Collimation System

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WP7: Collimation System

- Reduce risk
- Reduce cost
- Prepare project execution plan
- WP and allocation plan

- Re-affirm identified risks
  - **Mitigating fallback solutions**
- Re-visit costs
- Deliverables definition per task, single institute taking responsibility on each

Tasks Overview

- Phys. design of collimators
  - **Optics design of collimators**
  - **Physical design of collimators**
  - **Theoretical analysis of collimator wakes**
  - **Computing analysis of collimator wakes**
  - **Optimiz. background & coll. w. eng. constraints**
- Eng. design of collimators
  - **Eng. design of collimators**
- Beam damage tests of collimators
  - **Prepare KEK infrastructure for tests**
  - **Build prototypes & do beam test**
  - **Define test requirements and analyze rests**

Tasks Overview – 0^{th} guesses

- Phys. design of collimators
  - **Optics design of collimators - STFC**
  - **Physical design of collimators**
  - **Theoretical analysis of collimator wakes - SLAC**
  - **Computing analysis of collimator wakes - Cockroft**
  - **Optimiz. bkg & coll w. eng. constraints - FNAL**
- Eng. design of collimators
  - **Eng. design of collimators – STFC**
    - Marble shells - FNAL
- Beam damage tests of collimators
  - **Prepare KEK infrastructure for tests**
  - **Build prototypes & do beam test**
  - **Define test requirements and analyze rests**
  - **Materials studies - BNL**
- Damage detection system
  - **Design/prototype - Birmingham**

Related tasks from other WPs

- Consider movement of tasks between WPs, or similar to ensure effective co-working
  - **Essential to avoid duplication (or interference)**
- WP3: Collimation optimisation
  - **Halo/efficiency**
  - **Iterate to include improvements in wakefield modelling**
  - **Iterate with damage simulation**
- WP9
  - **ESA wakefield tests**

- Overlap with other groups important, e.g. RTML, positron source, use standardised designs where reasonably possible?

Process of allocation of tasks

- LoIs received from SLAC, FNAL, INP/MSU, UK
  - **All tasks are covered**
- Other institutes?
  - **Will contact others who have not replied to Andrei's call**
- Deliverables definition per task, single institute taking responsibility on each
- Agree on this as soon as reasonably possible
- Institutes should be prepared to adapt their contributions during EDR phase, e.g. if priorities change, or alternatives become baseline
  - **Resource redirection may have implication with funders**

Aims

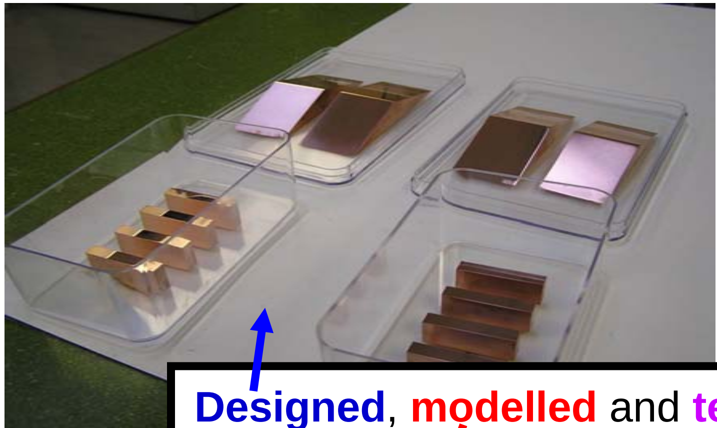
- More reliable analytic calculation of wakefields
  - **Jitter amplification/emittance dilution**
  - **Inclusion in tracking simulations**
  - **Main purpose, more realistic optimisation of**
- Improved accuracy
  - **Benchmarking with test beam data**
- 3D numerical e.m. calculations
  - **Compared with test beam data**
  - **Full geometry of physical collimator**
- Damage detection
- Alternative Configurations – higher risk, potentially large benefits
  - **Crystal collimators**
  - **Renewable spoilers – value engineering**

Examples of Deliverables

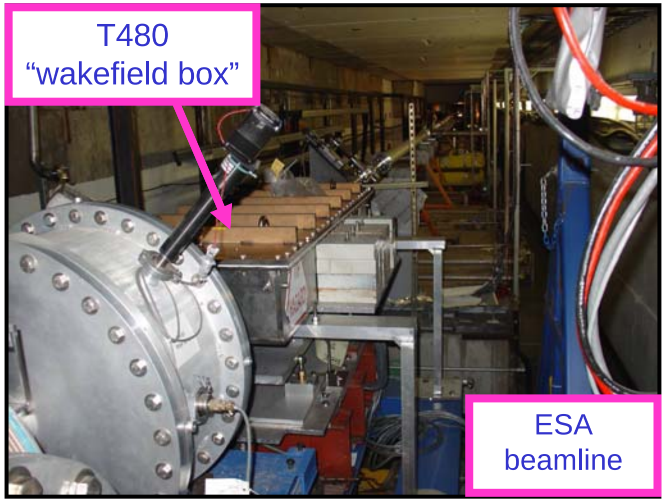
- 3D wakefield simulations for collimator prototypes
- 3D wakefield theoretical calculation (package?)
- Wakefield test beam results for collimator jaws
- Data-validated material response simulations for BDS components
- Prototype damage detection system for collimators
  - **Quantify damage after beam loss, decide whether acceptable to continue or intervention required (cf. renewable spoiler scheme)**
- Full engineering details of absorbers, protection collimators and masks in the BDS
- Prototypes of critical subsystems of adjustable jaw collimators
- + …

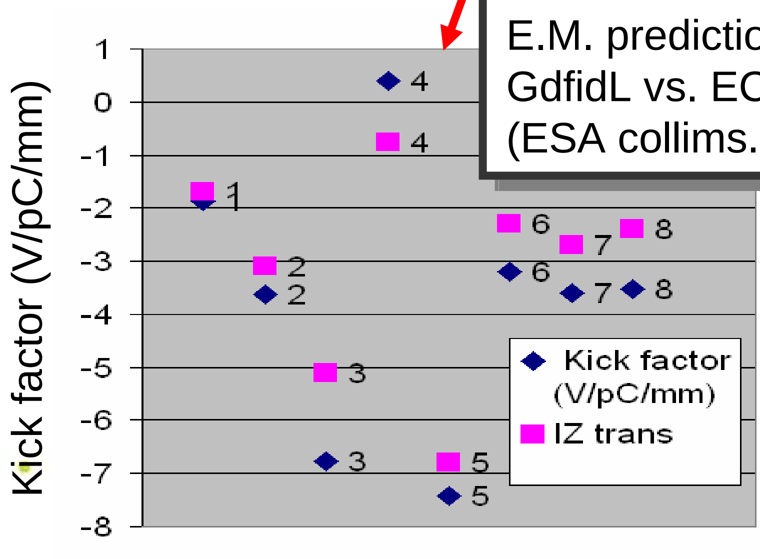
Examples, wakefield measurements

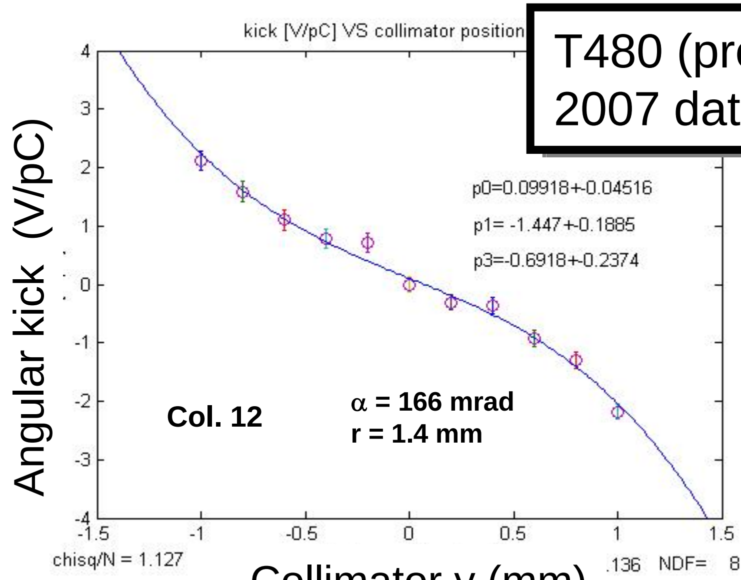
Wakefields, survivability. Strong collaboration between SLAC and EUROTeV groups.



Designed, **modelled** and **tested** collimators at SLAC ESA facility



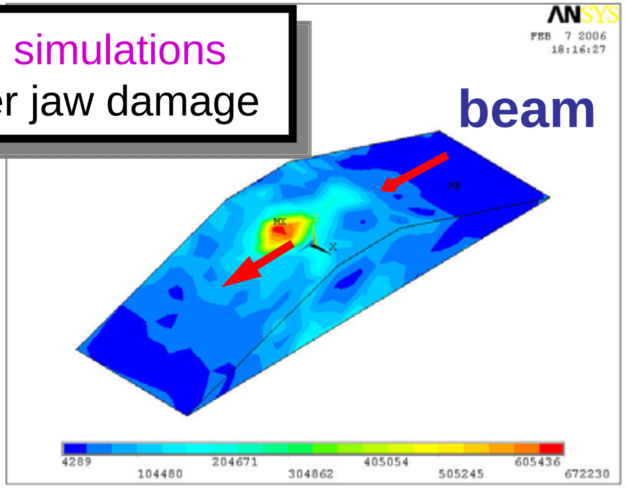


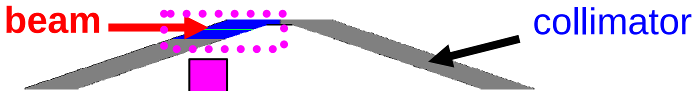


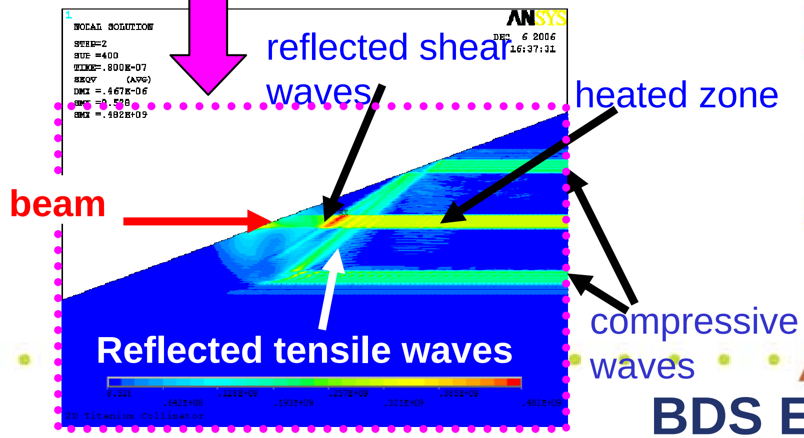
Examples, damage studies

Wakefields, **survivability**. Strong collaboration between SLAC and EUROTeV groups.

Detailed simulations of spoiler jaw damage



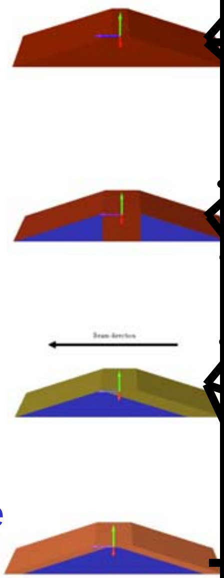




Temperature increase from 1 bunch impact

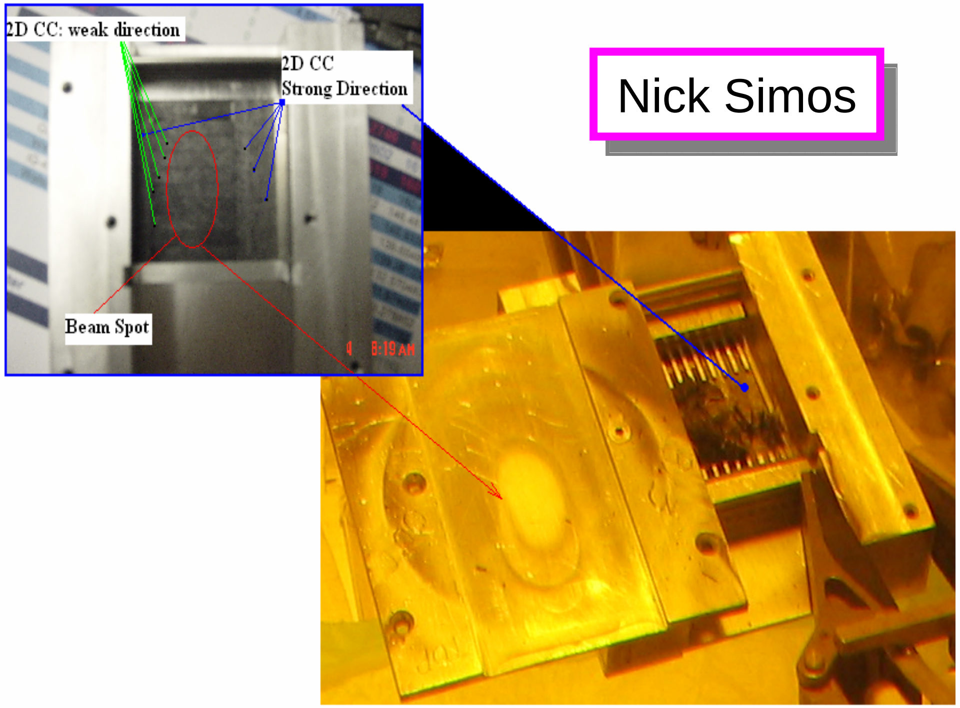
Exceeds: [red] fracture temp. [yellow] melting temp.

[green frame] Best candidate designs

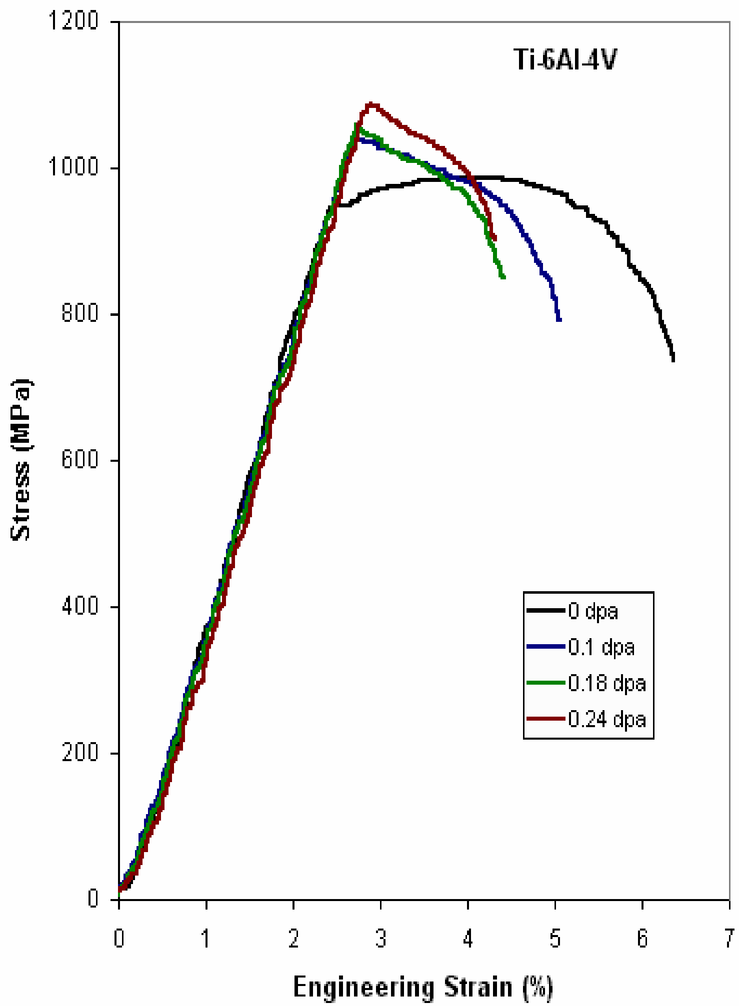


	2mm depth		10mm depth	
	250GeV 111×9 μm²	500 GeV 80×6 μm²	250 GeV 111×9 μm²	500 GeV 80×6 μm²
Ti	420 K	870 K	850 K	2000 K
Al	200 K	210 K	265 K	595 K
Cu	1300 K	2700 K	2800 K	7000 K
C+Ti	325 K	640 K	380 K	760 K
Be+Ti	-	-	-	675 K
C+Ti	290 K	575 K	295 K	580 K
C+Al	170 K	350 K	175 K	370 K
C+Cu	465 K	860 K	440 K	870 K
C+Ti	300 K	580 K	370 K	760 K

Damage studies



Nick Simos



- Also ATF/ATF2 damage study, UK + SLAC
  - **Thin coupons initially, then shockwave measurements by VISAR**

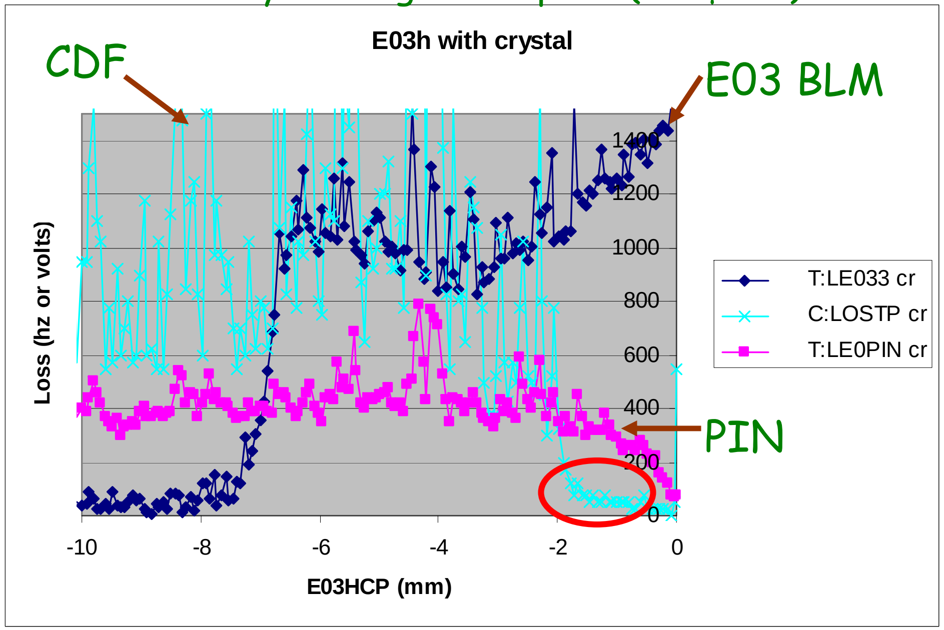
Examples

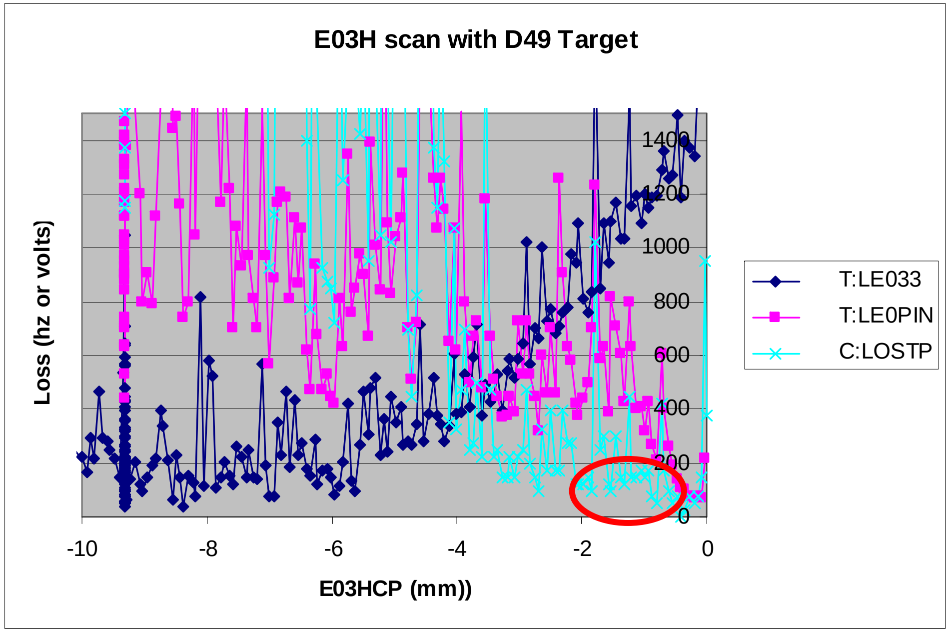
- Marble encased collimators at FNAL to reduce activation

COMPARING EFFECTS OF PROTON HALO LOSSES FOR BENT CRYSTAL AND TUNGSTEN TARGET

Nikolai Mokhov

Crystal aligned at peak (118 μrad)





Using the crystal:

- The secondary collimator can remain further (1 mm or so) from the beam thus reducing impedance.
- Almost a factor of 2 better reduction of CDF losses achieved a half a ring (2 miles) downstream (in agreement with modeling) !!!