MDI – Solenoidal Field Effects on BIB

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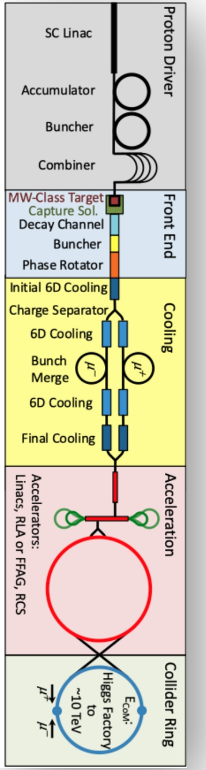
International MUON Collider Collaboration

CERN

Outline



- **MDI geometry:**
  - Lattices under study
  - Accelerator line and detector area
  - Solenoidal field in the detector area
- **10 TeV solenoidal field effects:**
  - Effects of the solenoidal field with the old lattice

Interaction region: MDI

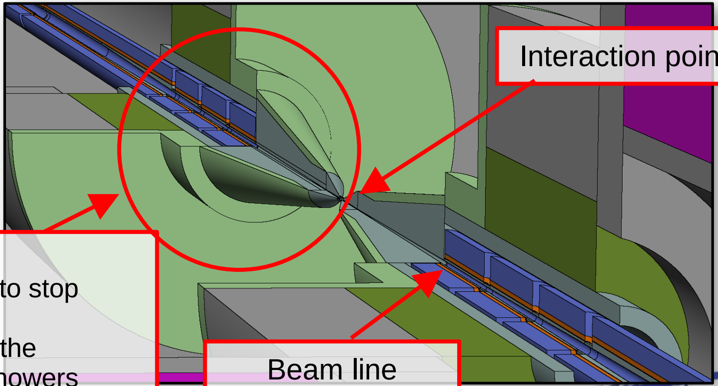
- MDI is a **difficult challenge** for the muon collider. First studies were done by the MAP collaboration (energies up to 6 TeV). So far, IMCC focused on studies for energies up to 10 TeV.
- Objectives of the new studies:
  - Devise a conceptual IP design achieving **background** levels **compatible** with **detector operation**, both in terms of physics performance and acceptable cumulative radiation damage.
  - The focus energies are 3 TeV and 10 TeV.

Tentative target parameters
Scaled from MAP parameters

Comparison:
CLIC at 3 TeV: 28 MW

Parameter	Unit	3 TeV	10 TeV	14 TeV
L	10^{34} cm^{-2}s^{-1}	1.8	20	40
N	10^{12}	2.2	1.8	1.8
f_r	Hz	5	5	5
P_{beam}	MW	5.3	14.4	20
C	km	4.5	10	14

Geometry of the MDI



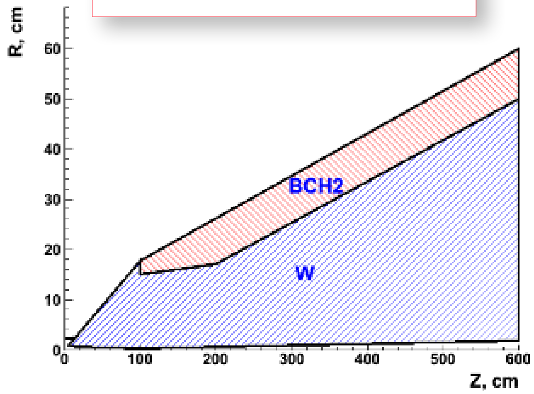
MDI: past results and geometry

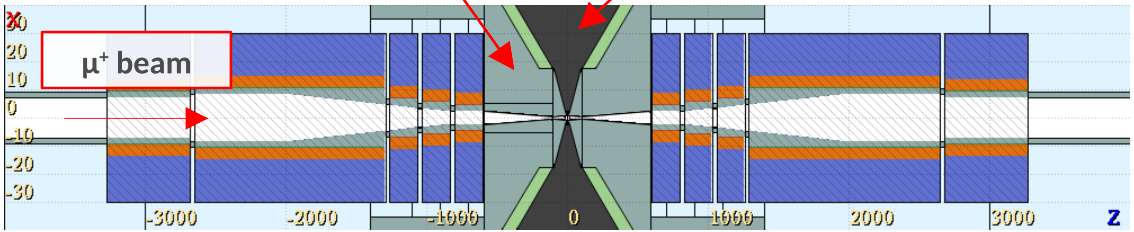
- In the context of the **MAP collaboration**, the muon collider detector background and Machine-detector interface has been thoroughly studied [5-8].
- They observed that most **background** particles are generated in the last **25 m straight section**, except **muons** that can be produced **further away**.
- The MAP collaboration optimized **nozzles** for colliders up to 1.5 TeV (with MARS code).
- Recent **FLUKA** results are in a **eccellent agreement** with the past studies.

FLUKA/MARS15 results for the BIB of a 1.5 TeV muon collider from [9]

Particle (E_{th})	MARS15	FLUKA
Photon (100 keV)	$8.6\ 10^7$	$5\ 10^7$
Neutron (1 meV)	$7.6\ 10^7$	$1.1\ 10^8$
Electron/positron (100 keV)	$7.5\ 10^5$	$8.5\ 10^5$
Ch. Hadron (100 keV)	$3.1\ 10^4$	$1.7\ 10^4$
Muon (100 keV)	$1.5\ 10^3$	$1\ 10^3$

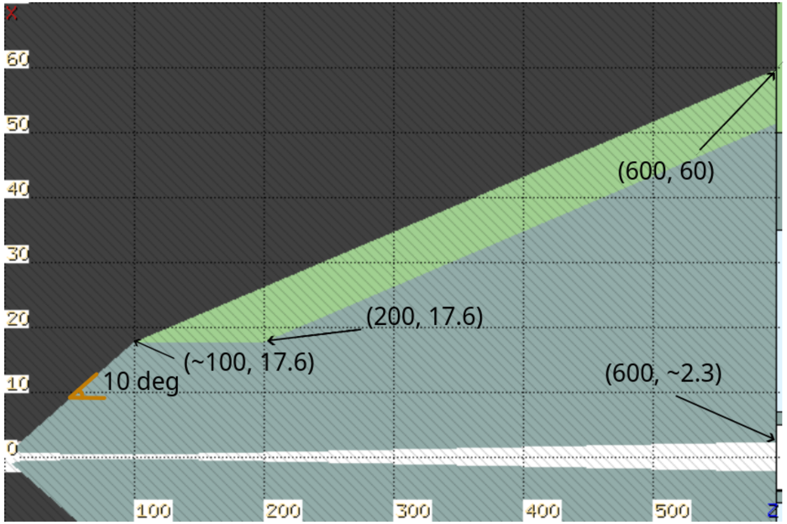
Original nozzle design



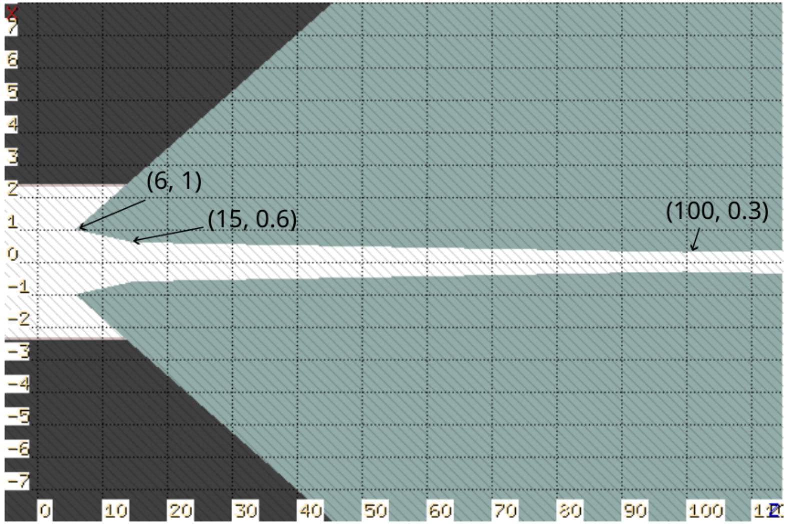


MDI: nozzle details

- Our implementation of the nozzle follows the original design from MAP collaboration



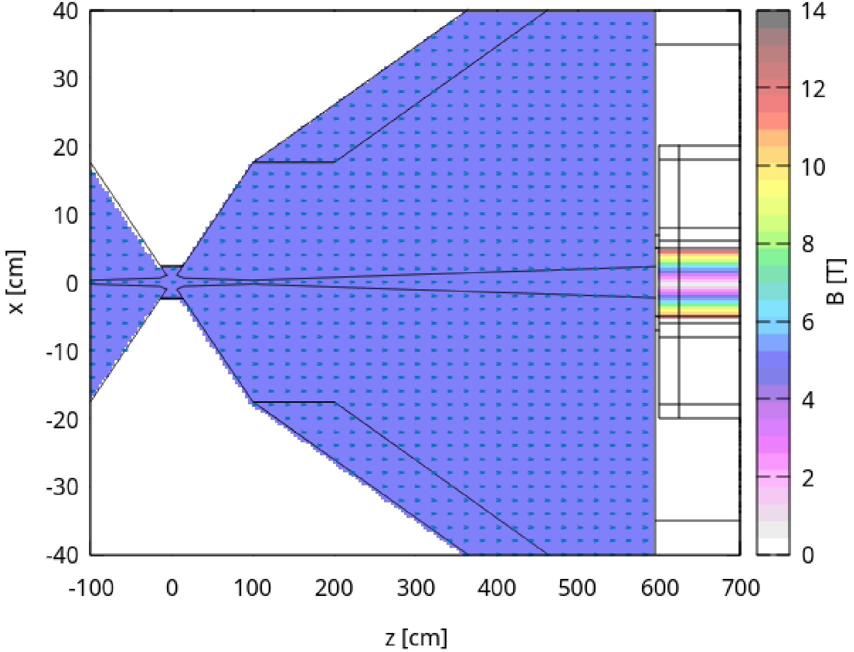
(a) Nozzle shape



(b) Tip details

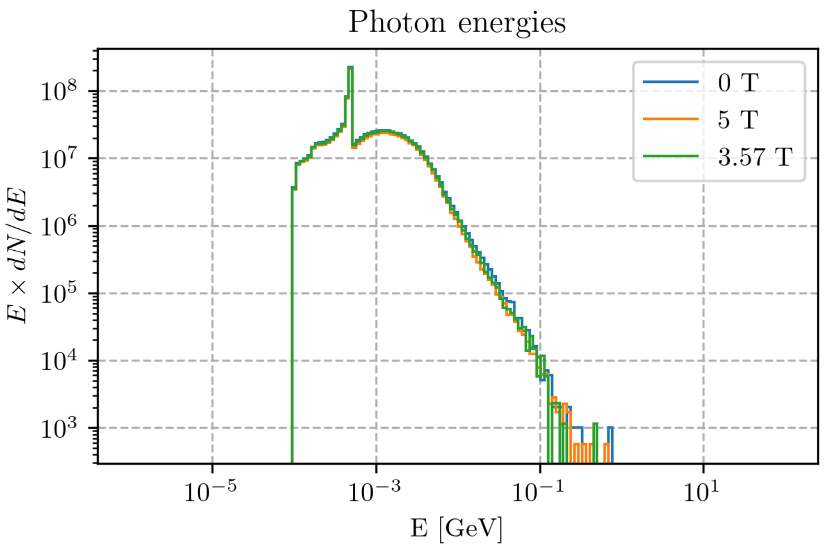
Field in the detectors: effect

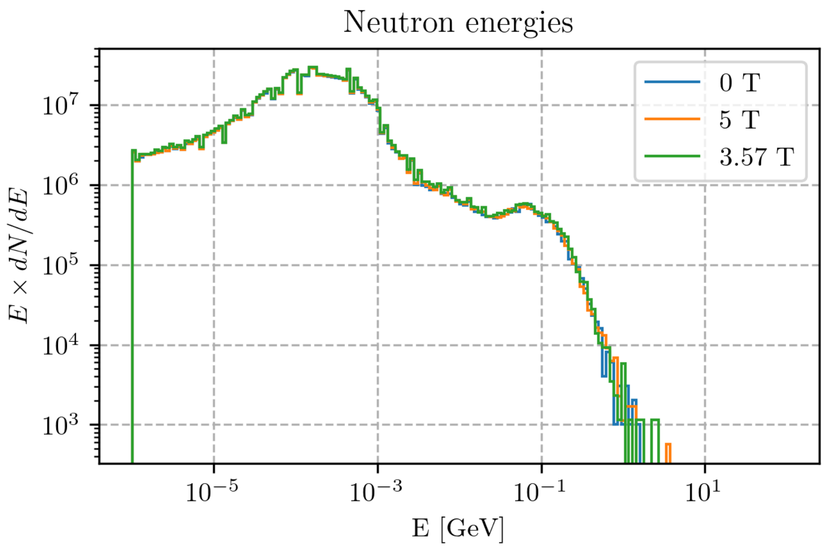
- The scope of these simulations is to assess the effects of the solenoidal field in the detector area. The field is assumed to be **hard edge**
- I conducted the same studies for the 10 TeV machine to answer the same questions: ***is the solenoidal field strongly affecting the BIB particle going in the detector area*?**
- The machine configuration is the one without the long drift, but the same considerations applies also in that case.



10 TeV: n and γ spectra

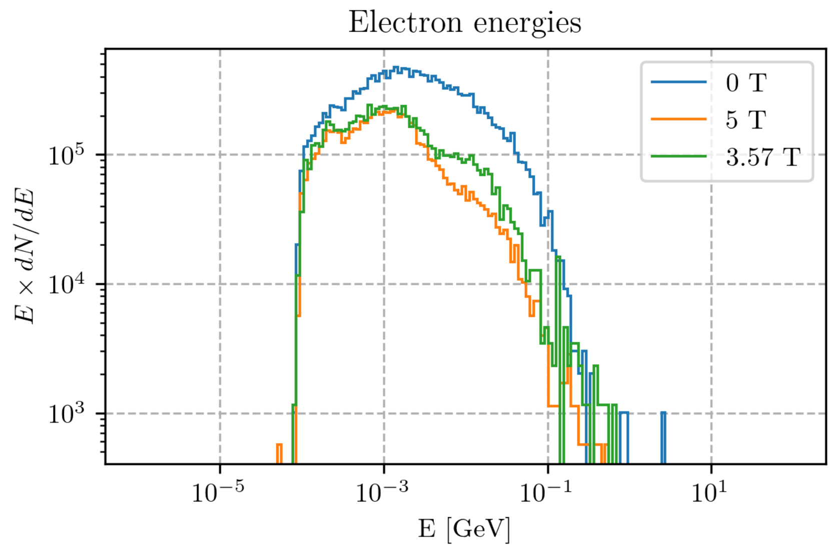
- No difference seen for photons and neutrons

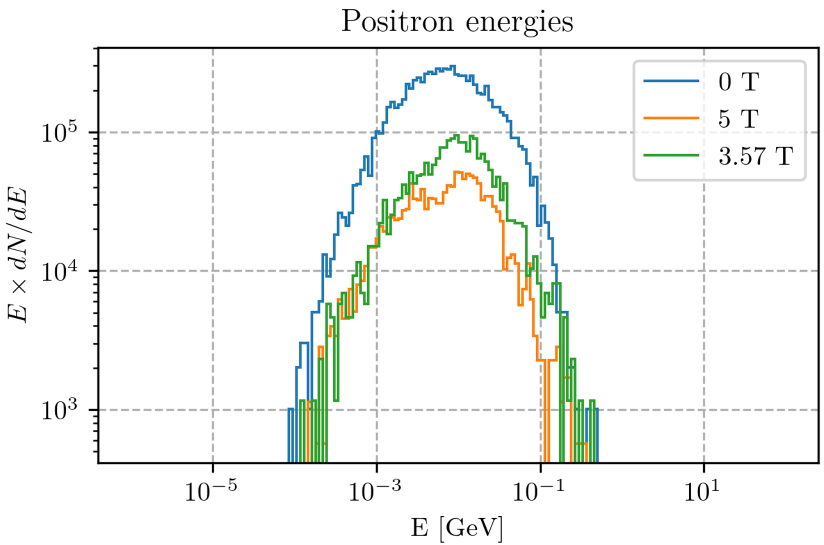




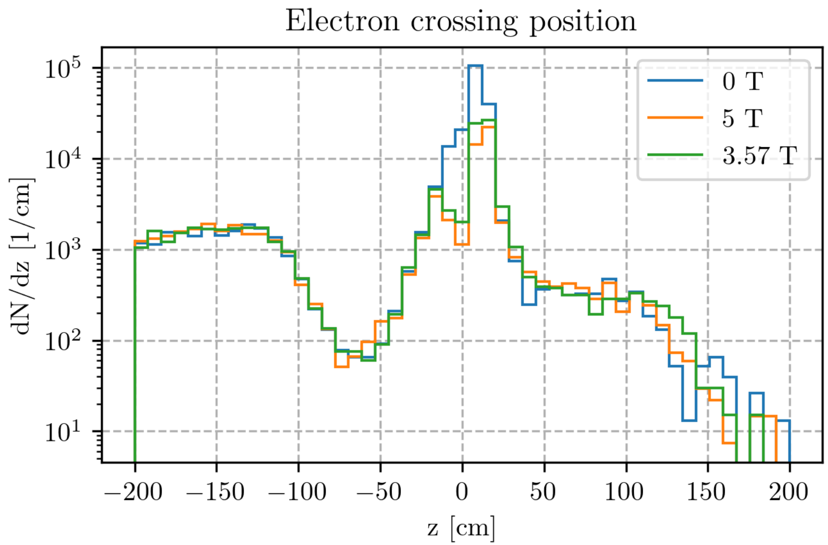
10 TeV: e+/e- energy

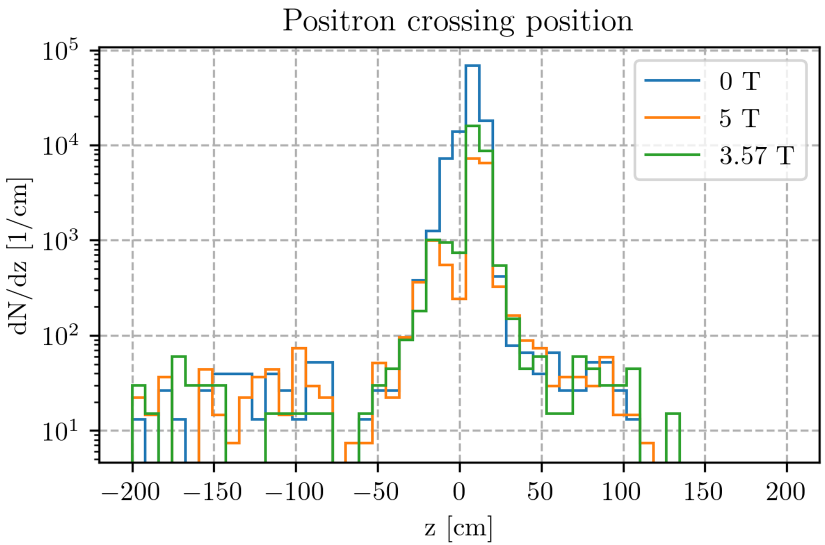
- Significant difference when the magnetic field is absent. The 3.57 and 5 T cases are similar



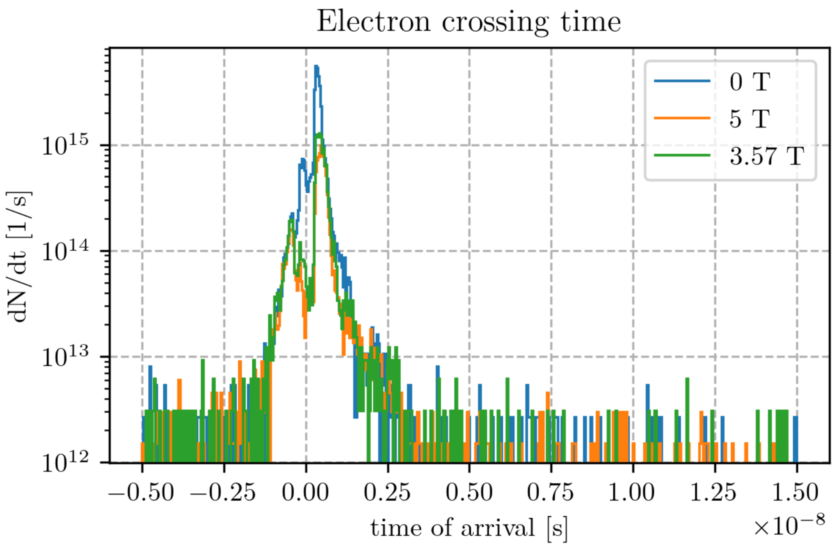


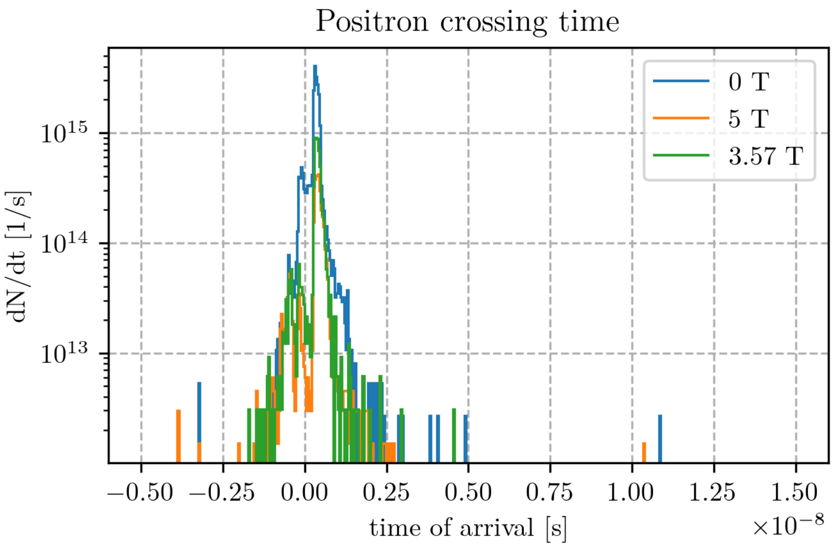
10 TeV: e+/e- crossing position





10 TeV: e+/e- time





Conclusions

- Having no field increases the number of electrons and positrons going in the detector area.
- The strength of the solenoidal field is not strictly dominating the BIB from the muon decay (changes from 3.57 to 5 T are minimal)