

# Electron Systems Subgroup

John Corlett  
Max Cornacchia

# Commissioning to full energy

Excellent results

Reflects exceptional planning and execution

Major well-coordinated effort by many people

Demonstrated beam parameters sufficient to enable saturation at  $1.5\text{\AA}$  in 100m

We recommend beam tests at higher repetition rates, up to 120 Hz if possible

Early identification of problems

# Injector and BC1 components

The committee is pleased that the injector is fully commissioned and handed over to operations

Several problems fixed since last meeting

Gun RF probes

Diagnostics

BC1 dipole magnets

Laser system has > 99% availability

Second gun built and RF commissioned

Some indications of cathode deterioration

Recommend not to change cathode at this point

Again, we recommend a gun test facility that would allow investigations and development without disruption of operations

# Controls

Many high-level applications written by physicists in Matlab

Excellent utilities

Transition to operational software packages needs to be implemented

# Microbunching instability

Clear signature of micro-structure in the beam

Not fully understood

Needs continued attention

*evidence of beam dynamics that may affect lasing*

The laser heater is critical to control microbunching

Expected latest system availability January 2009

Recommend continued attention and priority to this

# FEL commissioning

LCLS project responded very well to the FAC request to present comprehensive plans for FEL commissioning

The plan is thoroughly considered and detailed  
Integration between installation, accelerator, undulator, and the x-ray teams is good

Schedule is tight for early science in mid-August 2009  
Beneficial occupancy later than expected may add pressure

# Undulator Subsystems

*K. Robinson, J. Pflüger*

- General
- Vacuum Chamber
- Undulator Measurements
- System Installation
- Beam Loss Monitor System

# General

- Impressive convincing effort in good shape!
- Climate change: From confrontational towards collaborative atmosphere,
- Results are visible: Vacuum chambers, Wire finders, girders, motors, undulator control
- All these items are in schedule and within critical path
- There are late changes and/or problems:  
K-Detuning, increased horizontal good field region
- Beam based methods such as the proposed K-measurement would be beneficial as a backup



# Vacuum chamber

- Changed from former Problem Child to a very good student!
- Impressive test setup presented in Hall 750
- Chambers produced, fulfill requirements, slope specs met
- Everything in time and in budget

# Undulator Measurements

- There are two late chances:
  - Slight K-Parameter change of some stored devices requiring re-measurement
  - New horizontal shims with improved good field range  $\pm 6\text{mm}$
- Requires at least partial re-measurement
- As a result: Pressure on the time schedule; Last undulator to be measured in May. No more delays!
- Zack has a good plan to release pressure by installing and changing the horizontal shims at part of the routine undulator exchange (3 per month)

# System Installation

- No further benefit from Co-occupation.  
All installations that are possible have been done
- Additional installations only after BO (beneficial occupancy)
- This is likely to result in delay
- Planning needs to be accordingly

# Beam Loss Monitor System

- BLM system has appropriate importance
- Is available for commissioning ! **But:** only 5 BLMs will be available in 2009 for commissioning
- Workarounds need to be carefully developed
- System shown maybe sufficient but adds additional risks.
- Dosimetry using TLDs is still planned.

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# **X-Ray Subgroup Summary Facilities Advisory Committee**

Lahsen Assoufid

*Josef Feldhaus*

Paul Fuoss

Tom Rabedeau

Peter Takacs

*Thomas Tschentscher*

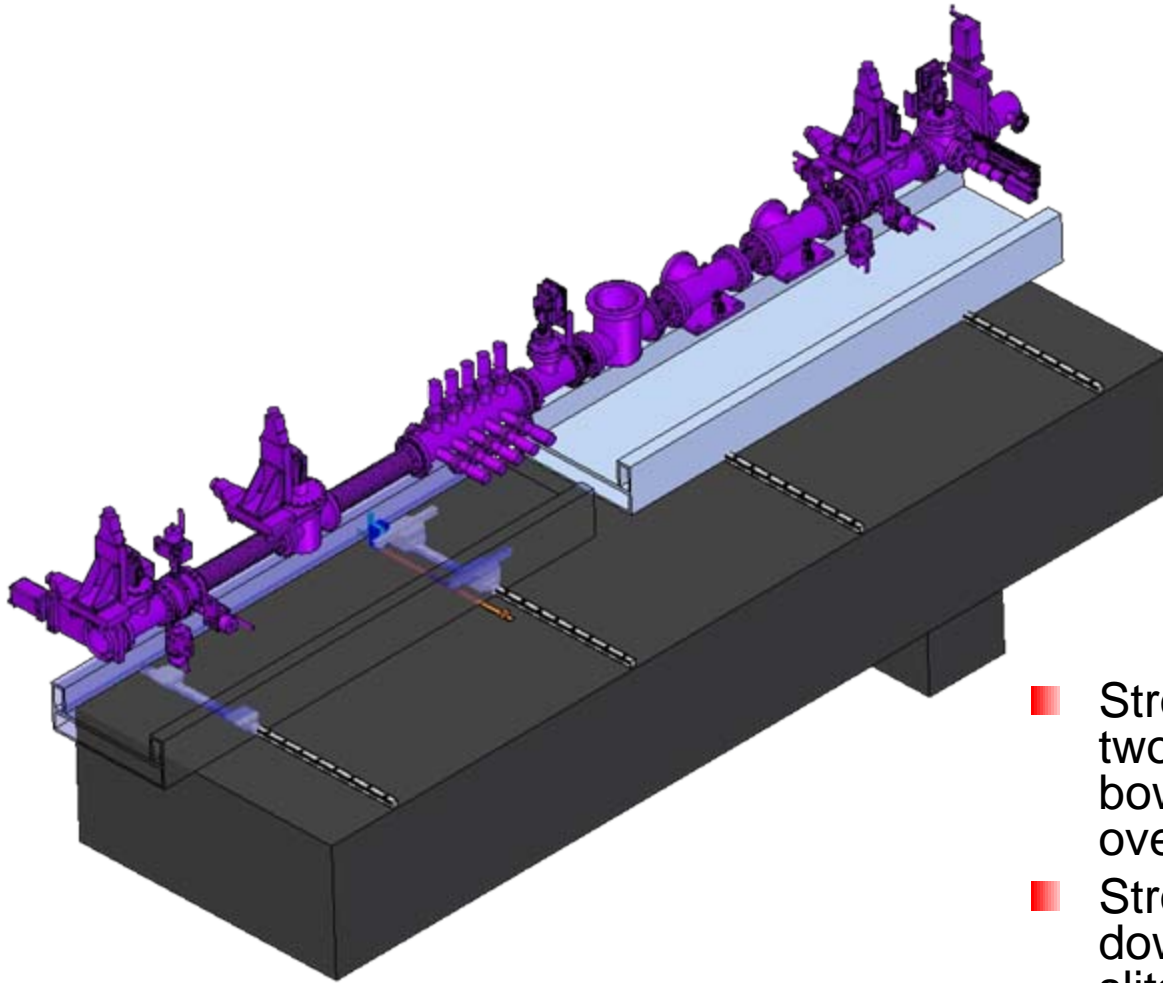
# Overall Conclusion

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**Main X-Ray Challenge:** The funding profile is very negatively impacting construction of the hard x-ray capabilities. Early scientific opportunities in the hard x-ray regime will likely be lost on the current project trajectory.

**Mitigation:** Install the basic X-ray Pump Probe optics support table as soon as possible. Coupled with the state of the art detector from Cornell (scheduled for delivery in Spring 09) and a borrowed diffractometer, this would provide state of the art capabilities for hard x-ray science.

# Optics Support Table – Design



- Strongback has been split into two sections to minimize bowing and to prevent system overconstraints
- Strongback is strategically tied down to rails near locations of slits

# Discussions

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- **X-Ray Overview (Arthur)**
  - **Mirrors have been ordered**
    - very good progress on the SOMS
    - HOMS mirrors need careful monitoring - visit Zeiss to confirm progress several months before delivery
  - **Cornell detector**
    - progress is good
    - detector is scheduled for Spring 09 delivery
  - **K spectrometer**
    - needs definition and a responsible person
    - Need to verify K spectrometer operation after installation
  
- **LUSI Overview (Fornek)**
  - **Budget is a challenge**
  - **Program scope is being actively managed**
  - **Good structure for managing interactions with LCLS**
  - **Strong interaction is encouraged with groups donating instruments**



# Discussions (continued)

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- **X-Ray Pump Probe (Fritz)**
  - **Overall design if progressing well**
  - **Use of robot for detector seems good**
    - other synchrotron groups should be consulted about their experiences
    - are there standards (ANSI) for robot design that should be included
  - **Diffractometer needs an optimized design**
    - Don't rely too strongly on manufacturer specifications
    - Define performance metrics based on realistic experimental loads
  - **Is monolithic granite really necessary.**
  - **Match stability of input flight path and diffractometer**
  
- **Coherent X-Ray Imaging (Boutet)**
  - **Bilayer mirror is a concern**
    - Delamination is a significant risk
    - Interface stability under intense illumination is a risk
    - Coherence degradation in intermediate energy regime
  - **Motivation of low energy performance requirement is not justified**
  - **Aperture damage is still an issue**

# Discussions (continued)

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## – X-Ray Correlation Spectroscopy (Robert)

- Monochromator wasn't discussed
- No new status information on delay line
- Diffractometer progress is good and design is sound
- Common design specification (e.g. sample mounting) within LUSI is great

## – Atomic-Molecular-Optical (Bozek)

- Instrument is on schedule but there is no float.
- Any delays in procurement will result in late availability
- Relocation of the AMO experiment from hutch 2 to hutch 1
  - seems technically sound but schedule impact is worrisome
  - space for additional user chambers is questionable
  - focused effort is needed to resolve space allocation issues

## – LUSI Diagnostics and Optics (Feng)

- Will zone plate wavefront analyzer survive FEL beam
- Designs need to be finalized and physics requirements met

# Discussions (continued)

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## –Mirrors (McCarville)

- **First three SOMS blanks have been delivered**
  - First two are very close but just out of spec
  - Third blank is comfortably within spec
- **HOMS blanks are being fabricated**
- **HOMS mirror pointing system has been redesigned**
  - Prototype works
  - Final design review in next couple of months
  - How will pointing and active stabilization be achieved

# Recommendations

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- **Install the basic X-ray Pump Probe optics support table as soon as possible.**
  - **Include only basic components (i.e. slits and beam monitor)**
  
- **Continue to optimize commissioning schedule**
  - **Schedule has been worked out but is tight**
  - **Identify responsible person for critical items such as K spectrometer**

# Controls

Tom Himel

6/18/08

# Controls Progress

Great progress has been made since the last FAC

- Installation and commissioning of BC2 went smoothly
- Met tight schedules
- MPS first modules are working in the field with a test DB. Still considerable work to do and the system still needs a name
- Hamid has a deputy at last!!! Welcome Enzo.

# Very Very Old Comments

- Hamid badly needs a deputy. We know they have been looking. Keep looking. We can always hope.
  - Enzo Carrone is now on board and has rapidly come up to speed.

# Old Comments

- High level applications
  - Infrastructure is planned – **changed plans recently**
  - Improved Save/Restore application (Phase I) to be delivered in soon – **Done and works well**
  - XAL (from SNS) modified for modeling applications
  - The selection of the high level applications infrastructure and plans for specific applications is significant. Developing the applications will involve many man years of effort. This should be reviewed by external software experts and internal customers (e.g. Physicists and Operations representatives) – **informal internal review was done, plans changed.**



# New Comments

- High level applications (HLA) remain a major concern.
  - Now suffering from (proper) choice of delaying work on HLA in favor of more urgent matters
  - Concentrated work started only a year ago
  - Management and direction was changed a few months ago.
  - Only the actual model is taken from XAL. All other HLA are being written from scratch in Java and Swing.
  - It is fortunate that a good Matlab development environment was provided and the physicists have taken excellent advantage of it.

# New Comments

- High level applications (HLA) (continued).
  - These Matlab apps provide good functional requirements specification for new HLA
  - I was dubious at first that the applications should be rewritten rather than just improving the Matlab code, but became convinced that it was necessary.
  - It will be difficult to get physicists to transition to the new HLA when they arrive as they will be used to the Matlab apps and to the ease with which they can make impromptu changes.
    - Controls should team a physicist with a programmer for each application to ensure the proper functionality is provided and ease this transition. The work of Diane and Juaho on feedback is a past successful example of this teamwork concept.
  - The model is the most urgent application. If practical, extra resources should be put on it to ensure it is available in the next few weeks.

# New Comments

- An upgrade of the linac control system is planned. This will be reviewed tomorrow.
- Radiation modeling work needs to be done to help determine where thresholds for Beam Loss Monitors should be set.
- For budget reasons there are only 5 BLMs instead of 33. Does this provide enough protection for the undulators?
- It is a big job to make feedback go at high rate (120 Hz). Project is not sure if it is necessary and the implementation is low priority. If some test could be done early on to determine if this is needed, it would be very useful.
- The photon and experiment controls has made good progress since the last review.

# Linac Coherent Light Source Facility Advisory Committee Conventional Facilities Subgroup

H. Carter, T. Chargin, A. Kugler, K. Schuh

# Outline

- **CF General**
- **CF Design**
- **CF Construction**
- **CF Installation and Commissioning**
- **CF Safety**
- **CF Closeout**

## Charge to FAC Committee (from J. Galayda)

- Assess Installation Planning
- Identify technical risks remaining in
  - Photon Beam Systems
  - LUSI
- Assess Controls Applications Strategy
  - Comments on risks
  - Manpower, priorities
- Assess Commissioning Plans
- Advise on how best to integrate LUSI into FAC mission

# CF General

- **Oct. 2007 Review Recommendations & LCLS Responses**
  - **Design:** Four recommendations resulted from the October 2007 review. All have been satisfactorily addressed.
  - **Construction:** Three recommendations were made. All have been satisfactorily addressed. However, the issue of construction delays due to budgetary reasons should be revisited for the remaining CF work.
  - **Installation and Commissioning:** One recommendation which was satisfactorily addressed.
  - **Safety:** Two recommendations were made. The first was accepted and implemented, the second consisted of a Report on LCLS Safety Performance containing six sections, each of which contained additional recommendations

# CF Design

## Findings:

- Design work for Buildings 028 and 751 is scheduled to start in Sep08. This space will accommodate 171 users.
- Total construction scope is ~\$5M: CF will manage the subcontracts
- The Jacobs Title III contract has been extended thru the first quarter of CY09



# CF Construction

## ■ Status

- CF construction is ~85% complete
- An accrual system has been applied so that the progress payment schedule matches the construction completion quantities

## ■ Contingency

- CF contingency appears to be adequate and it is divided in parts by:
  - Contracts underway
  - Contracts to be placed
  - Expected claims

# CF Installation and Commissioning

## Findings:

- A general commissioning plan was prepared by Jacobs. Jacobs was not requested to prepare test-specific criteria and is not reviewing all test results.
- CF has established a commissioning organization which includes a commissioning contractor who will prepare a detailed plan
- In some cases, the technical equipment will not be in place to test the operating modes at design conditions
- Dimensional variations encountered in the tunnel include floor level variations in the undulator hall and the beam dump location relative to the beam centerline

# CF Installation and Commissioning

## Recommendations:

- Clear lines of custody need to be established for equipment handoff to operations following testing
- Floor settlement in the undulator hall needs to be monitored at the earliest opportunity. Additional data need to be taken to understand trends and establish a basis for alignment frequency.
- The commissioning sequence should consider operational needs, including the required safety systems
- Allow sufficient time in the commissioning schedule for documentation preparation and approval process associated with partial or full operational readiness reviews

# CF Safety

## Findings:

- The SLAC JSA Safety process works when followed
- While Turner's injury rate has been poor, no lost time injuries in the past two months have occurred
- Management of co-occupancy appears to be successful to date
- LCLS Project Management has added 3 UTRs, an on-site medical professional and 2 Turner superintendents to improve Turner's safety performance
- CF UTRs manage by subcontract, while Turner superintendents manage by construction geographical area
- LCLS managed activities have a zero DART rate, while Turner's performance has been unacceptable
- CF has implemented a Safety Stewardship Committee
- Turner has increased its presence in the field by meeting with individual work crews daily

## CF Safety

### Recommendations:

- LCLS should take the lead role in improving safety performance at the laboratory
- After beneficial occupancy and commencement of operations, LCLS and SLAC safety responsibilities will require close co-ordination
- DOE Lessons Learned database should be utilized as a tool to improve JSA preparation
- Don't underestimate the time required to prepare safety related documentation and the time it takes for the approval process

# CF Closeout

## Findings:

- CF needs a comprehensive closeout checklist
- CF has a detailed plan for personnel re-assignment
- Turner has a project destaffing plan that needs to be updated
- Turner has not provided a demobilization plan

## Recommendations:

- Develop a closeout checklist
- Document and compile lessons learned: successes and failures
- Critical staff must be maintained until work scope is complete, in CF and Turner
- Update and maintain a detailed Turner destaffing plan
- Obtain and review Turner's demobilization plan

# End of Presentation

# Facility Advisory Committee (FAC) Closeout - General Aspects

LCLS Facility Advisory Committee

June 18, 2008



# General Observations

- Progress continues to accelerate and is strong
- Commissioning results so far are great
- Project team working strongly together
- No obvious pitfalls

# Organization

- Project office is strong and functioning well
- Integration and installation processes functioning very well
- Switch to operating organization well underway
  - Accelerator Systems Division
  - LCLS Experimental Facilities
  - System (LCLS) Engineering

# Working Together

- No one is whining or complaining about other parts of the project team or SLAC
- Focus is strongly on getting things done right
- Full evidence of a strong mature team
- Focus is appropriately on the deliverables and end goals

# Transition to a Facility

- The project must focus on deliverables
- The Lab must focus on a facility
- Look at those aspects where facility aspects can/should be pursued that do not belong *on-project*
  - Example: monitoring of floor motions throughout new construction
- Fully understand the interplay of all aspects of the Lab, the Facility, and the Project
  - The Project is driving to completion
  - The Facility is striving to get established
  - The Laboratory is driving for a single entity with a multipurpose mission
- A healthy tension naturally exists be aware of it

# Schedule and Installation

- Installation in several places has nearly gone as far as possible with co-occupancy
  - May need to delay further technical systems installation in places
  - Suitable environment and controls necessary before many systems can be attempted
- Do not unwittingly assume greater risk in an attempt to mitigate or transfer other risk

# Early Science Milestone

- Commissioning has gone well so far, but ...
- FELs may be *Free*-electron lasers, but they require payment in the form of blood, sweat, and tears
- Do not promise users a usable x-ray beam by a given date
  - Promise that there may be beam available of a certain quality no earlier than \_\_\_\_\_
  - Put first users “on call” to be notified when characteristics and stability advanced sufficiently
- Take care to not allow desire for the Early Science milestone to compromise aspects of the facility

# The FAC Should Evolve

- Just as the project changes the FAC should evolve to meet LCLS needs
  - The Electron and Undulator subcommittees should be merged into a Commissioning subcommittee
  - Conventional Facilities should remain for at least one more meeting
- Stronger coordination with SAC to ensure complementary roles

# Closing Comments

- This continues to be an exciting project to watch and comment on
- Don't lose opportunities to preserve and provide valuable lessons learned throughout the project for projects that follow at SLAC and elsewhere
- Thanks everyone for the organization of the meeting, again especially Helen and Siony



# Proof that there is light at the end of the tunnel

