

-Tune scans until now have not accounted for space charge effects

-Presently incorporating the space charge BMAD module into the tune scan program to analyze the effects of space charge on the fractional tunes at and around the current working point

## Details

-Lattice used: ctf\_12wig\_v4c\_s2.lat

-All tune scans were over the same region in the tune plane:

Horizontal: 0.53 – 0.63

Vertical: 0.58 – 0.68

(Currently operating at 0.57 horizontal, 0.62 vertical)

-Scans were run for bunches with 0.5E10, 1.0E10, 1.5E10, and 2.0E10 particles

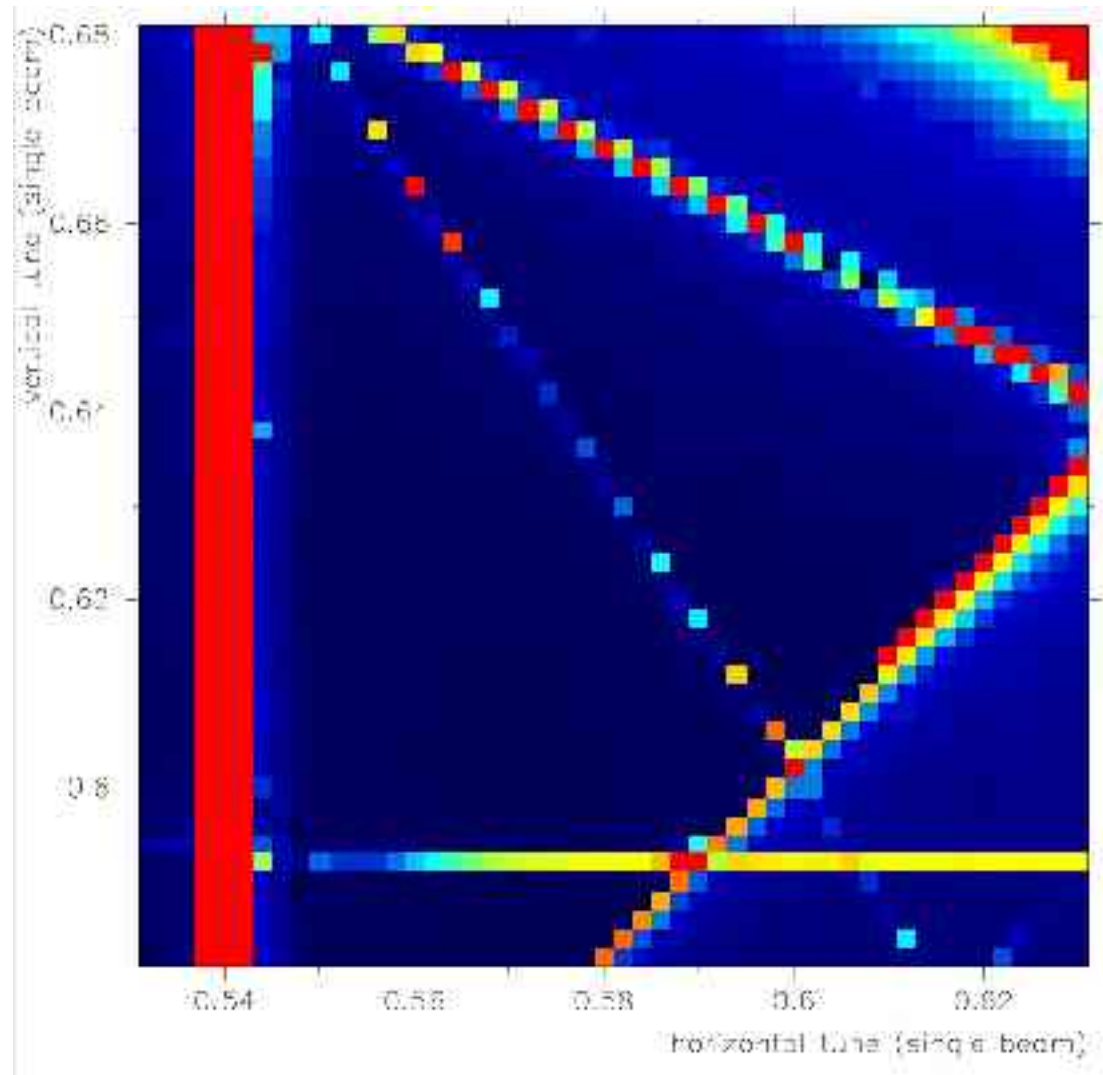
-Emittance values were assigned using two methods:

- 1) Calculating a-mode from radiation integrals, and assigning b-mode
- 2) Assigning both a- and b-mode values based on IBS studies (Ehrlichman) for a specific number of particles

n_part	Horizontal	Vertical
0E10	2.5nm	5pm
0.5E10	3.5nm	8.1pm
1.0E10	4.3nm	10pm
1.5E10	5.2nm	11.5pm
2.0E10	5.8nm	13pm
No IBS	2.5nm*	10pm

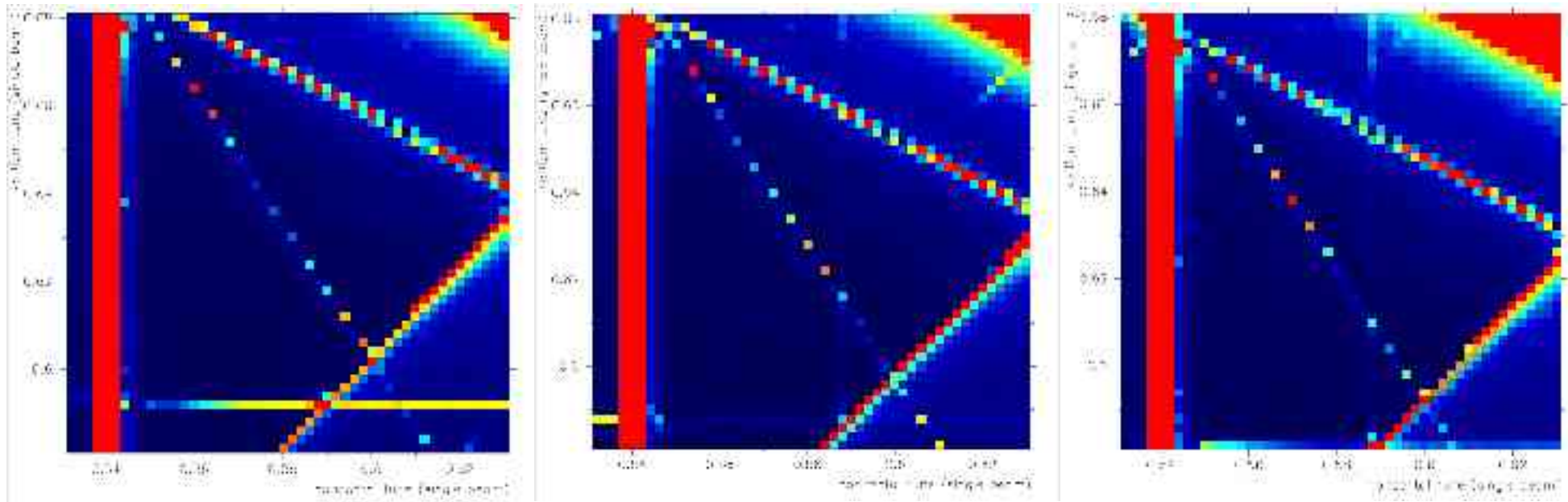
\*Calculated from radiation integrals

# Without IBS – No Space Charge Effects



(0mA current)

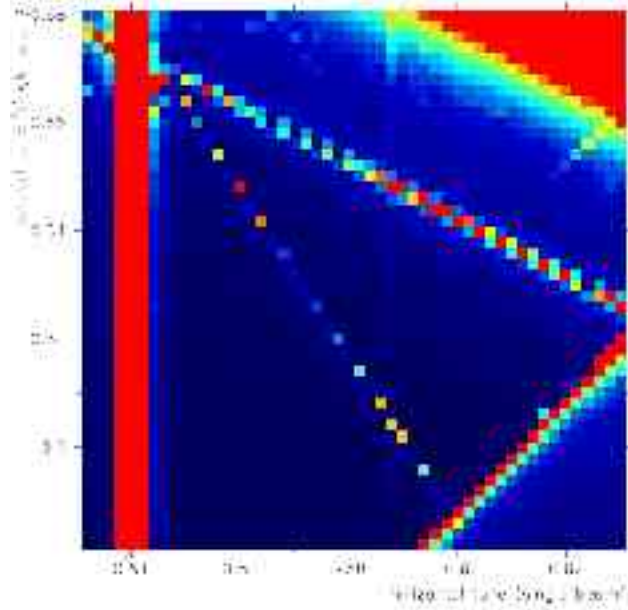
# Without IBS – Space Charge Enabled



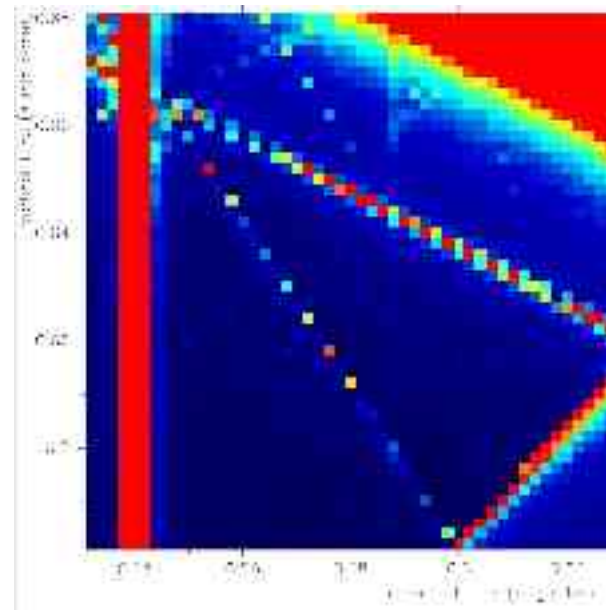
0mA

0.5E10

1.0E10

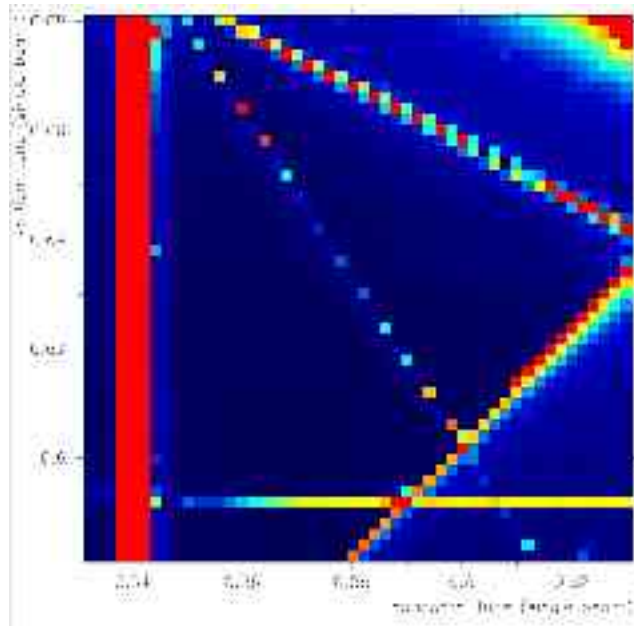


1.5E10

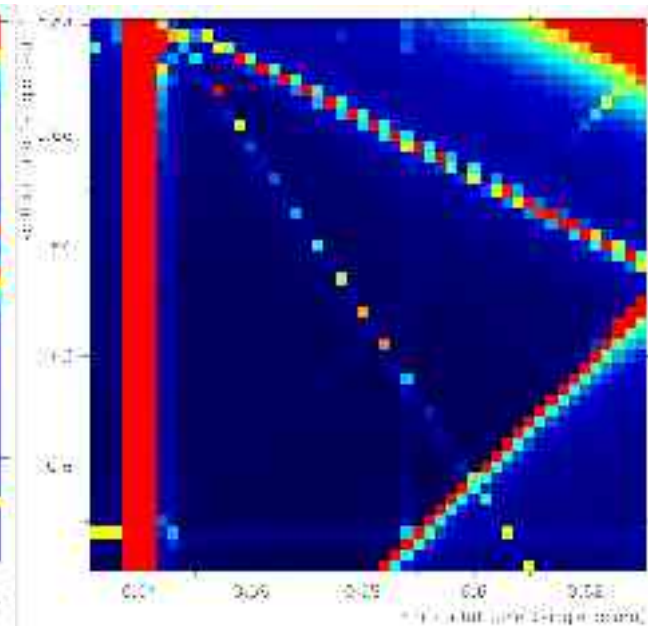


2.0E10

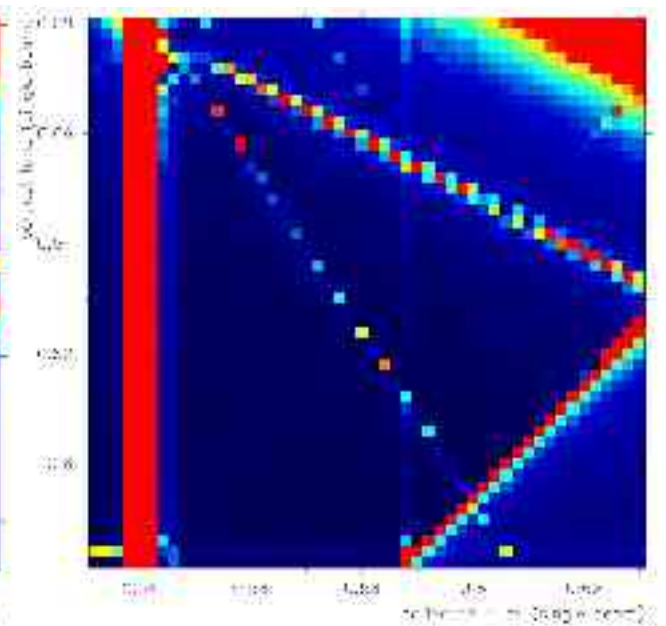
# With IBS – Space Charge Enabled



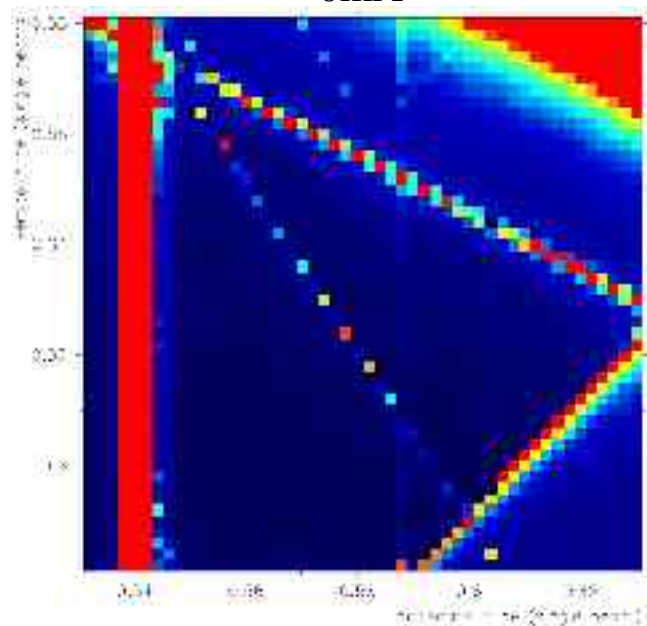
0mA



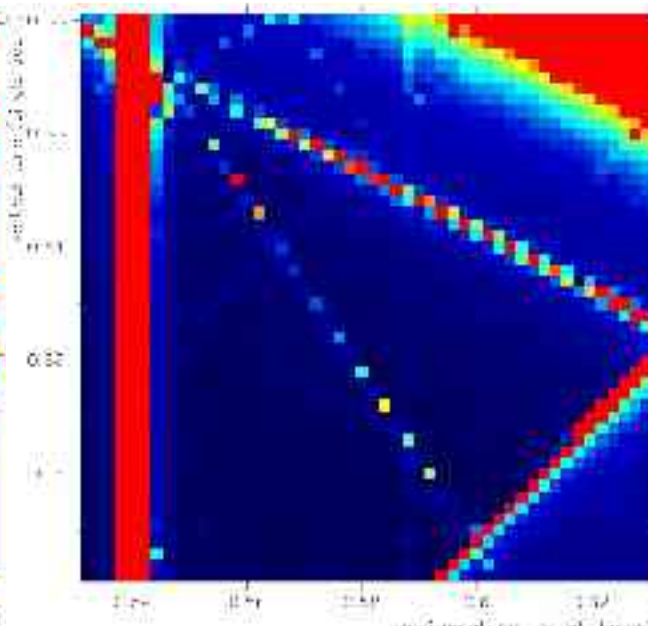
0.5E10



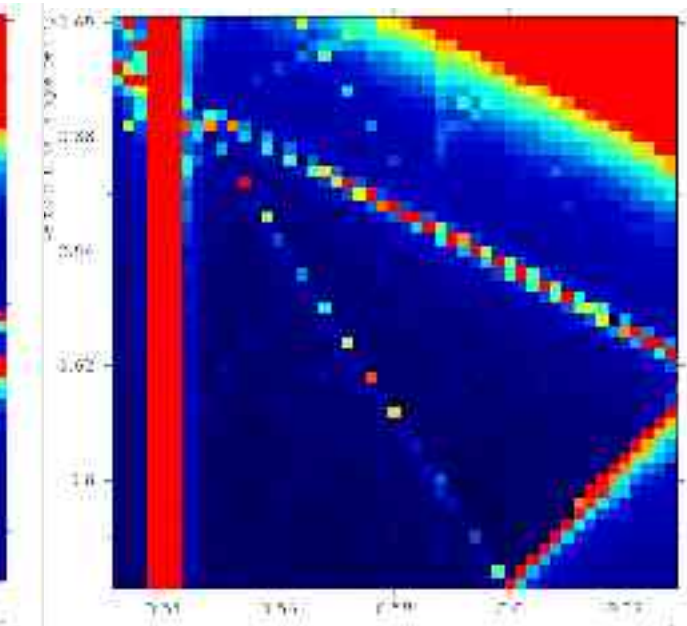
1.0E10



1.5E10



2.0E10



2.0E10 (no IBS, for comparison)

## Conclusions:

- Very noticeable shift in the resonant lines
  - Increases with current
  - Inverse with emittance (IBS decreases the shift)
- Missing something in the implementation of the space charge module?