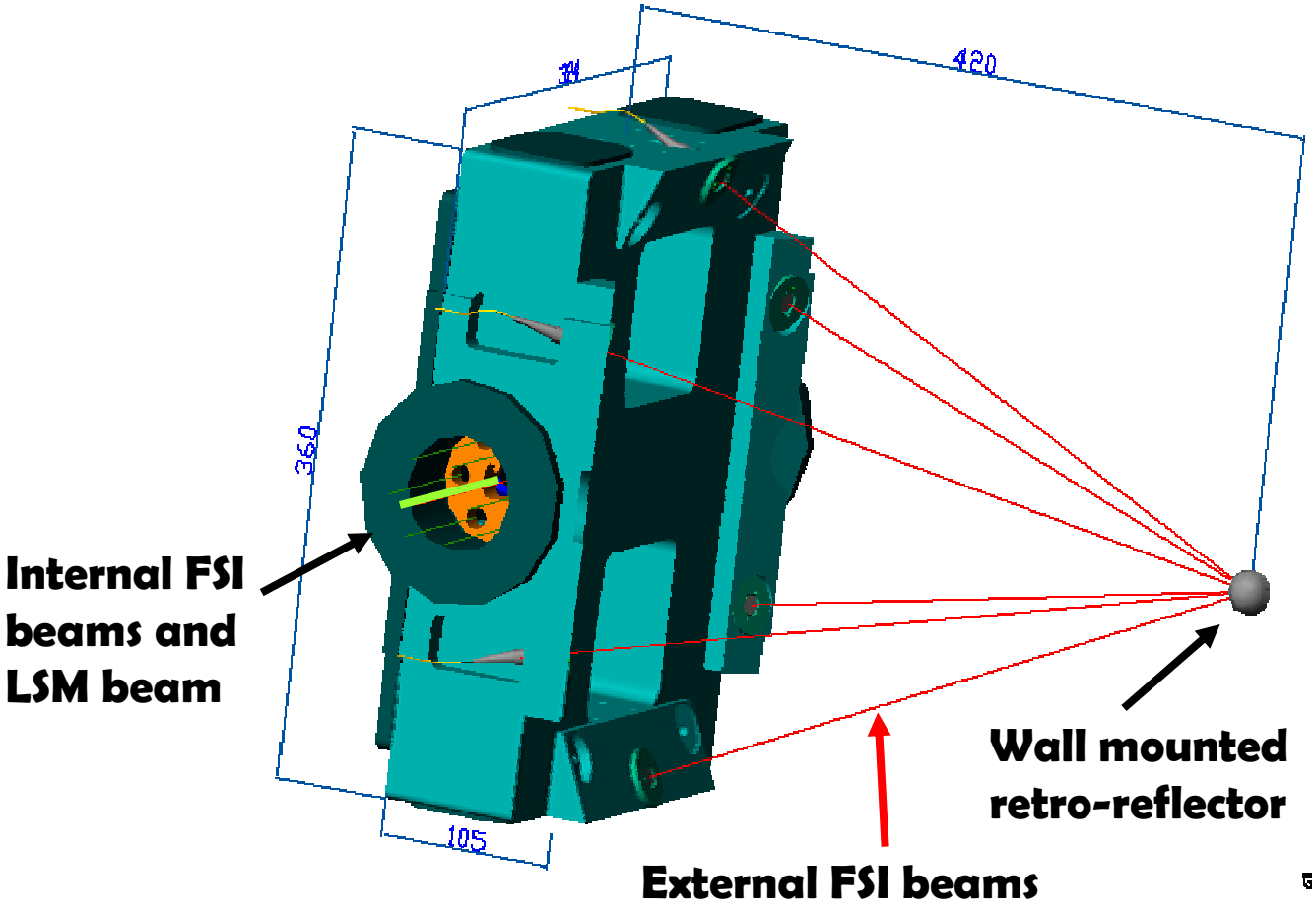
X-coord Y-coord

Clean 10-bit camera



X-coord Y-coord

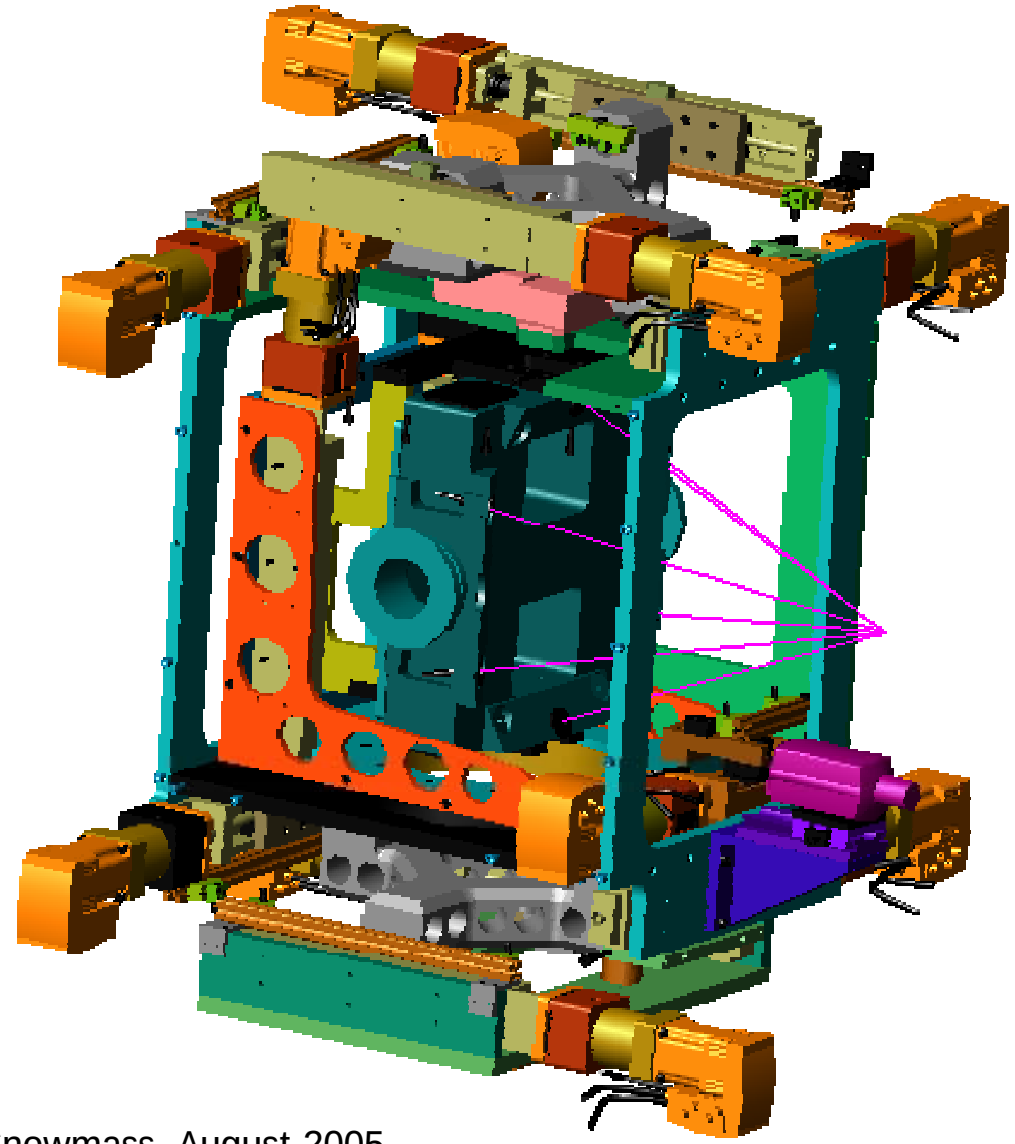
LiCAS Measurement Unit



All measurements in mm

- CAD Design completed
- Invar casts for bodies arrived
- precision machining to start in Oxford next month
- vac testing and assembly to start in Oxford in October

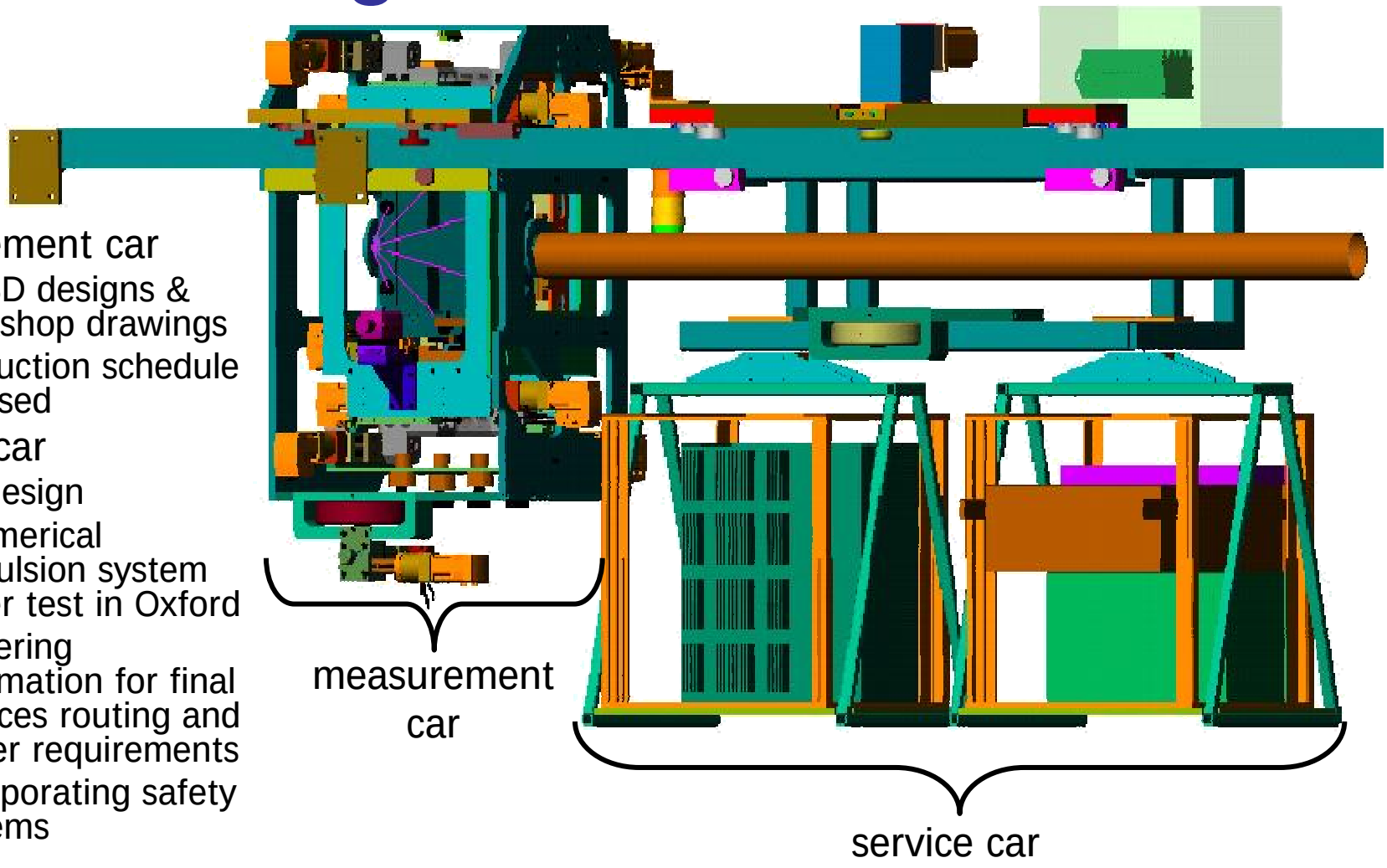
Inner Chassis



- Inner Chassis provides
  - 6-DOF motion for unit alignment
  - vibration damping
  - sensing of tunnel bar codes

RTRS global Mechanics

- Measurement car
  - full 3D designs & workshop drawings
  - production schedule finalised
- Service car
  - full design
  - commerical propulsion system under test in Oxford
  - gathering information for final services routing and power requirements
  - incorporating safety systems



Previous Generation RTRS (Gelis, DESY)

Tunnel preparation

- 55m long (effective) service tunnel at DESY
- tunnel tests showed walls stable enough
- air conditioning
- installed high speed WLAN and LAN
- installing laser interlocks and safety systems
- ready for use well before RTRS prototype expected to arrive

DAQ and Electronics

- Final custom ADC boards (FSI)
  - single channel performance tests passed
  - nearing completion of firmware O(1 month)
- Final cutom photodetector & amplifier boards (FSI)
  - pre-series boards being equipped with parts now
  - green light for serial production in 3 weeks
- Trigger and Clock distribution system
  - first design completed
  - test prototype in 2 months
- DAQ software:
  - lab system in C++ to replace initial LabView this month
  - lab system is prototype for train system DAQ and main train control

What do we do next

Up to autumn 2005

- Completion of FSI and LSM and global analysis codes
- Production of Electronics
- Construction of 3-car prototype components
- Partial assembly of inner systems at Oxford
- Sub-system calibrations
- Installation in DESY test tunnel = 1. Nov. 05

What do we do next

Up to Spring 2006

- Operate prototype at DESY
  - commissioning
  - many calibration programs on full train
  - multiple test surveys of tunnel
  - tuning of operation and analysis algorithms
  - study of systematic errors

Up to Spring 2007

- In Oxford
  - Improvements of component calibration programs & hardware
  - Design of second generation instrument
    - much smaller ➔ could fits into i.e. X-FEL tunnel
    - much simpler ➔ reduce from R&D to production functionality
    - 6 cars
  - Design integrated stake out instrument

What do we do next

Up to Spring 2008

- Operate improved first prototype at DESY
- Construct second prototype *
- Construct stake out instrument *

*(needs additional funding)

Why did we tell you all this?

- The main linac survey is "*under control*"
- More ILC components need survey and alignment
- Technology-base, expertise and will exists to tackle these items but we need to ...
  - re-visit specifications for main linac survey & alignment
  - find out what all the other survey aspects are
  - specify these as survey and alignment tasks
  - integrate alignment and survey into ILC project
- We will ask you for input to a proto-BCD chapter on Survey and Alignment **NOW**