

Proposal : Polarized Deuteron Ion Source

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Objectives

To install, commission, and operate the COSY polarized deuterium ion source at the BNL Tandem Van de Graaff Facility. By delivering polarized D- beams and establishing routine polarization measurements this forms the basis for follow-on AGS/EIC applications.

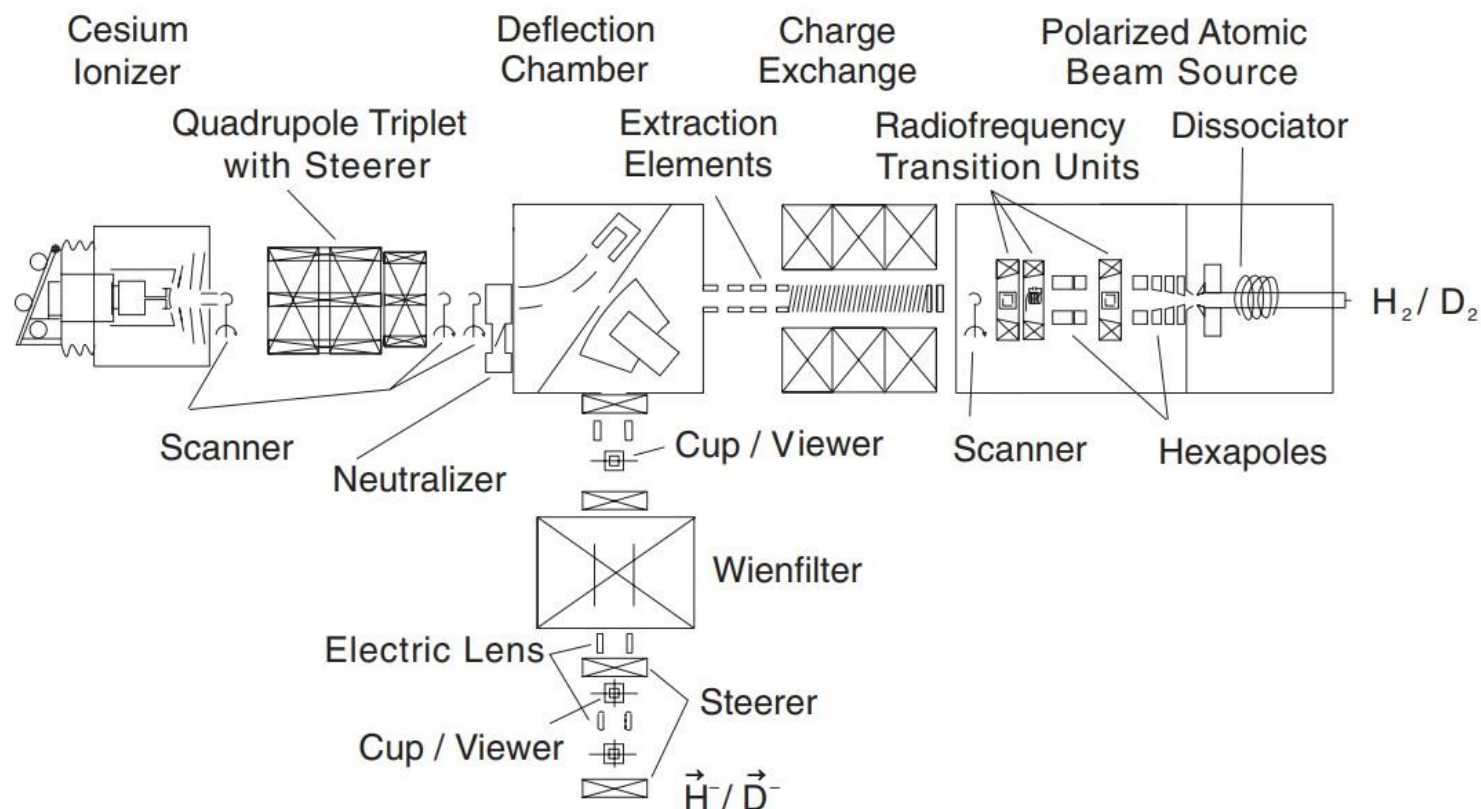
Motivation

“The EIC accelerator design team must make it a priority to develop ion spin control and manipulation from source to collisions of the deuteron, ^3He , ^6Li and ^7Li nuclei.*”

*from executive summary of “*Realizing the Scientific Program with Polarized Ion Beams at EIC*” (The EPIOS Scientific Consortium)

The availability of the COSY Polarized ion source to BNL for a fraction of the replacement value

COSY Polarized D⁻ Ion Source



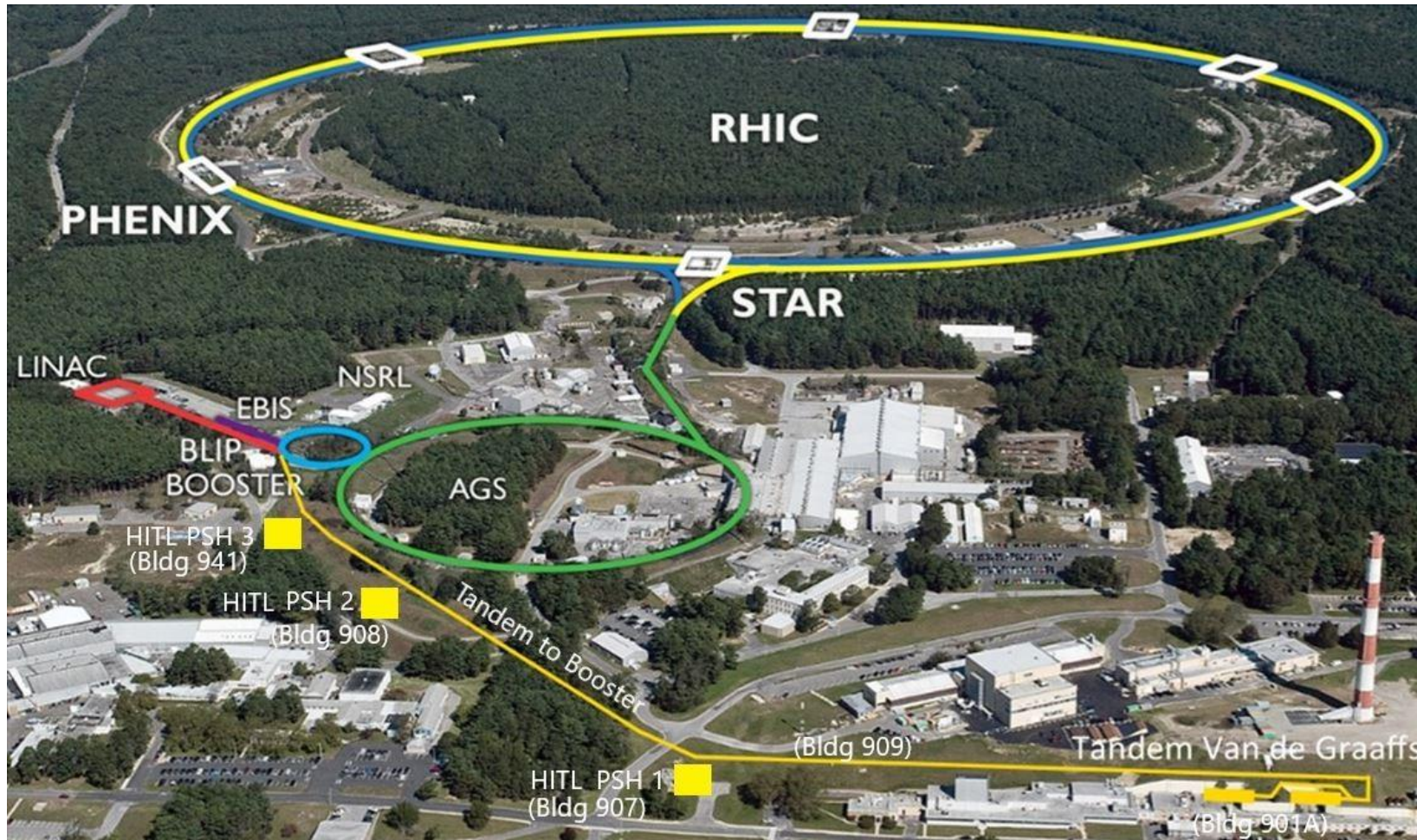
- COSY Polarized deuterium source available to BNL
- Two 40 ft shipping containers worth of equipment from Julich
- Space is limited at EBIS
- Proposed to locate the Polarized Deuterium Ion Source at the Tandem Van de Graaff Facility
- Project divided into two parts: Ion Source and Polarimeter
- Ion source to be located between the two Tandems (MP6 & MP7)
- New HV platform to injected polarized deuterium into MP7
- Polarimeter at the High Energy of MP7

Partial list of Equipment to be shipped

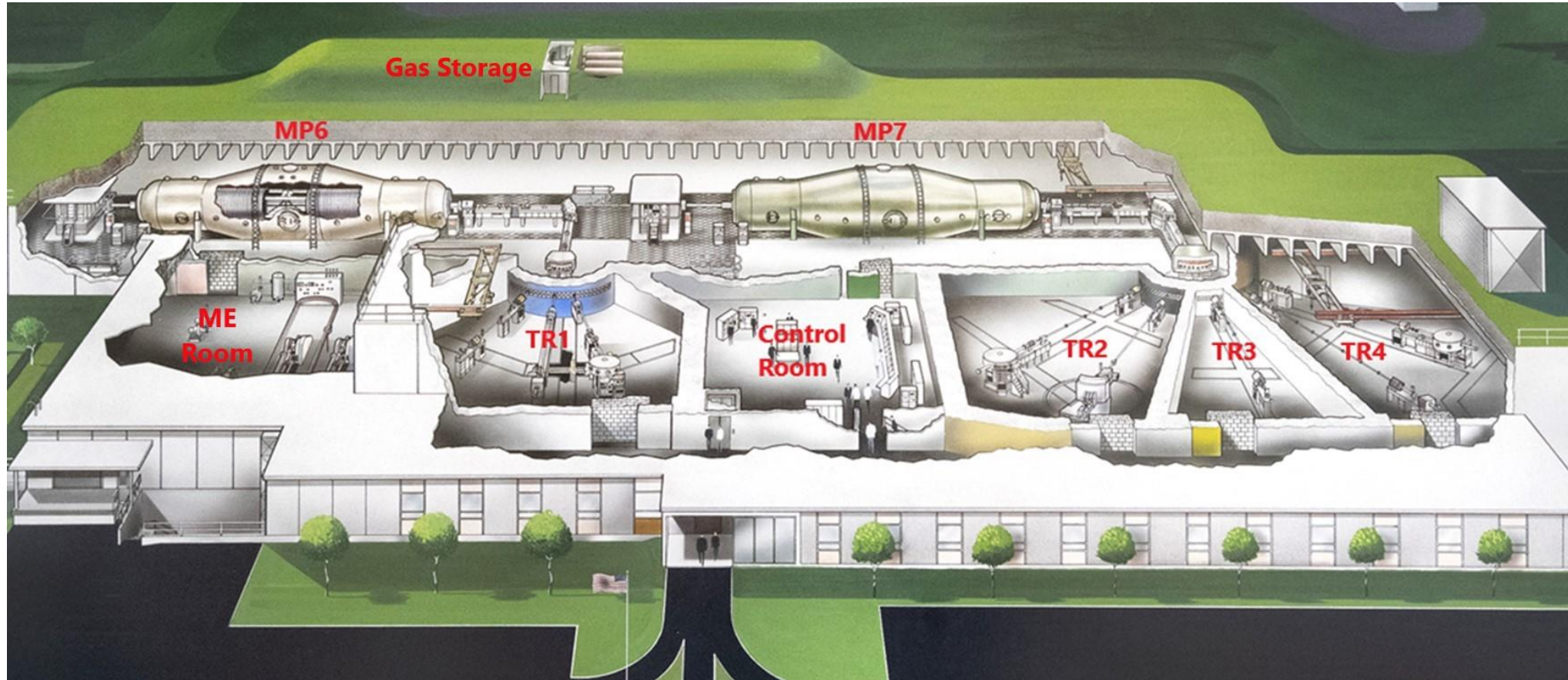
No.	Description	No.	Description
1	3 sets of permanent sextupole magnets	10	Several 27 MHz fixed frequency amplifiers
2	2 electromagnets	11	Siemens controllers
3	Vacuum chambers for two atomic beam	12	Pressure regulators and flow regulators
4	Time-of-flight spectrometer for atomic beams with chopper	13	Cold heads and compressors for 25K - 80K operation
5	Vacuum equipment for two sources, diagnostic chambers, Valves	14	9 RF transition units with spare parts
6	3 mass spectrometers	15	Amplifiers for RF transition units
7	Scanner for profile measurements	16	10 Signal generators
8	Temperature controllers	17	Magnetic field controllers
9	Dissociators	18	10 EDDA holding field power supplies

Tandem Van de Graaff Facility

C-AD Complex



The BNL Tandem Van de Graaff Facility



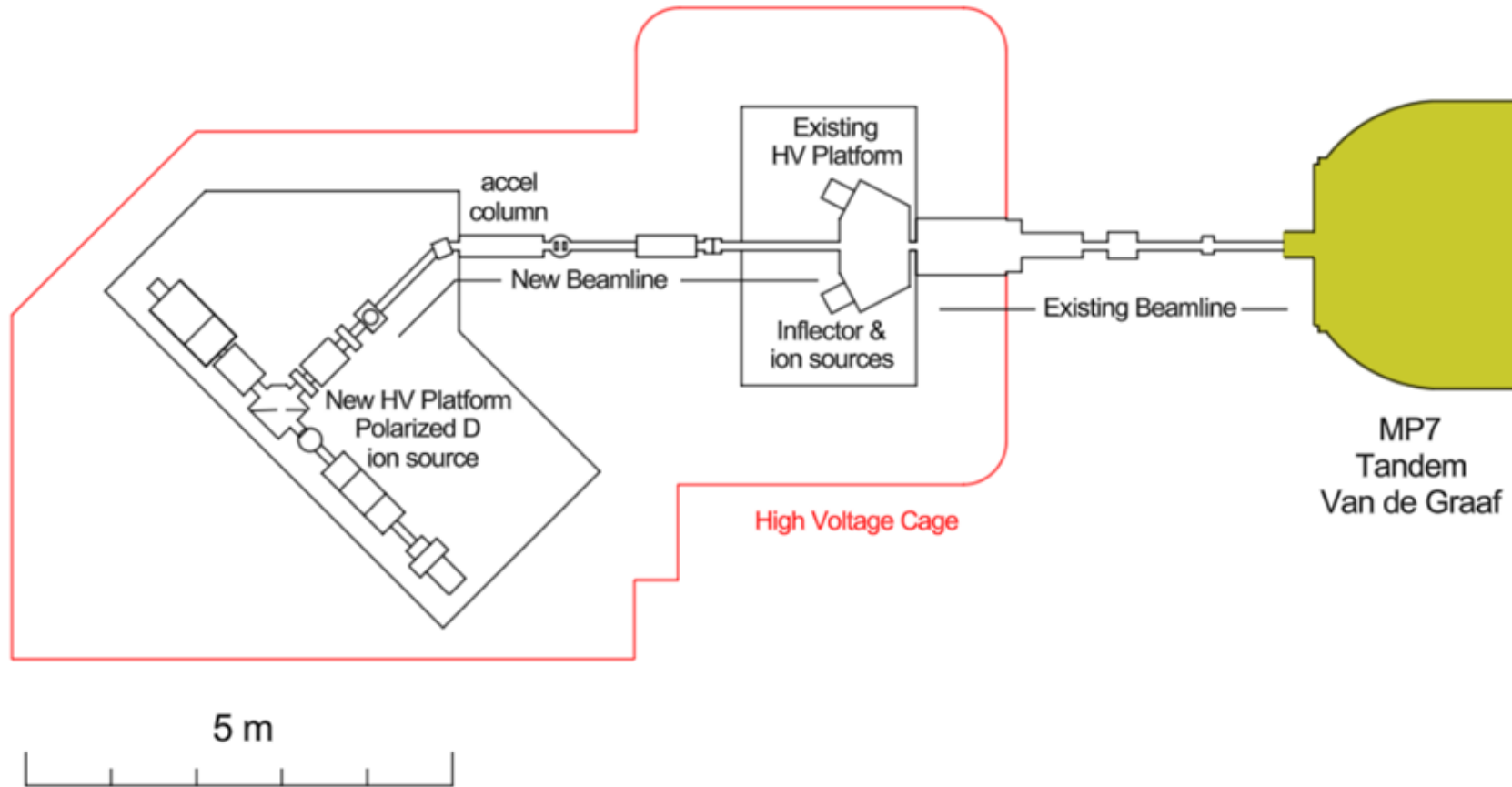
Tandem Van de Graaffs



- Two MP class Tandem Van de Graaffs (MP6 & MP7)
- Supplied the Au beam for the FY 23 and FY 25 Au-Au run
- Provided unpolarized deuterons in 2003, 2008, 2016 and 2023 for Au-d collisions in RHIC

Polarized Deuterium Ion Source

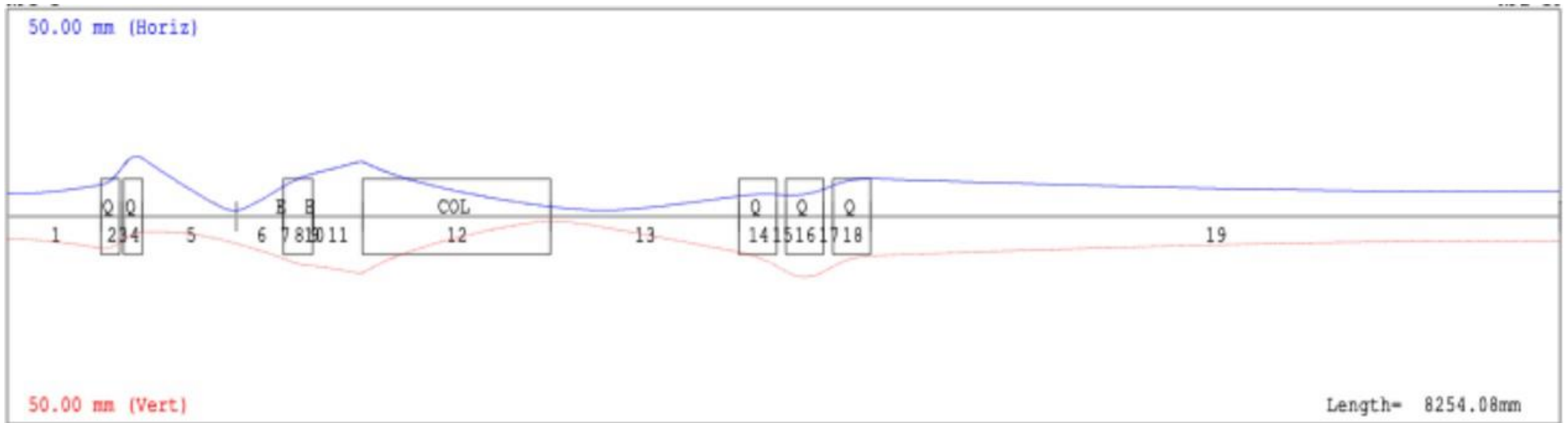
Location of Polarized Deuterium Ion Source



New beam line elements

Z (mm)	Element / Diagnostics	Length (m)m	Gradient / Voltage	Beam radius (mm)	Comments
0.0	Entrance	—	—	5	T = 9 keV
100	Faraday cup (FC1)	100	—	—	9 keV current monitor
200	Emittance scanner #1	100	—	—	9 keV emittance / Twiss
500	Electrostatic quad (F)	100	± 340 V	25	Part of ES doublet
620	Electrostatic quad (D)	100	∓ 380 V	25	Part of ES doublet
730	Horizontal (X) steerer	50	± 1000 V	—	Beam centering
750	Vertical (Y) steerer	50	± 1000 V	—	Beam centering
1525	Electrostatic $\sim 45^\circ$ bend	160	$\rho = 0.20$ m, ± 900 V	20	Aligns beam to MP7 axis
1700	Accelerating column	1000	120 kV	50	T = 120 keV
2800	Faraday cup (FC2)	100	—	—	120 keV current monitor
2900	Profile monitor	100	—	—	Transverse profile at 120 keV
3800*	Electrostatic quad triplet	700	+670 / -1400 / +870 V	25	120 keV matching section
4500	Horizontal (X) steerer	100	+ -1000 V	25	Beam centering
4600	Vertical (Y) steerer	100	+ - 1000 V	25	Beam centering
8250	Exit of existing ion source	—	—	—	Handoff to existing M& optics

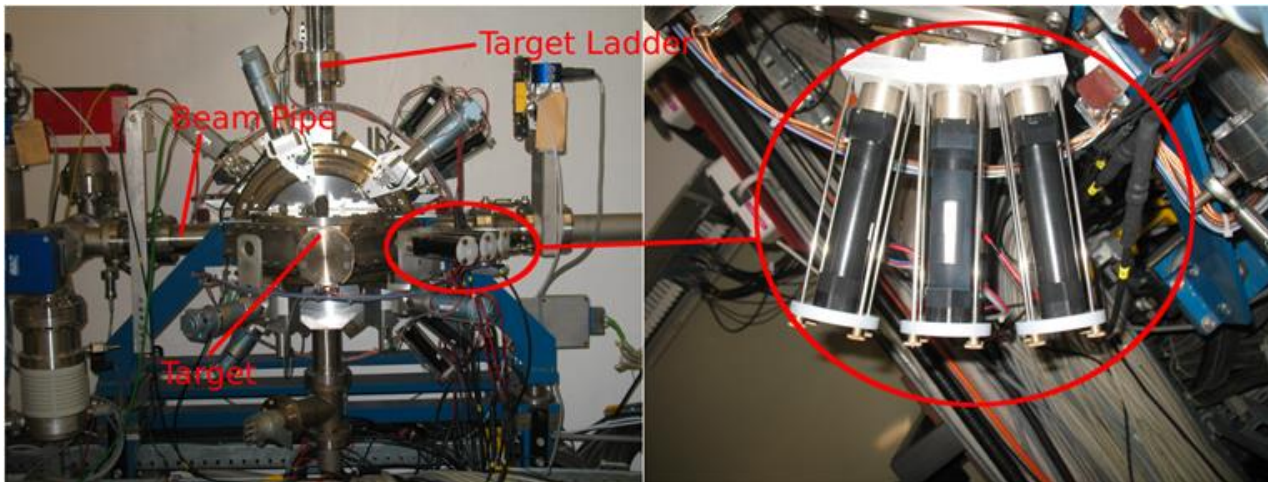
Beam Optics



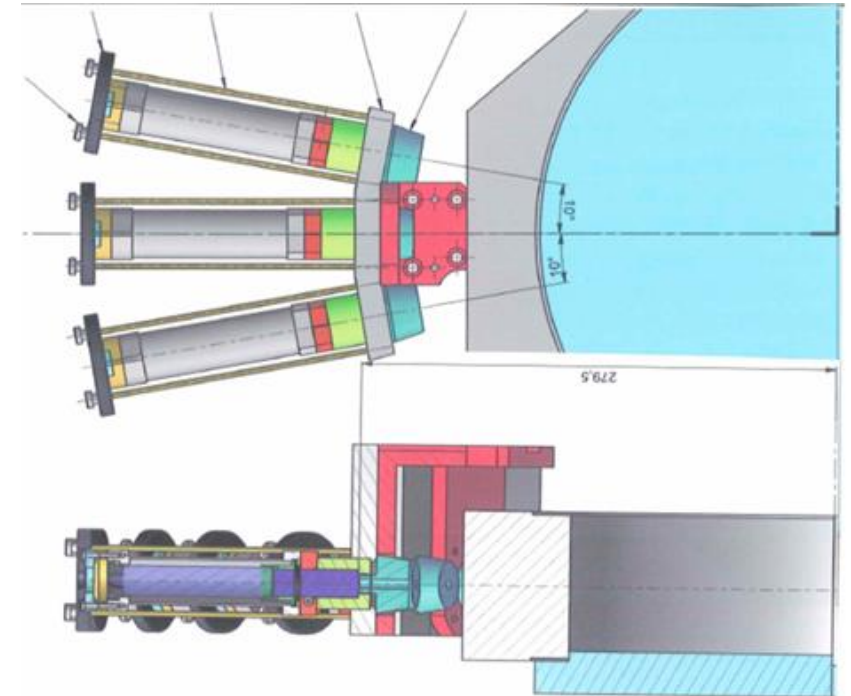
Beam envelope along the transfer line (Horizontal: Blue, and Vertical: Red).

Tandem Polarimeter

COSY Low Energy Polarimeter

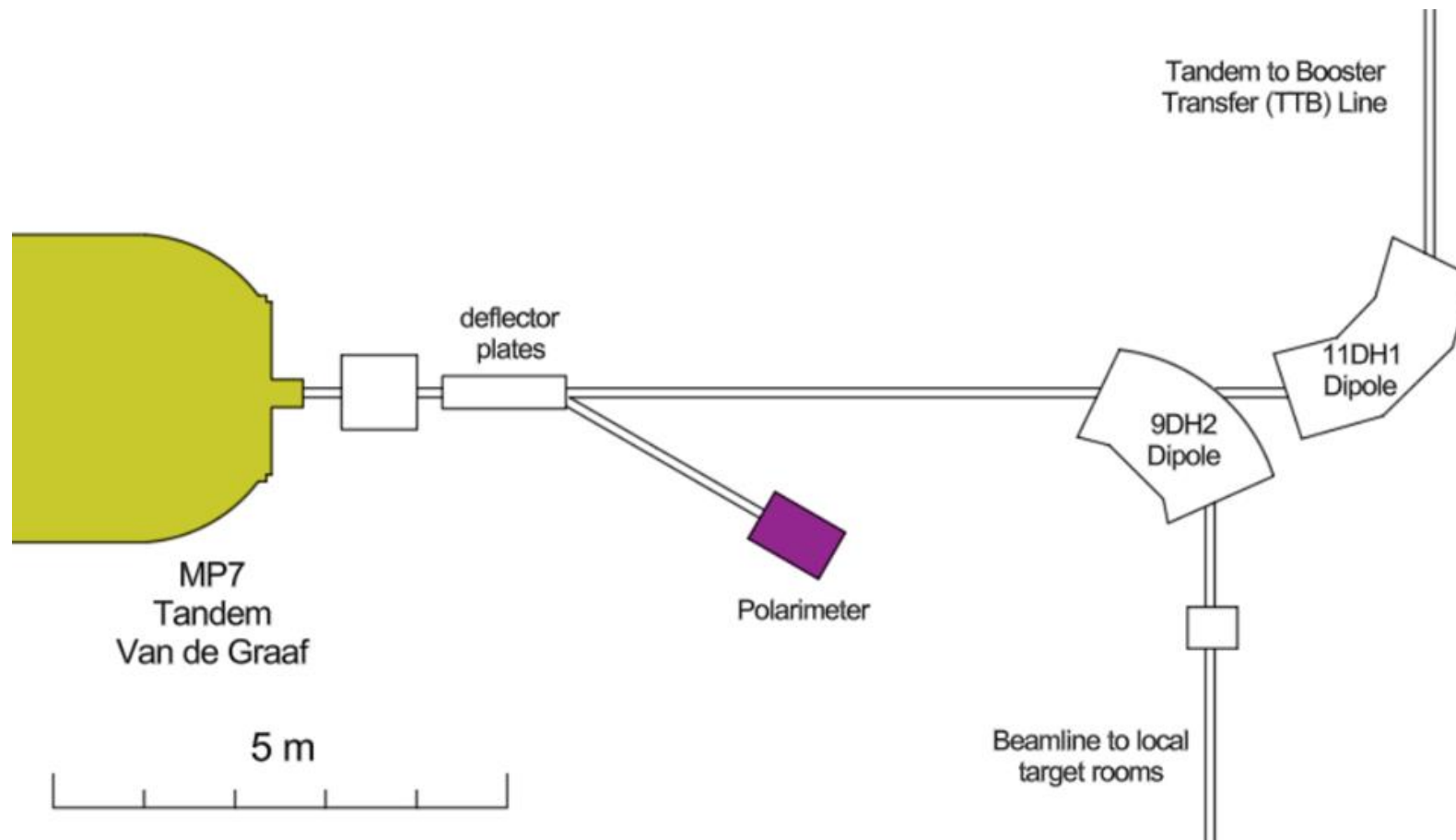


COSY LE Polarimeter



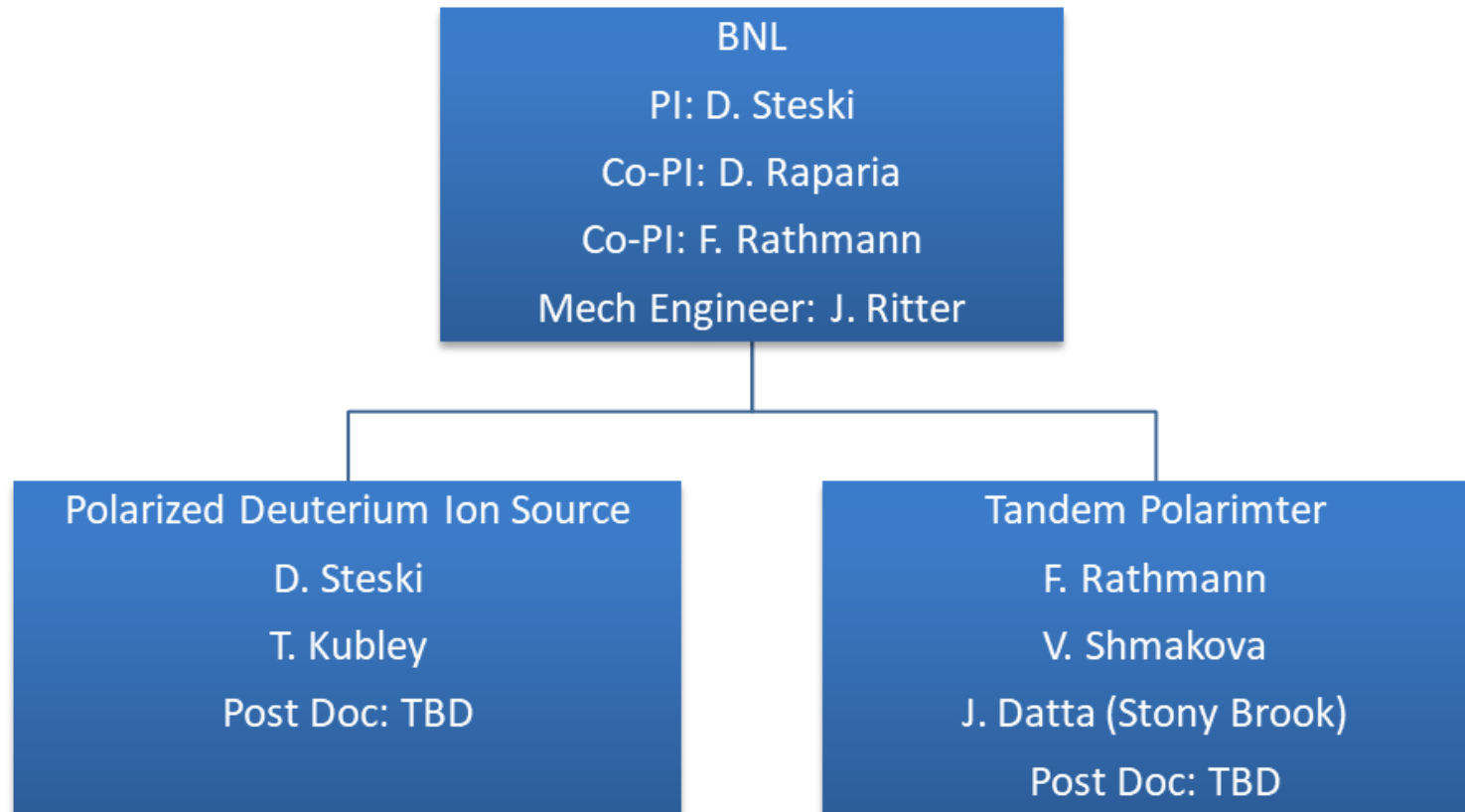
Drawing of COSY LE Polarimeter

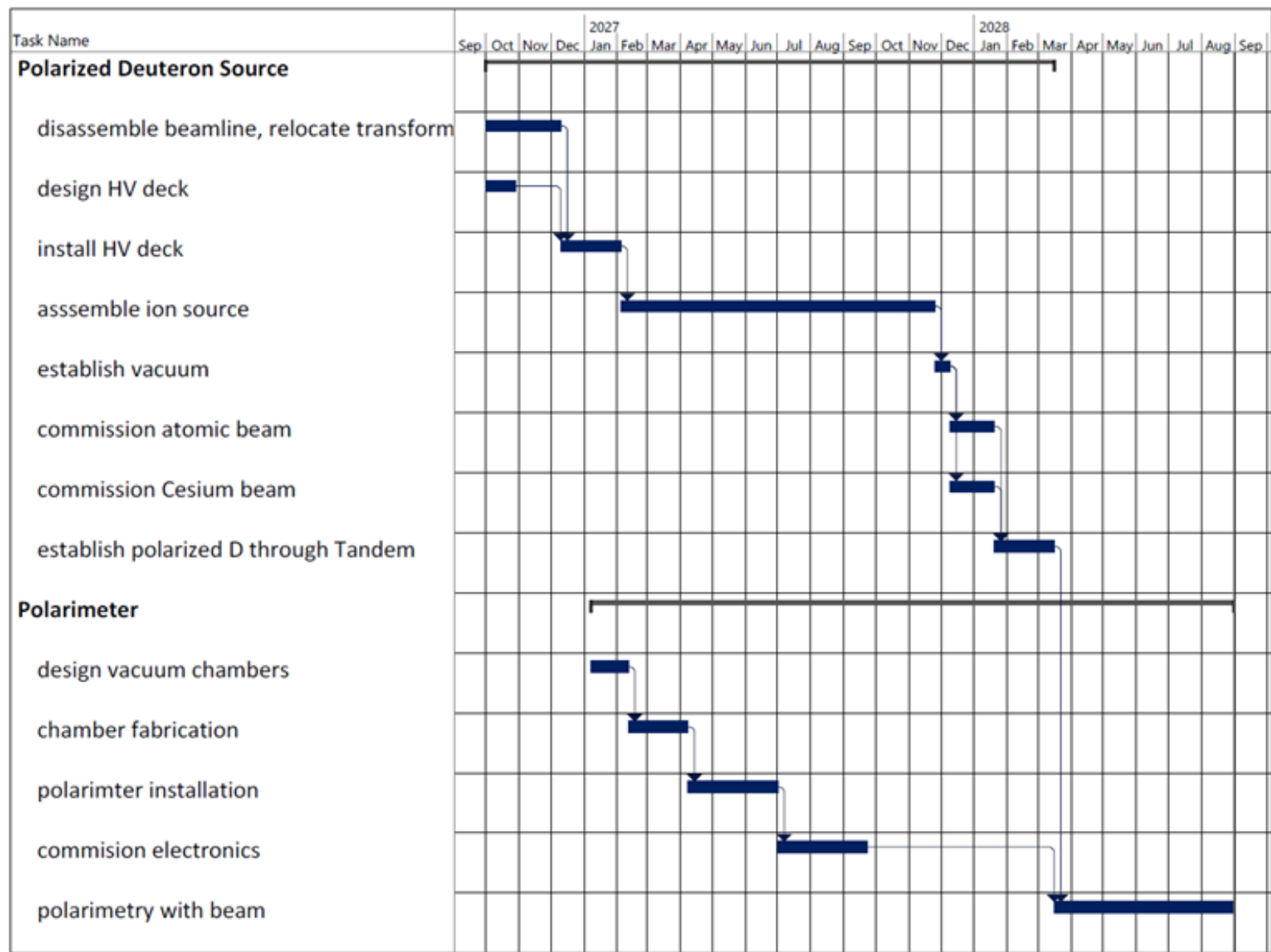
Location of Tandem Polarimeter



Proposal Organization

Proposal Organizational Chart





Summary

- Proposal submitted 12/10/25, 2 Years, \$2 million
- Polarized Deuterium Ion Source available from COSY
- Layout of Ion Source at the Tandem
- Preliminary beam line design
- Layout for Polarimeter High Energy end of the Tandem
- Polarization preserved in Tandem to Booster (TtB) transfer line
- Polarization preserved in EIC* (*H. Huang, F. Méot, V. Ptitsyn, V. Ranjbar, and T. Roser. “Polarization preservation of polarized deuteron beams in the electron ion collider at Brookhaven National Laboratory.” Phys. Rev. Accel. Beams, 23:021001, 2020)