OSC Radiation

- Use Lienard-Wiechert fields directly for calculation
- Compare with Lebedev paper

Lienard-Wiechert Code

- Assume electron moves in undulator sinusoidally in x, sinusoidally in z with constant drift and doubled frequency
- Use position, velocity, acceleration, to get field at lens 6m from center of undulator – assume lens has 1 cm radius, 3 m focal length, only permits passage of 1^{st} harmonic
- Integral over lens gets field when light is focused
- A telescope configuration should give perfect focusing at all points

Results for Field

- Use undulator with 1 micron radiation, six 30 cm periods
- From one electron, field in 2nd undulator should peak at 30.6 V/m
- Lebedev predicts ~30 V/m

Results for Energy Transfer

- If constant field amplitude, in phase with electron's transverse motion, energy transfer is ½ e |E| |v| ΔT = 92 meV

- Lebedev predicts ~69 meV – extra factor to account for variable relative phase between light and electron (longitudinal speed not constant)

- Don't think this is wanted in our case – light is made by electron itself and focused to where electron will be in 2nd undulator

Future Work

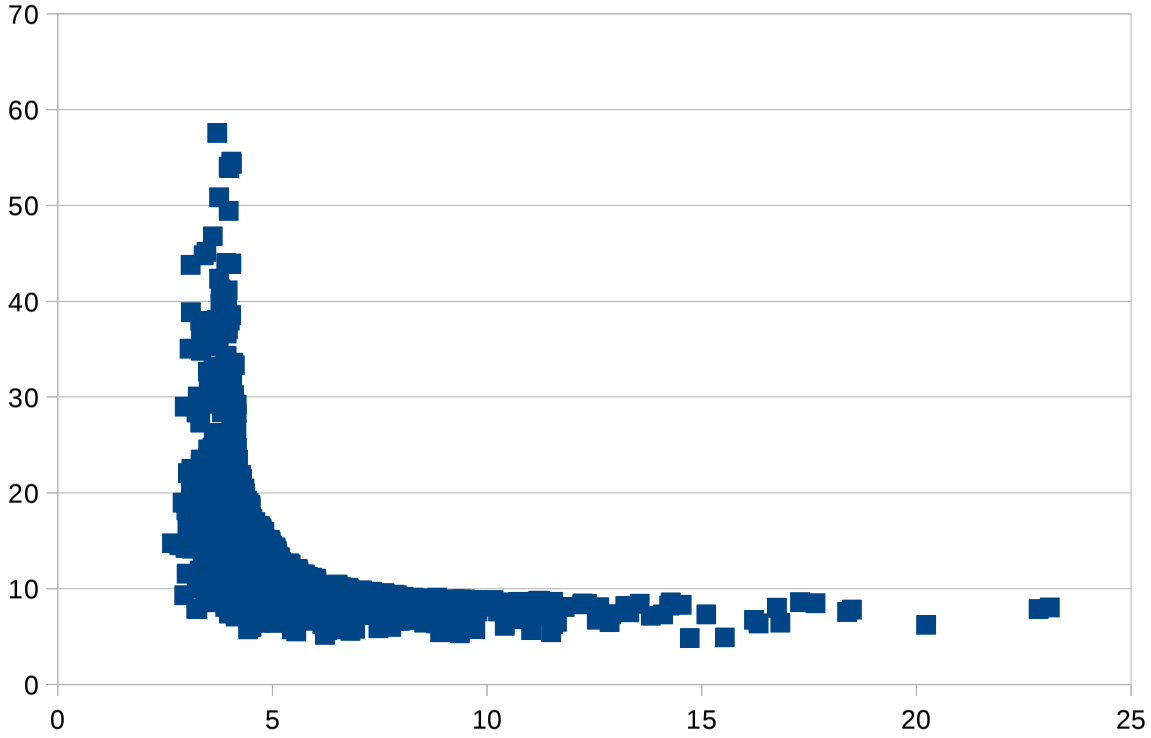
- Vary undulator geometry and energy, see effect on energy transfer

- See effect of electron being off-axis – may be easier with SRW to see fractional changes, if not absolute scale

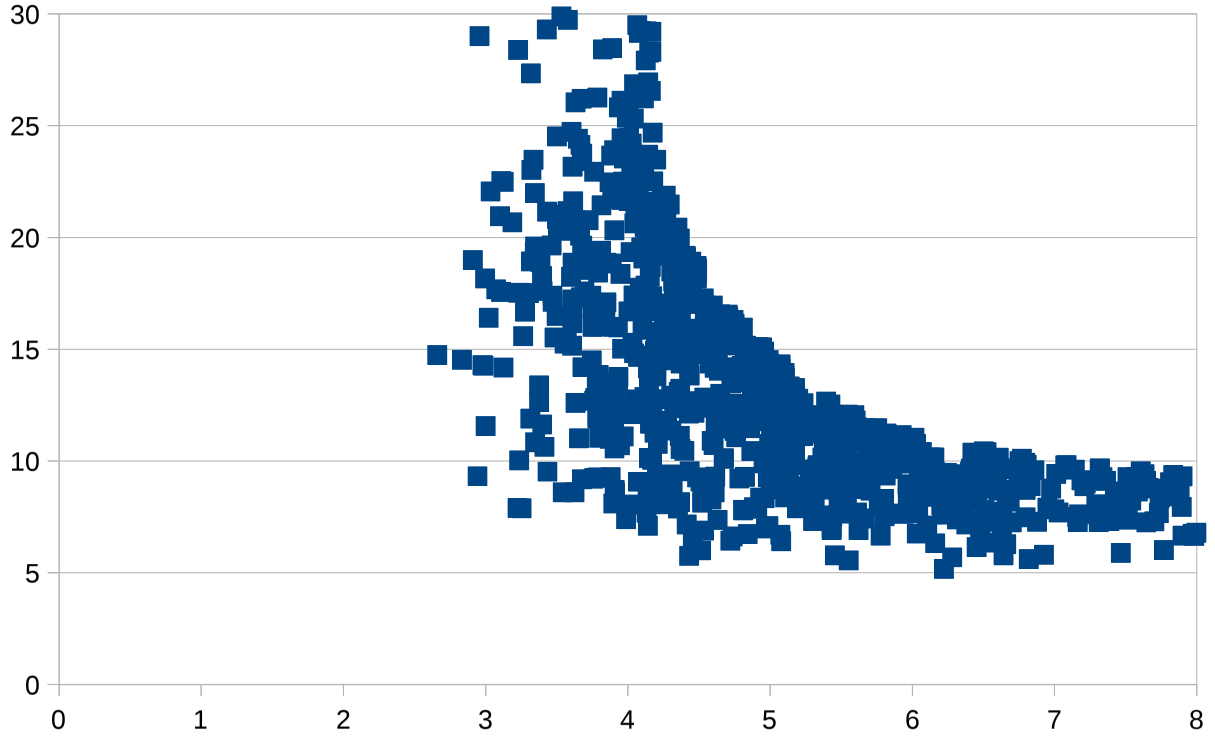
Sloppy Models

- Began applying PISA to emittance-tuning problem
- 2 objectives are minimize emittance and minimize sum of squares of vertical orbit at our BPMs
- Experiment with using both emittance knobs and raw magnet values as genes

Use Raw Magnets as Genes (1,000 pop, 100 generations)



Use Raw Magnets as Genes (1,000 pop, 100 generations)



Use Emittance Knobs as Genes (1,000 pop, 100 generations)

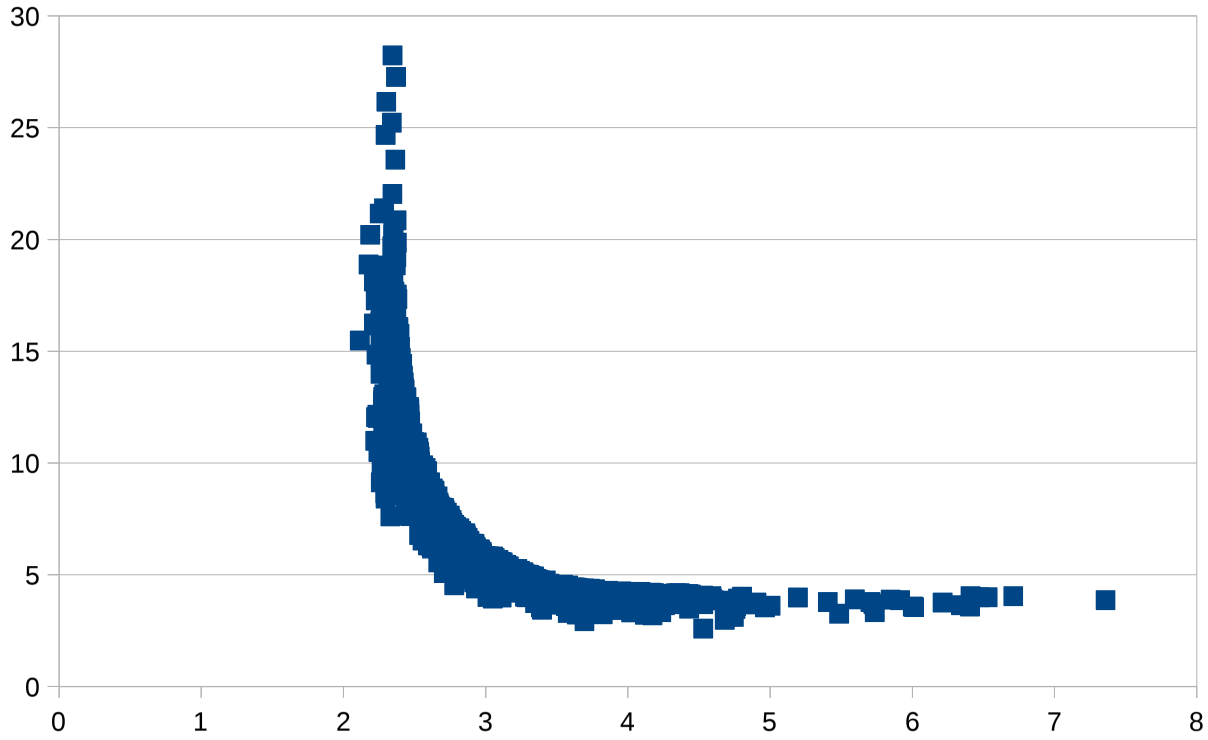


Table of Results

	min_emit (pm)	min_orbit (mm^2)	corner_emit (pm)	corner_orbit (mm^2)
Initial Values (Only Jim's Tuning)	6.18	2.33	6.18	2.33
8-Knob Tuning (Not Genetic)	2.50	27.32	2.50	27.32
Full Step	89.00	468.57	89.00	1074.77
1/10 Step	4.87	9.05	4.99	14.91
1/100 Step	4.62	2.01	4.78	2.59
4e-5 Knobs	3.67	6.81	4.38	9.64
1/10 Step, Many	2.66	4.85	3.25	7.88
1/100 Step, Many	3.28	1.78	3.54	2.65
4e-5 Knobs, Many	2.11	2.59	2.67	5.56

“Many” refers to 100 generations, 1,000 population – otherwise, we used 10 generations and 100 population

“Knobs” refers to use of knobs as genes – otherwise, we use raw magnet values

For raw magnet values, a “step” is 4e-4 for kickers, 6e-3 for skew quads

Min values are the minimum obtained for each parameter, while corner values are the values of some specified individual with relatively low emittance and orbit

Future Work
(or ideas for Cameron)

- Experiment with other combinations of magnet misalignments
- Determine optimal ranges for magnets/knobs
- Determine tradeoff between generations and population
- Do we also want knobs for orbit, or some combined emittance-orbit knobs?
- Add realistic measurement errors