FFA@CEBAF Working Group | MINUTES

Meeting date | time *05/05/2023 | 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

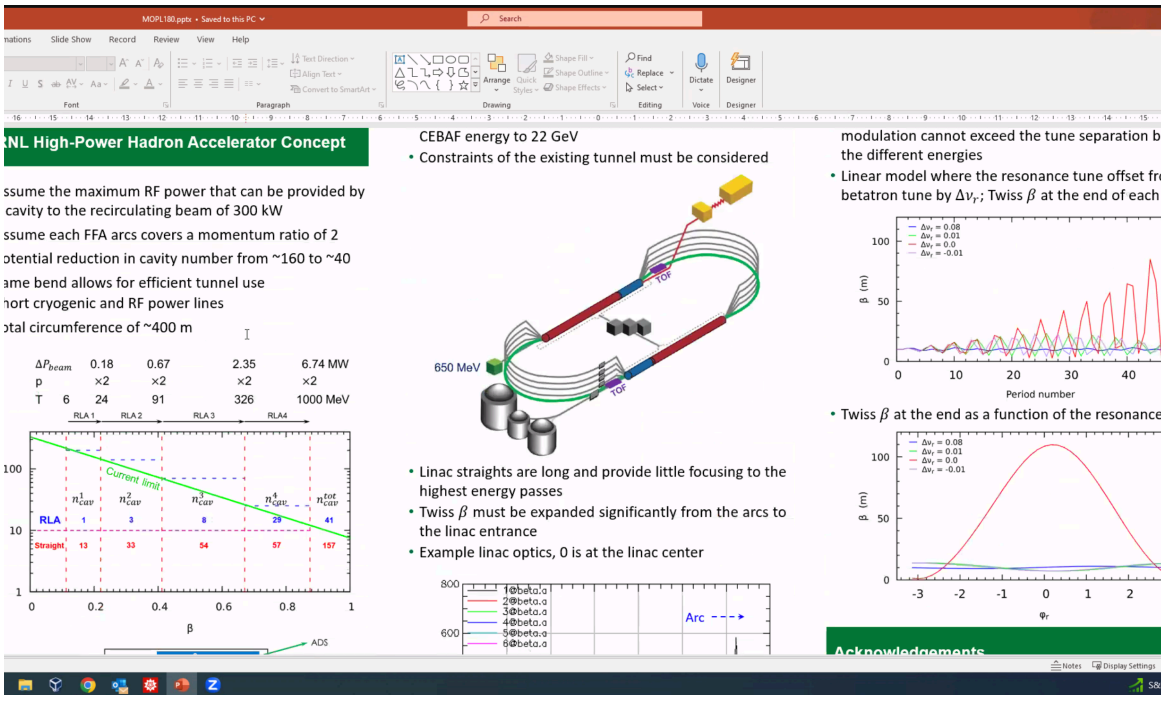
Alex B, Dejan, Scott, Alex C, Randika, Edy, Donish, Andrei, Vasiliy

INTRO DISCUSSION

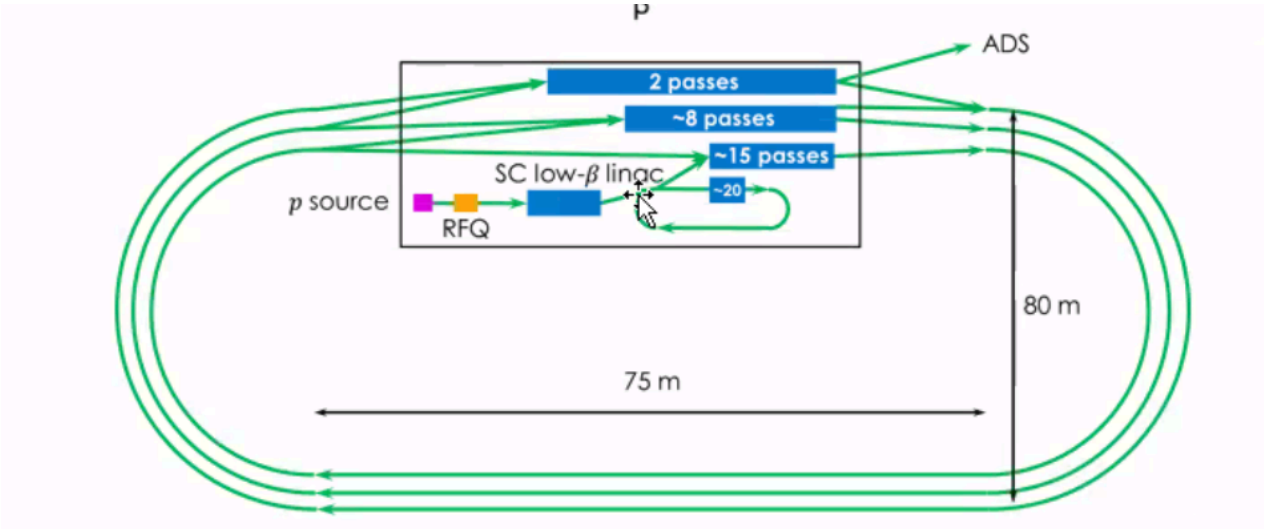
Final look at IPAC23 contributions. Scott, Ryan, Kirsten, Todd are going from FFA crew.

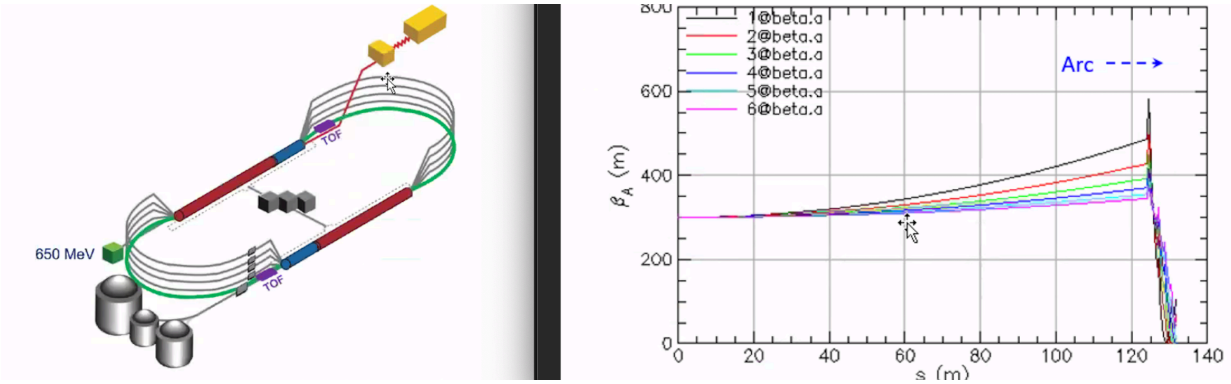
AGENDA TOPICS

Time allotted | *45 mins* | Agenda topic *Parametric Resonance Optics* | Presenter *Vasiliy*



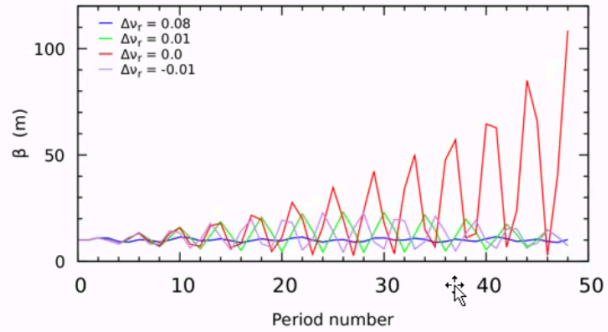
- Vasiliy goes through poster concepts
    - Dejan: Essentially 3 papers/concepts in 1 poster

- 

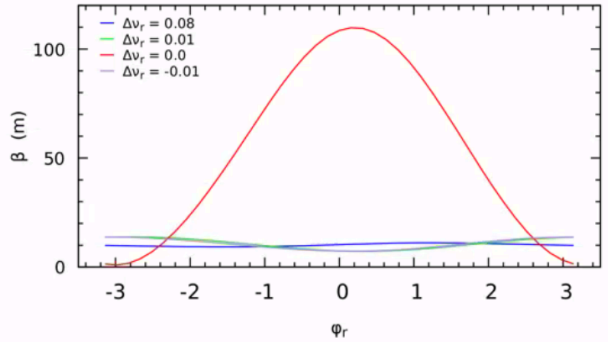
  - Hadron accelerator concept
  - Alex B: This is first design of proton recirculating linac with FFA arcs; 25 passes
  - Still under work, have an idea of timing and can make it work
  - Multiple rings for freedom from factor of 2 momentum increase
  - FFA cell here is similar for FFA cell in CEBAF
    - Lower beta functions than CEBAF because linacs are designed from scratch
- 

  - Now, for FFA@CEBAF
  - CEBAF very little focusing in the linacs for higher energies
  - Not real solution (right plot), just an attempt
    - Takes space to match because lose periodicity from fodo cell with energy variation

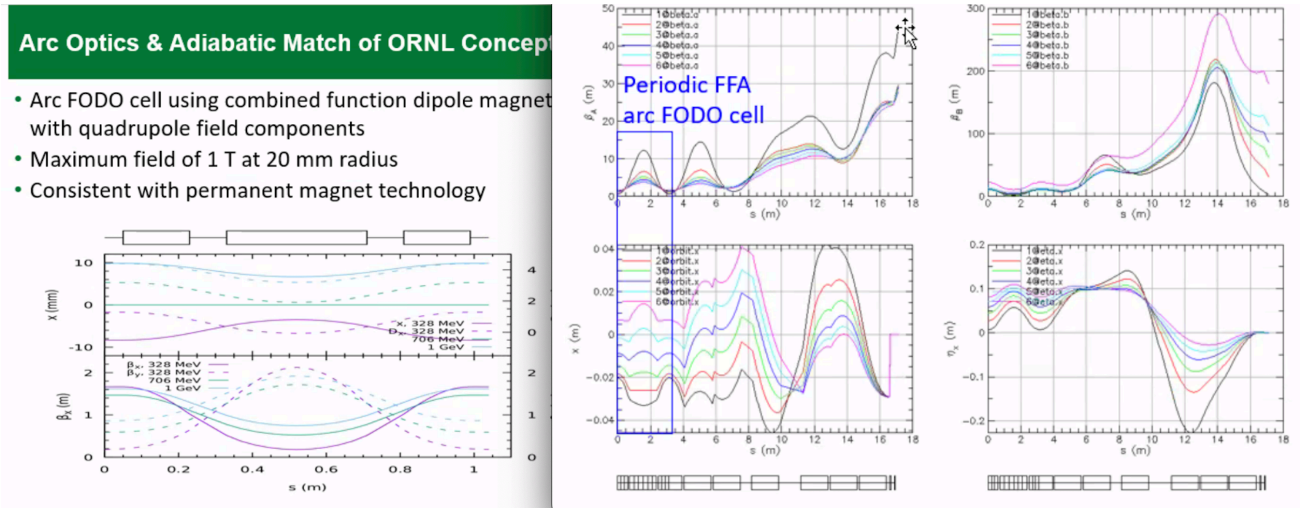
- • Linear model where the resonance tune offset from the betatron tune by $\Delta\nu_r$; Twiss β at the end of each period

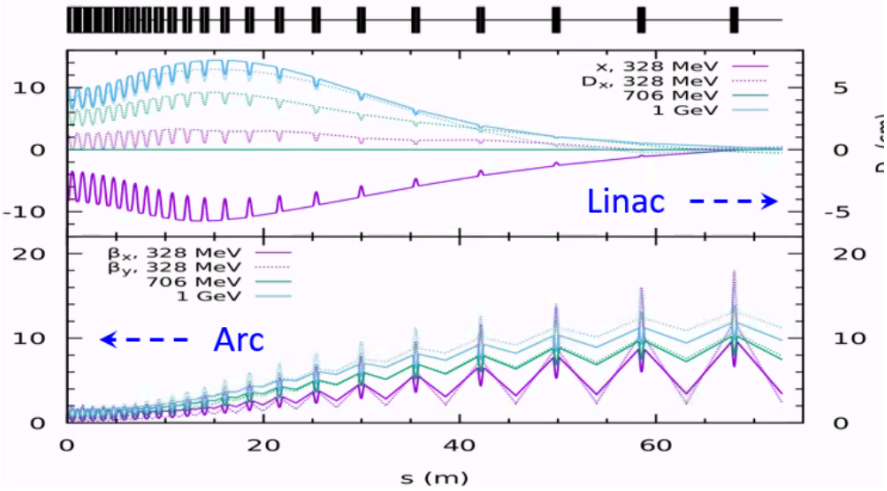


• Twiss β at the end as a function of the resonance phase



- ○ Parametric resonance & excitation of beta functions
  - ▪ Periodic cell with liner matrix
  - ▪ Differences between passes/energies: beta function and **tunes**
  - ▪ Use the different tunes to control the passes independently
- ○ At the end of each period, put thin quadrupole kick
  - ▪ Modulation of EM quadrupole current or kick element
  - ▪ Phase advance of kick = 2*phase advance of betatron motion
- ○ No optimization presented here. With optimization could save space.
- ○ Dejan: Apply this to FFA by placing quad at specific phase advance positions for each particular pass.
  - ▪ Dejan & Stephen did similar to fix path length in FFA (parabolic)
  - ▪ Allows you to have equal betatron functions for all energies at the end of matching section
  - ▪ Best for straight parts not so much in arcs
  - ▪ Two knobs in quads: strength and phase

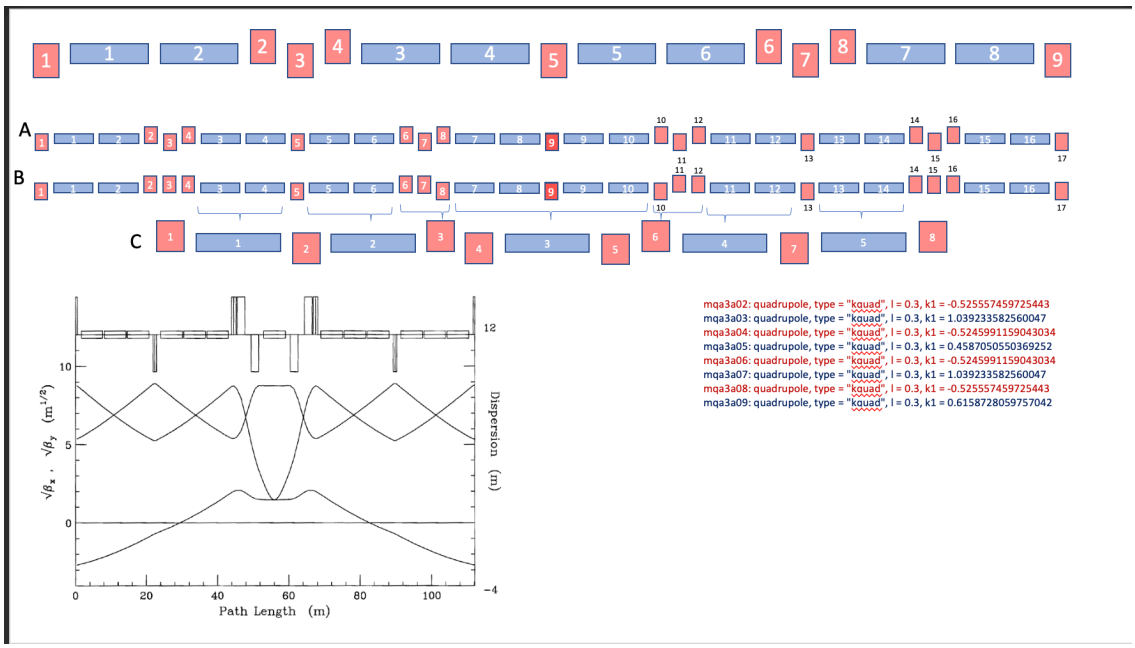
- 

    - Betatron phase does not change along channel; could apply parametric resonance to the betatron tunes
    - Orbits and dispersion will not be in resonance anymore
- abatic match of arcs to linacs using 22 cells
  parameters scale as
  $f(i) = 1 - 3[i/(n_T + 1)]^2 + 2[i/(n_T + 1)]^3$
  $= f(i)\theta_a\ ,\ l_i = l_s[l_a/l_s]^{f(i)},\ k_1^i = k_1^s[k_1^a/k_1^s]^{f(i)}$
  uires sufficient space to maintain adiabaticity
  

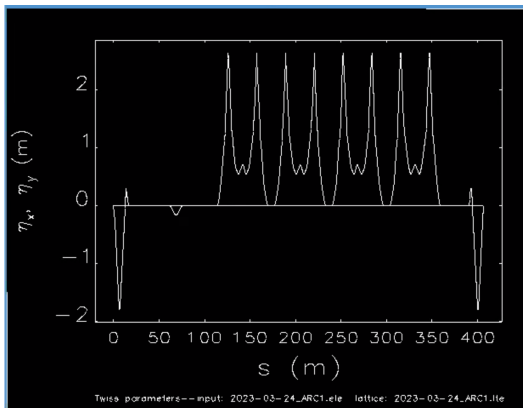
    - Scaling law f(i) in the power of length and strength
    - Vasiliy: Got from example, doesn't know where the scaling law came from
    - Scott: Stumbled on good idea

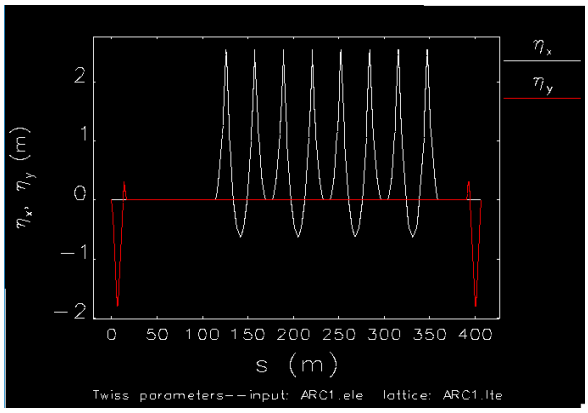
AGENDA TOPICS

Time allotted | *15 mins* | Agenda topic *Dejan's Transitionless Lattice For CEBAF ARC* | Presenter *Donish*

- 

  - Dejan sent ideas for modification of ARC optics
    - Will reduce dispersion
    - Have null momentum compaction in ARC proper
    - Need to account for non-zero momentum compaction in spreader/recombiners
  - Donish: Applied the idea but not getting good beta functions
  - Dejan: troubled about combining central dipoles (7,8,9,10) might be too long
  - Top cell is nominal ARC optics
    - Cell A: Two fold symmetry
    - Cell B: Two fold symmetry; different quadrupole polarity
    - Cell C: Completely different design
  - Dejan: Switching phase of betatron function with the doublets
    - No correction applied to this either, so this is simply what happens from ISR/CSR
  - Scott: What problem are we trying to solve?
    - Dejan: Applying transitionless lattice concept to ARC1 optics, the dispersion function was not minimized

- 



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  - Left is nominal optics, right is ARC1 proper with transitionless concept (R56=0)
  - The peak of dispersion is not decreased by substantially with transitionless concept
  - Dejan: Let me take a look at this, could decrease dispersion by factor of 4

Action Items	Person responsible	Deadline

Special notes

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