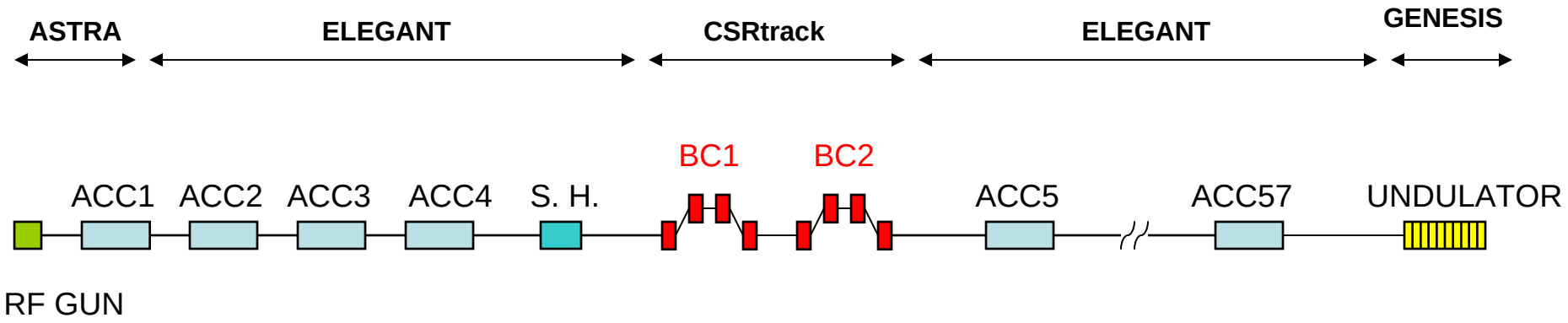
# XFEL simulation with Genesis

- Machine layout
- Input files
- Steady state simulation (effective $P_{in}$ = 2 kW, single wavelength)
- Time dependent simulation: Elegant2genesis beamfile (5 days - 16250 slices)
- Time dependent simulation: Elegant distfile (5 days - 16250 slices)

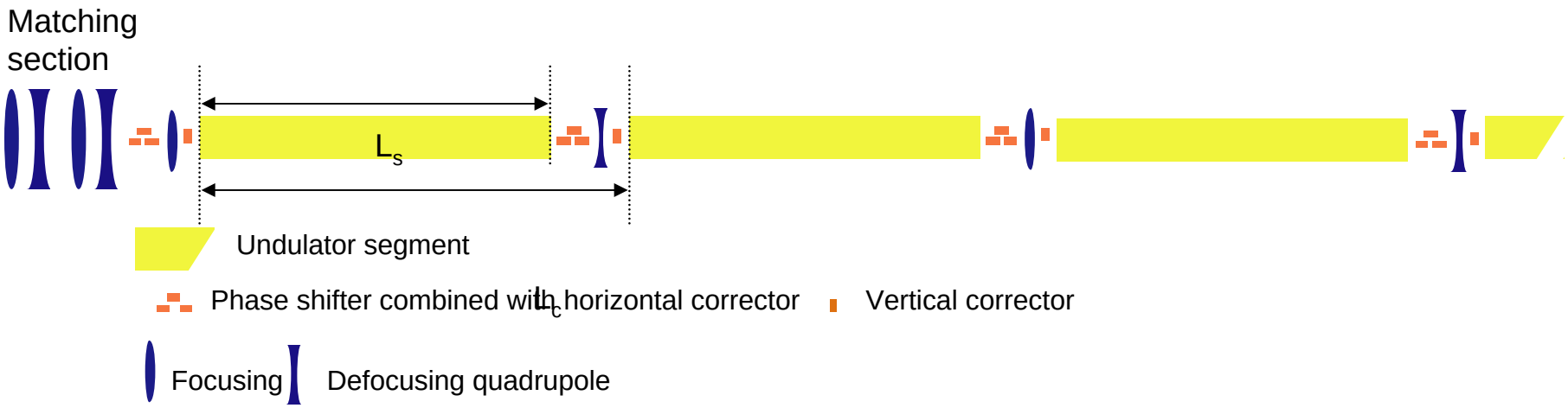
# XFEL SCHEMATIC (3rd Version, ESFRI Oct 03)

200k particles
Injector TTF2 40 MV/m ATRA up to end cavity #7 in ACC1
Elegant up to the entrance of the double chicane
CSRtrack in chicane and then Elegant up to undulator entrance




- **RF GUN : 40 MV/m, -2.773 deg w.r.t max energy gain**
- **ACC1 : 4 × 13.00 MV/m, -25.0 Deg and 4 × 20.22 MV/m, -20.8 Deg**
- **ACC2 to ACC4 : 20.22 MV/m, -24.3 Deg**
- **S.H. (3.9 GHz cavity) : 32.5 MV/m, 160.6 Deg**
- **BC1 : 4.25 deg, R56=100.7 mm**
- **BC2 : 0.93 deg, R56=4.8 mm**
- **ACC5 to ACC7 : 21.65 MV/m, phase max energy gain**

# Undulator description




Matching described by Yujong Kim
Phase shifters not included (auto-match by Genesis)
Quadrupole length/strength adjusted to increase stepsize

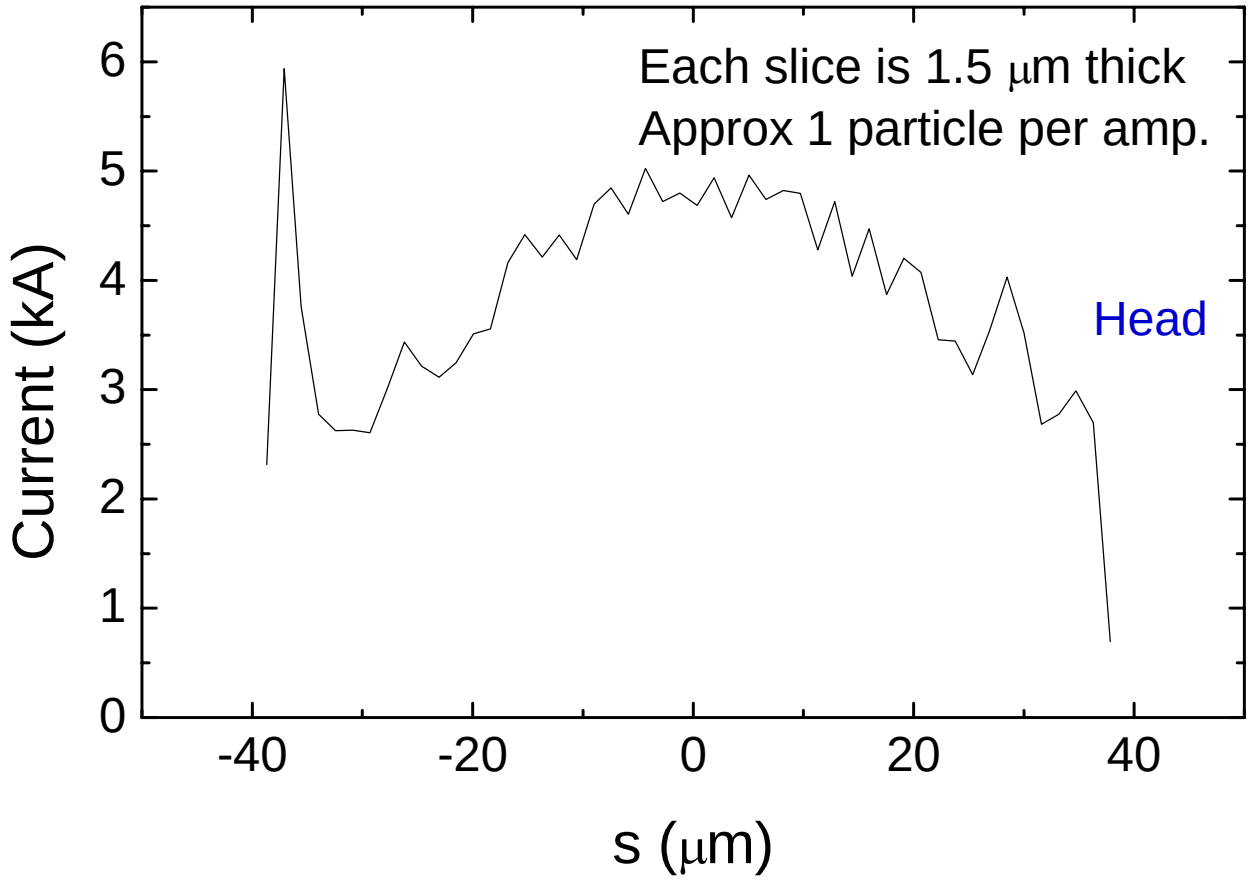
# Input files

NAMELIST input
Lattice file describing focusing structure
Beam description:
- Internally generated
- Elegant2Genesis slice information (beamfile, reformatted)
- Elegant distribution file (reformatted)

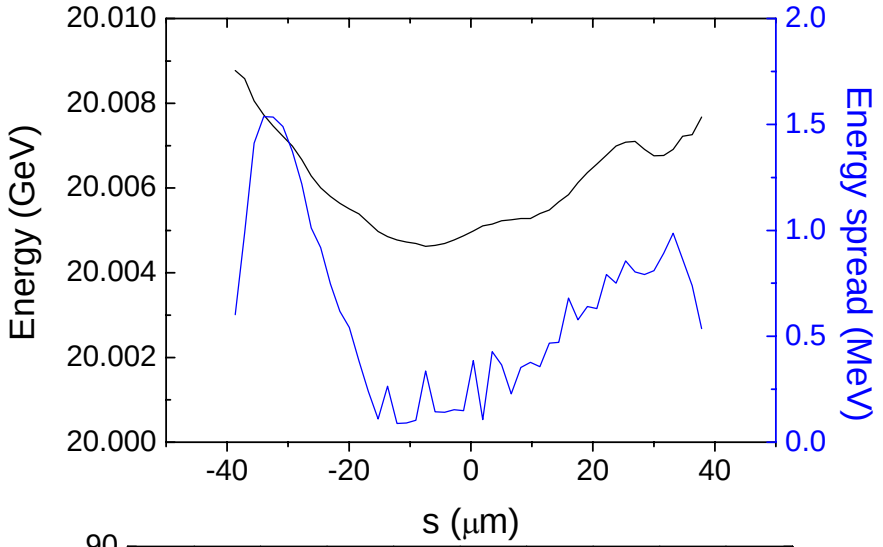
Beamfile: global beam parameters given, actual distribution for each slice generated internally by Genesis is Gaussian

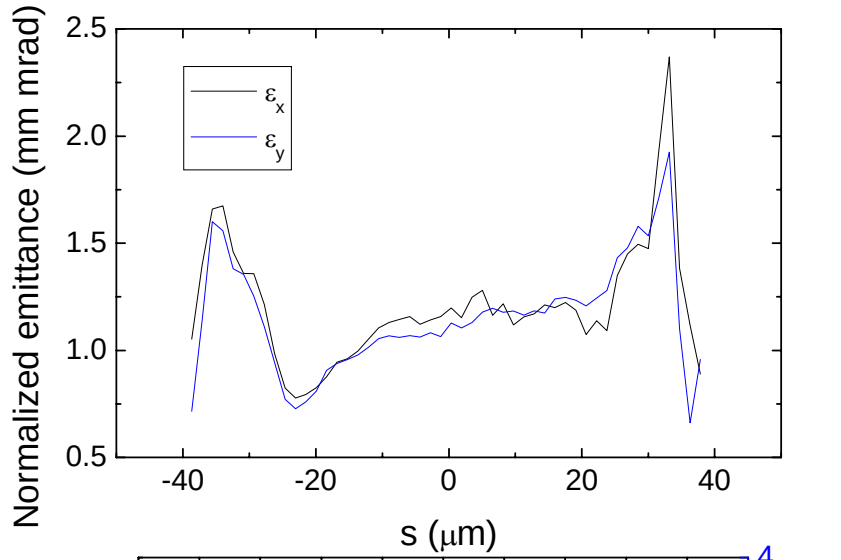
# Not included

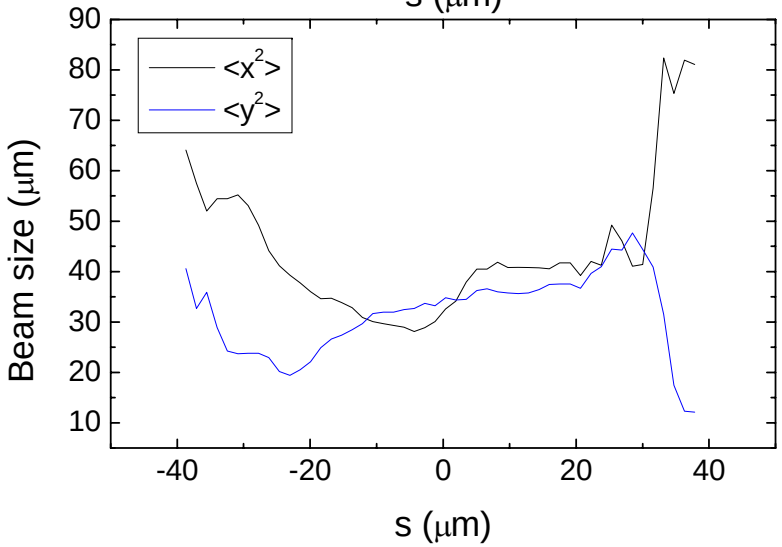
Space charge: could be included, takes CPU time
Wakefields: can be included in beamfile, not (?) in distfile
Quantum fluctuations: could be included

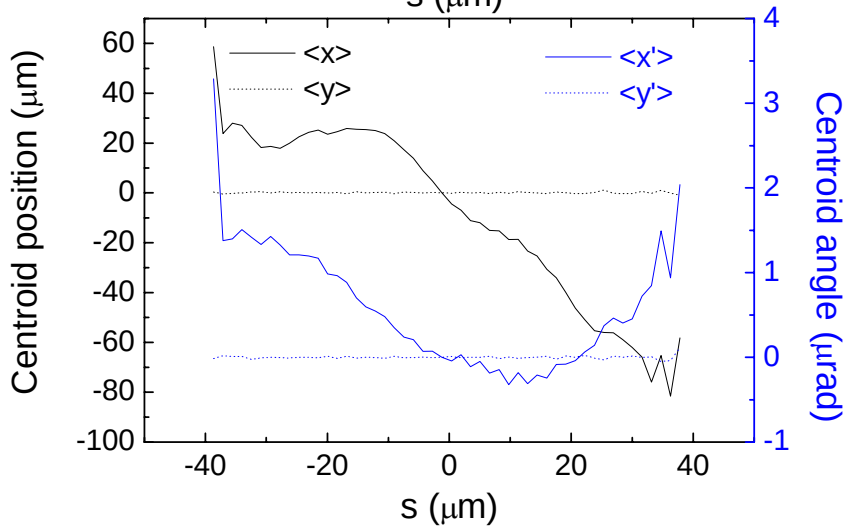

Each slice is 1.5 μm thick
Approx 1 particle per amp.
Head
Current (kA)
s (μm)
0
1
2
3
4
5
6
-40
-20
0
20
40

# Input distribution: beamfile (50 slices)

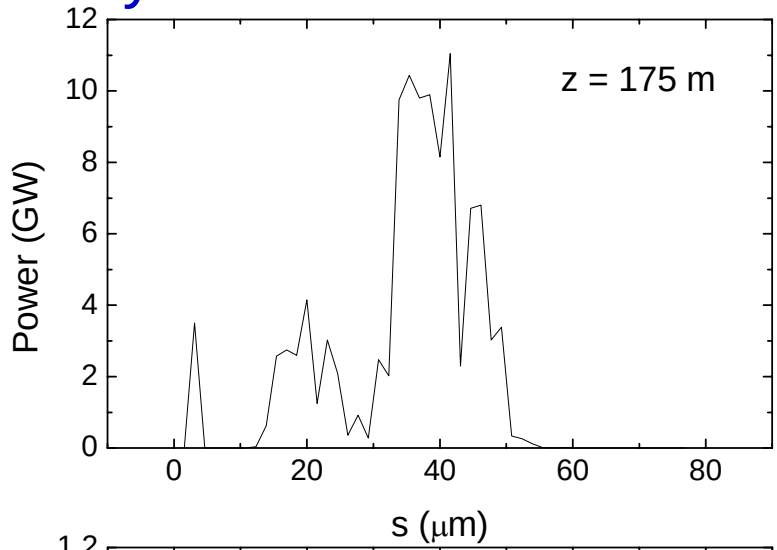


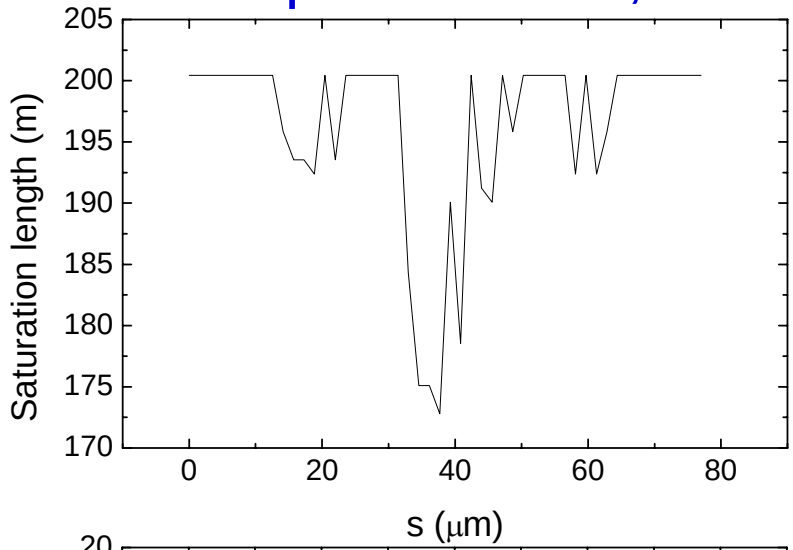



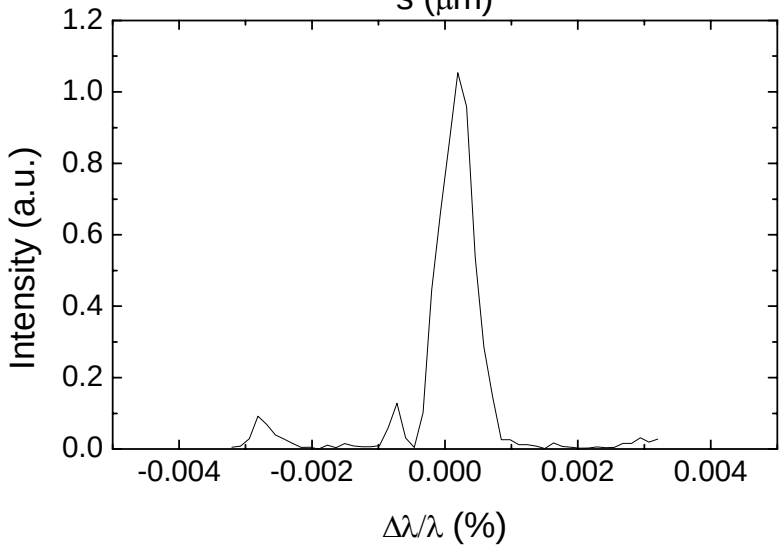



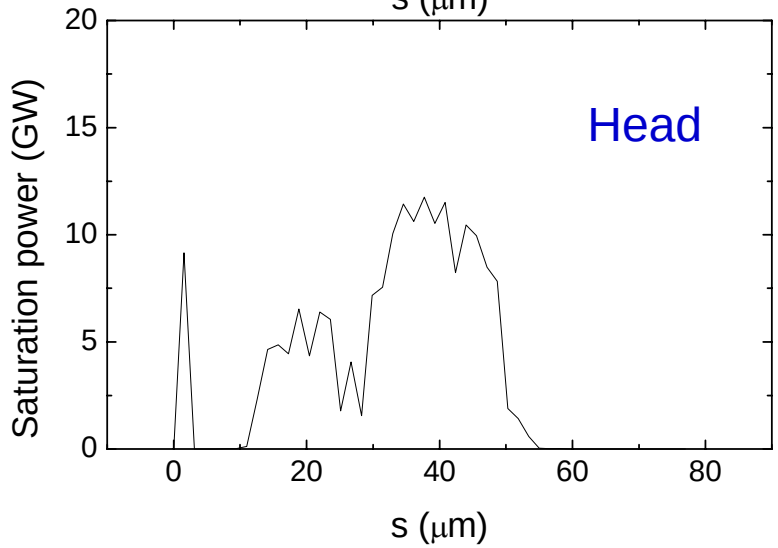



# Steady state: e-beam slice corresponds to a photon slice, 0.1 nm

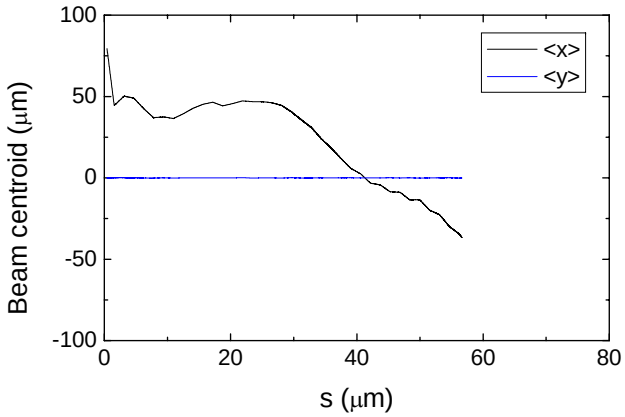


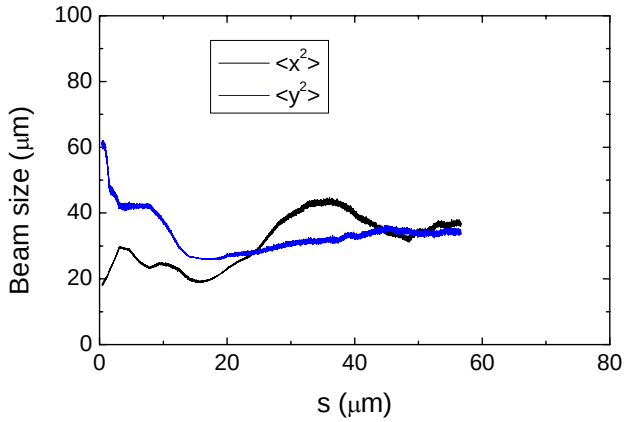



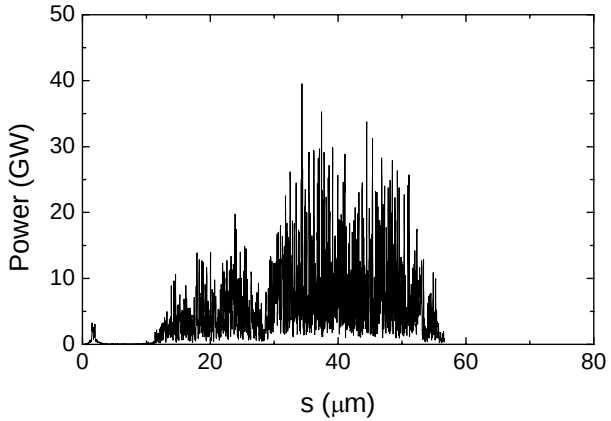



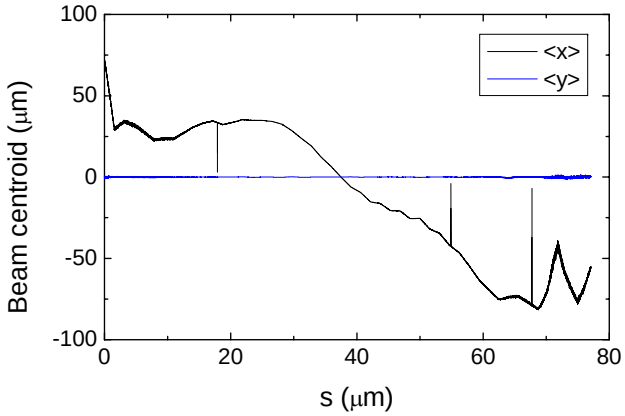
# Time dependent results with beamfile @ 180 m

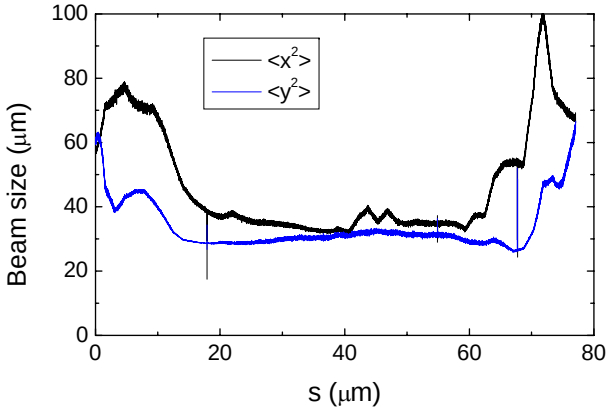


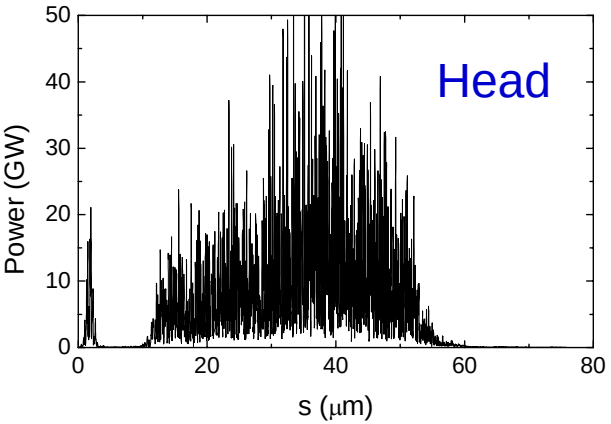




Direct from Yujong Kim output

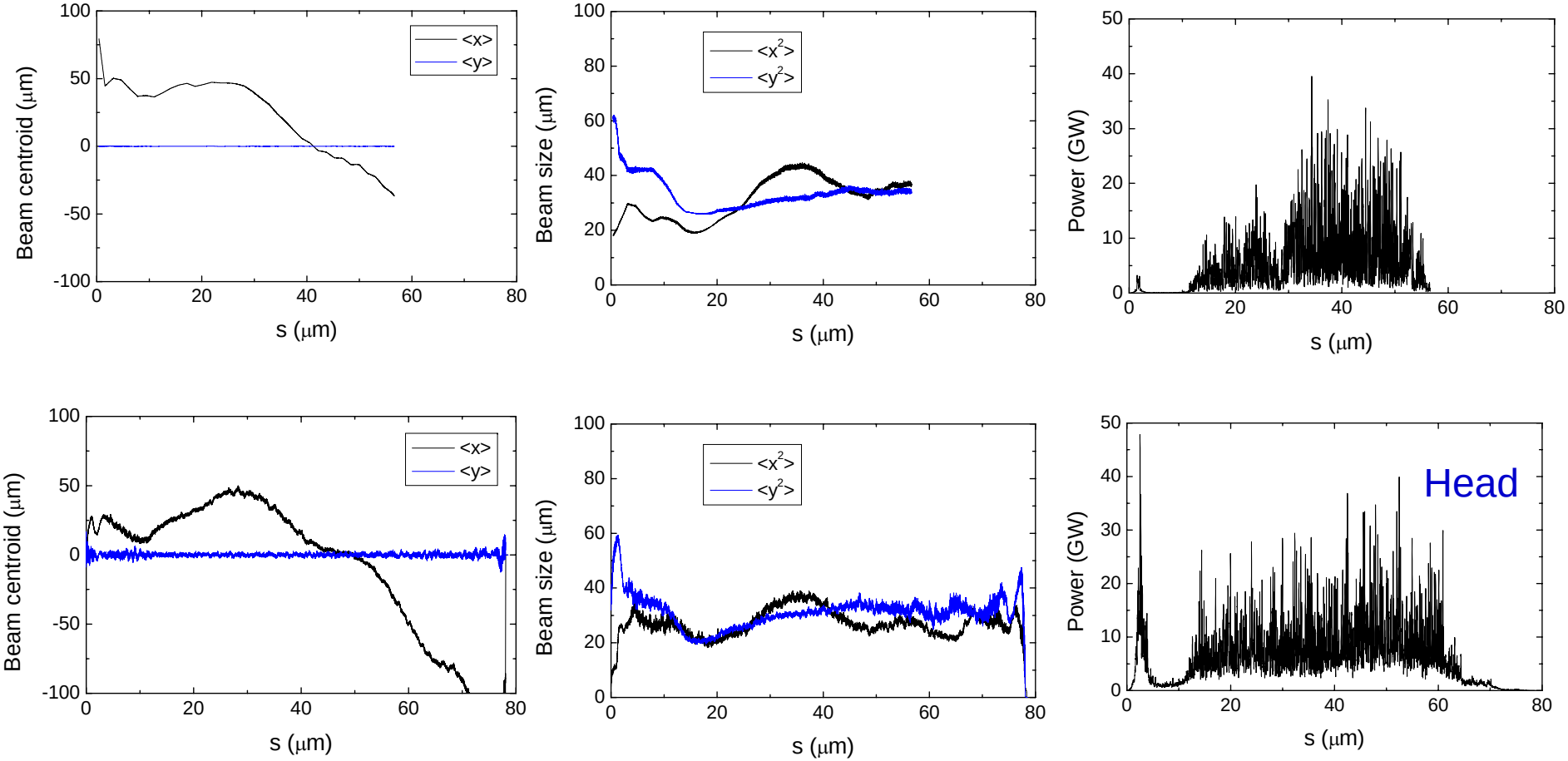


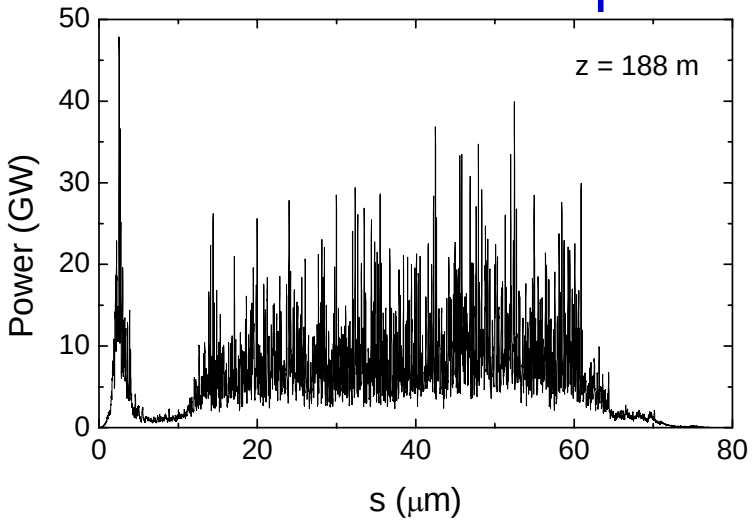

Optics/angle adapted

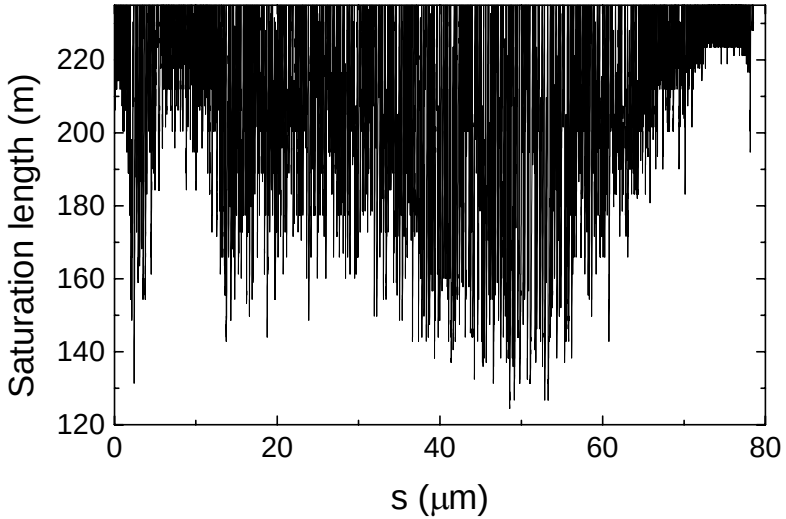
# Results compared beamfile/distfile @ ~180 m

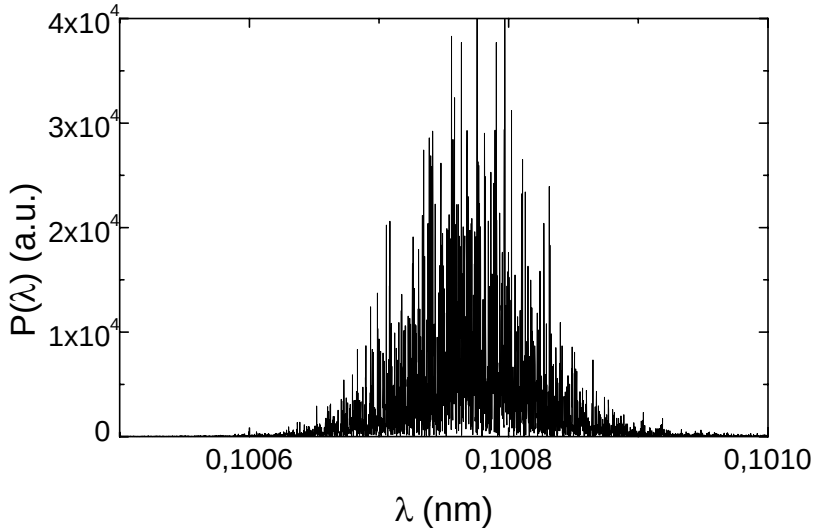


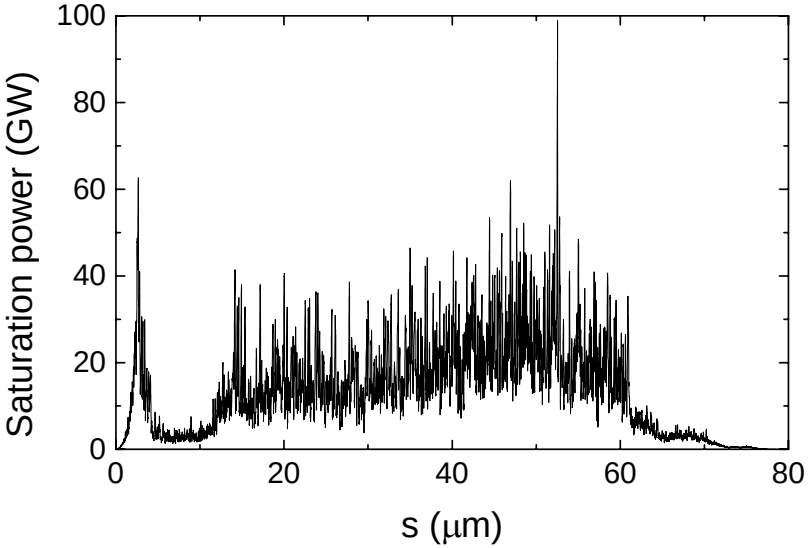

Beamfile: distribution cut into longitudinal slices, each slice in Genesis has Gaussian distribution
Distfile: 5D phase space directly taken from Elegant output in ASCII format (more particles needed)

# Time dependent simulation: DISTFILE

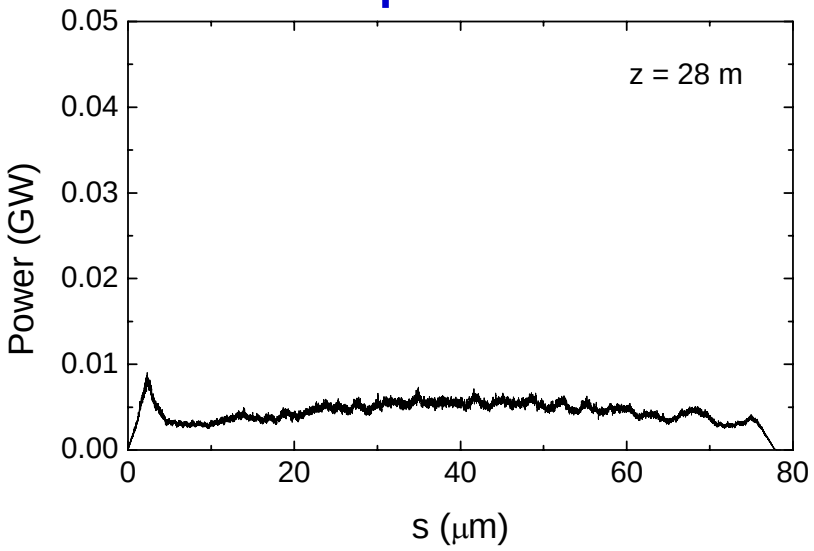


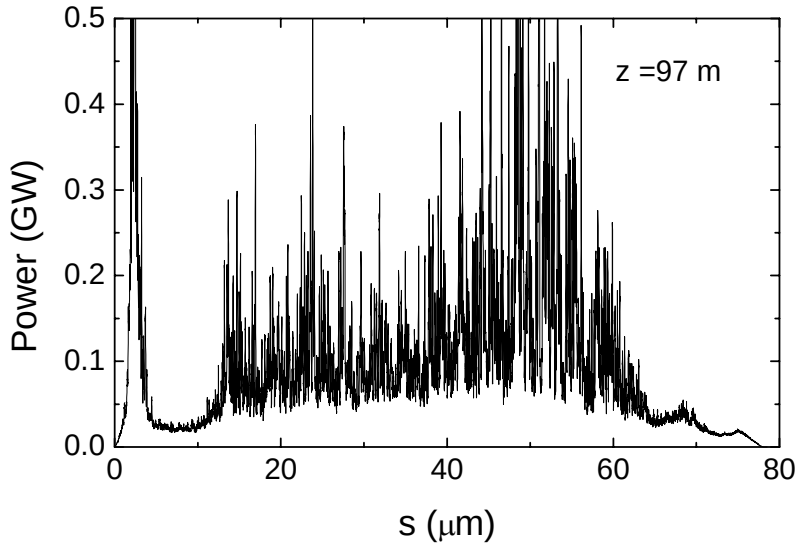



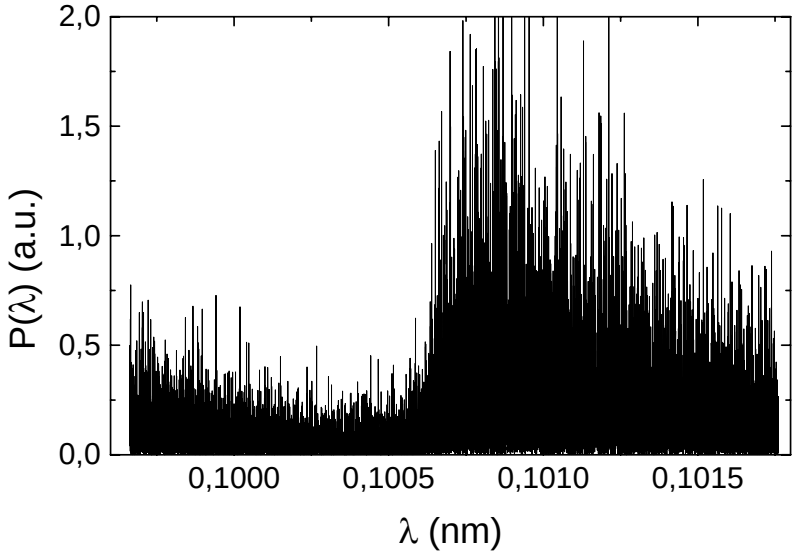



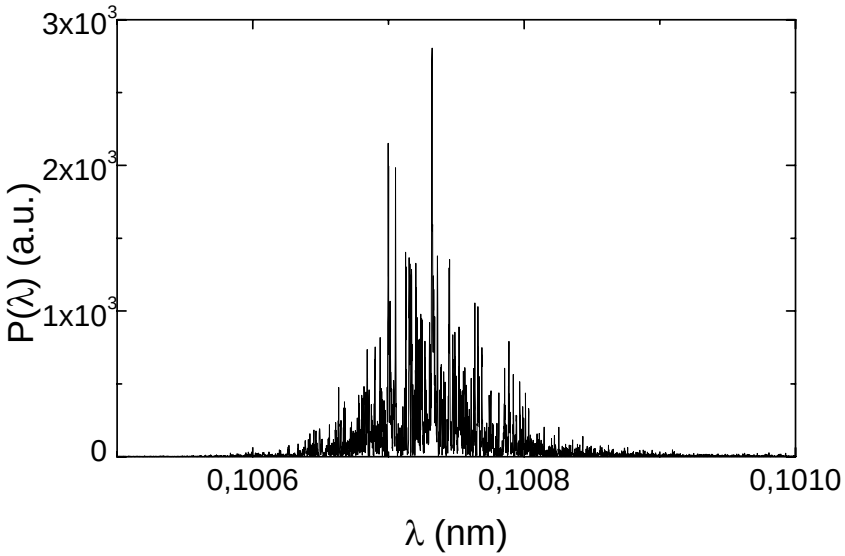



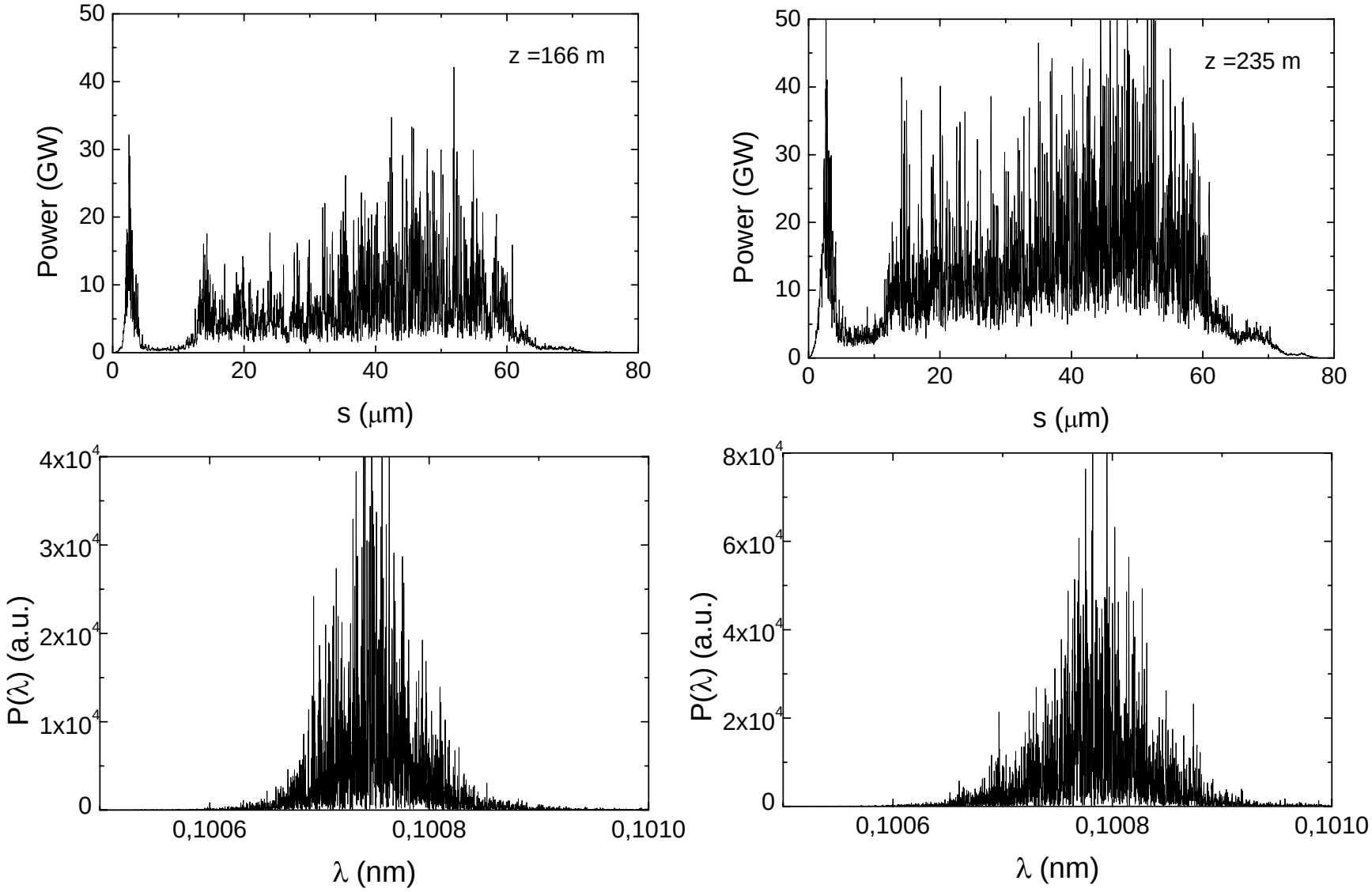
# Spectral results with ‘distfile’



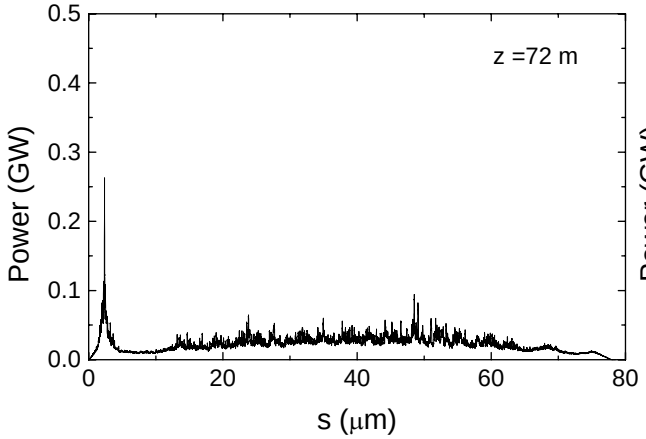



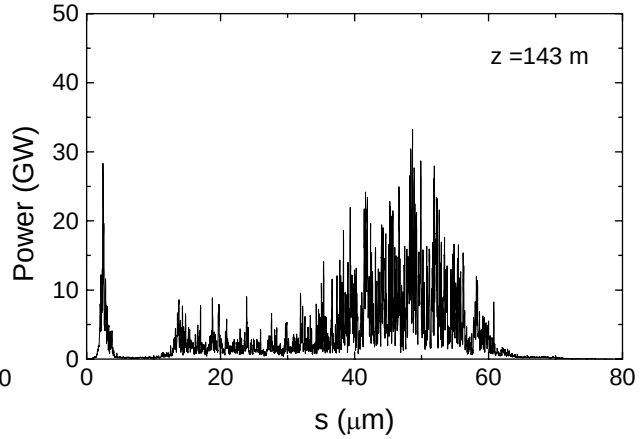



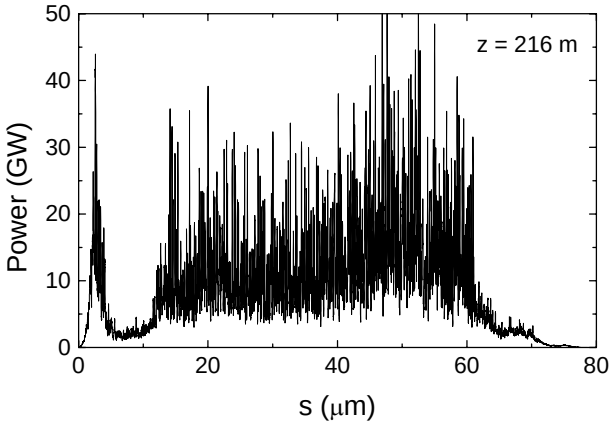




z =166 m
Power (GW)
s (μm)
z =235 m
Power (GW)
s (μm)
P(λ) (a.u.)
λ (nm)
P(λ) (a.u.)
λ (nm)

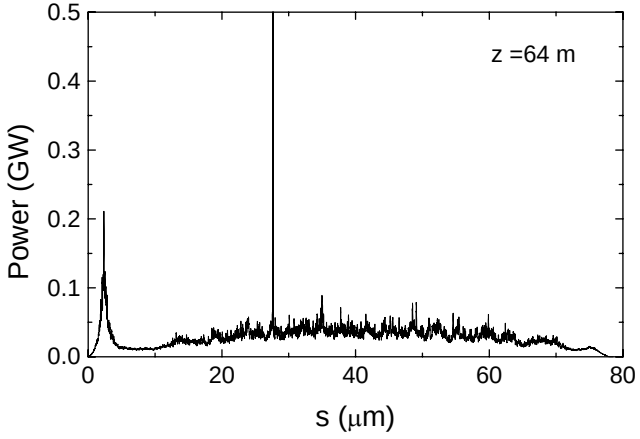
# Standard ‘undulator’

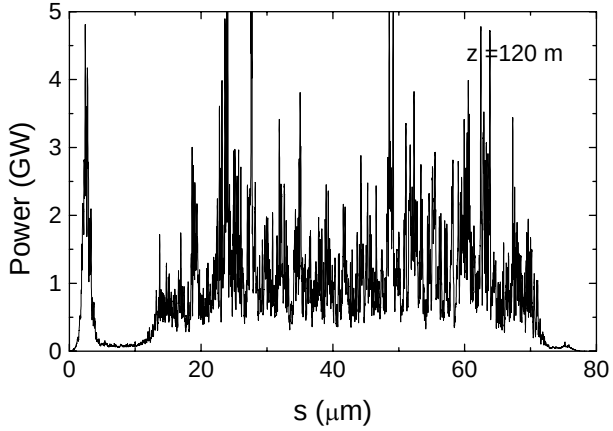


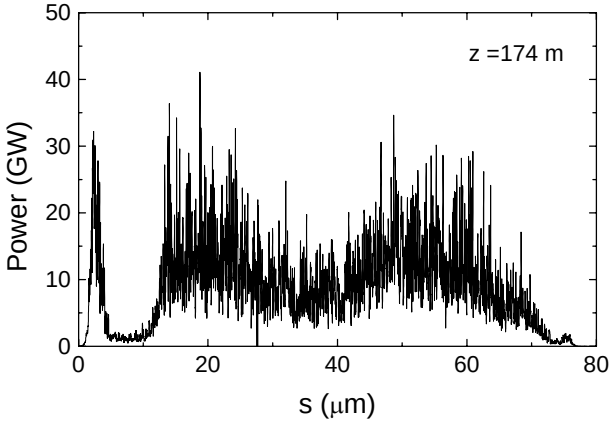



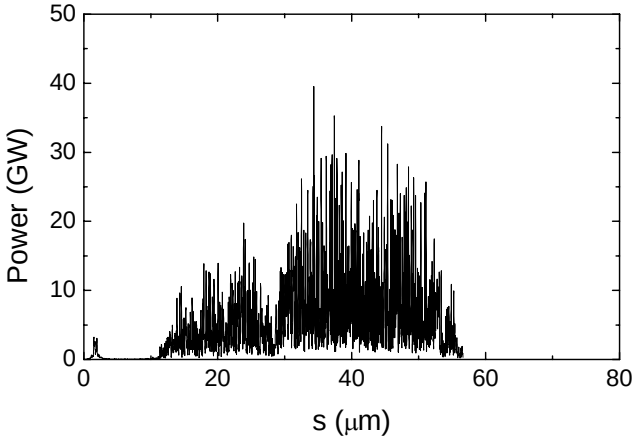

# Standard ‘shortened single segment undulator’ (matching?)

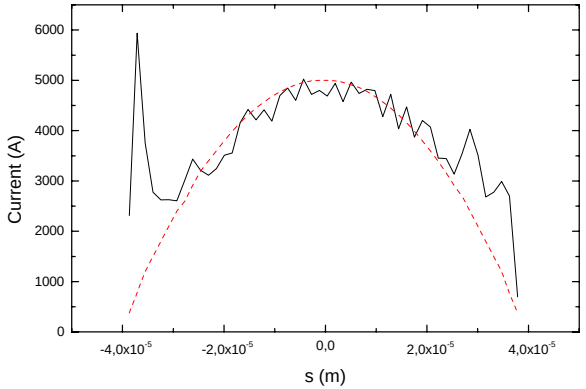


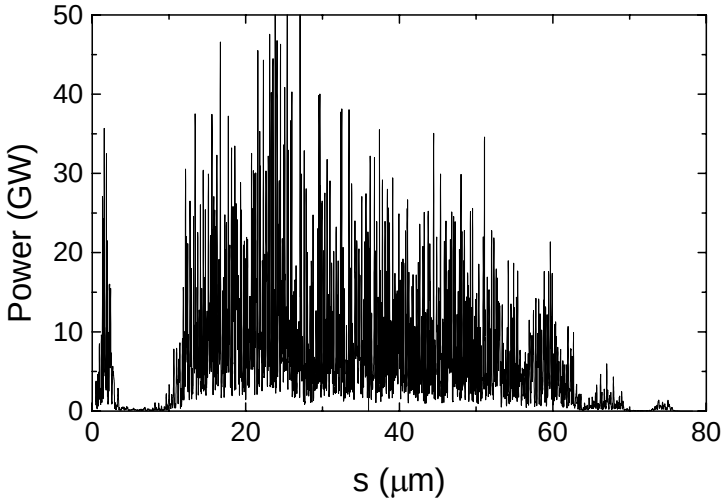



Simulation with beamfile @ 180 m

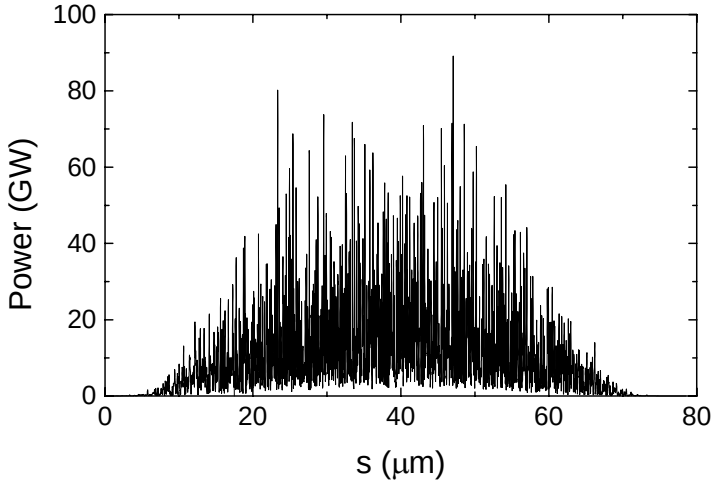



Same simulation with beam centroid/angle on axis (beamfile)




Same on-axis simulation with beam profile smoothed/matched



To be continued