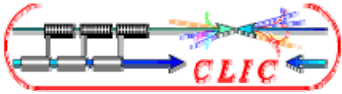


# CLIC workshop "Two beam hardware and integration" working group Supporting System

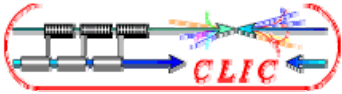
Risto Nousiainen

17.10.2007



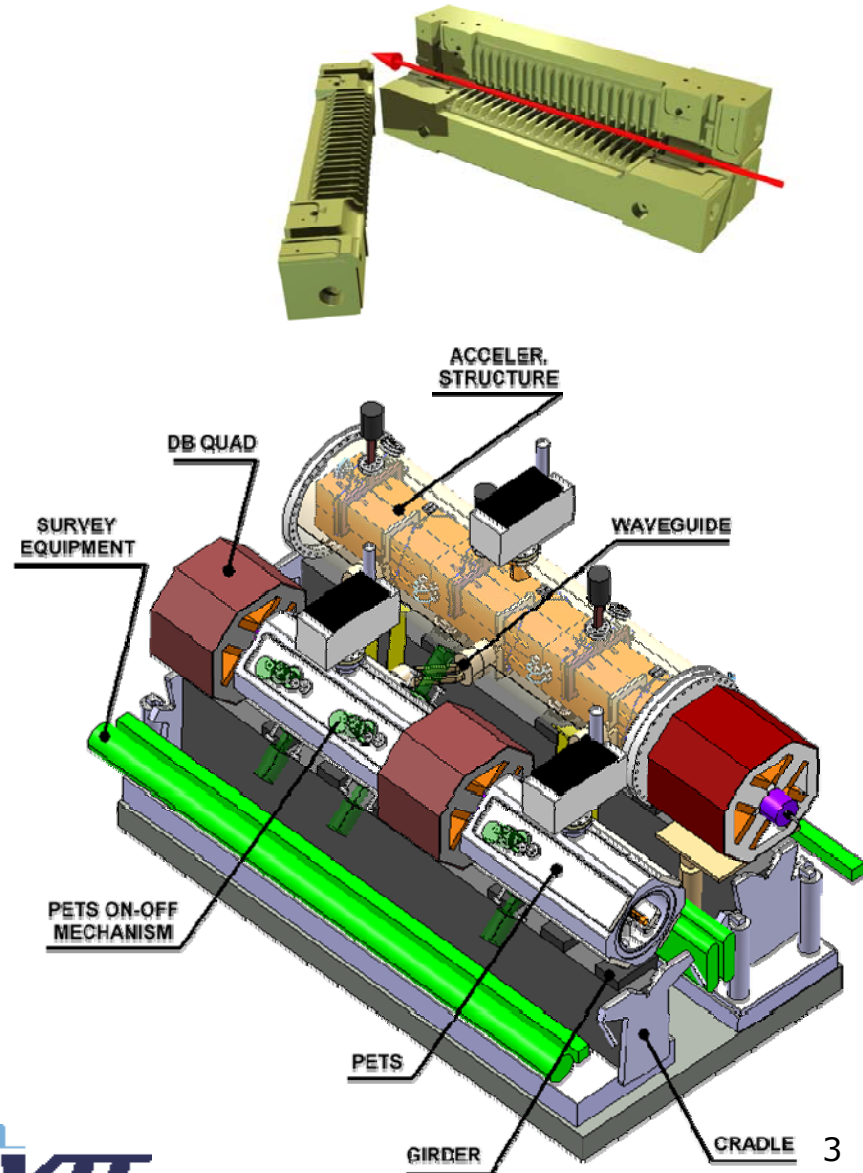
# Introduction

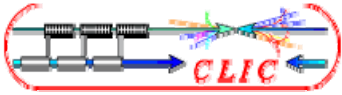
- Supporting system
  - Module components and accessories
  - Requirements for alignment and stabilization
- Tolerances
  - Specified tolerances with respect to induced effects
- Supporting strategy
- Preliminary sizing of components
  - Girder optimization
- Discussion
- Conclusions and future work



# Supporting system

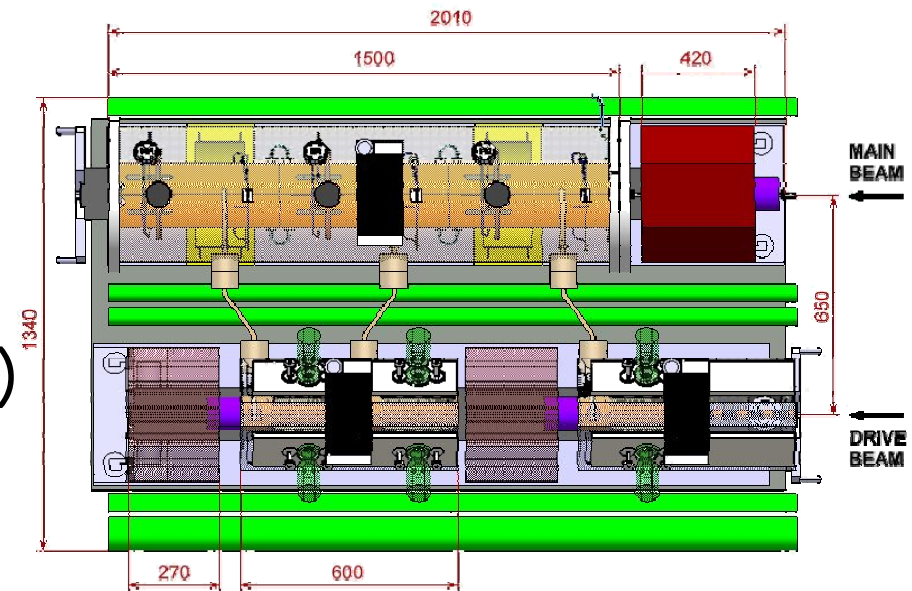
- Main components in a module
  - MB: AS + WFM, Quadrupoles, BPMs
  - DB: PETS, Quadrupoles, BPMs
- Accessories
  - Vacuum Tank
  - Interconnections
  - Waveguides
  - Vacuum pumps
- 5 module types
  - Standard and Quadrupoles

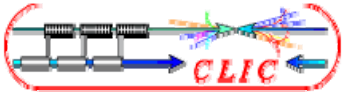




# Supporting system

- Requirements for module pre-alignment ( $1\sigma$ )
  - AS  $\sim 0.014$  mm
  - PETS  $\sim 0.031$  mm
  - MB Quad.  $\sim 0.017$  mm
  - BPM  $\sim 0.014$  mm
  - DB Quad.  $\sim 0.031$  mm
  - BPM  $\sim 0.031$  mm
- Stabilization (vibrations)
  - MB Quadrupoles  $\sim 1.3$  nanometer in vertical direction ( $> 4$ Hz)



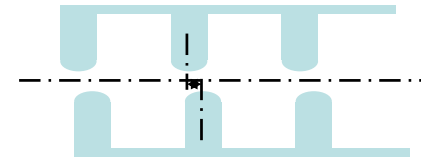


# Tolerances

- Errors and their effects caused by assembly and alignment

- Longitudinal errors

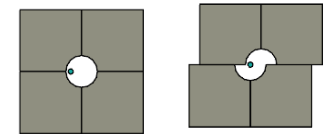
- RF induced transverse kick



- Lower efficiency

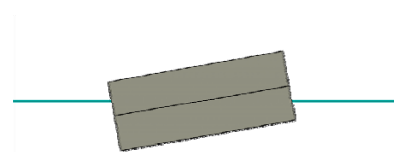
- Transverse errors

- Wake fields → beam induced transverse kick

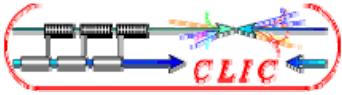


- Tilt

- Transverse kick

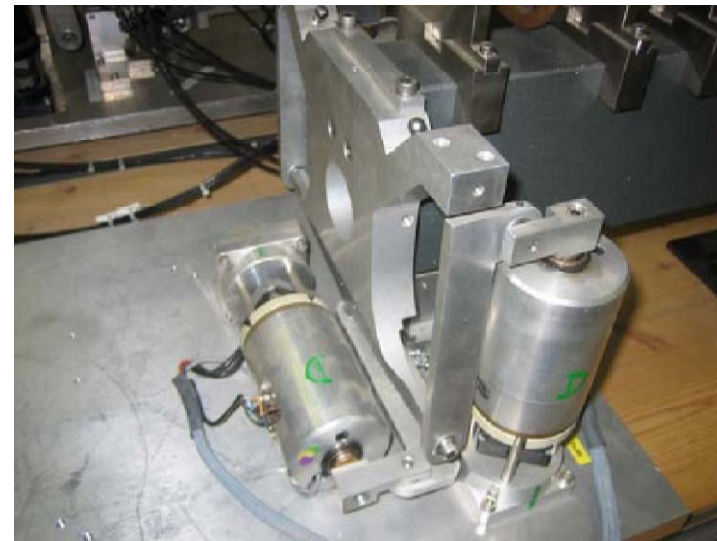
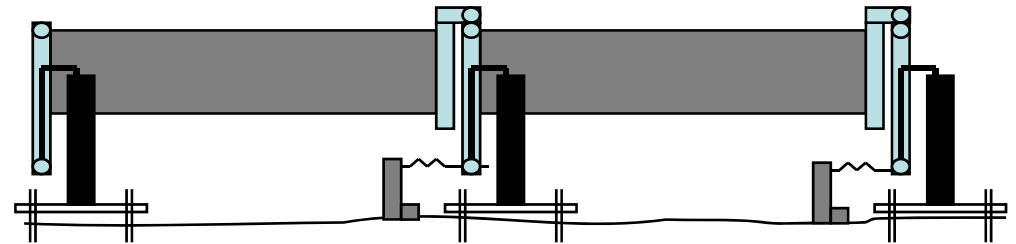


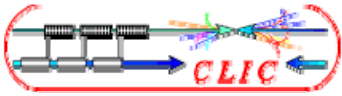
NB. Riccardo Zennaro gave his contribution to the definition of effects



# Supporting Strategy

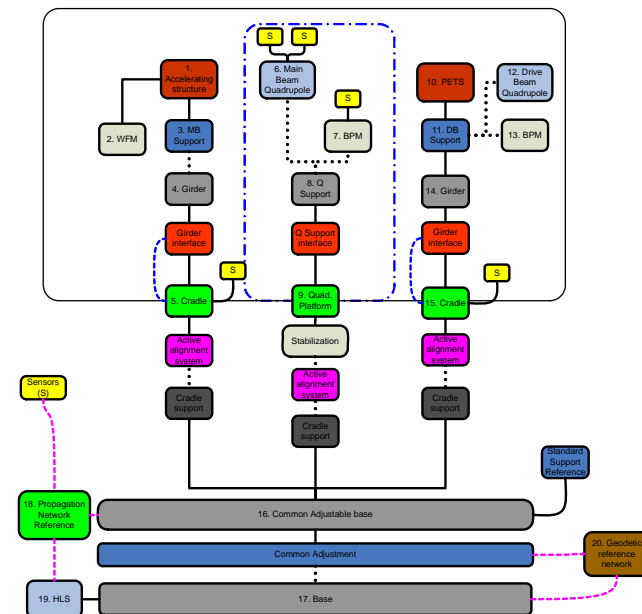
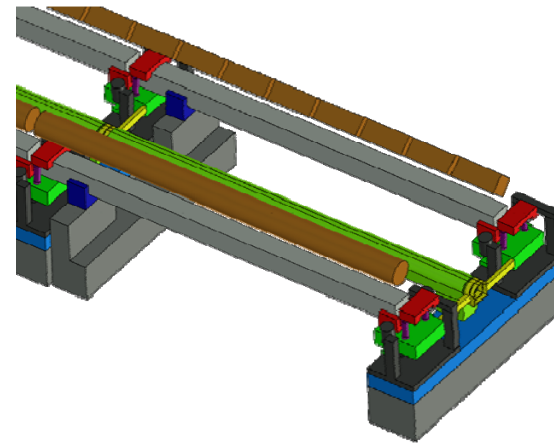
- Girder concept
- Cradle concept with articulation points
- Actively aligned girders and MB Quadrupoles
- Common base with adjustment





# Supporting Strategy

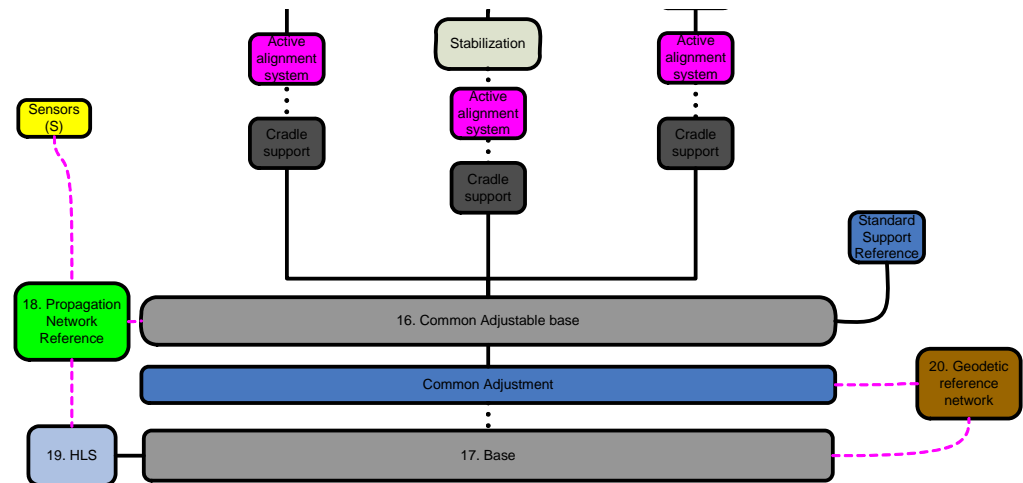
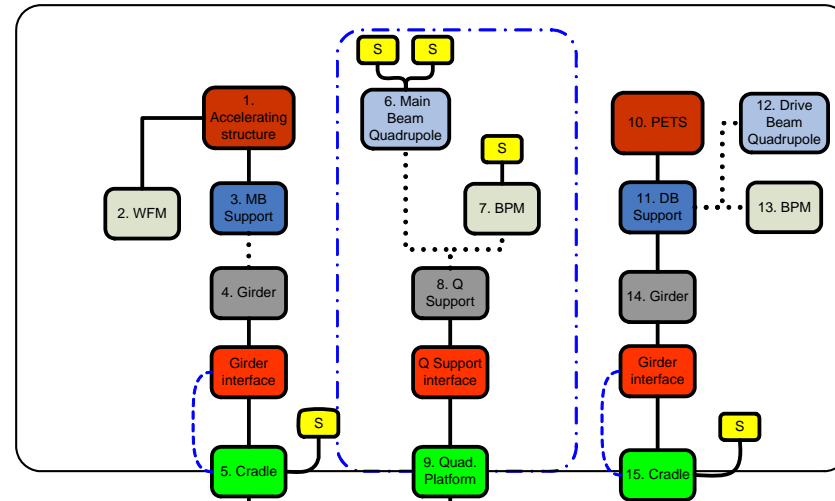
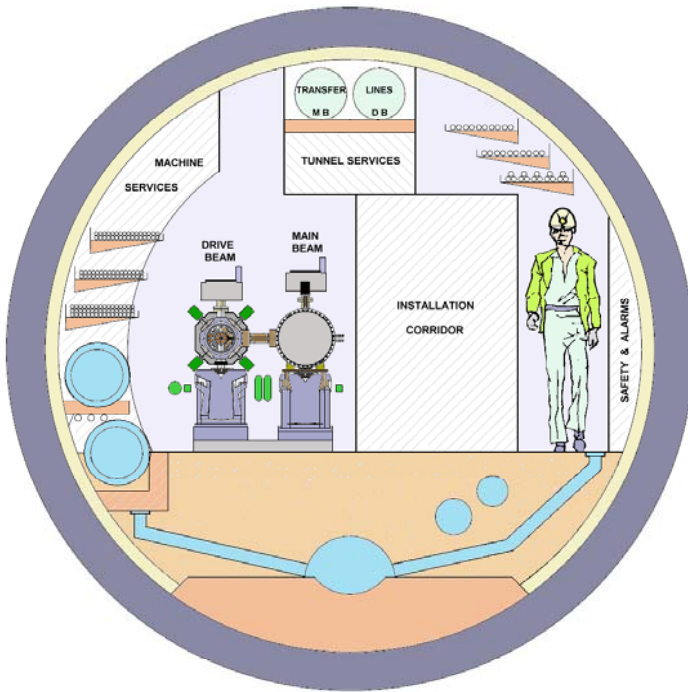
- Improved precision
  - Separate supports
    - AS girder
    - PETS girder + Quad.
    - MB Quadrupole
  
- Vacuum tanks
  
- Flexible interconnections



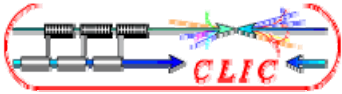


# Supporting Strategy

- Installation
- Transportation

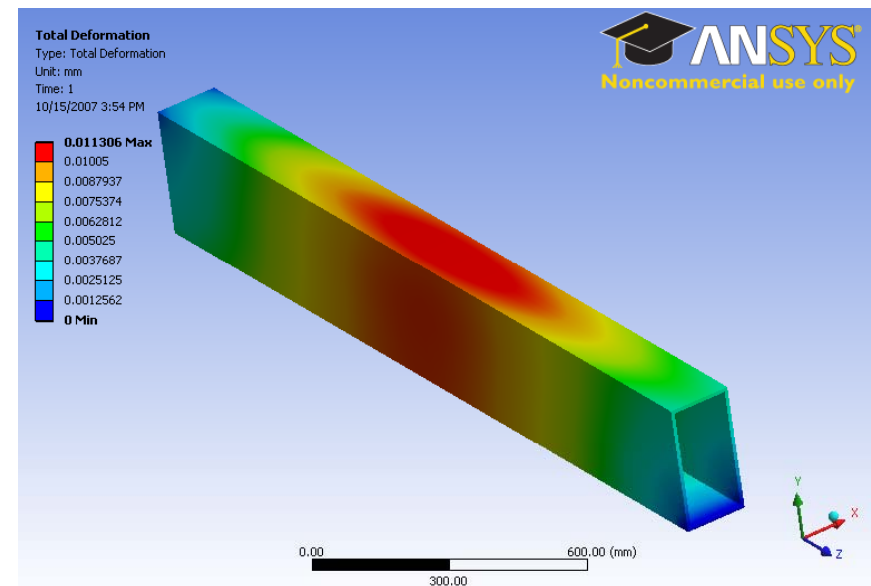


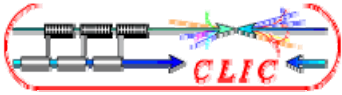




# Girder optimization

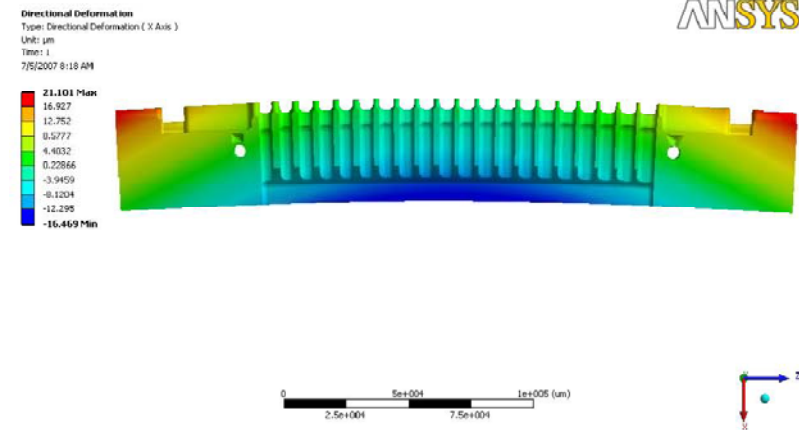
- One example:
- Deflection optimization with Mathematica 5.2
- Allowed deflection 10 microns
- Girder dimensions :
  - 2000 x 300 x 150 x 8.7 mm
  - Weight ~ 50 Kg
- Verification with ANSYS





# Discussion

- The main challenges
  - Tolerances
  - Initial error compensation during pre-alignment
    - Thermal
    - Mechanical
  - Operational errors
    - Mechanical stability
    - Thermal expansion
    - Vibrations → Stabilization
  - System integration
    - Alignment
    - Interconnections
    - Vacuum
    - Cooling





# Conclusions and future work

- Previous Study
  - Magnet stabilization
  - CTF2, alignment study
  - Cooling induced vibrations
- Current work
  - Specifications for supporting system
  - Conceptual design
- Future work
  - Continuation of vibration measurement
  - System design
  - System integration