Enhancement of Energy and Operational Flexibility for 22 GeV CEBAF

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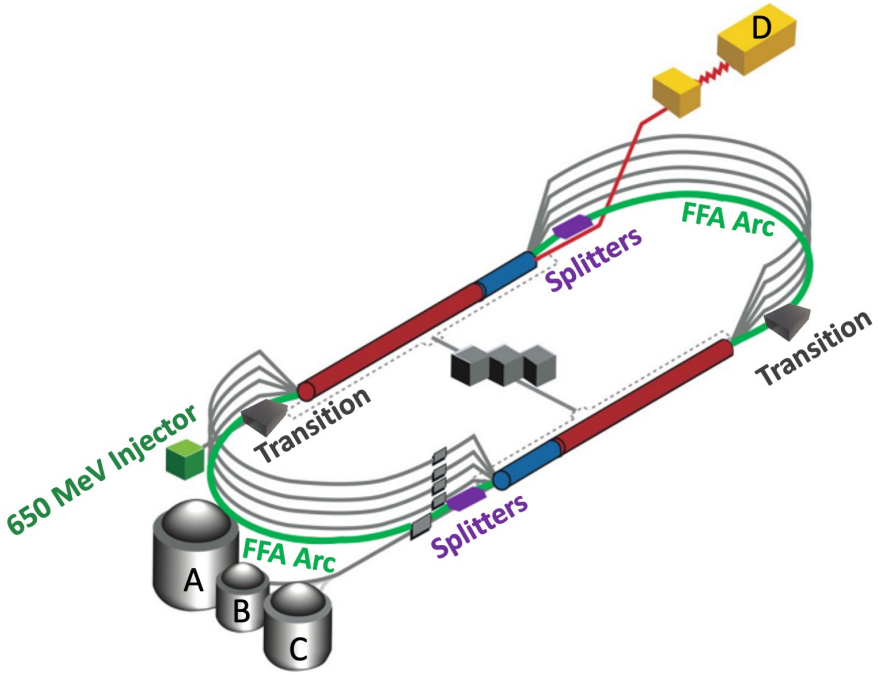
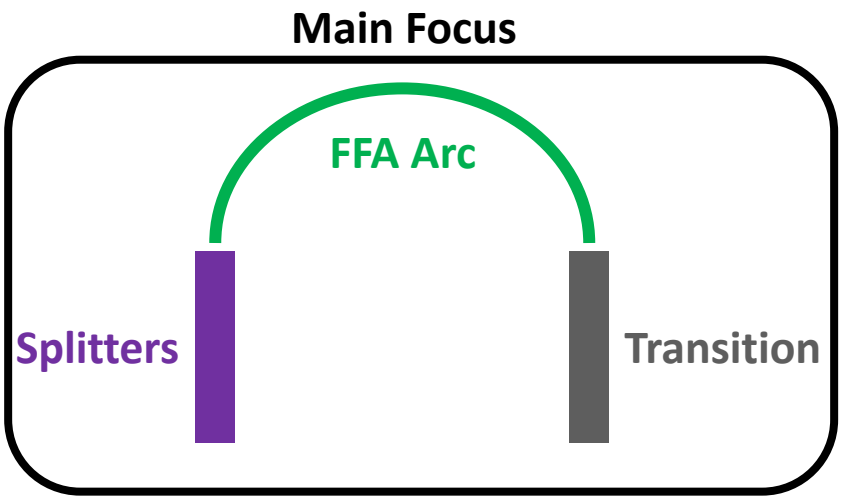
Jefferson Lab

U.S. DEPARTMENT OF ENERGY | Office of Science

JSA

Proposal Background

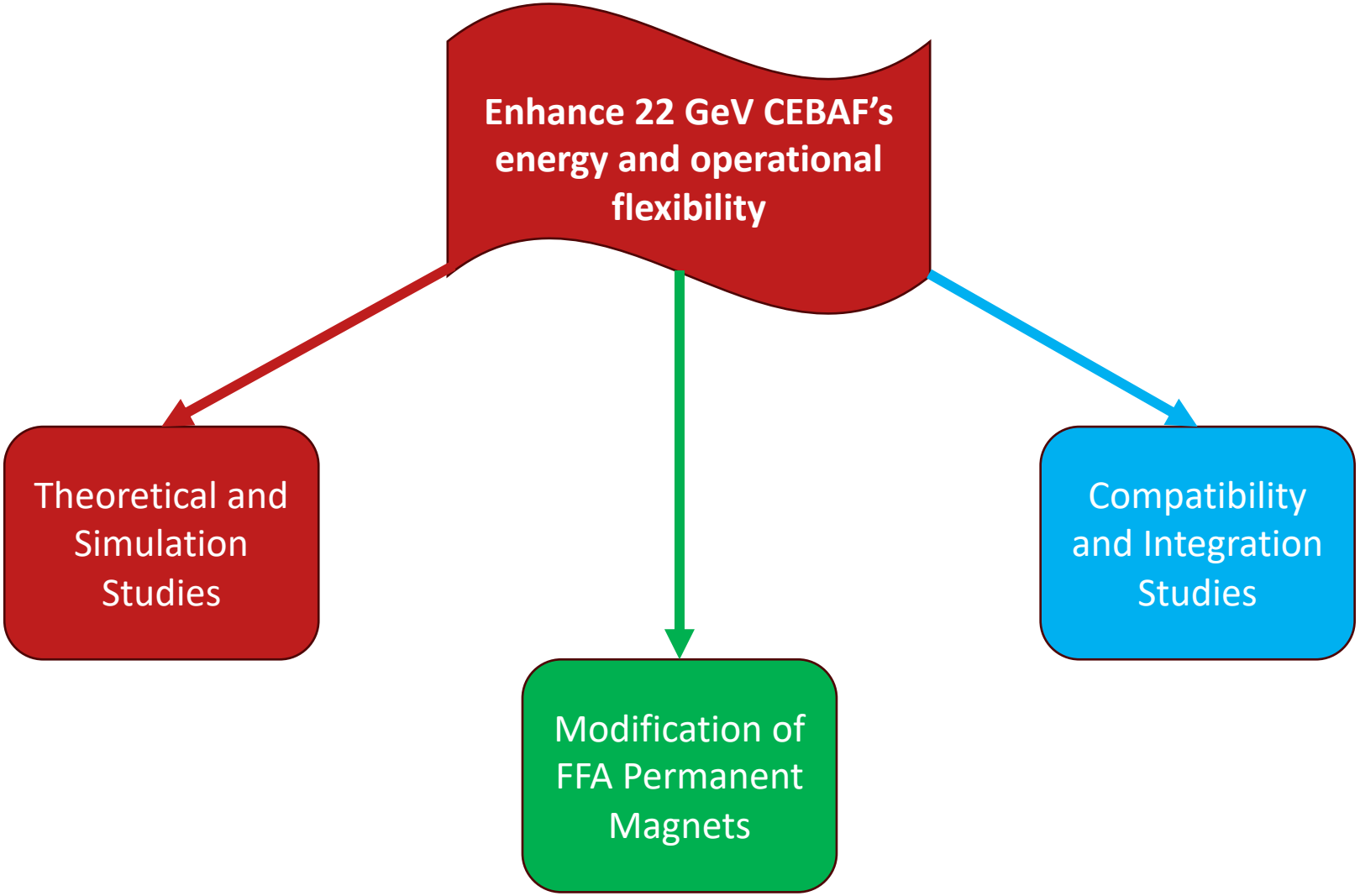




- Our proposal focuses on the 22 GeV CEBAF upgrade and addresses JLAB's **Accelerator S&T initiative**!
- We will look to enhance the energy and operational flexibility of the current 22 GeV CEBAF beam transport
  - Current energy acceptance is 1%
  - Goal energy acceptance is 10%
- Modification of the Fixed-Field Alternating (FFA) gradient arc's lattice:
  1) Using a Flexible Momentum Compaction (FMC) structure
  2) Incorporating higher-order magnetic field components into the FFA permanent magnets.

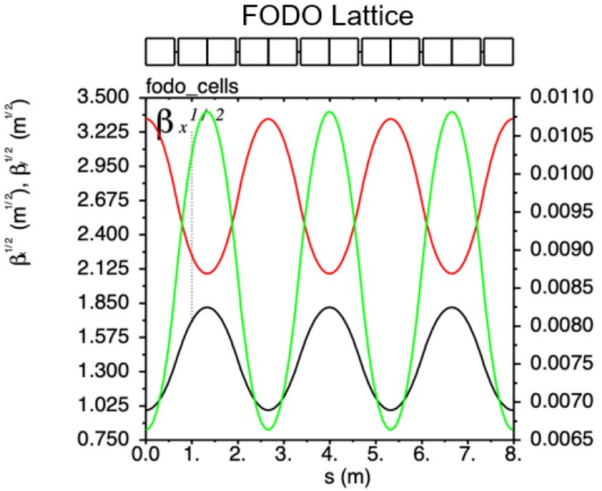
Project Scope

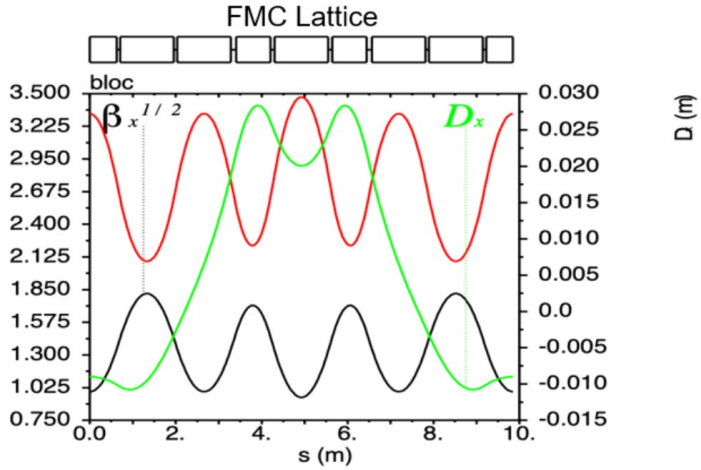
- Our project's scope can be organized into 3 categories:



Project Scope 1: Theoretical and Simulation Studies

- Theoretical and Simulation Studies:
  - Modify the FFA arc lattice using an FMC structure.
  - Translate the redesigned lattice optics into simulation codes (**Bmad, ELEGANT, OptiMX**).
  - Conduct consequent studies on dynamic aperture, betatron tunes, error tolerance, orbit correction, collective effects, and energy acceptance.



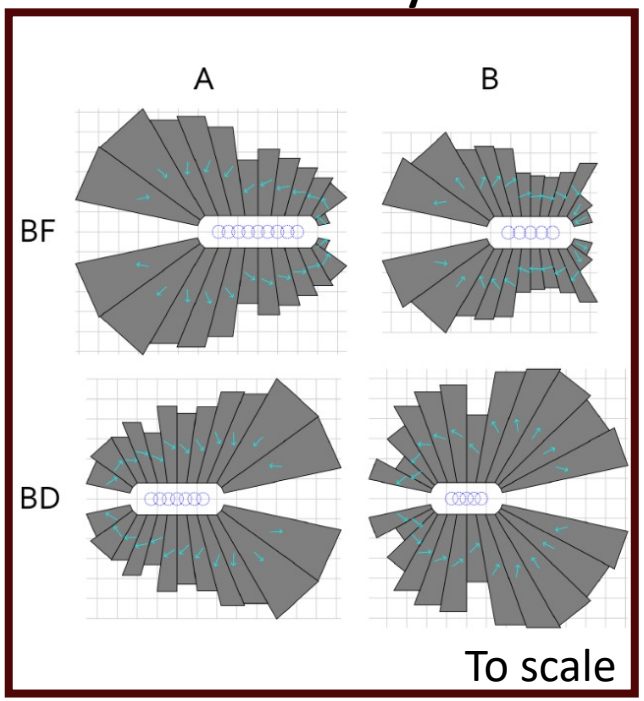


- Notice the FMC dispersion, D_x it's bipolar and isochronous! Expected to ***relax*** the conditions of the adjacent Splitter/Transition sections

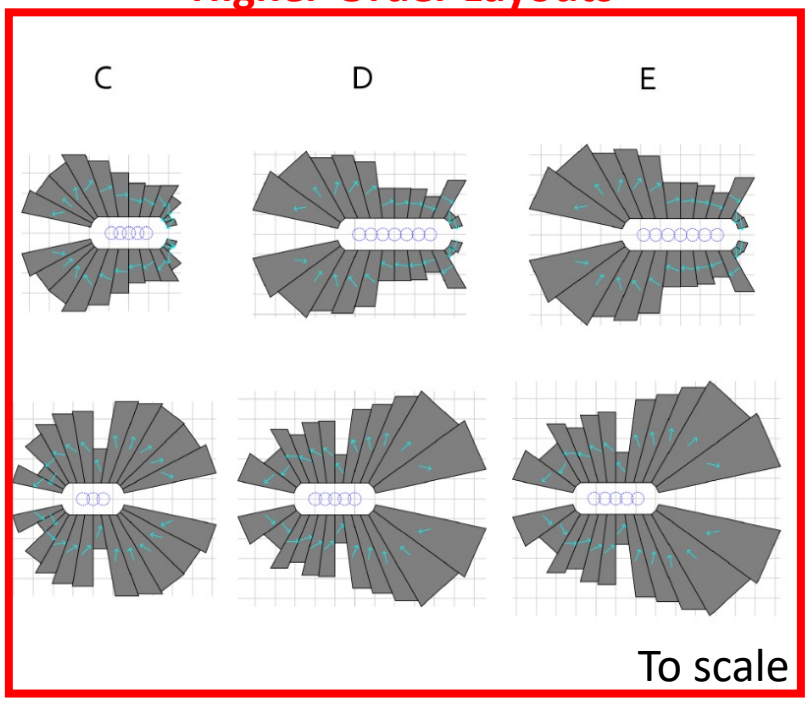
Project Scope 2: Modify FFA Permanent Magnets

- Modification of FFA Permanent Magnets:
  - Model FFA permanent magnets using higher-order magnetic field components (i.e. sextupole).
  - Optimize the geometric design of the magnets using in-house tools and collaboration with Brookhaven National Laboratory (BNL).

First-Order Layouts



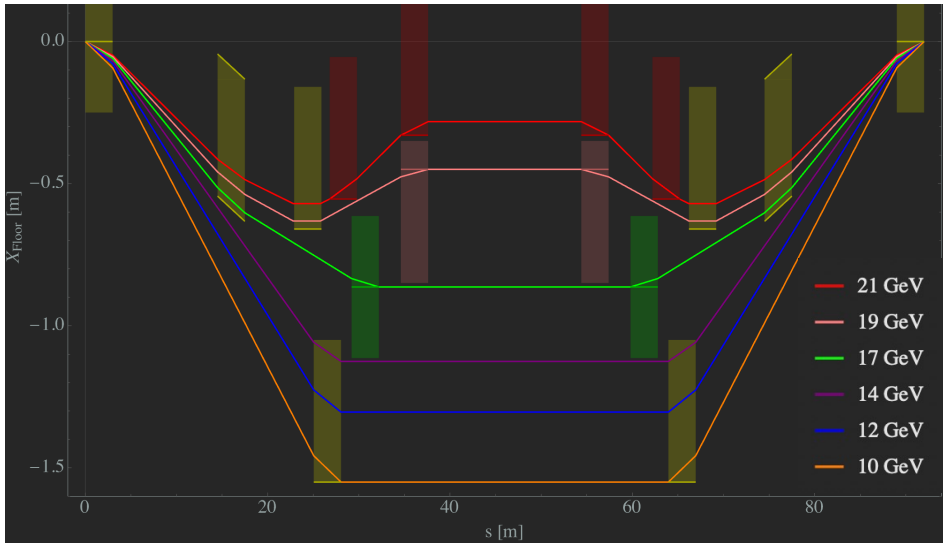
Higher-Order Layouts



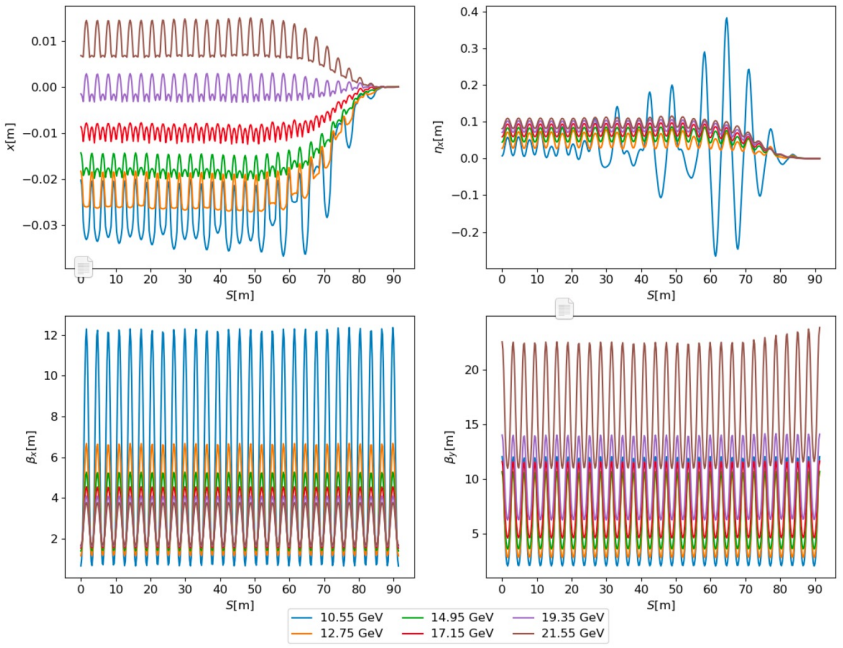
Initial magnet designs have shown to increase FFA's energy aperture!

Project Scope 3: Compatibility and Integration Studies

- Compatibility and Integration Studies:
  - Ensure compatibility of the modified FFA lattice with the rest of the CEBAF beam transport systems.
  - Tune the Splitter and Transition beamlines to match the new FFA optics; expected to alleviate matching workload.
  - Perform pseudo start-to-end (S2E) simulations to evaluate the impact of the new FFA arcs on the entire accelerator system



SPLITTERS



TRANSITION

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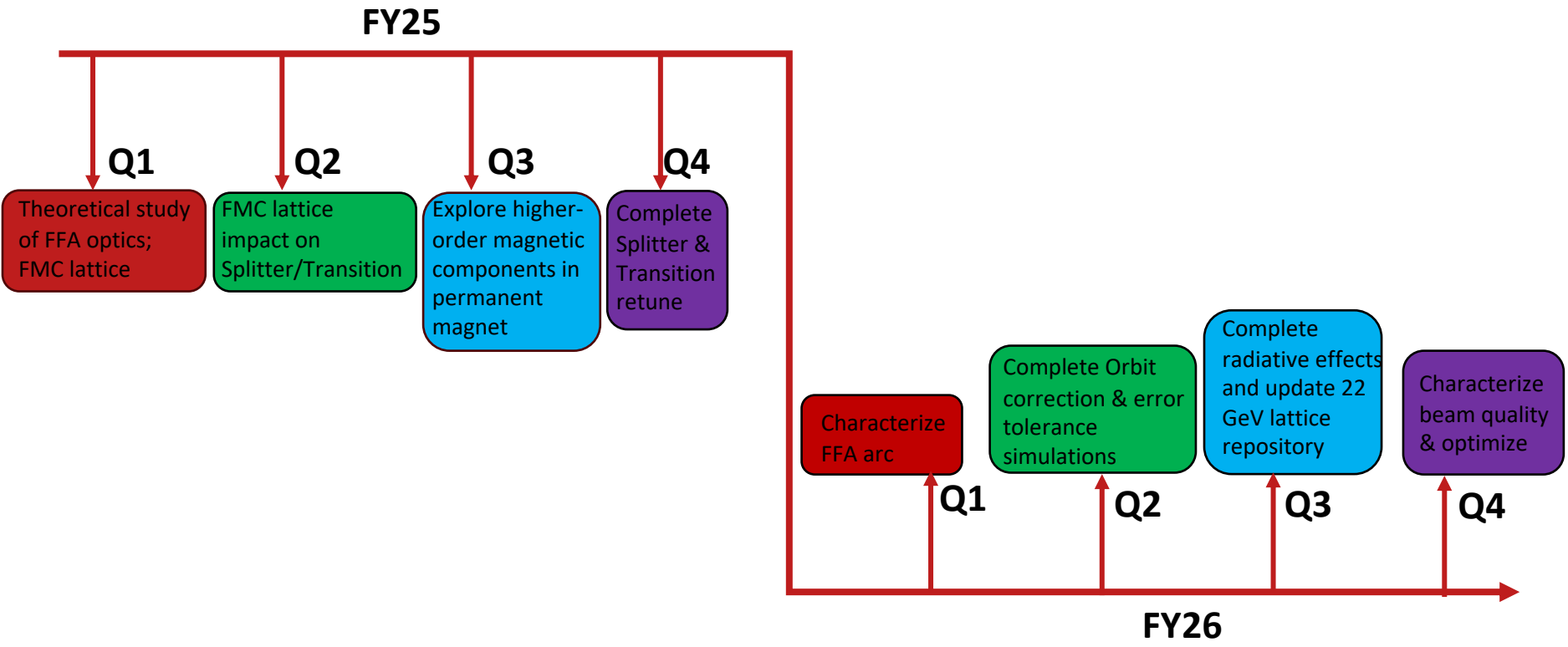
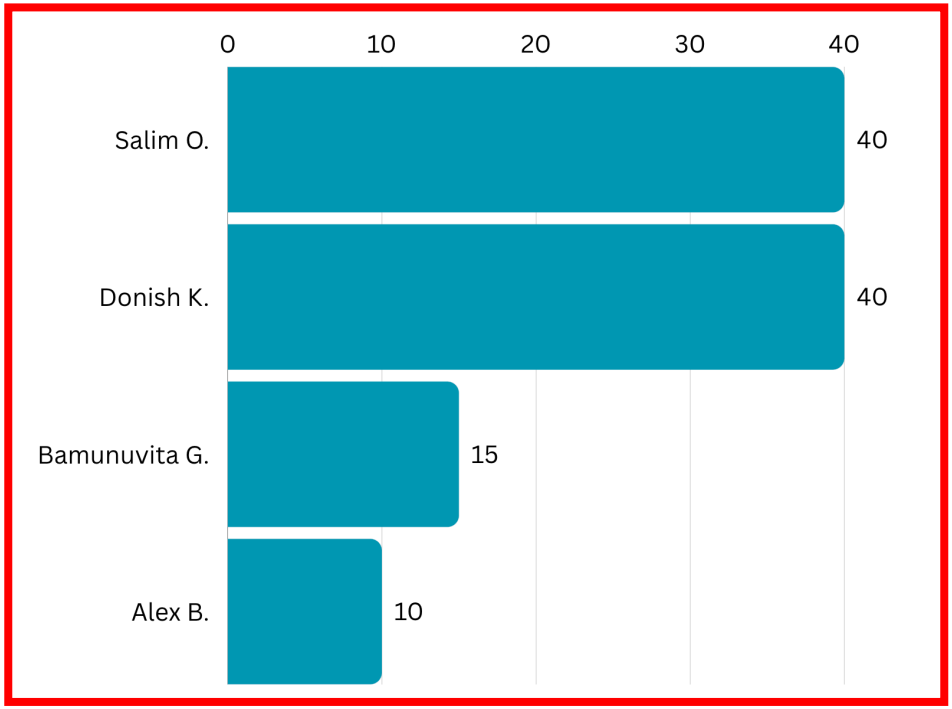
Milestones & Deliverables



Meet The Team

- **Salim Ogur** (Principal Investigator):
  - Manage the project, perform theoretical calculations, design work, and assist with simulations.
- **Donish Khan** (Co-Investigator):
  - Deputy for oversight, perform design work, and provide simulation support. Splitters SME.
- **Randi Gamage** (Co-Investigator):
  - Perform design work, simulations, and calculations. Transition SME.
- **Alex Bogacz** (Co-Investigator):
  - Provide general guidance and senior expertise in accelerator beam optics and lattice design.

FTE % Effort For FY25-FY26



- Software: **Bmad, ELEGANT, OptiMX, HalbachArea**