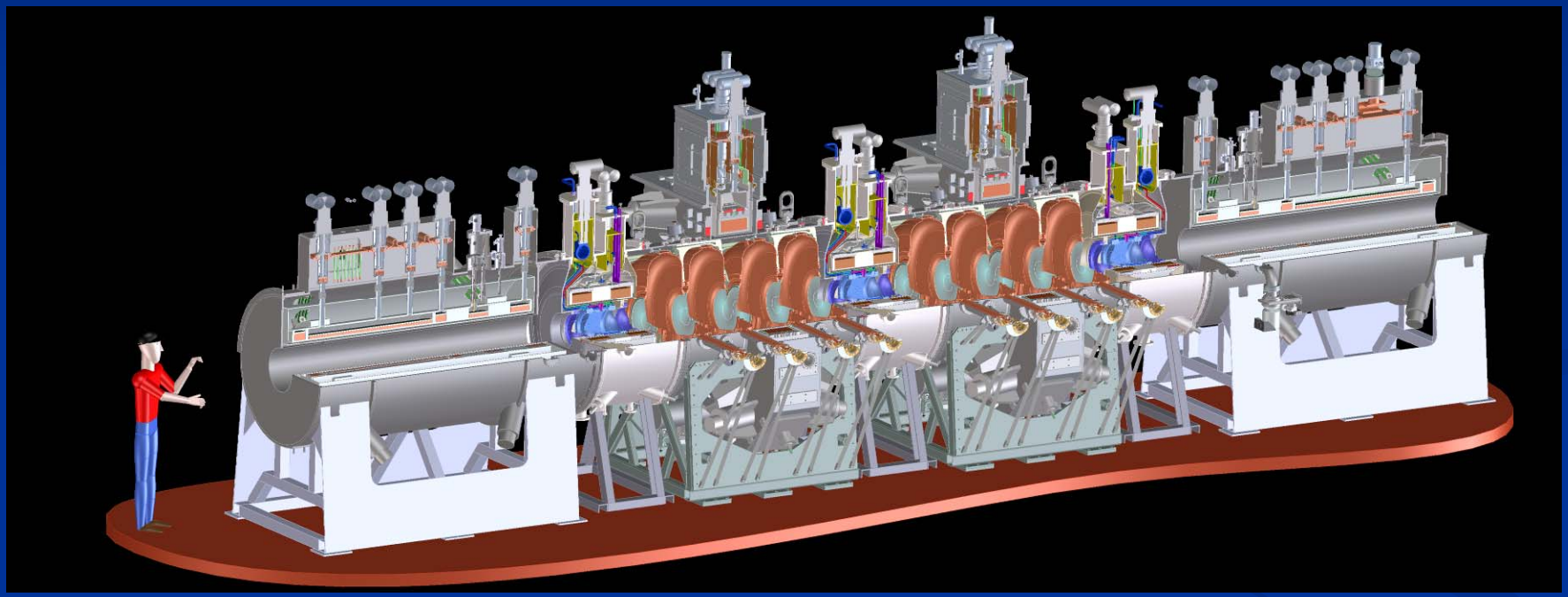
MICE Operations



Linda R. Coney – UC Riverside

MAP – Aug 2013

Outline

- Current Operations
  - Recent data-taking
  - Shifter & MOM training
  - Ongoing Operations efforts
- Step IV and VI Operations
  - Organization
  - Operational plan
  - Operations Risks
- Conclusions

Current Operations: Recent Running

- February 2013 – Activation run, CKOV commissioning data
  - 14 hours running MICE target with ISIS beam bump at 4V beam loss
  - Double previous limit on beam loss – investigate effects (if any) on activation of beam line components
  - PPS modifications in progress required beam to DSA only – acceptable for this run
  - Successful test – after post-run analysis, ISIS agreed to new standard loss limit of 4V
- July 2013 – two day shifter training period
  - 10 new shifters trained as prep for detector commissioning and Step IV running
  - Refresher course likely to be necessary prior to Step IV running early 2015
- Aug 2013 – short data-taking run prior to EMR commissioning in October
  - Beamline optimization for rate at TOF2 (w/o DS this is low ~5/spill)
  - PID data for pion/muon discrimination – for paper
  - TOF calibration, CKOV data
  - Quadrupole alignment studies
  - Went reasonably well – some issues with target & online systems – need improve reliability
  - Persistent difficulties w/shifter availability (in spite of recent doubling of trained people)

Upcoming Operations

- October 2013 – EMR commissioning run
  - 1 week debugging detector/DAQ with beam
  - 3 weeks data-taking
  - MOM for this period under recruitment
  - Shifter scheduling soon to start – will require lots of MICE
  - Call for action on MICE collaborators to take shifts
- EMR run prep
  - Good news –
    - C&M expert on site (Pierrick Hanlet – IIT)
    - DAQ expert on site (Yordan Karadzhov – UniGeneve)
    - MAUS expert on site (Chris Rogers – RAL)
    - EMR expert on site (Ruslan Asfandiyarov – UniGeneve)
  - Bad news – Decay Solenoid unavailable → muon rate at TOF2 very low
  - Beamline optics optimization needed for tracks to TOF2 (also useful for TOF calibration and straight tracks to trackers for Step IV)
- Running in 2014
  - Priority to Step IV installation & commissioning
  - Likely to be minimal – primarily system/detector testing & maintenance
  - Shifter training periods
  - Weekends/short

Current Operations: Training

- **Shifter training**
  - Continue & refine shifter training
    - Difficult to train while taking data – difficult to train fully without running
  - Increasing pool of trained personnel
  - Upcoming EMR commissioning run
    - 3+ weeks of running
    - Organizing staffing now

- **MOM training**
  - Institute formalized MOM training
  - Better prepare wide range of MICE collaborators for duties/expectations during MOMing
  - Solicited feedback from recent MOMs
  - Developing off/on-site training protocols
    - Includes documentation, in-person handover, online tools, possible remote training

Ongoing Operations Efforts

- Continued development of all Online systems for incoming equipment
  - Necessary emphasis on reliability and longevity
- Improve/integrate C&M systems
  - Run Control
  - Use of Configuration Database (CDB)
  - State machines – Spectrometer Solenoids (SS), Focus Coil (FC), Decay Solenoid (DS)
  - System monitoring – MLCR computing, HV, Hall & Rack Room environment, Alarm Handler
- Computing
  - New head of MICE Computing (Chris Rogers, RAL)
  - Stabilize support for (Janusz Martiniak, Imperial) and availability of preproduction CDB
  - Automate data-mover
- DAQ – incorporate EMR & Trackers, new trigger system
  - Timing – with tracker (successfully done with single station) & next with RF…
- Online Monitoring & Reconstruction
  - Finish resurrection/upgrades to Online Monitoring (low level detector, DAQ info)
  - Online Reco/Data Quality – add EMR, KL
  - Implement Global Reconstruction

Ongoing Operations Efforts

- Reinforce consistent safety procedures/culture with long term stability
  - Presentation by Andy Nichols (project manager) at monthly VC clarify procedures
- Understand implications of field mitigation plan – new rack room and expanded MLCR
- Documentation
  - PPS user guide in progress
  - Target software/hardware upgrades – updates to docs needed
  - C&M documentation
    - Run Control manual
    - State Machine documentation
    - HV control guide
    - Debugging guide for all Step I-related applications
  - DAQ – reinstallation instructions needed
  - Computing – improving
    - list of all MLCR and PPD computing in place
    - Online Reco manual – need updating
    - Online Monitoring – documentation in progress

Operations Efforts:

with an eye toward Step IV

- Automate calibrations
  - TOF calibration (Durga Rajaram, IIT)
  - PID calibration (KL, EMR)
  - Tracker calibration (David Adey, FNAL)
- Feedback Online Reconstruction/Data Quality info to data-taking
  - Need confirm taking quality data – beam time is precious
- Standardize/automate data-taking
  - (Re)define standard run settings
    - For emittance/momentum points, for straight tracks, for calibration runs & feed into Run Control
  - Nail down beam optics (Maria Leonova, FNAL)
- Standardize survey procedure/data storage
- Keep DS operational – need good muon rates for Step IV

More Operations Efforts for Step IV

- Shifter pool
  - Need continue effort to recruit and train MICE
  - More later in Step IV discussion..will need people!
- Develop operational protocol/procedure for new beamline components
  - Will have significant impact on data-taking
  - Ex. SS ramp time = several hours
    - How we are able to use it? Overnight procedure and restart running will affect data-taking efficiency
  - Ex. LH2 requires 24/7 on site coverage
    - What is required for magnet commissioning & RF tests?
  - Tied in with C&M – confidence in a comprehensive C&M system enables us to rely on the system w/o external intervention
  - In process of determining local support level required for each system
- Decision on field mitigation by October 2013
  - Incorporate plan into Operations – schedule impact?
  - Data-taking impact?

Extending Operations to Step IV

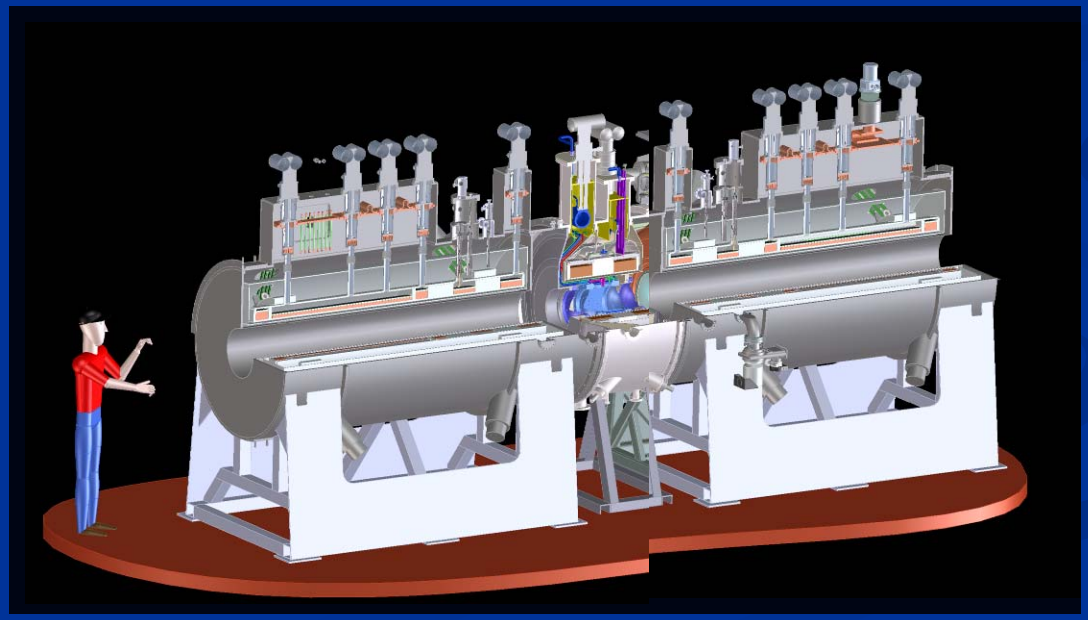
- Current running experience feeds into Step IV/Step VI preparation
  - Commission final detector systems (EMR, full trackers)
  - Gain experience operating beam line & equipment
  - Refine initial procedures & extend to new equipment

- Current run personnel
  - MOM (MICE Operations Manager)
    - Rolling monthly appointment
    - Responsible for meeting scientific goals of MICE
    - Safety responsibility delegated from Project Manager
  - BLOC – BeamLine On Call expert
    - Trained member of MICE collaboration
  - 2 shifters for ~9 hour shift
    - Trained members of MICE collaboration
  - SOC – Software On Call expert – often remote

- Procedures & preparation
  - Run during ISIS User Runs – Normal working hours (plus weekends)
  - Run planning, beamline testing, online system testing, and software preparation understood

MICE Step IV

- Change operational mode
- Define for rest of experiment (Step IV, Step VI)
- Equipment:
  - Both Spectrometer Solenoids
  - Two trackers installed in the SS magnets
  - One AFC (Focus Coil magnet & LH2 system)



Step IV Operations

- Operational support plan in development
  - New positions being defined
    - Run Coordinator/SuperMOM/Beamline Physicist
      - Understands STFC safety and operational environment
      - Provide link between MOMS
      - Local – full time – not necessarily STFC employee
    - Integration Physicist
  - Will use system-expert professional operators
    - RF – *this person has now joined MICE*
    - Cryogenics
    - Magnets – *recent experience with DS emphasize need*
    - Work in cooperation with MICE collaborators as shifters
    - 1 in MLCR on shift during running
- Retain MOMs – *on call* for 1 month
  - Continues current role – responsible for daily experimental planning & running duties
- Retain on call experts
  - BLOC (beam line), SOC (software), TROC (tracker), and more

Step IV Operations

- **Data-taking operations**
  - ***Run requirements – max 12 hr/day, 5 days/week***
  - Need two of each type of shifter/day
  - Long term running will be focused – no multitasking of Hall use
  - Single purpose during ISIS cycles – Hall secured/equipment in steady state

- **For Step IV**
  - Assume 100k muons in 2 hrs
  - Remember:
    - For each configuration – empty absorber, full LH2 absorber, solid absorber, wedge absorber, etc.
    - We have 3 momenta, 3 emittances, 2 field configurations, 4 β functions → 72 measurements at 2 hours/measurement
  - **Therefore it takes 144 hrs for 100k muons at each point**
  - ***Each configuration requires 12 days at 12 hrs/day → 2.5 weeks in calendar time***

Step IV Operations

- **Original (spring 2012) estimate for Step IV run time was 1 year**
  - Commission/calibrate detectors, check alignment
  - Magnet performance and alignment, Diffuser and beam matching
  - Empty channel measurements
  - First demonstration of cooling, empty absorber, full set of LH2 absorber measurements
  - Cooling measurements with LiH solid absorber
  - Cooling with solid absorbers, multiple scattering, energy loss
  - Wedge and half-wedge absorbers
- **Some can be accomplished without beam or with selected magnets**
- **However, practically speaking, MICE Step IV run requirements extend the original estimate for run time from ~1 year to ~1.5 years**
  - 5 ISIS cycles/year, average 5 weeks/cycle = *25 weeks of running/year*
  - 5 days/week, 12 hrs/day with 2 MICE collaborators for each shift
  - *Therefore: 25 weeks * 2 shifters = 50 person-weeks of shift each year*
  - Would assume a similar case for Step VI

Step IV & VI Operations

- Safety
  - Understand implications under STFC rules of new equipment
    - Operations review of LH2 system completed
  - Will negotiate other system requirements for commissioning & operations
- PPS
  - Understand implementation of system with SC magnets
    - Recently reviewed/approved at Technical Board meeting
  - Step VI – understand implementation with RF
  - Recent annual PPS functional testing exercised SC permit and RF permit portions of system
- Step VI – includes everything from Step IV + RF
  - Full time RF engineer now in place in MICE
  - TIARA test fall 2013

Step IV Operations Risks

- **Personnel (on several levels)**
  - **Step IV requires three new expert positions**
    - Mitigation: 1 in place now, other two likely to be recruited starting ~ April 2014
  - ***MICE head of operations (L. Coney, UCR) leaving***
    - Mitigation: find new person to lead Ops effort
  - **Will run 50 person-weeks of MICE shifters each year for Step IV/VI**
    - Mitigation: must recruit/require standard shift requirement for each collaboration member/institute
  - **Will train all MICE collaboration shifters**
    - Training procedures in place; however, need to ramp up numbers
    - Difficult to maintain shifter knowledge w/o consistent operation of experiment
    - Training has continued – long term effort required
  - ***MICE experiment largely working with shifters who are volunteers from universities when running/doing data analysis – we cannot lose this effort***

Step IV Operations Risks

- Smooth operations requires robust and comprehensive C&M system
  - Mitigation: intense effort under way to create necessary C&M tools and provide local expert support at RAL
    - Pierrick Hanlet to RAL, new C&M member – Ian Taylor (postdoc – Warwick U)
- Unknown effect of magnets operating in proximity to each other for purposes of both training and experimental use
  - It may take longer to take desired data
  - Mitigation – not clear how to predict this – need magnets at RAL and operational
- Delays or loss in data-taking time
  - Accelerator down-time – scheduled or unscheduled
  - MICE equipment maintenance/lifetime
  - Mitigation – increase efficiency of running – increase beam loss, target rate, online analysis

Step IV Operations Risks

- **Online Systems reliability/stability**
  - Mitigation: intense effort under way to create necessary C&M tools and provide local expert support at RAL
    - Pierrick Hanlet to RAL, new C&M member – Ian Taylor (postdoc – Warwick U)

- **Software – define and produce required analysis tools for Step IV**
  - TOF reconstruction – good
  - Tracker reconstruction – good
  - EMR reconstruction – by end 2013
  - Global reconstruction – in progress
  - Accelerator optics online tools – effort needed
  - Mitigation – need clear connection between analysis goals/plan and software group. Define necessary tools & ensure effort well-supported. (Durga Rajaram – IIT, Chris Heidt, UCR)

Conclusions

- Current running provides solid foundation for extending into Step IV operations
- Many changes coming for Step IV
  - New equipment, new procedures, long periods of running – much to do!
- Making progress toward meeting challenges of Step IV Operations
  - Developing operational plan – support and scope
  - Identifying/hiring necessary personnel
  - Making solid advances on technical handling of new hardware (DAQ, Controls, magnet integration, upcoming EMR commissioning)