

Tools, tracking with losses, MAD-X

following the [MDISim](#) concept :

use whenever possible existing tools (MAD-X, ROOT, GEANT4)

improve + interface

- **MAD-X update**, <https://github.com/MethodicalAcceleratorDesign/MAD-X>
- **sample FCC-ee sequence and job with two beams, apertures and solenoid, on [GitLab](#)**
- **tracking with losses over several turns based on transformation from [MAD](#)**
- **general interface for beam generation + and particle scattering generators**
- **as starting point applied to thermal photon scattering all around ring**

MAD-X code improvements in close collaboration with Tobias Persson / BE-ABP

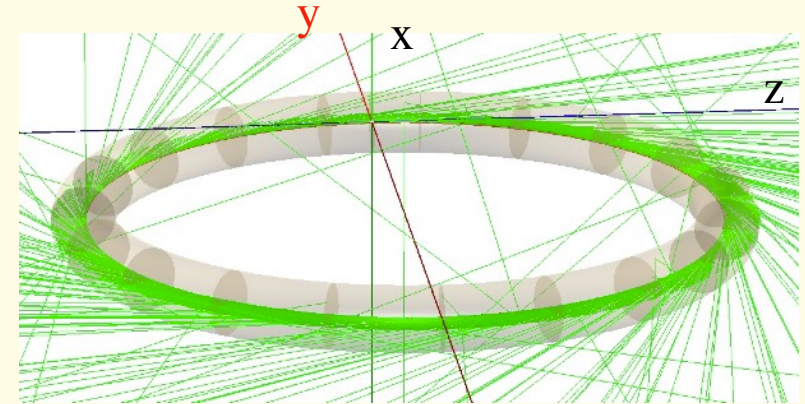
- Comments in sequence files, written by TWISS to TFS output
provide all essential information for tracking with losses including Material type and thickness
`mb, apertype=circle, aperture:={ aper }, comments="Material_is_Cu,Thick_is_0.1";`
- Synchrotron radiation, benchmarking, MAD8, A. Latina + J.Jowett, spectrum generator H.B.
- Solenoid, new parameters `xtilt, rot_start` by T.P. based on my [9/2017 proposal](#)
- MAKETHIN, extended flexibility, thin slicing for all element types + selected thick slicing for bending magnets, quadrupoles, solenoids
- Sample job on [GitLab](#) with two beams, apertures and solenoid [job fcc ee.madx](#) started from ML+HB based on recent K. Oide sequence

outstanding :

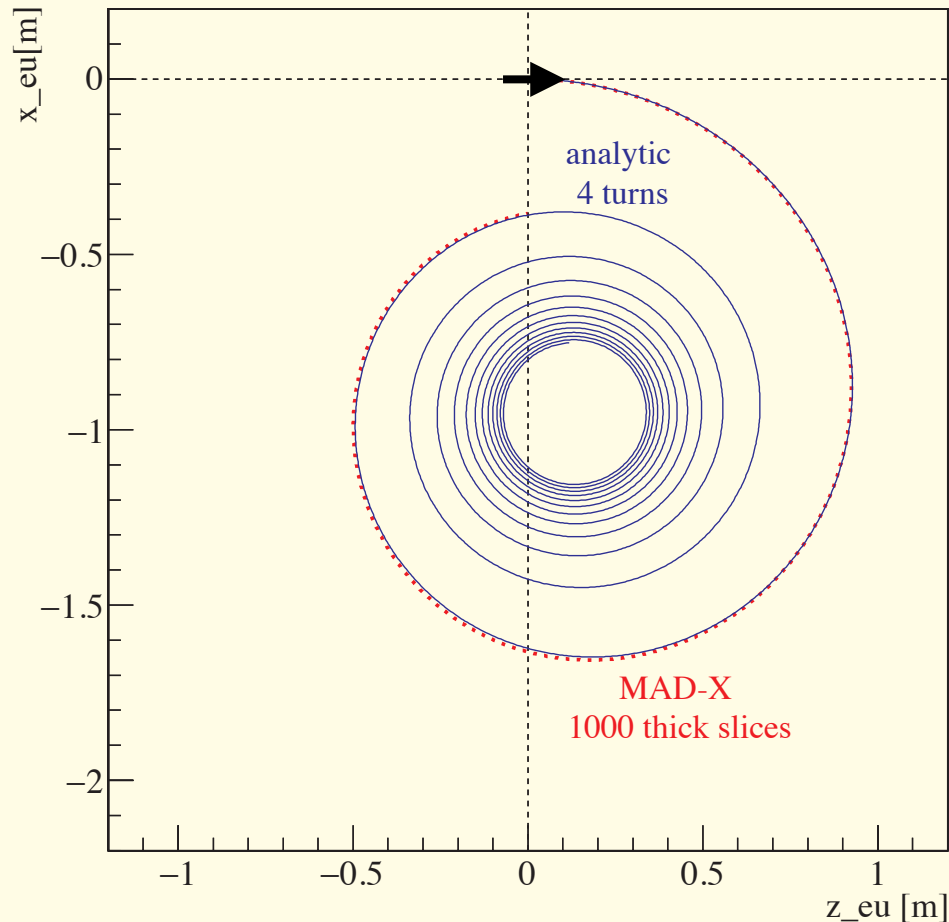
overlapping fields — when really needed (I.R.) by hand on MDISim / G4 level, Marian+H.B.

Uniform field in **y**-direction, circular motion in x-z plan
 tested with very strong SR

MDISim Geant4 TestEm16



1 turn damping time (e^+ , $q = 1$ m, $p = 22.443$ GeV)



Spiralling, comparison

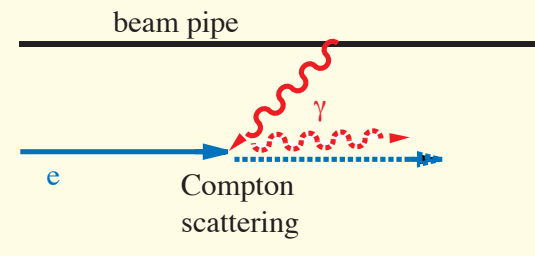
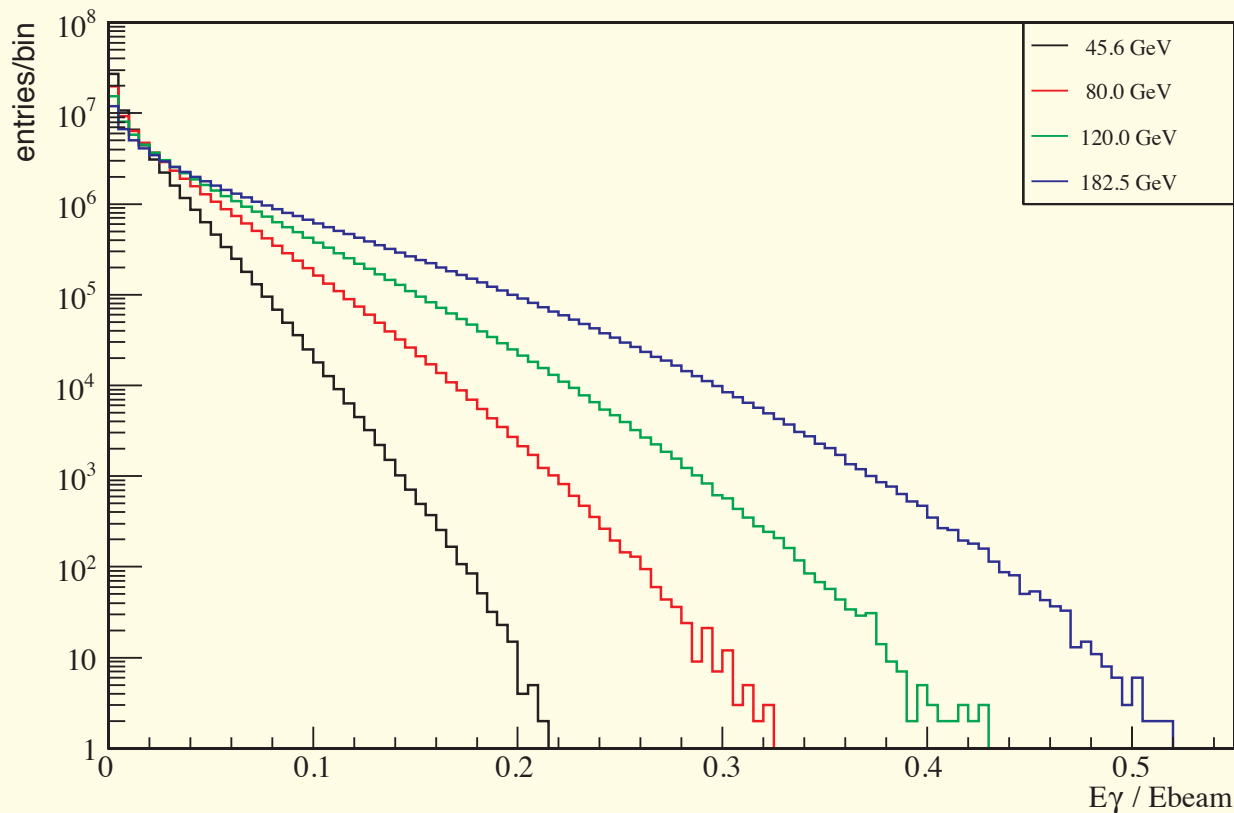
- analytic
- field stepping
- Geant4

match within plot resolution /
 photon statistics

also good agreement with MAD-X
 when using many thick slices

Algorithm of [SL/Note 93-73](#) (main single beam lifetime limitation in LEP)

with C++ multithreading now 10^8 events in < 10 secs



Ebeam GeV	σ barn
0	0.665246
45.6	0.649864
80	0.63886
120	0.626924
182.5	0.609609

26.2 h

Fraction lost, at 2% energy acceptance, increasing from 19% at 45.6 GeV to 54% at 182.5 GeV

Studies of photons require eu-geometry, done with MDISim + Geant4 around IP up to ~ 1 km complement with charged particle tracking in cs-system using MAD-X sectormaps beam generation as [presented](#) in FCC-ee MDI meeting#12

MDISim : Transformation eu-cs, normalized - real space, GEANT4 / accelerator tracking interface with scattering all around the ring (at element boundaries - if required with slicing) driven by tfs-input form MAD-X + flexible run parameters start / end., #particles, beam shape

First impressions :

off-momentum particles lost all around the ring, some concentration at peaks of dispersion

~ only locally produced off-momentum particles lost in IR region

quantitative estimates on the “to-do” list, not expect a major issue

many detailed studies (example injection induced) background remain to be done

Design details remain to be defined (example collimation) and likely changing with time

Importance of proper flexible tools !