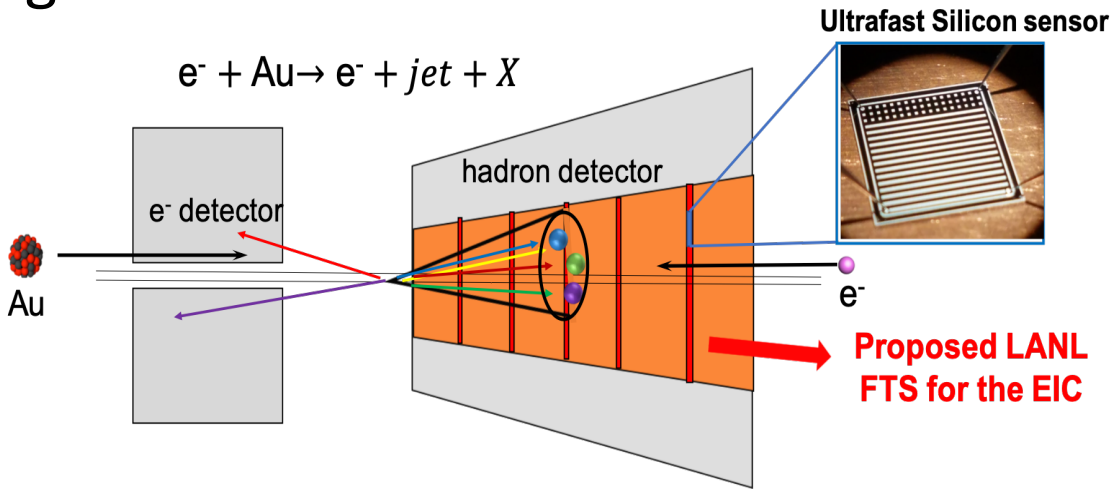
EIC physics program status and plans at Los Alamos National Laboratory

Xuan Li on behalf of
Los Alamos National Laboratory
9/18/2019, UC EIC Consortium meeting

LANL proposed a new physics program together with relevant detector R&D for the EIC

- We submitted a LDRD proposal (PI: Ivan Vitev, Co-PI: Xuan Li) to develop a new physics program to precisely measure the heavy flavor products (charm/bottom hadrons) and jets in the nucleon/nucleus going direction at the EIC.
- These measurements have a close connection with the ongoing heavy ion programs at RHIC and LHC.
- We also proposed to

  Build the prototype of the forward (nucleon/nucleus going direction) silicon tracking for the EIC.



- We gets the LANL LDRD supports for FY20-22 with joint efforts on both theoretical and experimental developments.

LANL EIC program status and plan (I)

- Status:
  - Theoretical developments are underway.
  - Fast simulation for proposed detector and physics evaluation is being set up.
  - Initial studies in fast simulation to evaluate the proposed Forward Silicon Tracking (FST) performance are under way.
  - The silicon R&D lab is being set up.

EIC detector performance requirements

- From the EIC detector handbook.

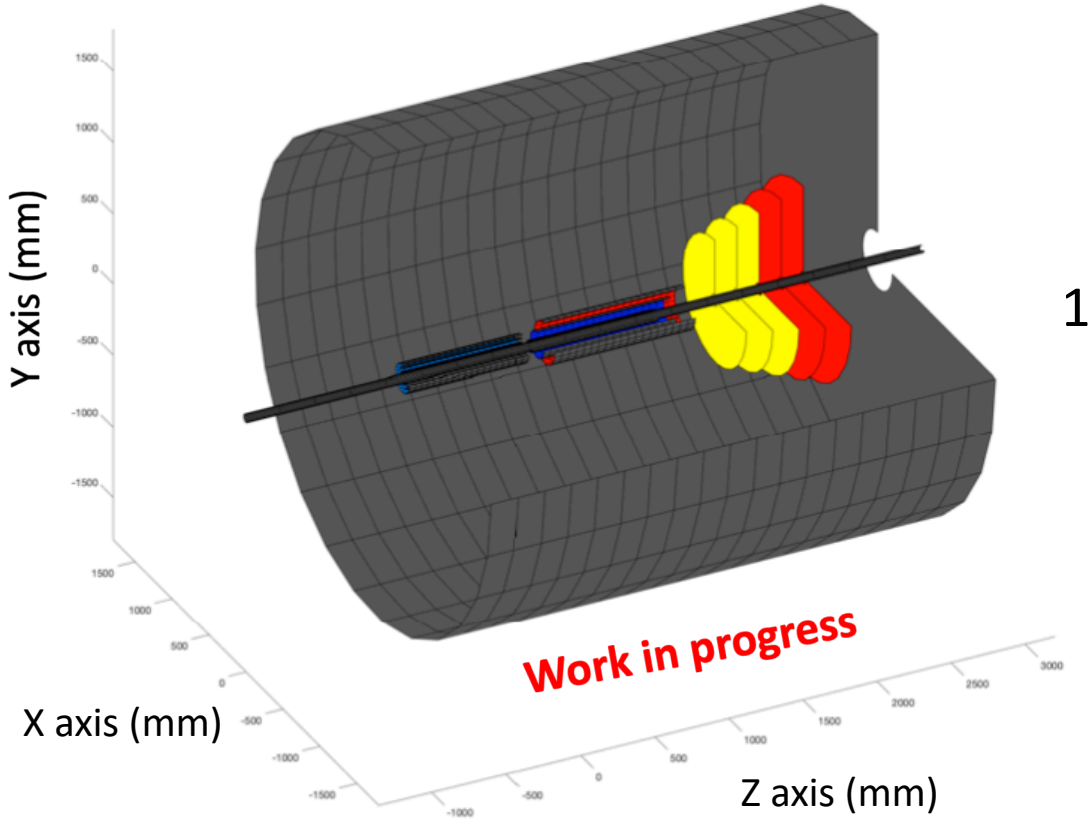
EIC Detector Requirements

η	Nomenclature			Tracking			Electrons		π/K/p PID		HCAL	Muons
				Resolution	Allowed X/X$_0$	Si-Vertex	Resolution σ_E/E	PID	p-Range (GeV/c)	Separation	Resolution σ_E/E	
-6.9 — -5.8	↓ p/A	Auxiliary Detectors	low-Q^2 tagger	$\delta\theta/\theta < 1.5\%$; $10^{-6} < Q^2 < 10^{-2}$ GeV^2								
...												
-4.5 — -4.0			Instrumentation to separate charged particles from photons									
-4.0 — -3.5												
-3.5 — -3.0		Central Detector	Backwards Detectors	$\sigma_p/p \sim 0.1\%\times p + 2.0\%$	~5% or less	TBD	2%/√E	π suppression up to 1:10^4	≤ 7 GeV/c	≥ 3σ	~50%/√E	
-3.0 — -2.5												
-2.5 — -2.0												
-2.0 — -1.5				$\sigma_p/p \sim 0.05\%\times p + 1.0\%$			7%/√E					
-1.5 — -1.0												
-1.0 — -0.5			Barrel	$\sigma_p/p \sim 0.05\%\times p + 0.5\%$		$\sigma_{xyz} \sim 20$ μm, $d_0(z) \sim d_0(r\phi) \sim 20/p_T$ GeV μm + 5 μm			≤ 5 GeV/c		TBD	TBD
-0.5 — 0.0												
0.0 — 0.5												
0.5 — 1.0												
1.0 — 1.5			Forward Detectors	$\sigma_p/p \sim 0.05\%\times p + 1.0\%$		TBD	(10-12)%/√E		≤ 8 GeV/c		~50%/√E	
1.5 — 2.0												
2.0 — 2.5									≤ 20 GeV/c			
2.5 — 3.0				$\sigma_p/p \sim 0.1\%\times p + 2.0\%$								
3.0 — 3.5									≤ 45 GeV/c			
3.5 — 4.0	↑ e	Auxiliary Detectors	Instrumentation to separate charged particles from photons									
4.0 — 4.5												
...												
> 6.2			Proton Spectrometer	$\sigma_{intrinsic}(\|t\|)/\|t\| < 1\%$; Acceptance: $0.2 < p_T < 1.2$ GeV/c								

Table 2: Physics requirements for a an EIC detector

LANL EIC program progress (I)

- Detector design in fast simulation:
  - Mid-rapidity silicon vertex detector: 3 barrel layers of MAPS type detector.
  - Forward-rapidity silicon tracking detector (FST): 3 barrel layers of MAPS + other silicon detector and 5 forward planes of MAPS + other silicon detector.

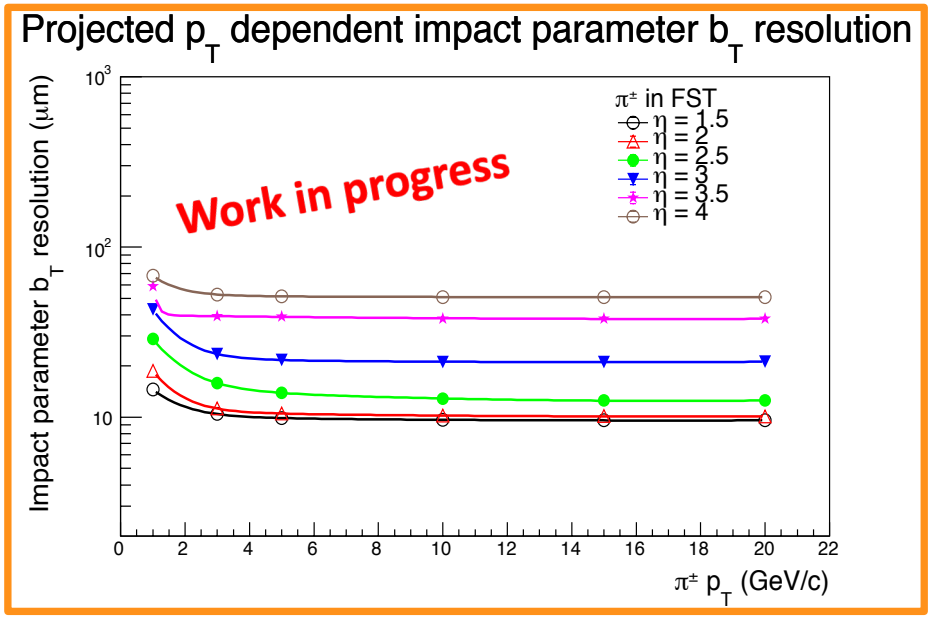


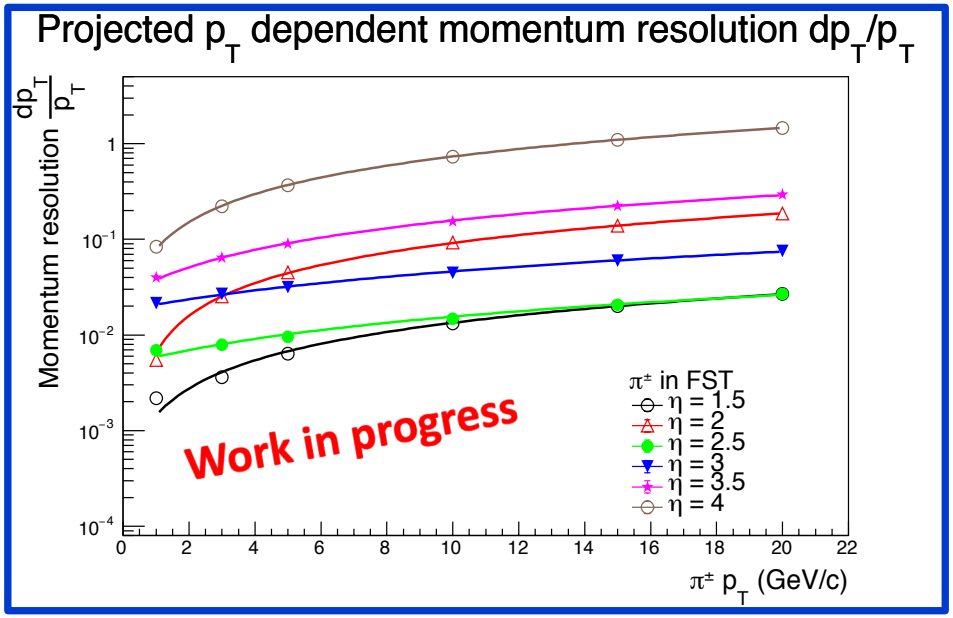
B = 3T

$1.0 < \eta < 4.5$

LANL EIC program progress (II)

- Track performance from the FST:





- Better than 70 μm resolution can be achieved by the initial FST design for the transverse decay length b_T measurements for tracks with $p_T > 1$ GeV/c over the $1.5<\eta<4.0$ region.
- The momentum resolution dp_T/p_T are better than or consistent with the forward tracking requirements from the EIC detector handbook.

LANL EIC program status and plan (II)

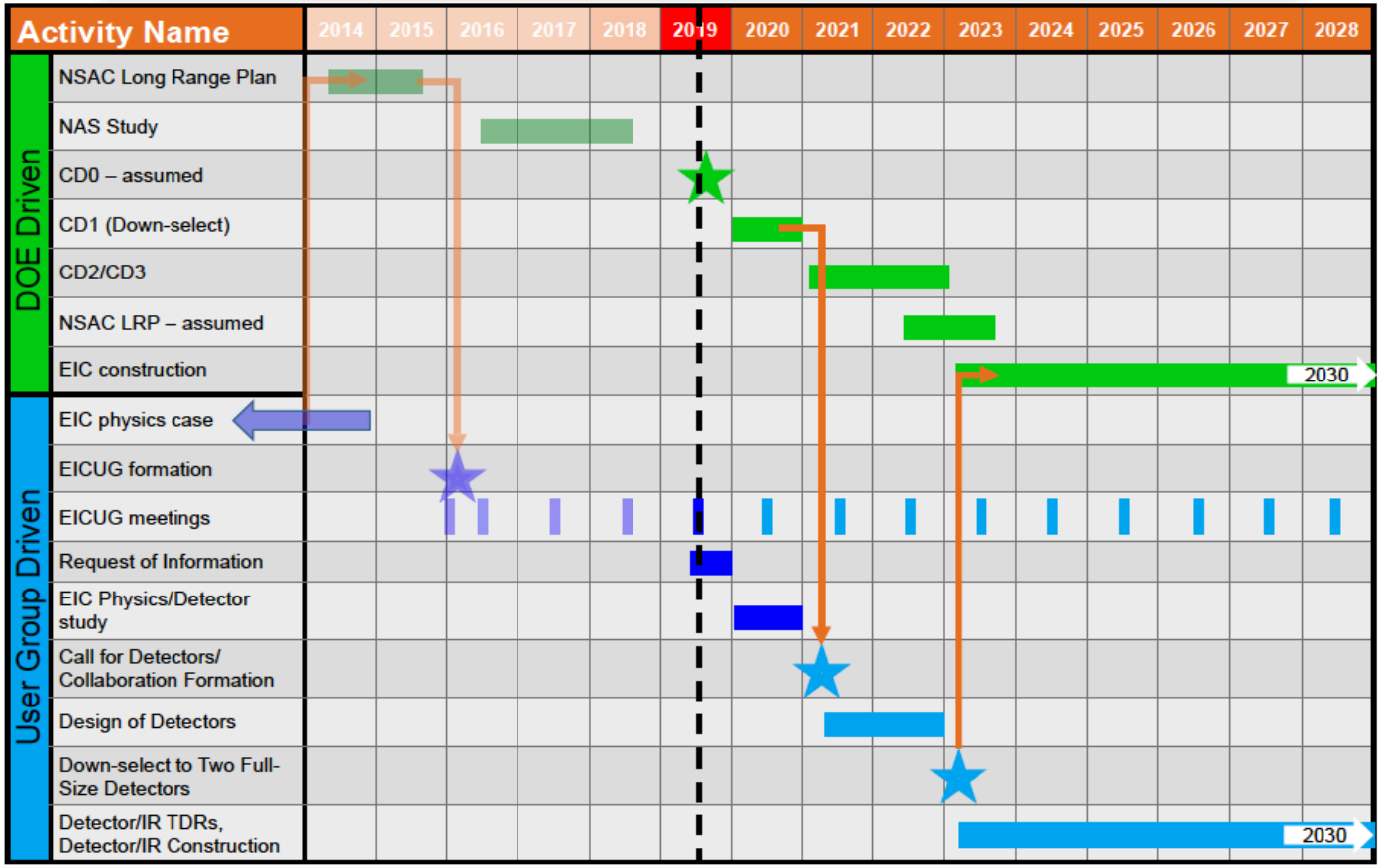
- Plan:
  - Will work on the detector and physics projections for the proposed heavy flavor and jets measurements.
  - Will provide the detector performance guidance based on the simulation studies.
  - Will setup the R&D lab and characterize proposed silicon techniques.
  - Will build a prototype tracker after silicon technique down selections.
  - Will perform lab and beam tests to demonstrate the prototype tracker performance.

LANL EIC program status and plan (III)

- We look forward to build a collaboration with UC consortium institutions.
- We encourage qualified candidates to apply for our EIC postdoc position (LANL IRC75106):
  - http://inspirehep.net/record/1746549
  - https://jobszp1.lanl.gov/OA_HTML/OA.jsp?OAFunc=IRC_VIS_VAC_DISPLAY&OAMC=R&p_svid=75106&p_spid=3413351&p_lang_code=US
- If you have further suggestions or questions, please contact me (xuanli@lanl.gov).

Backup

Updated EIC timeline from the UICUG



- Detailed timeline of EIC just got updated.
- We would like to deliver the physics projection and build a protype silicon tracker along with the EIC timeline.