FFA@CEBAF Working Group | MINUTES

Meeting date | time *05/30/2025 | 11 AM EST* | Meeting location https://jlab-org.zoomgov.com/j/1614898082?pwd=TnUzMS81M2sxbDZIbERJU01tYkJCQT09

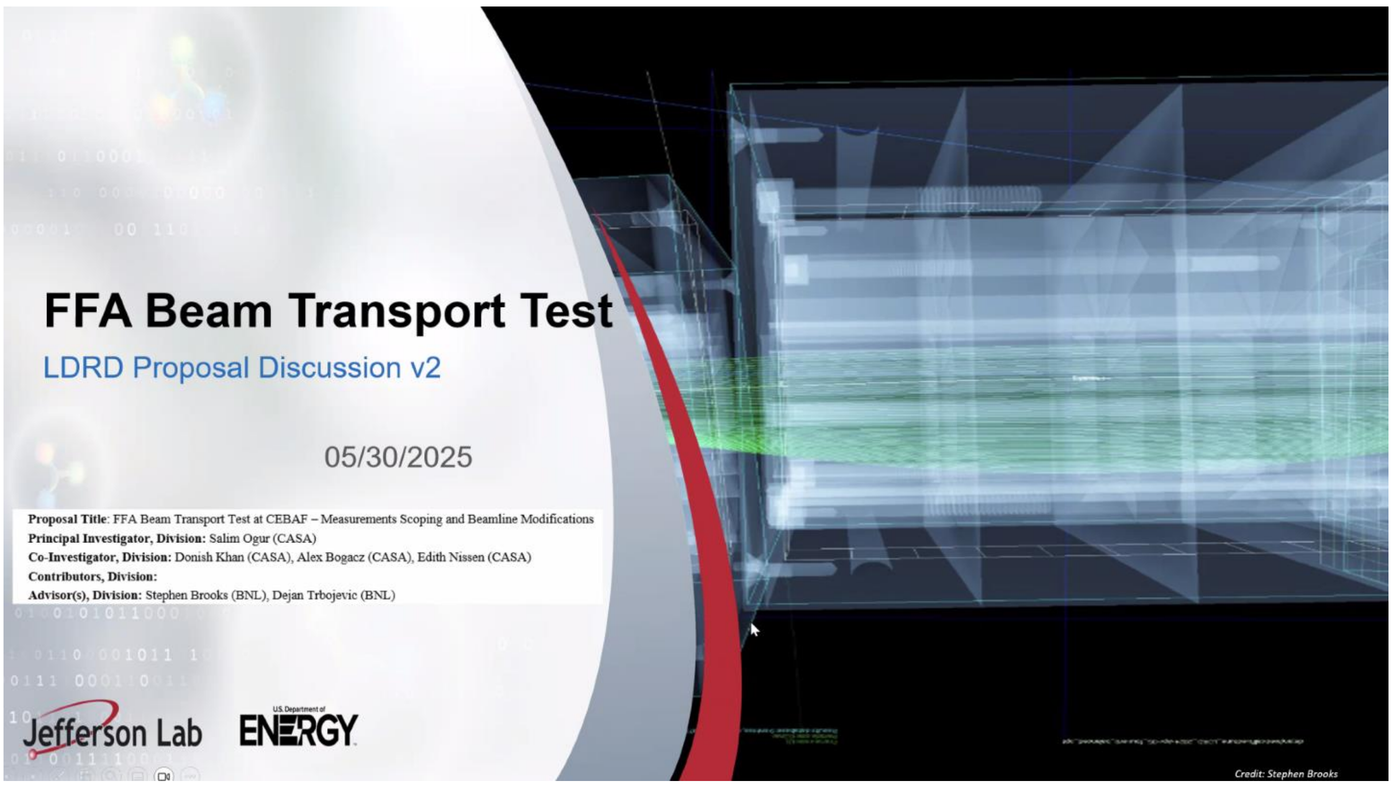
Meeting called by	Alex B
Type of meeting	Weekly Meeting
Facilitator	Alex B
Note taker	Donish
Timekeeper	Alex B

Attendees

Alex B, Volker, Dejan, Stephen, Donish, Salim, Kirsten, Sadiq, Edy, Nick, Scott

AGENDA TOPICS

Time allotted | *25 mins* | Agenda topic *(S)RF History* | Presenter *Salim*

- 

- No green light yet on the LDRD proposal.
- Regardless of green light, underlying studies in proposal are still good to have for overall knowledge of FFA cell (and paper for NAPAC).

Today in this presentation

Jefferson Lab

a. The FODO magnet of S. Brooks already serves for 11 GeV beam. Half or full cell, periodic or open.

b. The flexibility of the existing magnetic hardware (quadrupoles, corrector magnets, etc.) in the BSY beamlines for matching to the FFA magnet. Matching to 11 GeV periodic solution of the FFA Cell.

c. Whether additional magnets (quadrupoles, skew quadrupoles, horizontal/vertical correctors, etc.) and beam diagnostics elements are needed. A discussion.

d. Whether the exact location of the FFA magnet array in the BSY beamline, so that the proposed goals are achieved. The first of the 3 dipoles for now.

e. The closed orbit (beam position and divergence) and matched (horizontal) dispersion functions using bends and correctors. An example at 11 GeV, except the centroid position and angle.

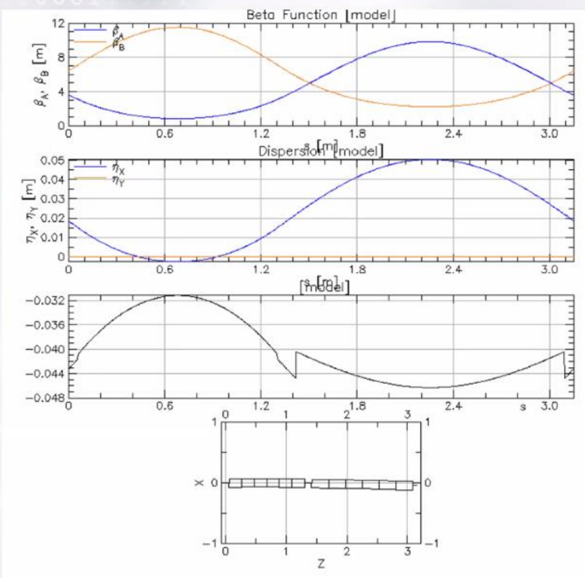
f. The beam polarization stability through the FFA magnet. The SLAC polarization example.

g. The 6D acceptance of the FFA magnets. Later.

1.1- FFA Lattice for 11023 MeV

Jefferson Lab

- Periodic solution for a full FODO lattice at 11023 MeV.

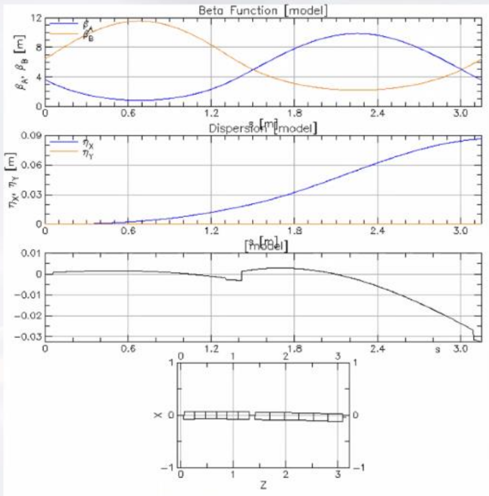



```
parameter[geometry] = Closed

parameter[p0c]                        = 2.00999999935045E10
parameter[particle]                   = Electron
bmad_com[rel_tol_tracking] = 1E-7
bmad_com[abs_tol_tracking] = 1E-7
bmad_com[radiation_damping_on] = T
bmad_com[radiation_fluctuations_on] = T

beginning[beta_a]     = 3.58734689238656
beginning[alpha_a]    = 2.5008144571055
beginning[eta_x]      = 0.0193338045330629
beginning[etap_x]     = -5.00036821364292E-3
beginning[beta_b]     = 6.43552833965767
beginning[alpha_b]    = -3.11319931351031
particle_start[x]  = -0.0440176197654463
particle_start[px] = 0.0157336548807662
particle_start[pz] = -0.45159
```

1.2-FFA Lattice for 11023 MeV

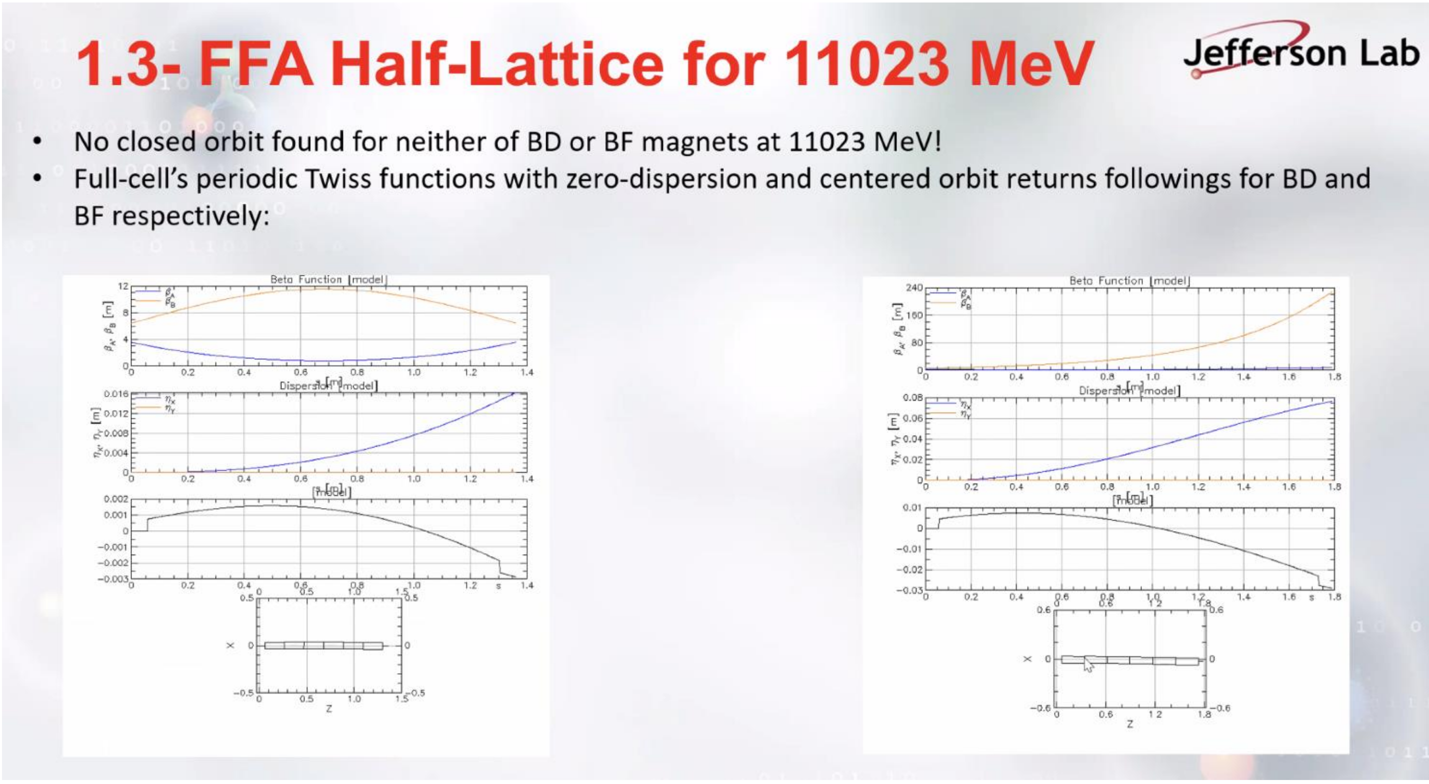
Jefferson Lab

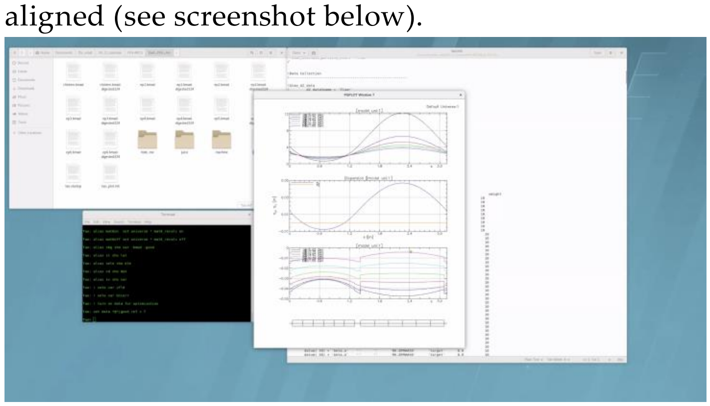
- Only Twiss(α,β) matched to its periodic solution, zero-dispersion and on-axis entrance for a full FODO lattice at 11023 MeV.
- Almost periodic Twiss(α,β) returned, is this what we seek?

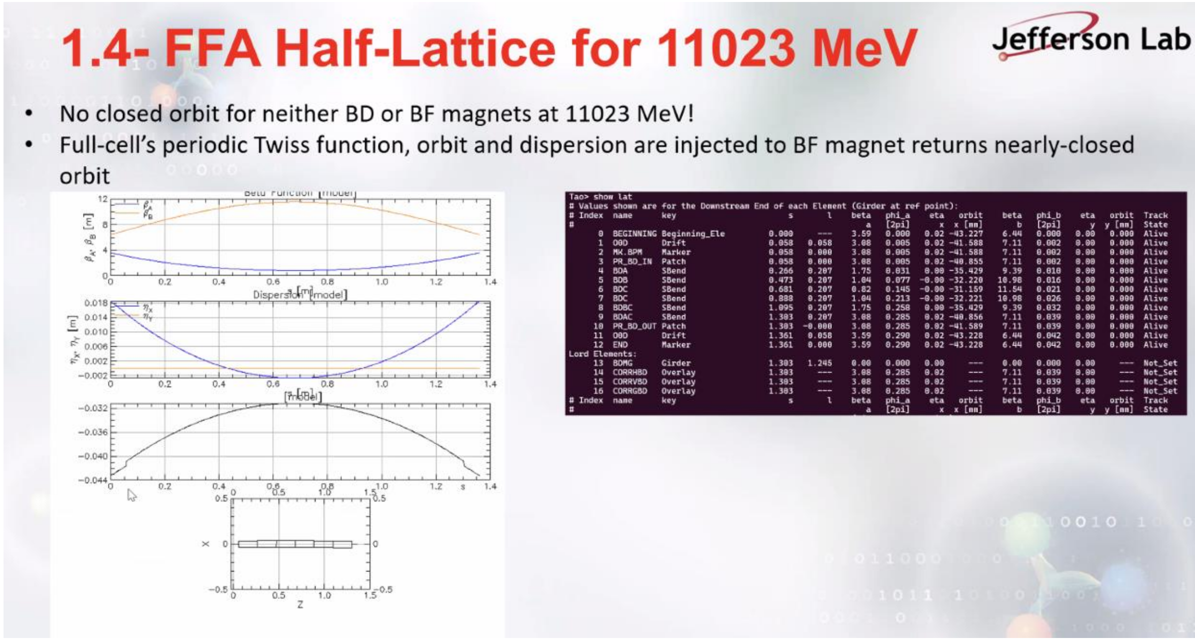


```
Tao> show lat
# Values shown are for the Downstream End of each Element (Girder at ref point):
# Index  name       key                  s       l    beta   phi_a   eta   orbit    beta   phi_b   eta   orbit  Track
#                                                        a   [2pi]     x  x [mm]       b   [2pi]     y  y [mm]  State
     0  BEGINNING  Beginning_Ele    0.000     ---    3.59   0.000  0.00   0.000    6.44   0.000  0.00   0.000  Alive
     1  O0D        Drift            0.058   0.058    3.08   0.005  0.00   0.000    7.11   0.002  0.00   0.000  Alive
     2  MK.BPM     Marker           0.058   0.000    3.08   0.005  0.00   0.000    7.11   0.002  0.00   0.000  Alive
     3  PR_BD_IN   Patch            0.058   0.000    3.08   0.005  0.00   0.737    7.11   0.002  0.00   0.000  Alive
     4  BDA        SBend            0.266   0.207    1.74   0.031  0.00   1.326    9.40   0.010  0.00   0.000  Alive
     5  BDB        SBend            0.473   0.207    1.04   0.077  0.00   1.573   10.98   0.016  0.00   0.000  Alive
     6  BDC        SBend            0.681   0.207    0.82   0.145  0.00   1.399   11.55   0.021  0.00   0.000  Alive
     7  BDC        SBend            0.888   0.207    1.04   0.213  0.01   0.765   10.98   0.026  0.00   0.000  Alive
     8  BDBC       SBend            1.095   0.207    1.75   0.258  0.01  -0.331    9.40   0.032  0.00   0.000  Alive
     9  BDAC       SBend            1.303   0.207    3.08   0.285  0.01  -1.854    7.12   0.039  0.00   0.000  Alive
    10  PR_BD_OUT  Patch            1.303  -0.000    3.08   0.285  0.01  -2.591    7.12   0.039  0.00   0.000  Alive
    11  O0D        Drift            1.361   0.058    3.59   0.290  0.02  -2.868    6.44   0.042  0.00   0.000  Alive
    12  O0F        Drift            1.419   0.058    4.14   0.294  0.02  -3.146    5.80   0.045  0.00   0.000  Alive
    13  MK.BPM     Marker           1.419   0.000    4.14   0.294  0.02  -3.146    5.80   0.045  0.00   0.000  Alive
    14  PR_BF_IN   Patch            1.419   0.000    4.14   0.294  0.02   1.313    5.80   0.045  0.00   0.000  Alive
    15  BFA        SBend            1.698   0.279    6.91   0.309  0.03   2.884    3.59   0.063  0.00   0.000  Alive
    16  BFB        SBend            1.977   0.279    9.05   0.319  0.04   1.429    2.52   0.090  0.00   0.000  Alive
    17  BFC        SBend            2.256   0.279    9.86   0.328  0.05  -2.732    2.21   0.125  0.00   0.000  Alive
    18  BFC        SBend            2.535   0.279    9.04   0.336  0.07  -9.175    2.52   0.160  0.00   0.000  Alive
    19  BFBC       SBend            2.813   0.279    6.89   0.346  0.08 -17.408    3.59   0.188  0.00   0.000  Alive
    20  BFAC       SBend            3.092   0.279    4.13   0.361  0.09 -26.916    5.79   0.206  0.00   0.000  Alive
    21  PR_BF_OUT  Patch            3.092  -0.000    4.13   0.361  0.09 -31.361    5.78   0.206  0.00   0.000  Alive
    22  O0F        Drift            3.150   0.058    3.58   0.365  0.09 -32.503    6.42   0.209  0.00   0.000  Alive
    23  END        Marker           3.150   0.000    3.58   0.365  0.09 -32.503    6.42   0.209  0.00   0.000  Alive
```

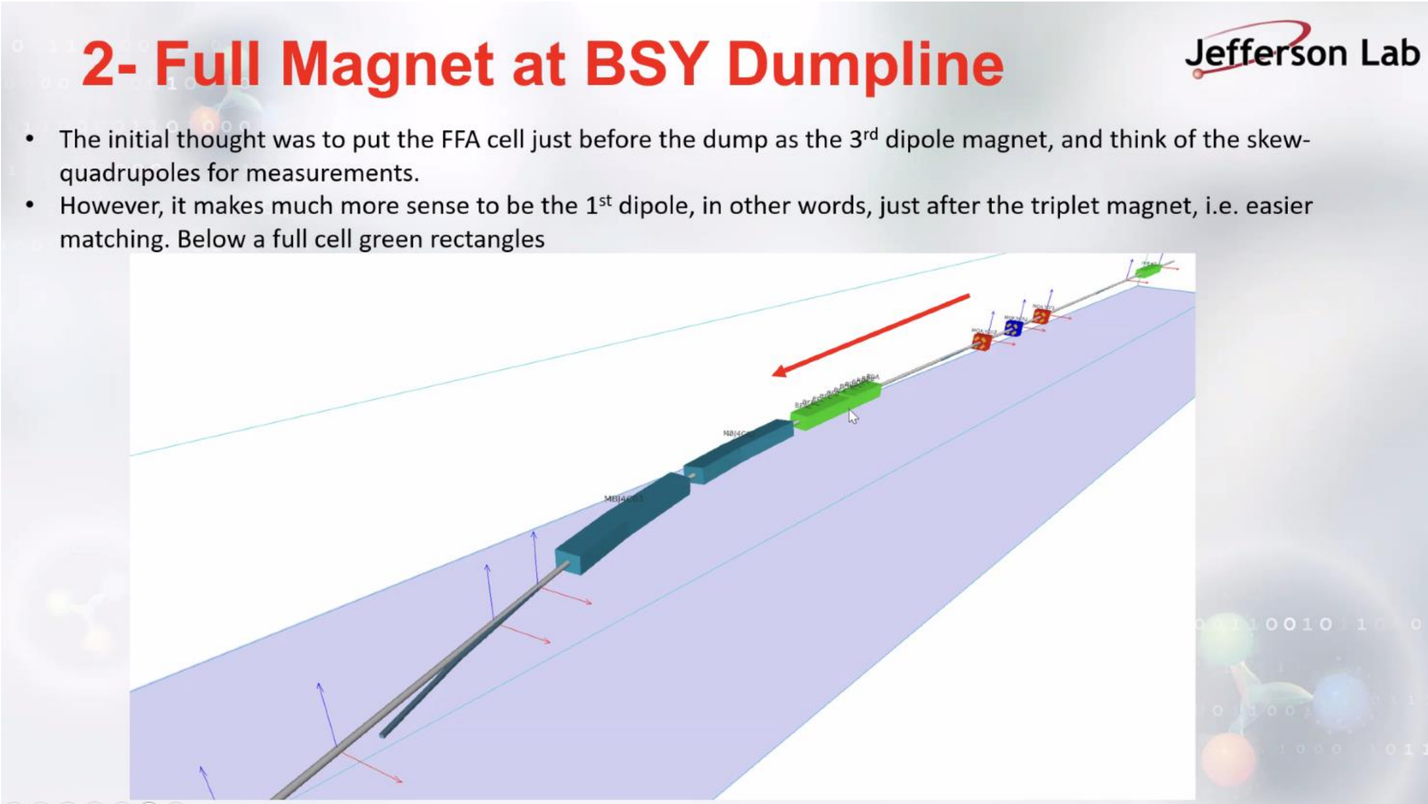
-
  - Stephen: The closed orbits do not make sense; they are too large and will fall out of the magnet. You need a new angle/position otherwise experiment fails.
    - Dejan: Use triplet with right angle of entrance and “slide” for different energies
    - Stephen: All that matter is that the closed orbit doesn’t fall out of the magnet.
    - Alex B: We can use correctors to keep the orbit within the FFA magnet.
  - Donish: Why is there a discontinuous jump in the orbit after the magnet?
    - Kirsten: The jumps are an artifact of using patches in Bmad.



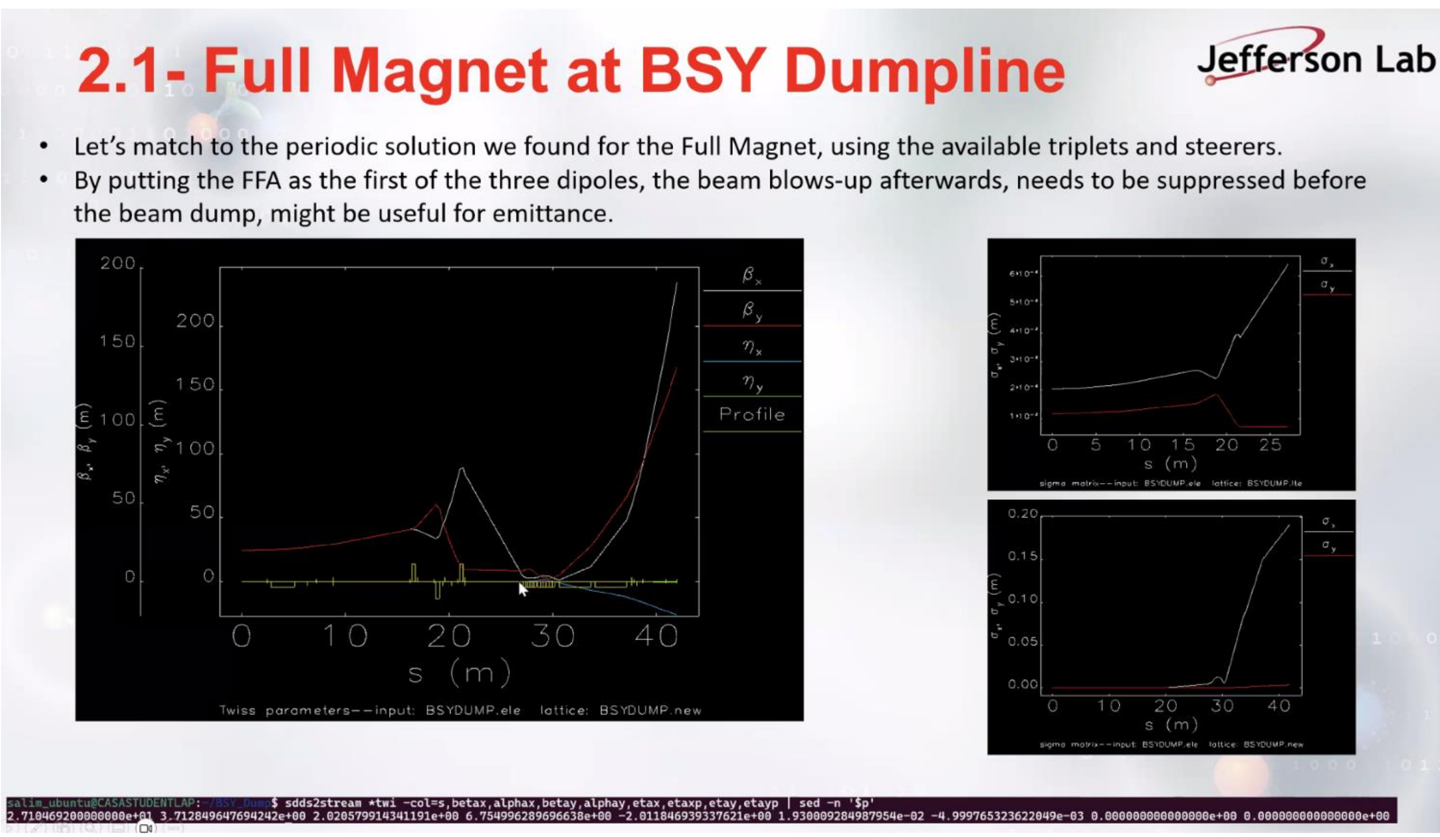
- Salim: No closed orbit could be found, but I am attempting to explore what we can study here.
- Stephen: You will not have a stable orbit, you only have one component of the FODO. You need match into the cell.
- Dejan: Inject the beam into your magnet with the proper injection conditions (Twiss parameters, orbit spatial and angular offsets).
    - Donish: You can use an "Open" lattice with proper injection conditions instead of “Closed” lattice setting.
    - Salim: In the next slide (slide labeled 1.4 FFA) I used the closed orbit solution and injected into the FFA.
    - Kirsten: The coordinate system used by Alex C. shows that the orbit is not aligned (see screenshot below).
    - 



- Stephen: I'm confused about the orbit coordinates. It still shows a 4 cm offset which would result in a failure.
    - Kirsten: One thing to keep in mind, the zero orbit is not where you think it is.
    - Scott: Would be better to align with coordinate system that Stephen is using.
    - Kirsten: It just a transverse translation between coordinate systems.
    - Scott: We have an understanding of what is happening here, we know what to do and can move onward.
    - Dejan: I'm surprised that we took this as the nominal orbit.
    - Salim: Is this something we (someone) should fix?
    - Everyone: Yes.
    - Kirsten: I will take a look at it, I'll emphasize that this lattice has been presented many times before.
    - Alex: If we can fix and put it in the Github that would be great.
    - Kirsten: Alex C used offsets of magnets (DX) and patches at the end.
    - Scott: Make the zero the same as Stephen's coordinate system.
    - Dejan: When I recreated this magnet I used sector instead of rectangular magnets with no disagreement. Why is all this patches being used here complicating everything?
    - Stephen: This is a engineering decision; I'm using rectangular magnets to construct the FFA.

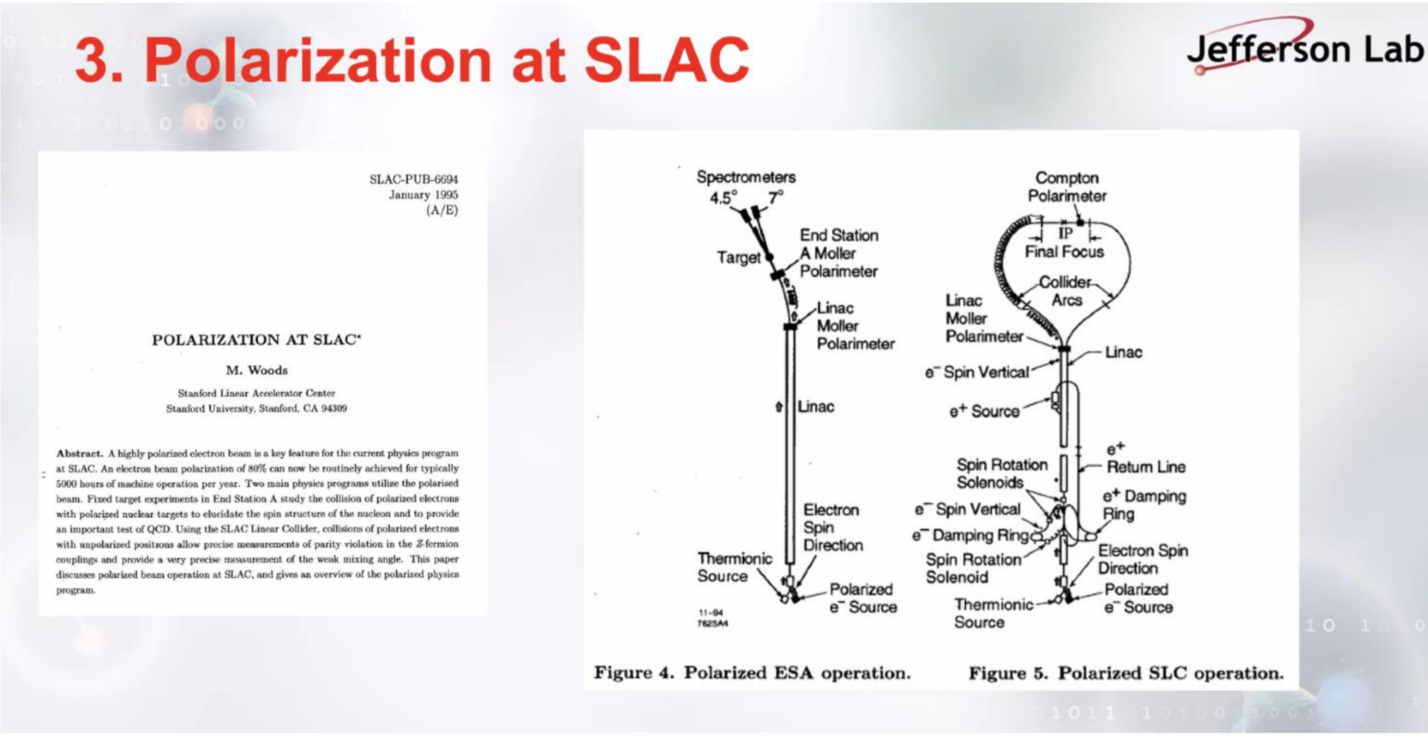


- Alex: We will use a wire scanner after the FFA magnets to do measurements (after green magnets in above)

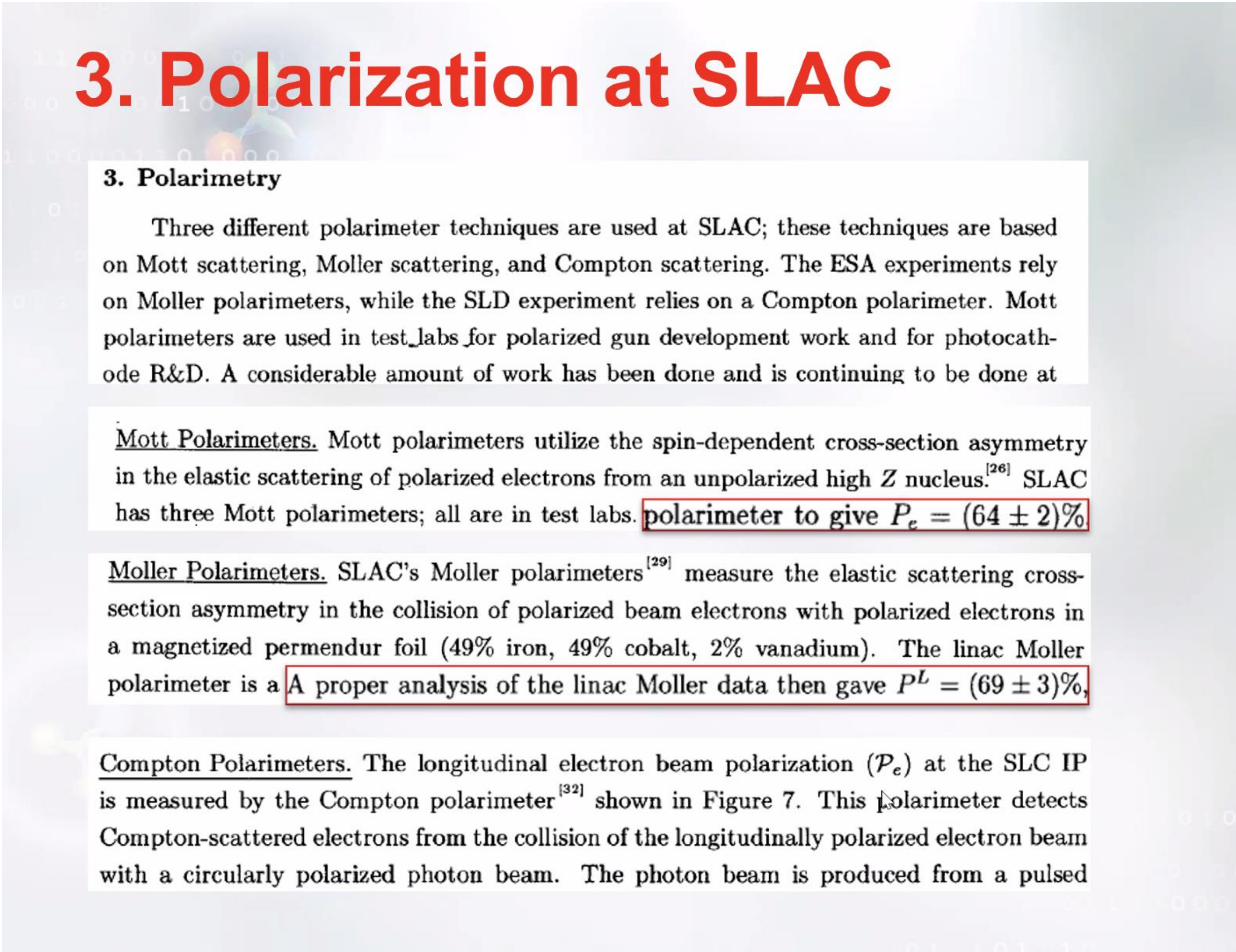


- Salim: I imported the FFA magnet array into Elegant; not sure if I trust it completely. This was done purely for demonstration purposes.

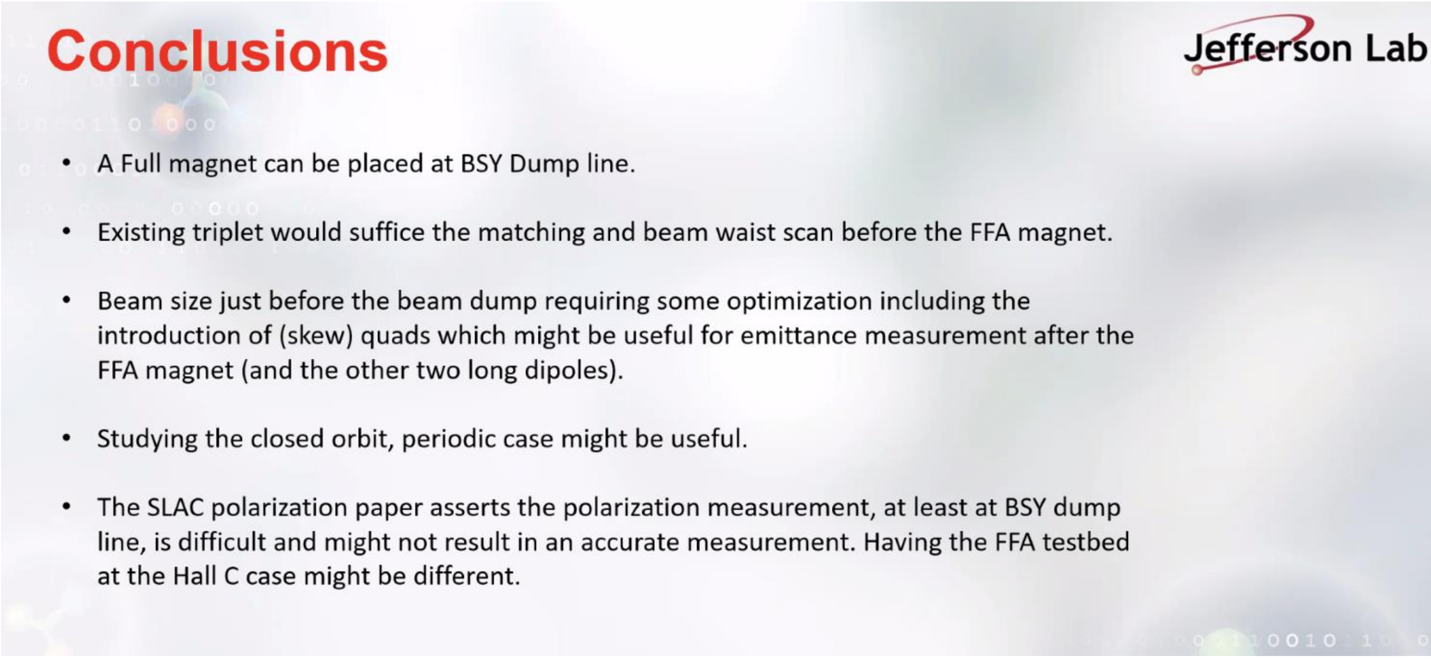
- Salim: How about if we use the upstream triplet to scan the beam parameters for measurement.
- Scott: Why not build an FFA magnet so that the alpha's and dispersion prime are zero at the exit.



- Salim: Are we going to measure polarization? I am looking at examples conducted at SLAC.



- Salim: SLAC outlines how to do this in three ways.
- Dejan: In prior studies (Francois et al), polarization was found to be preserved in FFA. Very comprehensive studies.



- Alex: Need to determine if the polarization can be meaningful to measure before we put it in proposal.
- Alex: Need to reconcile the coordinate system of the FFA magnet in Bmad.
- Dejan: Stephen has done studies

Special notes

Pathway to Repository: https://jeffersonlab-my.sharepoint.com/:f:/g/personal/tristan_jlab_org/EqZ5MeS-nipCgPfZB5p0oS4B9Is67d3nQb9sLJI3Zyev9g