Report from the 1st meeting of CLIC ACE

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Charge and Outline

A short version of the charge:

- Comment on parameters
- Key issues to be addressed
- Program to address issues
- Adequacy of resources

Outline of report:

- Parameters
- Scope of CLIC study
- Key issues: structures, PETS, other
- CTF3 and other experiments
- Resources and CDR

Review Schedule (1)

Wednesday 20 June 2007

- 08:00 Executive Session (30')
- 08:30 General Introduction: Parameters, Key Issues, Programme and Resources
- 09:30 Structure Issues, R&D and Limitations
- 10:50 Structure Optimisation (30')
- 11:35 Structure Tests: Results and Programme
- 14:00 Overall Complex and Parameters including Injectors, Damping Ring and BDS
- 15:00 Drive Beam Complex and Power Generation including CLIC Module
- 16:20 Cost Model including Civil Engineering and Conventional Facilities
- 17:05 Executive Session
- 19:00 Dinner

Review Schedule (2)

Thursday 21 June 2007

- 08:00 Executive Session
- 08:30 CTF3 Programme, Status and Collaborations including Commissioning and Operation
- 09:30 Lessons Learned (Past, Present and Future) in CTF3
- 10:50 Beam Dynamics (Main and Drive Beams) including Alignment and Stabilisation Issues, Luminosity and Background
- 11:50 Visit of CTF3
- 14:00 Review of CLIC Challenges and Key Issues
- 15:20 Review of (addressed and non-addressed) key Issues including Future Activities, Technical Programme in Preparation of Conceptual Design Report
- 16:20 Detector and Physics Issues (30)
- 17:05 Executive Session (1h45')

CLIC Parameters

- Reduction in gradient and rf frequency look very desirable
  - Detailed cost model developed to guide parameter choices
  - Do not understand all details of optimization but 'feels' right
  - Curves flat – need to rely on engineering and experience
  - Need another iteration on structure optimization
- Two main concerns
  - Parameterization is based on 'P/C' scaling
    - Uncomfortable with 300 ns pulse length at 100 MV/m
    - Not clear that scaling is valid over full range of interest
  - Emittance parameters are pushed very hard
- Suggestions:
  - Additional experiments to benchmark the 'P/C' scaling
  - Develop staged approach starting with more established ε's

CLIC Study Scope

- Focus on elements that are unique to CLIC concept
  - High gradient → 100 MV/m is ***4 times*** ILC geographic gradient
  - Two-Beam-Accelerator → allows high efficiency with short rf pulses

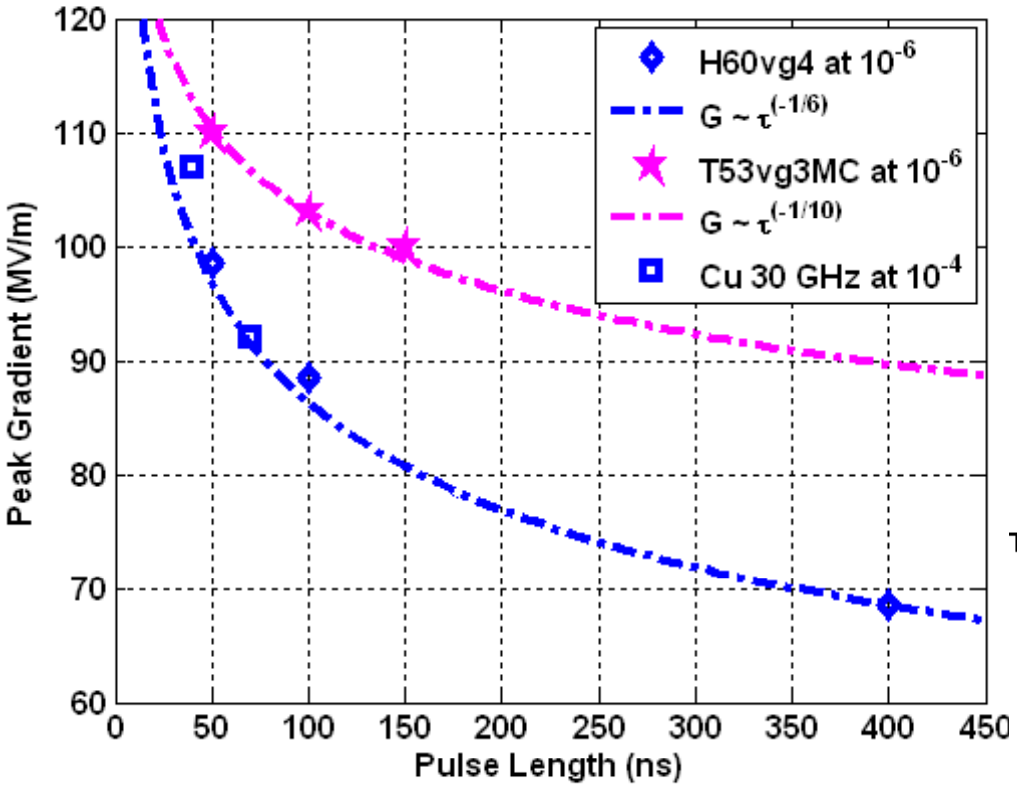
  → Scales to high energy in cost effective manner
- CTF3 demonstration addresses major technical issues
  - Power generation, PETS, and accelerator structures
- Adopt established parameters in areas where demonstration is less CLIC-specific or more difficult
  - Develop a staged approach to 3 TeV
    - Start from KEK ATF-like emittances and NLC/JLC tolerances
- Further develop the cost model
  - Use ILC estimates wherever possible and limit unique aspects

CLIC Gradient

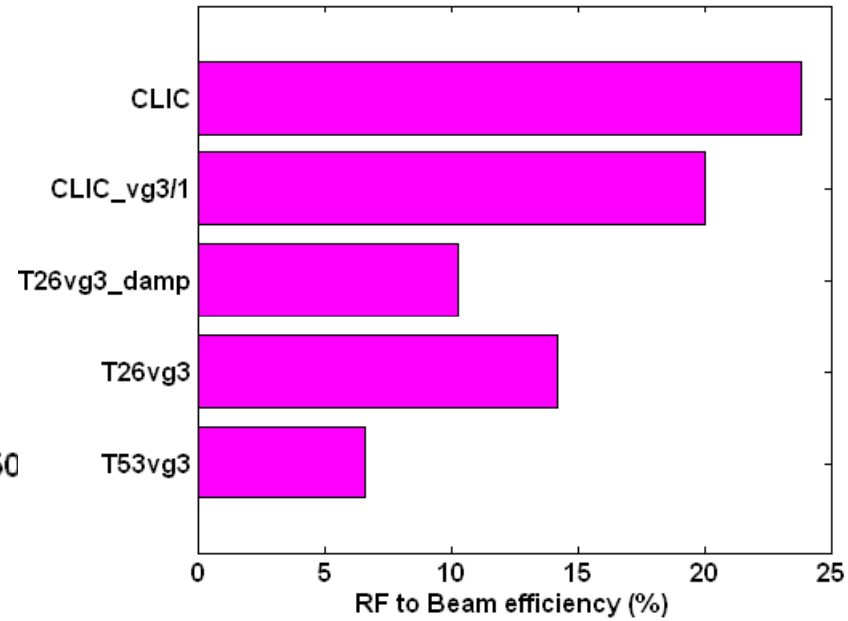
- Strongly support reduction to 100 MV/m loaded
  - SLAC T53 and H75 results are supportive although proposed gradient is still ~20% more than has been demonstrated
  - Concern that 300 ns pulse length is too long at 100 MV/m
- Need to demonstrate gradient performance quickly
  - Concern that mixing structure fabrication, damping, and gradient issues can make results hard to interpret
  - Suggest rapid demonstration of gradient
    - Test 'pieces' of CLIC structure to verify 'P/C' scaling – maybe do this instead of building the T26 structure at SLAC
- Take full advantage of existing facilities
  - Working with SLAC & KEK very good – Fermilab also ??
  - Use all available sources of power and fabrication
  - Stand-alone 12 GHz facility is very important

CLIC Gradient Issues

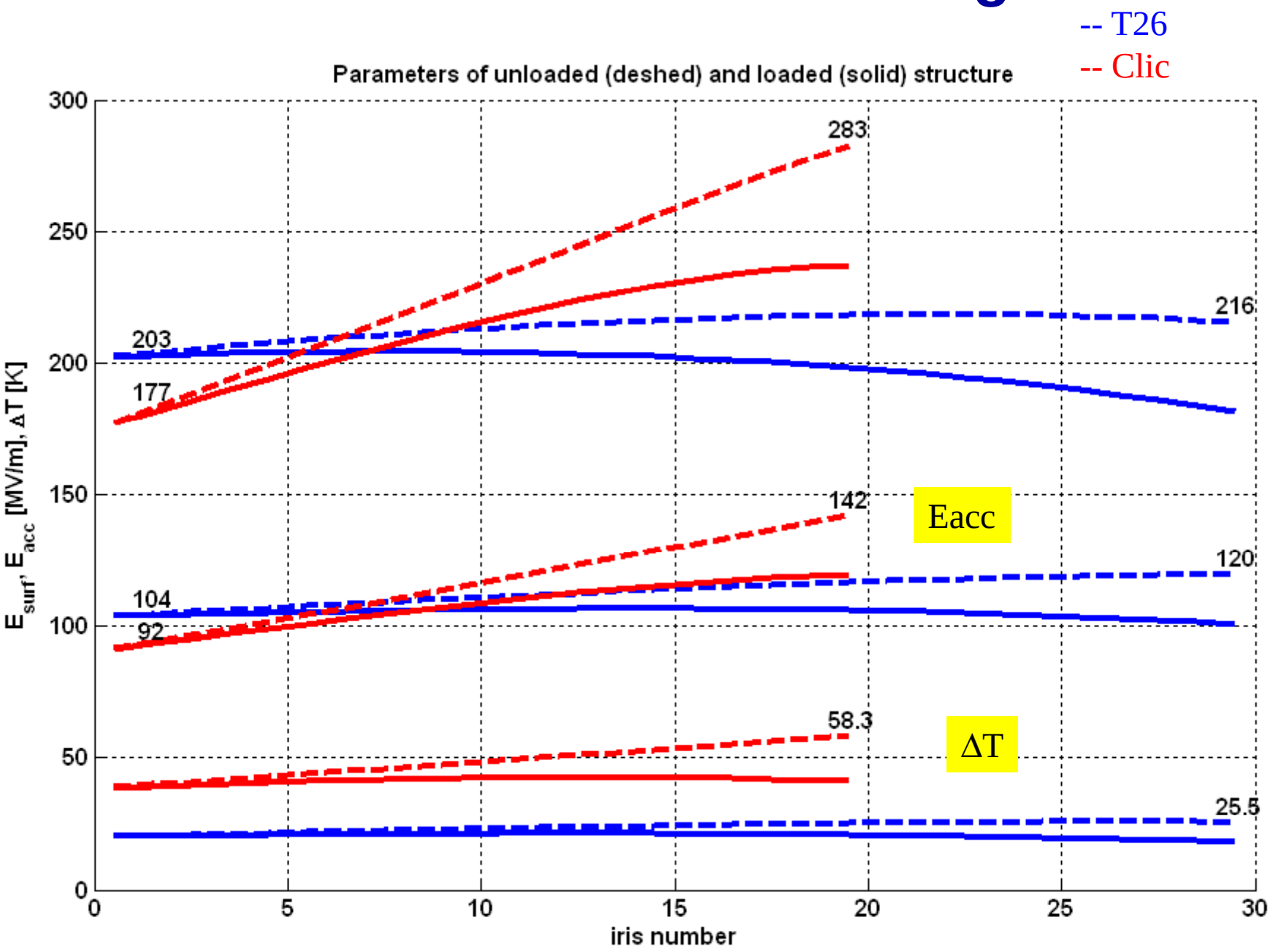
SLAC Structure Tests



Efficiency of Structures



Gradient – Structure Design



Other Structure Issues

- Heavily damped structure seems most promising
  - Permits close bunch spacing
    - Might consider 'tuning' wakefield with a/λ to further reduce wake at 2nd bunch
  - Develop tests (separate from gradient program) to understand choices
    - Loads, geometry, error sensitivity, etc
  - What about HOM diagnostics – structure alignment?
- Concept of quadrant structure seems very promising
  - Develop tolerance specifications
  - Work with CERN engineering to understand fabrication
  - Separate from gradient program
- Careful of cost model
  - Provides guidance but engineering and common sense important

CLIC Structure Development

- Structure program is a major effort that is critical to the CLIC concept
  - Would like to see detailed structure development program
    - Need detailed fabrication and testing schedule with milestones and decision points
    - Focus on most promising path - 3 separate issues:
      - » understand gradient and scaling
      - » understand impact of damping on gradient
      - » engineer cost effective structure
  - Structure R&D program has been very effective but need to evolve towards ‘project’ mode
    - Need strong management model and additional support

Power Extract Transfer Structure (PETS)

- PETS is as critical as the accelerator structure
  - Power and fields matched to P/C scaling but different regime
    - Relatively good experience with past PETS
  - Need experience with present concept for PETS
    - Probe limits of PETS to verify margins
    - CTF3 will operate at lower rep rate and short pulse
      - Need to verify lifetime of PETS – accelerated testing
    - Demonstration of PETsonov is also important
      - Need operational experience with this as well
- Two-beam Test Area important to study limits
- Would suggest planning to take power from TBL to power structures – later timescale but important

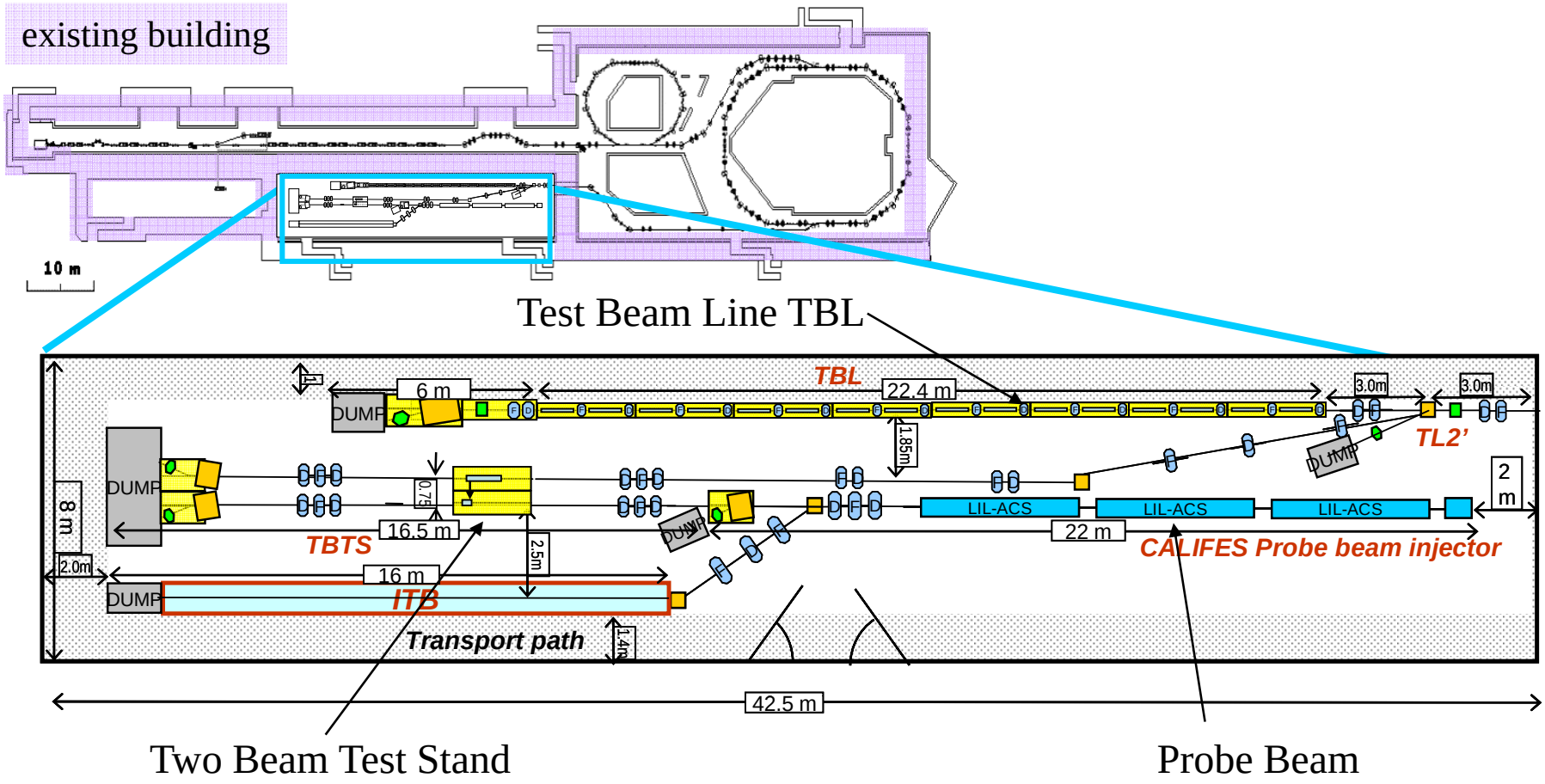
  → 400 MeV to 800 MeV test accelerator

  (Maybe some modules instead of 16 PETS in TBL)

CTF3 – CLIC Test Facility

- CTF3 will demonstrate critical part the CLIC concept
  - Very impressive facility!
    - Will be largest LC test facility constructed
    - Already demonstrated many critical issues
      - Heavily loaded acceleration
      - Delay loop and recombination
      - Commissioning combiner ring
    - Need to ensure this is an operational facility not just a test demonstration
      - Reliable routine operation with stable beams
  - Two significant differences:
    - Average power and pulse length
    - Need to consider how to deal with these
- Clearly need additional support to finish and operate facility

CTF3 Layout – from Gunther



Construction during 2006/beg 2007
installation of equipment from
2007 - 2009

Beam in CLEX from 2008 onwards

Other Critical Tests

- Vibration suppression
  - Important to demonstrate but explore if it is necessary to test as part of CTF3 – perhaps stand-alone test is sufficient
- Instrumentation
  - Take advantage of ATF and ILC programs
  - Demonstration of structure alignment important
- Emittance transport (structure and quadrupole alignment)
  - Explore studies at CTF3 to demonstrate main beam transport and emittance preservation (could this be part of a test linac built using the TBL??)
- Beam phase stabilization
  - Synergy with FEL and ERL programs ??

Resource Issues

- A CLIC CDR by 2010 is a huge undertaking
  - Excellent group but …
- Clearly very limited by resources
  - Proposal for additional 16MCHF and 70 FTEs over 3 years
  - Additional support from collaborations at SLAC, KEK, and ??
  - Still seems insufficient
    - Need more support for CTF3 and structure development
    - Need staff to share responsibility for projects
    - Do not see any engineering effort for CDR and costing
      - Potential resources at CERN that would be extremely useful for CLIC CDR and TDR
- Important to develop resource loaded schedule
  - Evolution from R&D group to more project orientated

CLIC Conceptual Design Report

- Development of a full CDR will be a large undertaking
  - Resources may be better directed towards demonstrations
  - CTF3 demonstration addresses major technical issues
- Focus on elements that are unique to CLIC concept
  - Two-Beam-Accelerator concept
  - High gradient accelerator
  - Adopt more established parameters in other areas with a staged approach to 3 TeV
- Develop international cost model – Important for acceptance of CLIC concept
  - Need to show cost scaling with energy
  - Use ILC estimates wherever possible
    - Participate in ILC engineering where common (civil, rf power, magnets, …)

Final Comments

- Very impressed with CLIC effort
  - Large amount of progress over the last decade
  - Has the potential to offer a real path to multi-TeV e+/e- LC
- CTF3 will demonstrate most of the critical issues
  - Potential to create an 800 MeV test linac using CTF3 TBL
    - Clearly needed for TDR but likely possible well before
- Like to have the next meeting focused on the structure and PETS development program
  - Dates TBD but probably January
- Excellent presentations
  - Thanks to all participants (extra thanks to Sonia!)