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Initial Parallel Collective Calculations with ORBIT

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Overview



- **ORBIT has been parallelized and we can run on:**
 - Our new cluster - 8 dual Athlon processors running RedHat Linux 7.3
 - Eagle - an ORNL supercomputer with 192 IBM RISC processors
- **We have begun studies of collective beam dynamics for injection in the SNS ring at 2 MW incorporating our full capabilities:**
 - 3D spacecharge
 - Transverse and longitudinal impedances
 - Beam pipe apertures and collimation (scrapers)
 - Nonlinear single particle terms (chromaticity, sextupoles)

Initial Studies at 2 MW

- **Transverse impedance effects**
 - No, 2D, and 3D spacecharge
 - Transverse impedance from old Davino measurements
 - Beam pipe apertures and collimation (scrapers)
 - Nonlinear single particle terms (chromaticity, sextupoles)
- **Longitudinal impedance effects**
 - No, 1D, 1D+2D, and 3D spacecharge
 - Longitudinal impedances from old J.G. Wang measurements
- **Injection and Scraper Positioning**
 - 3D spacecharge
 - No impedances
 - Beam pipe apertures and collimation (scrapers)
 - Nonlinear single particle terms (chromaticity, sextupoles)
- **Beam intensity studies**
 - 2D and 3D spacecharge
 - No impedances
 - No Beam pipe apertures and collimation (scrapers)
 - Nonlinear single particle terms (chromaticity, sextupoles)

Transverse Impedance Results



Percent Losses at 1060 and 1260 Turns

Impedance	Chromaticity	No SC	2D	3D
No	Natural	0.3 / 0.8	0.1 / 0.3	0.7 / 3.1
No	Corrected	1.4 / 2.9	0.4 / 1.2	1.6 / 4.2
Yes	Natural	0.3 / 0.8	0.1 / 0.3	8.4 / 33.9
Yes	Corrected	7.2 / 30.4	0.4 / 1.3	15.8 / 48.0
Yes	Linear transport	0.6 / 20.9	0.04 / 0.3	14.7 / 49.8

- 2D Space charge -> stable
- Chromaticity weakens instability
- 3D space charge enhances instability
- Get a broad spectrum dominated by $n = 7-15$

Longitudinal Impedance Results

- **1D evolution with no space charge**
 - Unstable at 2 x Impedance
 - Requires 20000 turns to fill gap
- **1D evolution with longitudinal space charge**
 - Stable at 2 x Impedance
 - Unstable at 3 x Impedance
 - Both cases checked for 20000 turns
- **2D and 3D calculations ongoing**
 - Results similar to each other and to 1D results at 1060 turns

Injection and Scraper Positioning Results

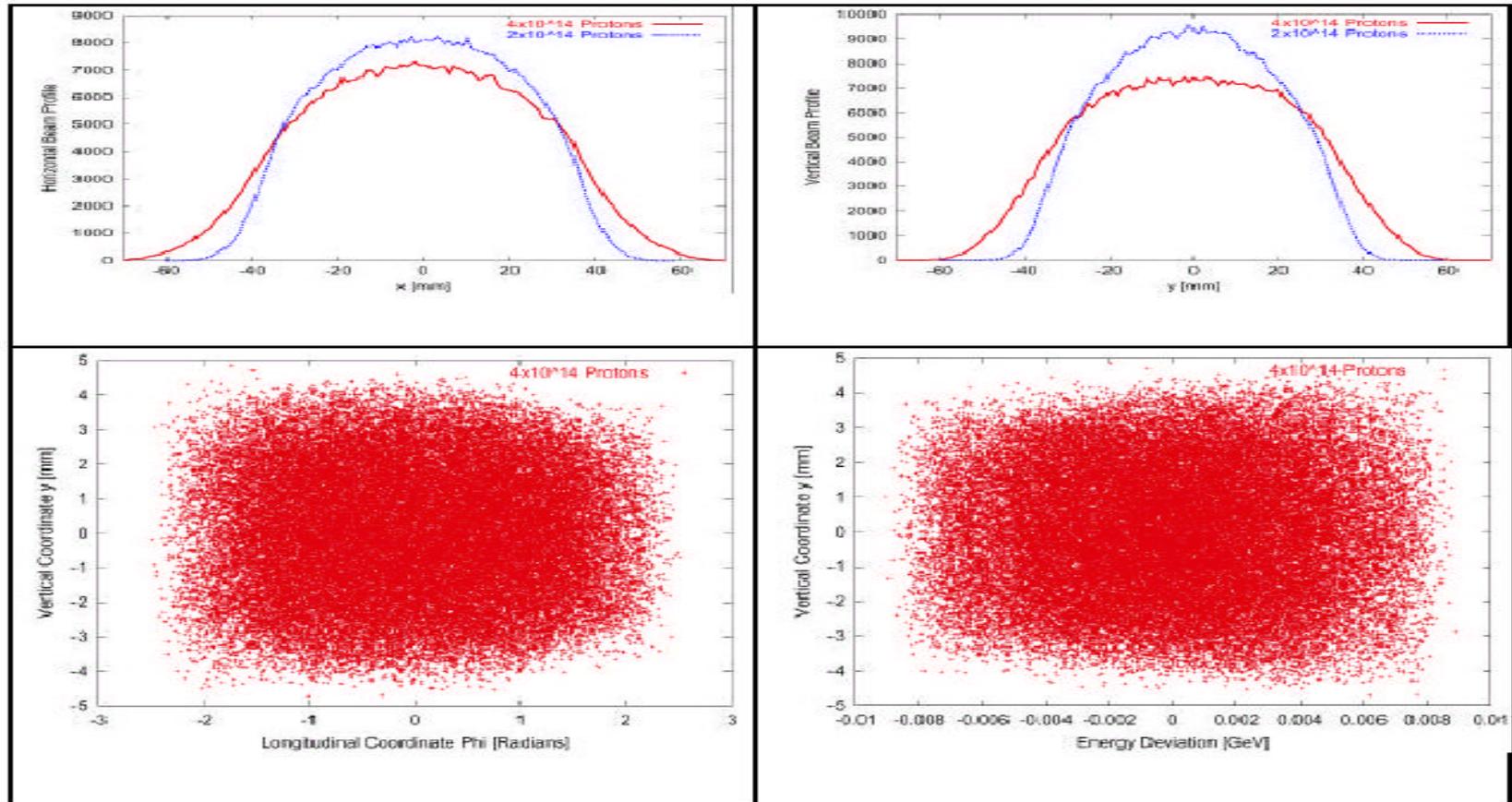


Percent Losses at 1060 Turns

Injection	Scrapers	Percent Losses
Default	220	0.7
90%	220	24.4
110%	220	20.0
Default	200	4.3
Default	Removed	None

- Chosen injected beam size seems about right
- Losses are large with scrapers at 200 pi
- The losses are zero with the scrapers removed, even though all other collimators and apertures remain

Intensity Study Results



- Space charge dependent beam broadening occurs at high intensity
- Chromatic effect: the broadening is greater among higher energy particles