STATUS OF THE POLARIZED SOURCE AND BEAM PREPARATION SYSTEM AT MESA

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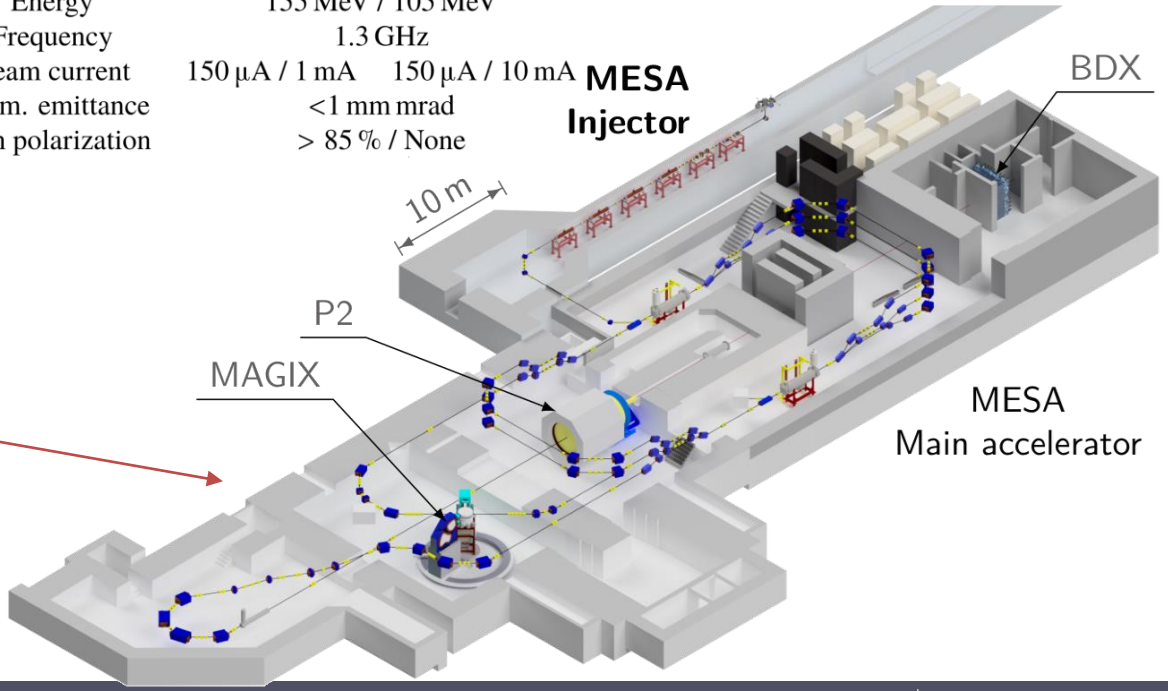
IPAC'21

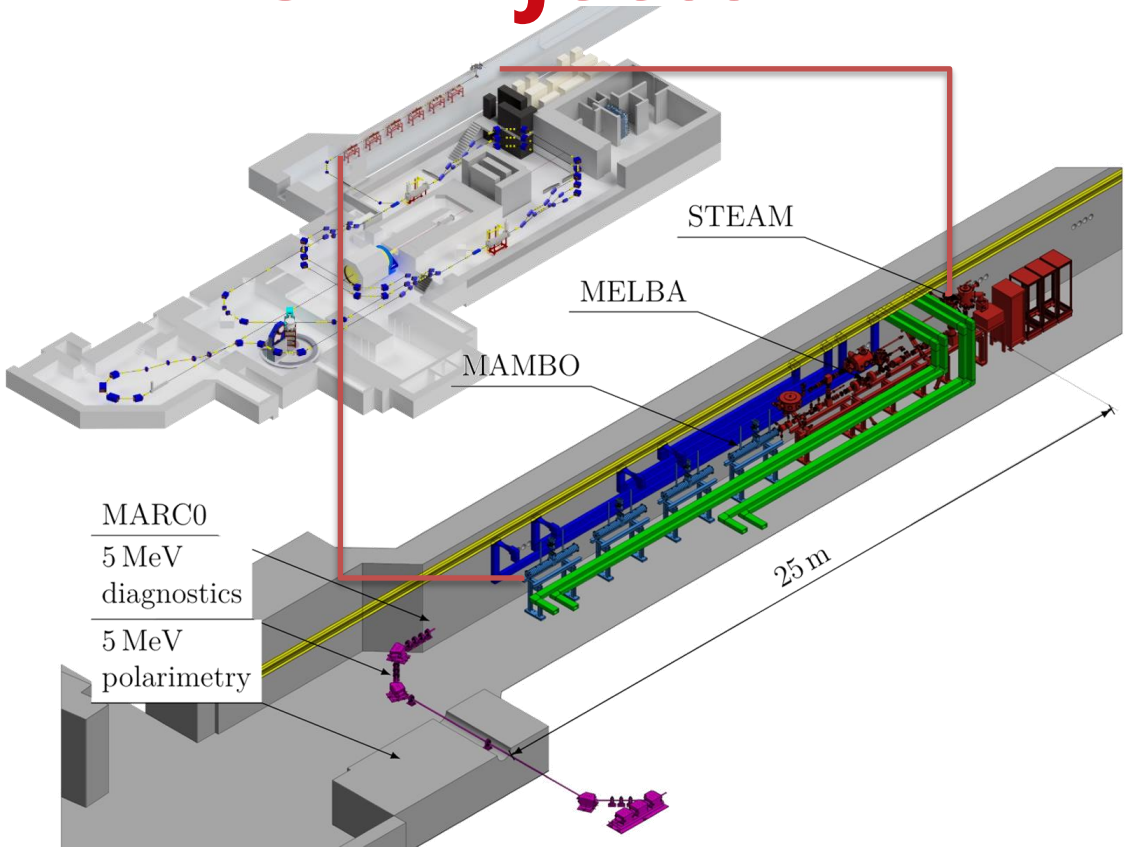
MESA

Mainz Energy-Recovering Superconducting Accelerator

Parameter	Stage 1	Stage 2
	(External Beam / ERL)	
Energy	155 MeV / 105 MeV	
Frequency	1.3 GHz	
Beam current	150 µA / 1 mA	150 µA / 10 mA
Norm. emittance	<1 mm mrad	
Spin polarization	> 85 % / None	



MESA Injector



Injector consists of

- STEAM: Small Thermalized Electron Source at Mainz, 100kV spin-polarized DC photoemission source
- MELBA: MESA Low-energy Beam Apparatus, spin and phase space manipulation
- MAMBO: MilliAMpere BOoster, n.c. acceleration to 5 MeV

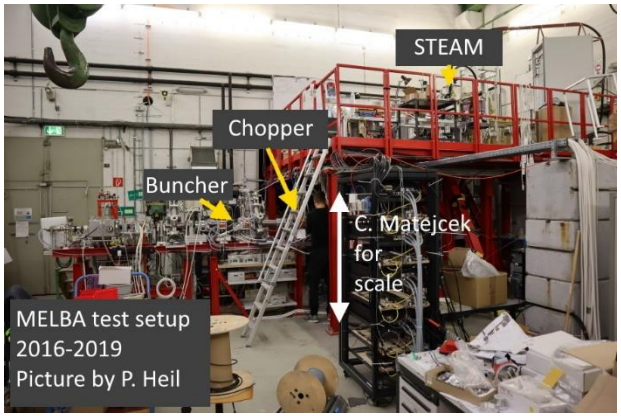
MELBA

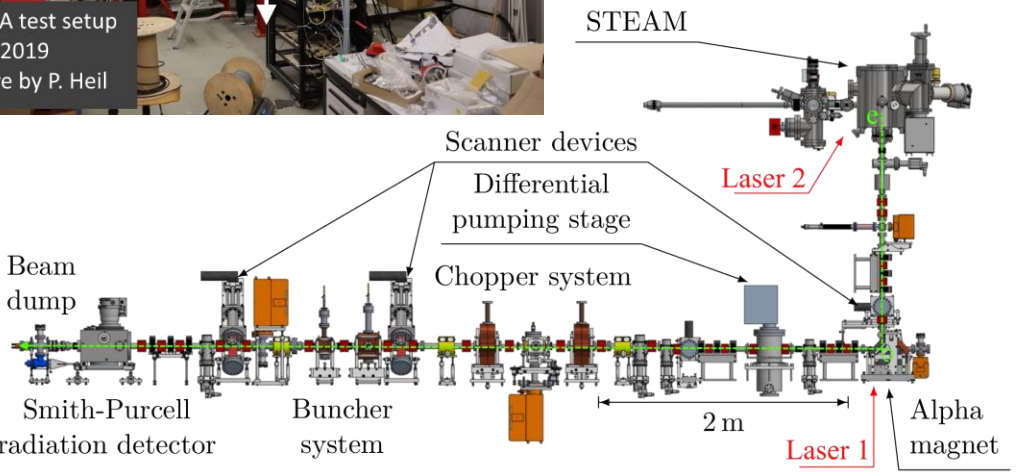
2016 – 2019 test setup results

- Polarized emission from GaAs and transport of up to 10 mA @ 100 keV

S Friederich et al 2019 J. Phys.: Conf. Ser. 1350 012045

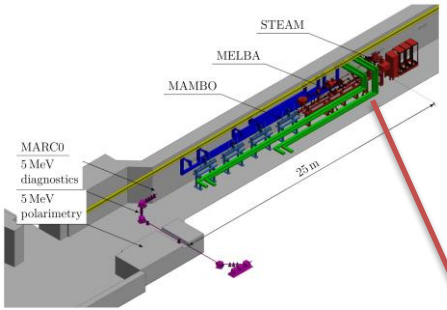
- Measured beam parameter @ s = 8 m, 1 mA beam operation
  - Normalized RMS emittances < 1 mm mrad
  - But, emittance growth due to big RMS beam sizes and fringe fields
  - Bunch length < 0.3° (Required by MAMBO: <=4.5°)
  - 4 PhD students graduated successfully





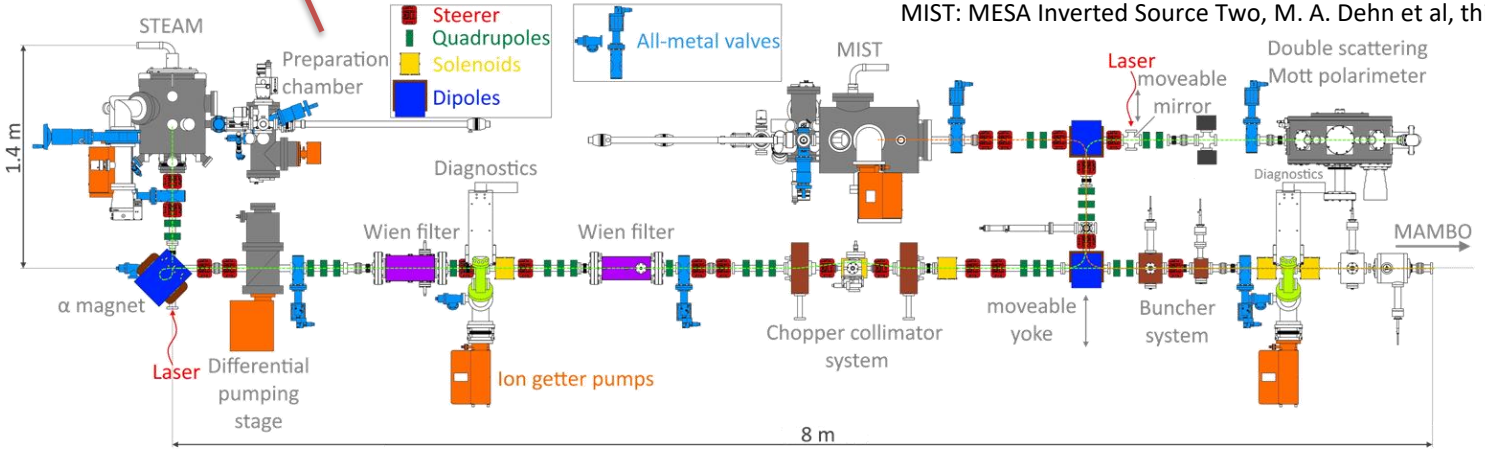
C. Matejcek et al 2019 J. Phys.: Conf. Ser. 1350 012027; Philipp Heil et al 2021 Phys. Rev. Accel. Beams 24, 042803

MELBA @ MESA



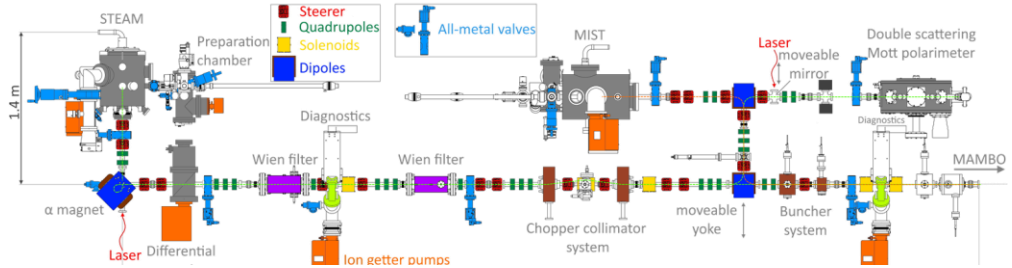
- Spin manipulation (Wien filter, Solenoid)
- Separation beam line
  - Spin diagnostics (Double scattering Mott polarimeter)
  - Second source (MIST) for high-current extraction

MIST: MESA Inverted Source Two, M. A. Dehn et al, this conference

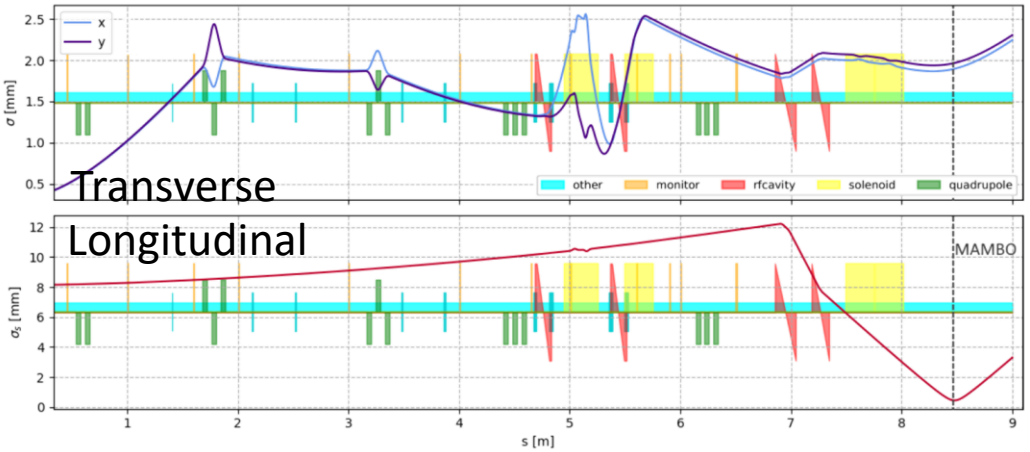


MELBA

OPAL simulations



RMS Beam sizes



Simulation results:

- Transmission of > 1 mA with small beam sizes
- Small transverse emittances

Not yet: Wien filter, alpha magnet

Parameter	initial	final
Bunch size σ_r in mm	0.5	2
Bunch length σ_s in mm | °	8 | 22	0.5 | 1.4
Bunch charge q_b in pC	1	
Norm. emit. $\varepsilon_{n,rms,\perp}$ in mm mrad	0.1	0.7
RMS energy spread ΔE in keV	0.04	2.2
Electron energy E_{kin} in keV	100 keV	

PRISMA+

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