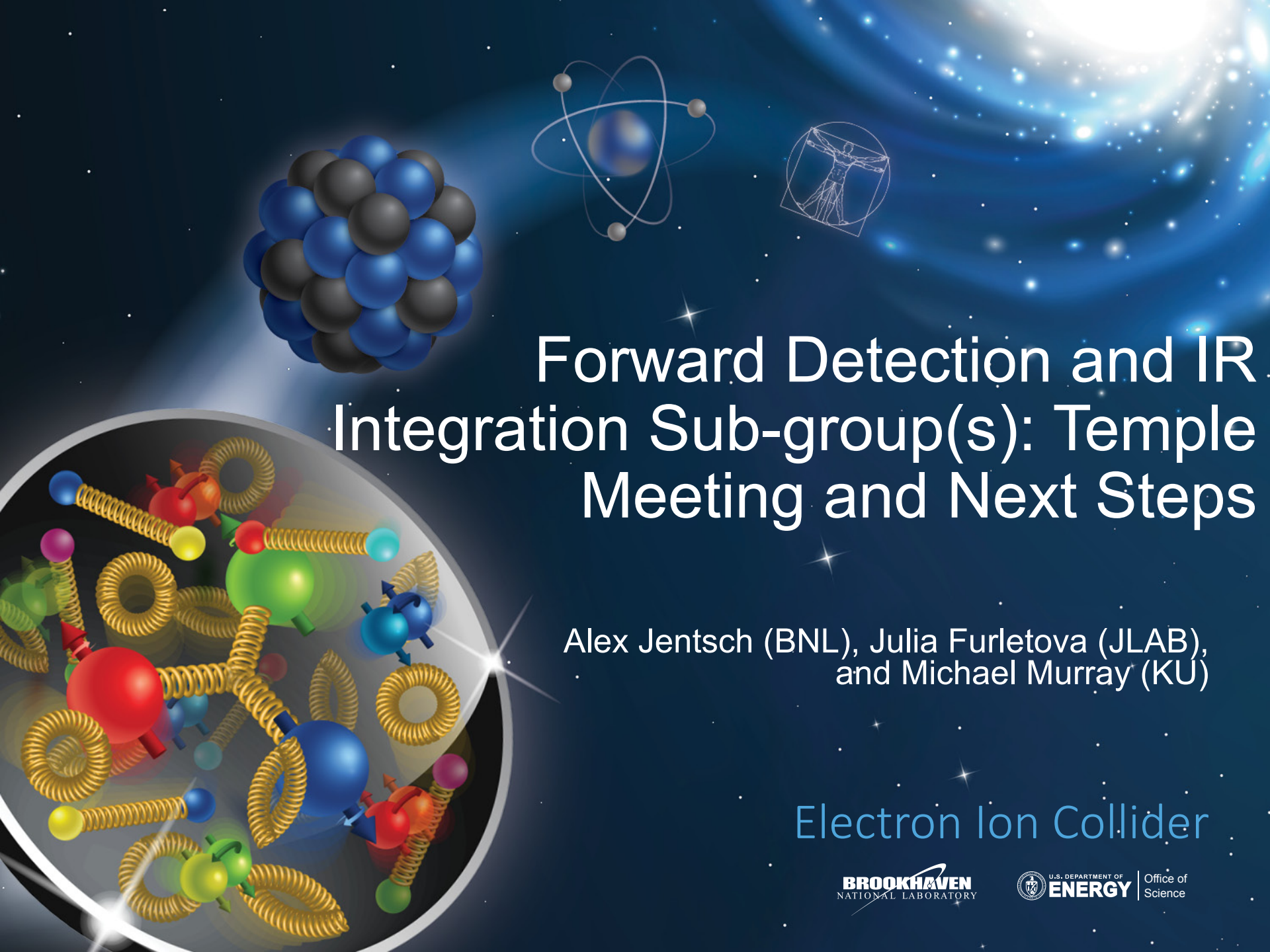


Forward Detection and IR Integration Sub-group(s): Temple Meeting and Next Steps

Alex Jentsch (BNL), Julia Furletova (JLAB), and Michael Murray (KU)

Electron Ion Collider

BROOKHAVEN NATIONAL LABORATORY
U.S. DEPARTMENT OF ENERGY | Office of Science

Proposed Talks for Temple

1. Overview talk by Julia (i.e. purpose of group, scope, and goals).
2. Presentation by Michael Murray (KU) on the TOTEM Roman Pots – lessons learned, etc.
3. Presentation by Xuan Li (LANL) on B0 silicon sensors.
4. Presentation by Alex Jentsch on RP/B0 simulations, plus additional sensors for light nuclear breakup protons (i.e. e+D).
5. Presentation by eRD24 on RP sensor R&D progress (TBD).
6. One talk on the exclusive physics from someone in that sub-group would also be very helpful (TBD) – especially on "golden channels" and available Monte Carlos.
7. One technical talk on the IR design from an accelerator person (TBD).
8. One talk on ZDC (TBD).
9. Talk on low-Q^2 tagger (TBD).

- **We think each talk could be 15'+5', and we could have two morning sessions with a coffee break in between (4 talks in session 1, 4 talks in session 2, with the opening summary talk being 10'+3').**
- **We are hoping to get as many of the speakers there in person as possible, and will try to find alternatives on the "TBD" to prioritize meeting that goal.**
- **We could also do 3 session (one after lunch) to allow for slightly longer talks (i.e. 20'+5').**

Story so far and next steps

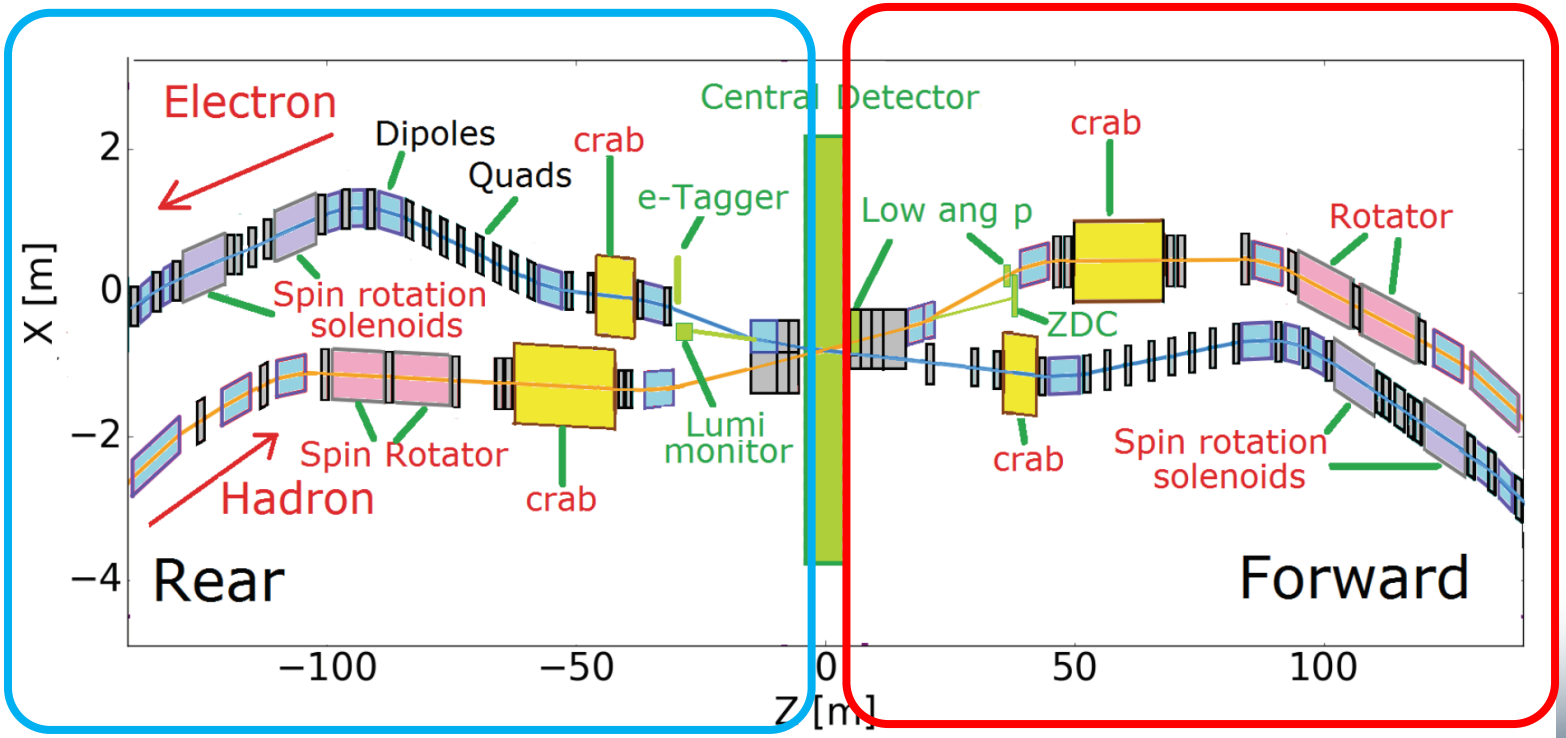
- Work has been done to simulate forward proton and neutron detection to establish acceptances with Roman Pots, silicon sensors in first dipole (B0), and ZDC.
- There has also been substantial work on luminosity monitoring and a low-Q^2 tagger.
- Presentations in the last two weeks on the IR layout/design, Roman Pots/B0, Lumi. monitor, low-Q^2, etc.
- Need to now begin the working on selecting technology for silicon (eRD24 for RP, and LANL for B0 - so far) and calorimetery.

Far-forward detectors and IR integration WG mailing list

- two meetings (joint) :

Far- Forward : https://indico.bnl.gov/event/7548/

Far-Rear: https://indico.bnl.gov/event/7587/



Far- Forward :

13:30 → 13:50 **Introduction**
Speaker: Yulia Furletova
YB_FarForward_Kic...

13:50 → 14:10 **Current eRHIC IR accelerator design** ¶
Speaker: Holger Witte
2020-01-26_BNL_EI...

14:15 → 14:35 **Current status of Forward Detectors and Simulation**
Speaker: Alex Jentsch
Yellow_Report_mee...

14:35 → 14:55 **summary**
Speaker: Michael Murray
Summary-Jan27_20...

Far-Rear:

1:30 PM → 1:35 PM **Introduction**
Speaker: Yulia Furletova

1:40 PM → 1:50 PM **accelerator design (rear)**
Speaker: TBD

1:55 PM → 2:15 PM **Luminosity and low-Q2 tagger**
Speaker: Jaroslav

2:15 PM → 2:35 PM **ZEUS Beam pipe calorimeter (BPC) and low-Q2 tagger**
Speaker: Bernd Surrow

2:35 PM → 2:55 PM **Electron Polarimeter**
Speaker: Alexandre C. /Dave G.

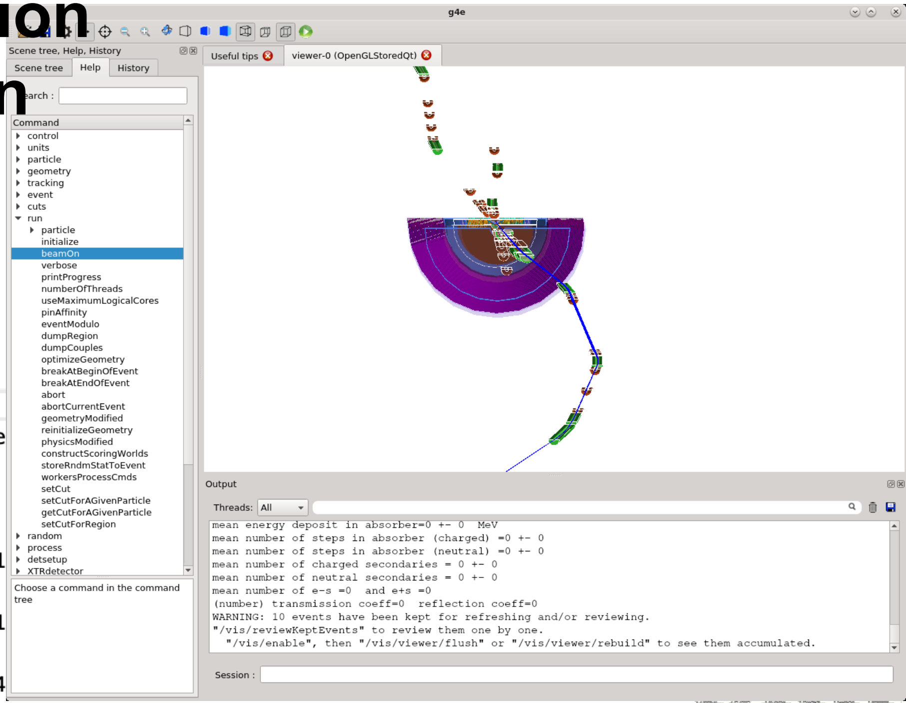
Need feedback from Physics groups on list of "golden"-channels (with MC samples, if available, preferably in LUND, HEPMC, BEAGLE formats)

Accelerator parameters table

Table 3.3: eRHIC beam parameters for different center-of-mass energies $\sqrt{s}$, with strong hadron cooling. High divergence configuration.

Species	proton	electron	proton	electron	proton	electron	proton	electron	proton	electron
Energy [GeV]	275	18	275	10	100	10	100	5	41	5
CM energy [GeV]	140.7		104.9		63.2		44.7		28.6	
Bunch intensity [10^{10}]	20.5	6.2	6.9	17.2	6.9	17.2	4.7	17.2	2.6	13.3
No. of bunches	290		1160		1160		1160		1160	
Beam current [A]	0.74	0.227	1	2.5	1	2.5	0.68	2.5	0.38	1.93
RMS norm. emit., h/v [μm]	4.6/0.75	845/72	2.8/0.45	391/24	4.0/0.22	391/25	2.7/0.27	196/20	1.9/0.45	196/34
RMS emittance, h/v [nm]	16/2.6	24/2.0	9.6/1.5	20/1.2	37/2.1	20/1.3	25/2.6	20/2.0	44/10	20/3.5
β^*, h/v [cm]]	90/4.0	59/5.0	90/4.0	43/5.0	90/4.0	167/6.4	90/4.0	113/5.0	90/7.1	196/21.0
IP RMS beam size, h/v [μm]	119/10		93/7.8		183/9.1		150/10		198/27	
K_x	11.8		11.9		20.0		14.9		7.3	
RMS $\Delta\theta$, h/v [μrad]	132/253	202/202	103/195	215/156	203/227	109/143	167/253	133/202	220/380	101/129
BB parameter, h/v [10^{-3}]	3/2	100/100	14/7	73/100	10/9	75/57	15/10	100/66	15/9	53/42
RMS long. emittance [10^{-3}, eV·sec]	36		36		21		21		11	
RMS bunch length [cm]	6	0.9	6	2	7	2	7	2	7.5	2
RMS $\Delta p/p$ [10^{-4}]	6.8	10.9	6.8	5.8	9.7	5.8	9.7	6.8	10.3	6.8
Max. space charge	0.006	neglig.	0.003	neglig.	0.028	neglig.	0.019	neglig.	0.05	neglig.
Piwinski angle [rad]	5.6	0.8	7.1	2.4	4.2	1.2	5.1	1.5	4.2	1.1
Long. IBS time [h]	2.1		3.4		2		2.6		3.8	
Transv. IBS time [h]	2		2		2.3/2.4		2/4.8		3.4/2.1	
Hourglass factor H	0.86		0.86		0.85		0.83		0.93	
Luminosity [10^{33}cm^{-2}sec^{-1}]	1.65									

Work is ongoing on implementation of the eRHIC accelerator optics in Geant4 (g4e, EicRoot, etc.)



preCDR_pRear_optics.275GeV.txt

```
# Values shown are for the Exit End of each Element:
#Index name          key                    s        l              be
  alpha                 phi                  eta                 etap
#
      b                   a                    a                    x
      0 BEGINNING     Beginning_Ele        0.000     ---       0.90348701
0.0096864373      0.0000000000      -0.0002440433      -0.0012828422
      1 FSR           Floor_Shift          0.000    0.000       0.90348701
0.0096864373      0.0000000000      -0.0002440433      -0.0012828422
      2 D_Q1APR       Drift                5.300    5.300      32.00577994
-101.5568071081     1.4008865132      -0.0070431069      -0.0012828422           ---            ---
      3 Q1APR         Quadrupole           7.100    1.800      71.9891639815    -18.5003188568    747.3831365023
-2.9027719213       1.4402781750      -0.0105403661      -0.0026986983           ---       -0.0915735020
      4 D_Q1BPR       Drift                7.600    0.500      91.6815434864    -20.8844401525    750.2890614533
-2.9090779807       1.4464327522      -0.0118897153      -0.0026986983           ---            ---
      5 Q1BPR         Quadrupole           9.000    1.400     181.8019758536    -46.8672673042    644.3900723086
74.4942574427       1.4575669373      -0.0167290119      -0.0043061397           ---       -0.0812169750
      6 D_Q2PR        Drift               10.500    1.500     349.6007686297    -64.9985945433    440.2874672384
61.5741459361       1.4635168190      -0.0231882214      -0.0043061397           ---            ---
      7 Q2PR          Quadrupole          15.000    4.500     738.5558598461     -2.5114155644    176.9425367445
8.7276409623        1.4714734952      -0.0336730801      -0.0001067714           ---        0.0310515477
      8 D_B2APR       Drift               30.498   15.498     818.7771620272     -2.6647534218     11.1753845807
1.9682561202        1.4914047885      -0.0353278451      -0.0001067714           ---            ---
      9 B2APR         Sbend               36.198    5.700     849.1202882828     -2.6578490675      2.9074524309
-0.5177415189       1.4982404407      -0.0946750574      -0.0207160772     -0.0206134242      0.0000000000
     10 D_B4PR#1      Drift               38.698    2.500     862.4688903582     -2.6815917627      8.2220349765
-1.6080914993       1.5011617955      -0.1464652504      -0.0207160772           ---            ---
     11 Q3APR         Quadrupole          40.198    1.500    1015.6215159922   -104.7628776713     12.2457901998
-0.9310425988       1.5028072128      -0.1901420373      -0.0382875143           ---       -0.0705044066
     12 D_B4PR#2      Drift               40.698    0.500    1123.0862516823   -110.1665937039     13.2149446781
-1.0072663577       1.5032753762      -0.2092857944      -0.0382875143           ---            ---
```

General Goals

1. Establish baseline acceptance with current IR design (essentially done for RP/B0, ZDC, Lumi.)
   - Extensively done for proton DVCS, in progress for nuclear breakup with e+D, e+He3, and e+Au with BeAGLE.
2. Include realistic reconstruction smearing for momentum and energy (e.g. from beam divergence).
   - Done for Roman Pots/B0 – in progress on the others.
3. Establish technologies for detector implementation.
   - eRD24 for RP, LDRD from Los Alamos for B0, etc.
4. Collaborate with exclusive physics WG, et al. to start simulations for other physics channels of interest (e.g. DVCS w/ light nuclei).
5. Iterate with machine folks with a comprehensive picture of current status so targeted improvement to IR design can be discussed.
   - Goal is to avoid piecemeal iterations for low-impact improvements – want to be able to suggest high-impact improvements if they are needed, reasonable to implement, or even possible.