

# The tilted solenoid

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# Outline

What we want to simulate

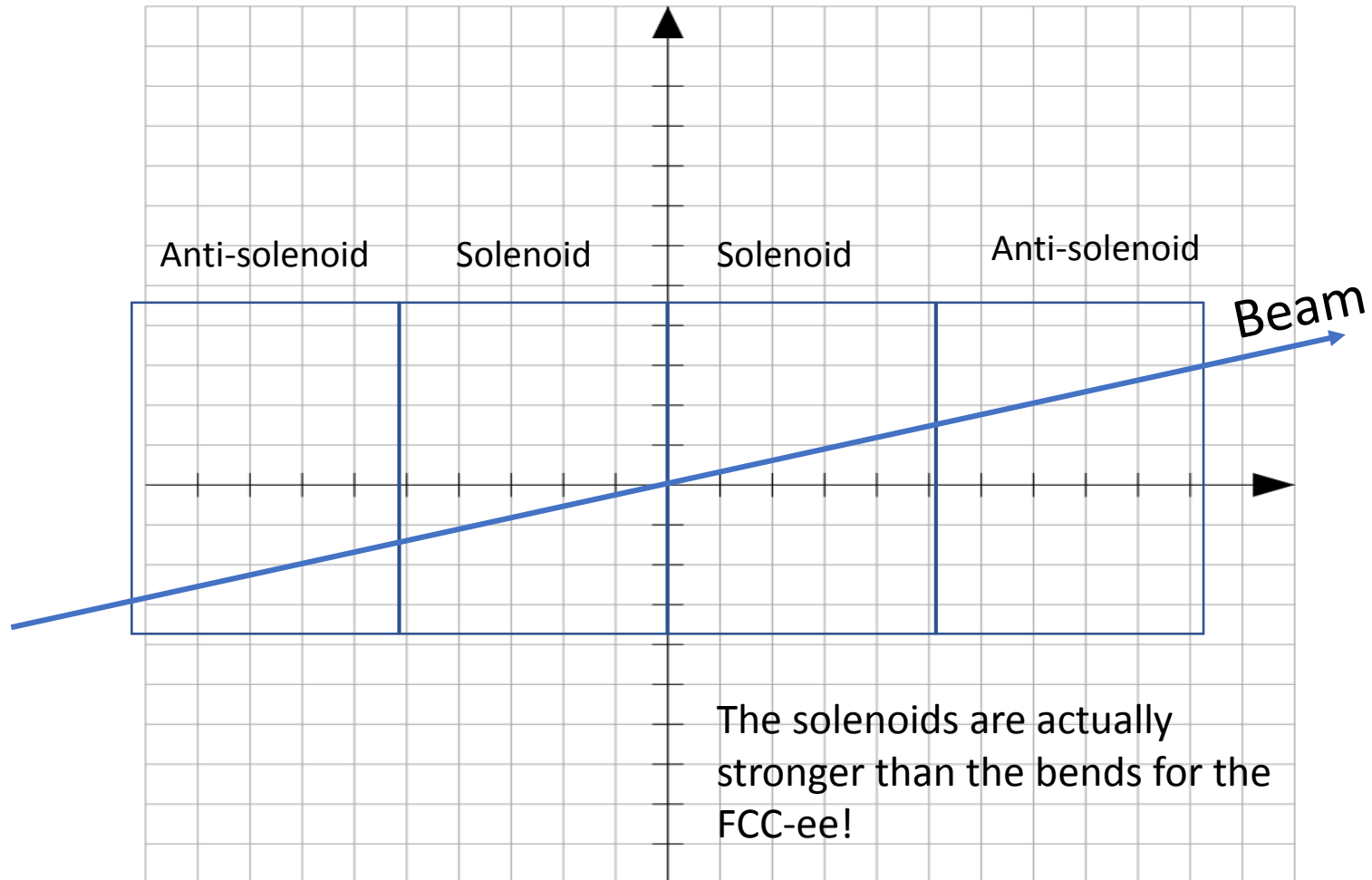
Implementation in MAD-X

How to use it in MAD-X

Results

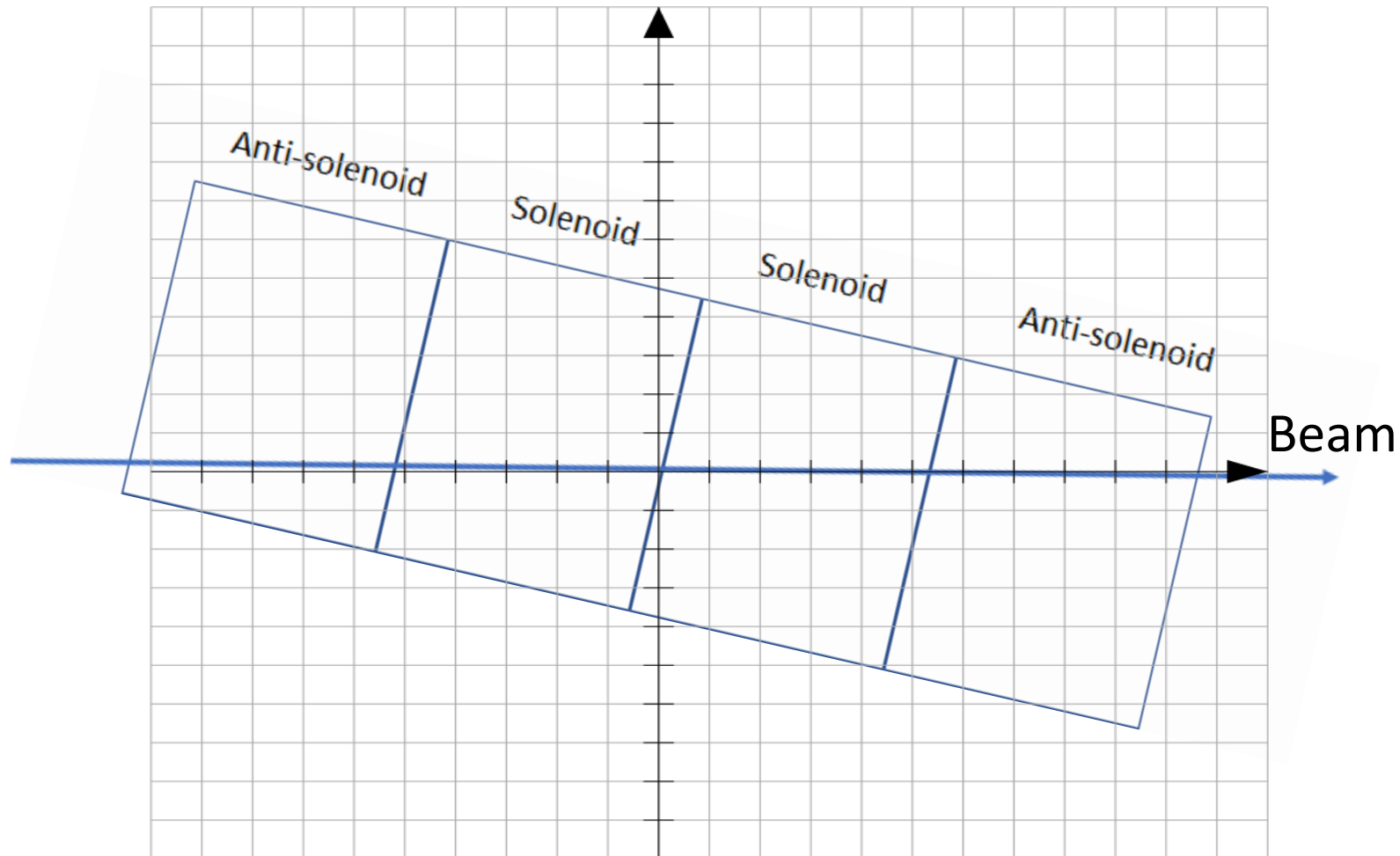
Conclusion and outlook

# System we want to simulate



# In practice

- The dipoles change the reference system
  - Tilt the solenoids instead

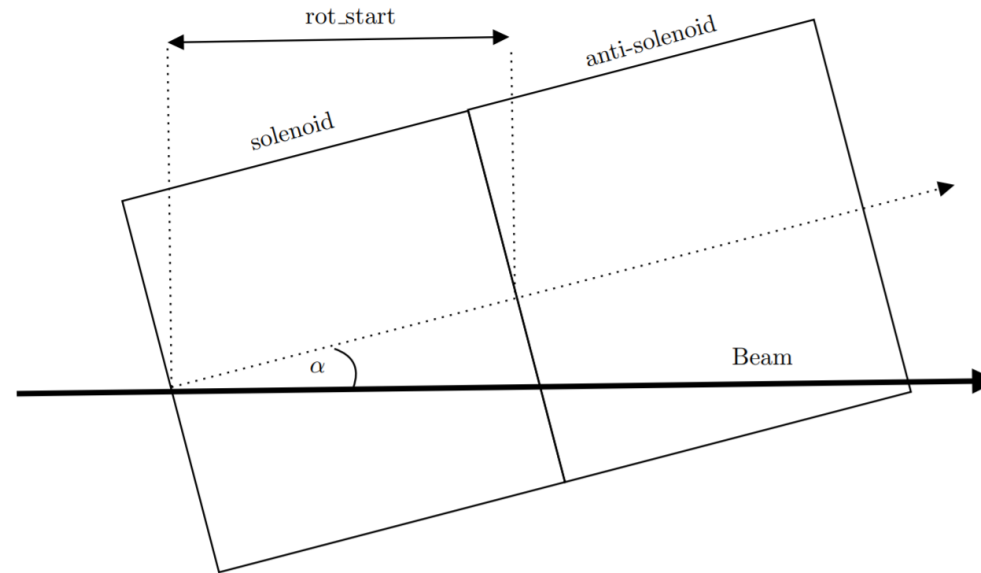




# Implementation in MAD-X

- Makes a transformation before and after the element
- Proposed by H. Burkhardt
  - 1. Tilt and displace the particle and map at entrance
  - 2. Track through the element
  - 3. Tilt and displace back the particle coordinate to the normal reference frame
- The map used can be found [here](#)
- We get the TWISS parameters before and after the tilt

# Example of how to use in MAD-X



Lsol =1;

Sol\_strength = 0.013;

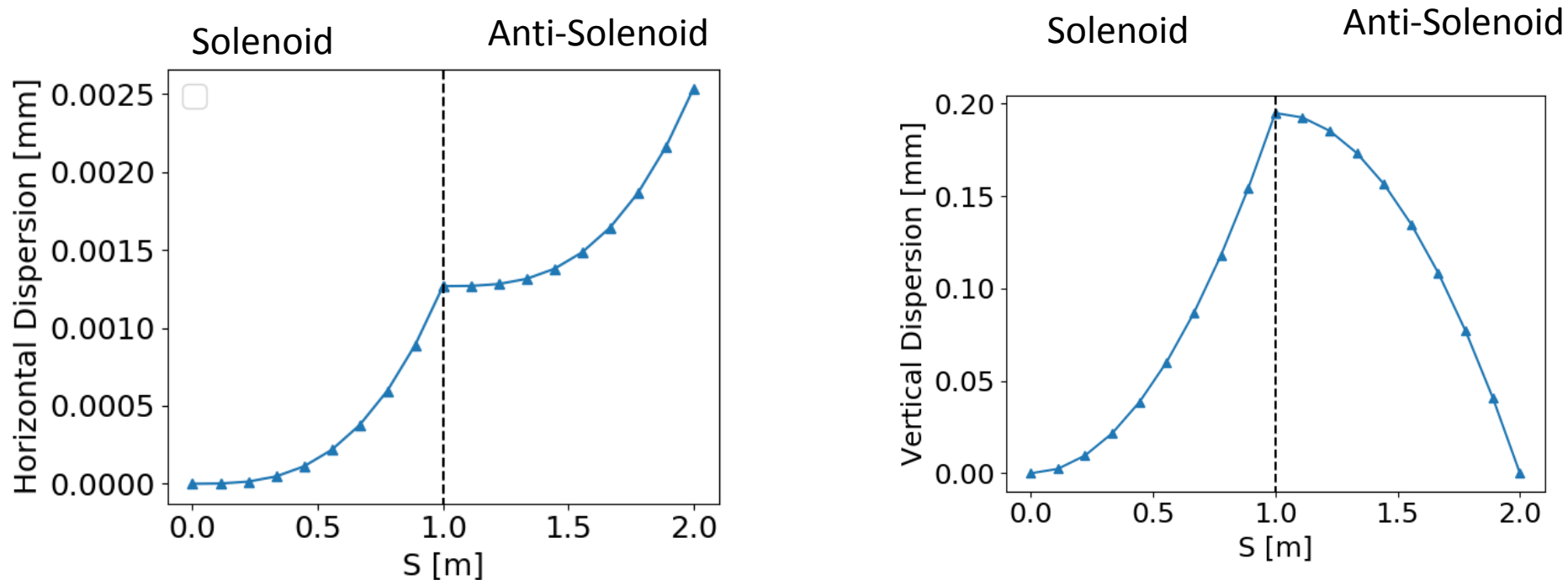
Alpha = 0.015

so : solenoid, L = lsol, KS = Sol\_strength xtilt= alpha;

anti : solenoid, L = lsol, KS = Sol\_strength , xtilt= alpha, rot\_start=len;

# Results

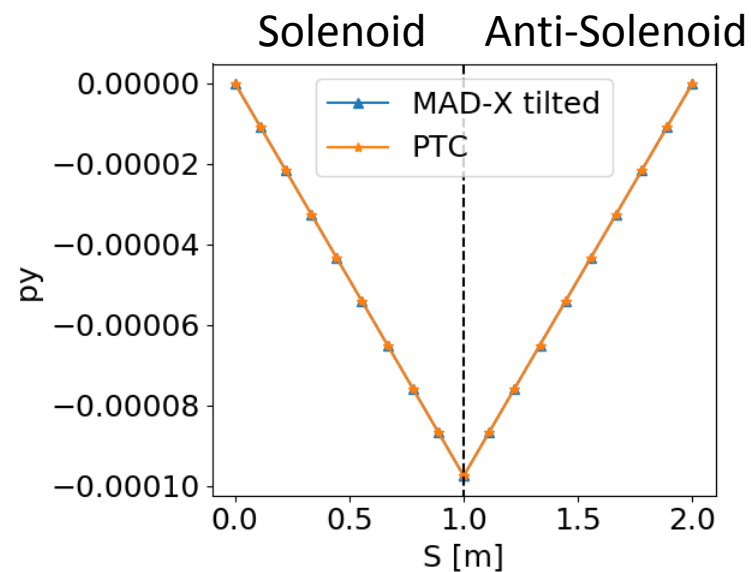
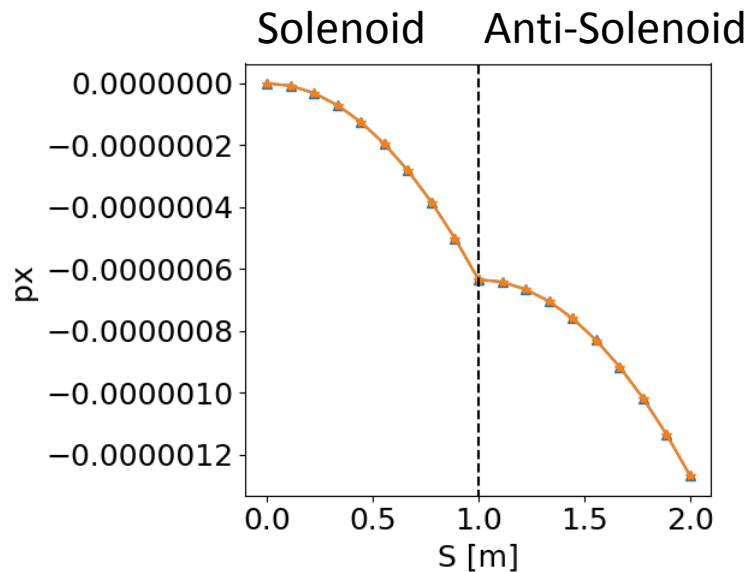
Every data point is created through changing the length of the solenoid and anti-solenoid after 1 m since intermediate points would otherwise be in the tilted frame



- Horizontal is small but not corrected by the anti-solenoid (even in the ideal case)
- Large vertical dispersion but well corrected with the anti-solenoid
- Careful studies of what is needed in terms of alignment and field quality are essential

# A more general approach

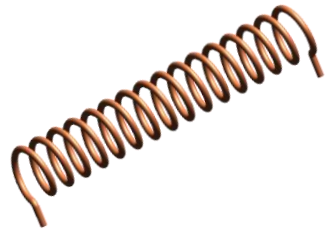
- We are currently implementing permanent misalignments of elements in MAD-X
  - Any element can be rotated and translated (defined in the sequence)
  - Translated into PTC



Good agreement between the two methods and codes but more checks are needed



# Conclusion and Outlook



Collaboration is welcome

## A tilted solenoid is available in MAD-X to be used

A more general implementation is also on-going which can be used for all elements

## Still things to investigate and implement:

- Slicing of the tilted solenoid
- Modelling of the solenoid fringe fields
- Overlapping fields with the solenoid
- [Continue the comparison to direct tracking methods](#)
- Studies on the impact in terms of coupling, dispersion and emittance of the tilted solenoid together with field errors

Thank you for your  
attention!

