THE CATHOLIC UNIVERSITY OF AMERICA
Department of Physics

ULF power in the BATS-R-US model and electron resonance conditions

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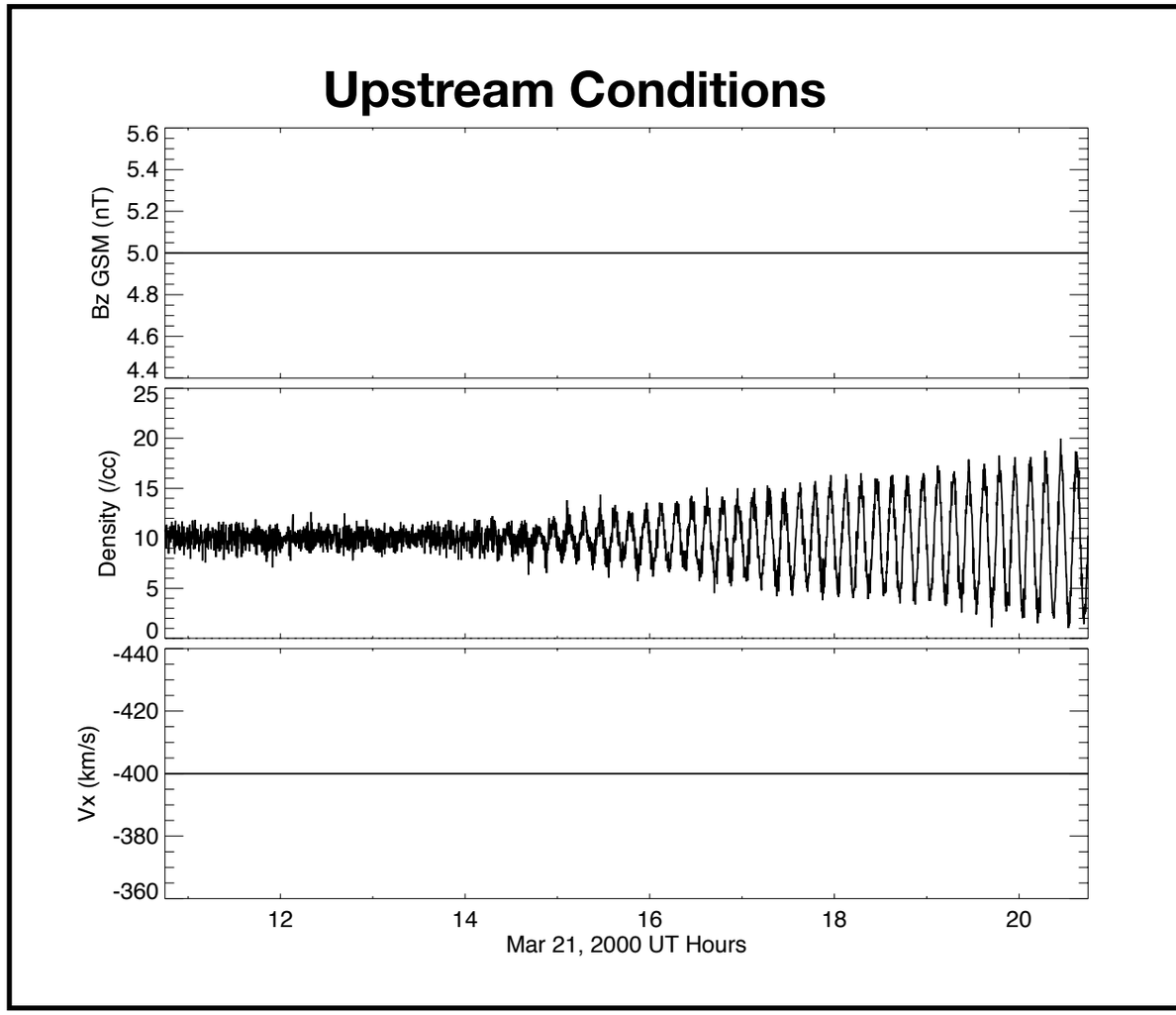
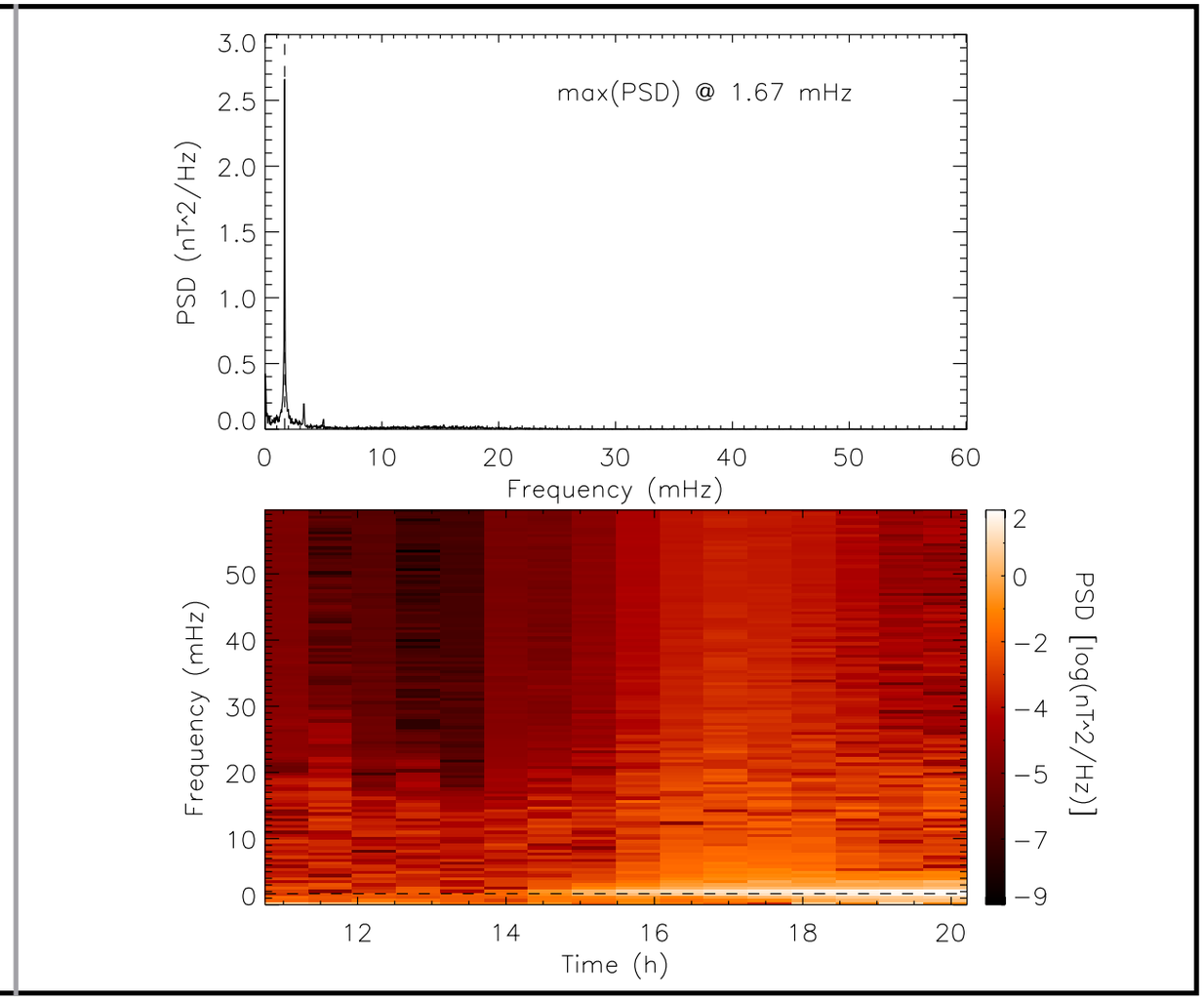
2015 GEM Summer Workshop
GEM ULF Wave Challenge

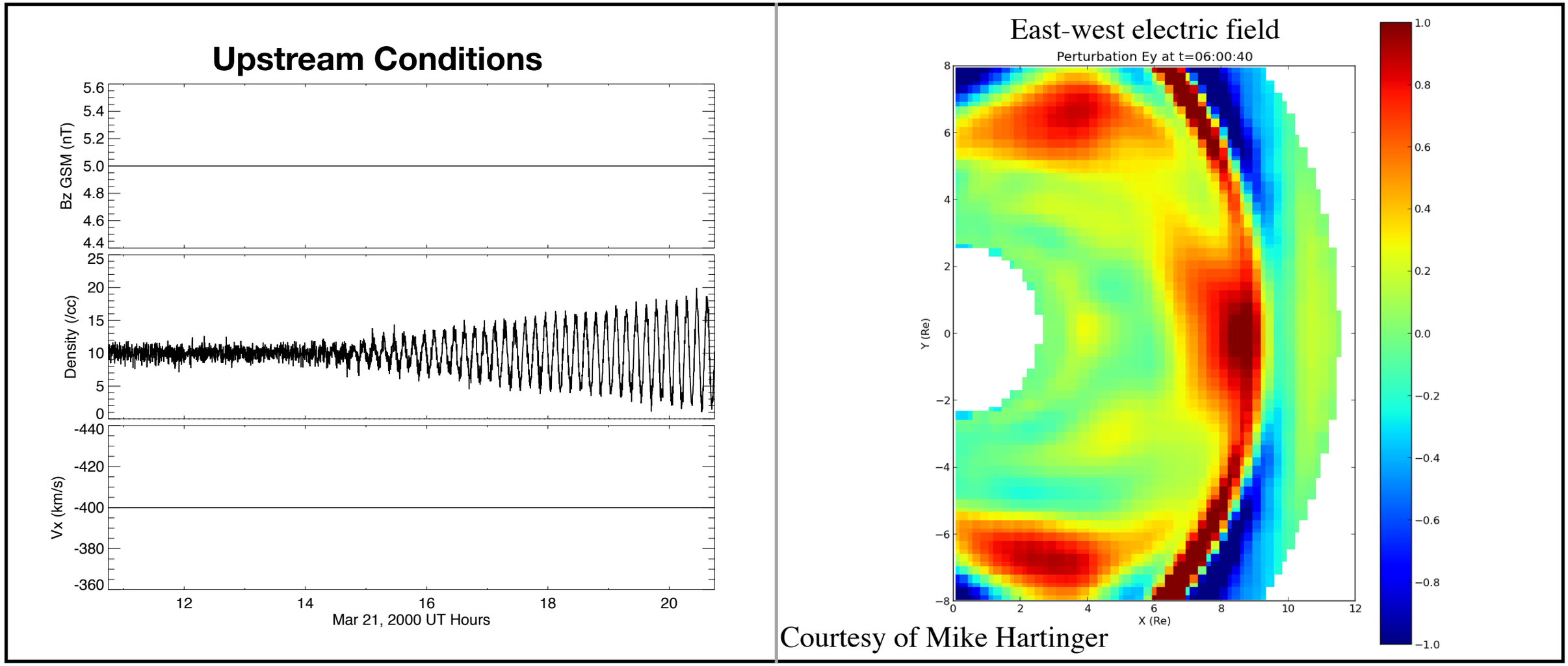
SWMF Simulated ULF Waves





- Simulation study of Hartinger et al., JGR 2014
  - Oscillating solar wind density with exponentially increasing amplitude
    - 10 minute oscillating period (1.67 mHz)
  - Measure fields, velocities and density with a simulated satellite fixed at $\mathbf{r} = (7.0, 0.0, 0.0)\ R_E$ (GSM)
    - Spectral analysis of B_z confirms low frequency oscillations at this location; Agrees with Mike's results

Electric field perturbations at t = 06:00



- Estimate ULF wave number in the ecliptic plane of magnetosphere from E_y
  - m ~ 2-3, but local description may be better than using assumption of azimuthal symmetry

Drift Resonant response in MHD+RBE

Resonant energy at r = 6.1 R_E at noon

m	1.67 mHz (10 min)	5 mHz (cavity mode)
1	*2.46 MeV*	*7.37 MeV*
2	*1.23 MeV*	*3.68 MeV*
3	*0.820 MeV*	*2.46 MeV*

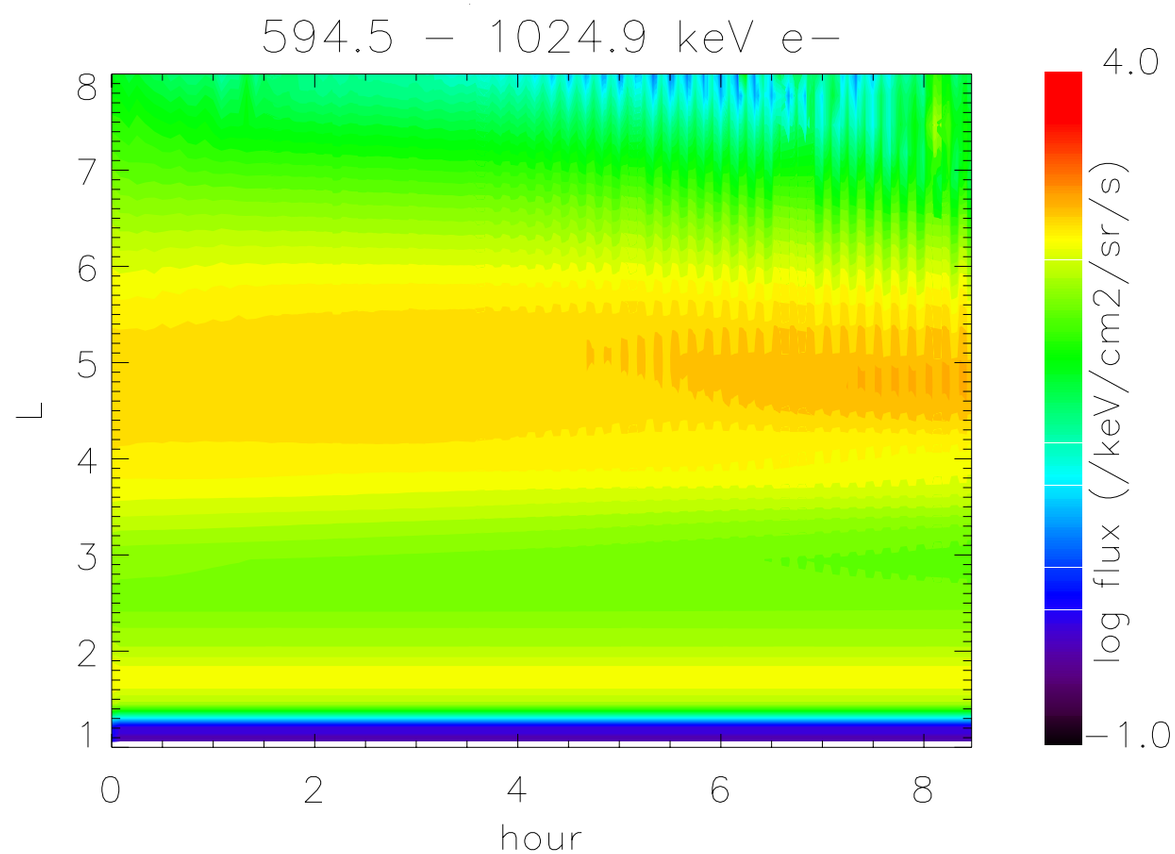
Resonant energy at r = 4.1 R_E at noon

m	1.67 mHz (10 min)	5 mHz (cavity mode)
1	*3.22 MeV*	*9.63 MeV*
2	*1.61 MeV*	*4.82 MeV*
3	*1.07 MeV*	*3.21 MeV*

Courtesy of Mike Hartinger

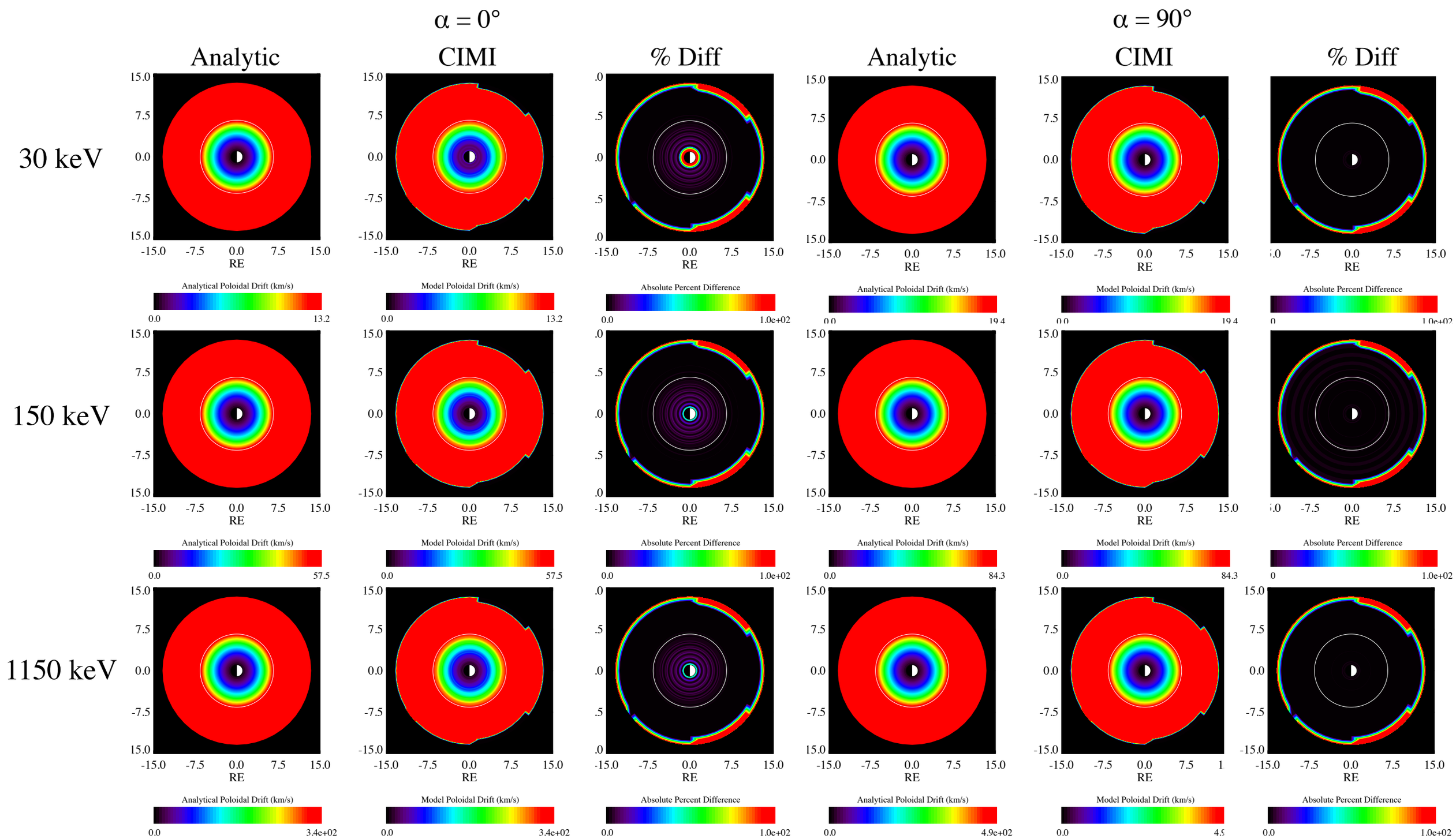
$$\omega = m\omega_D$$

RB Response (MHD one-way coupled CIMI)

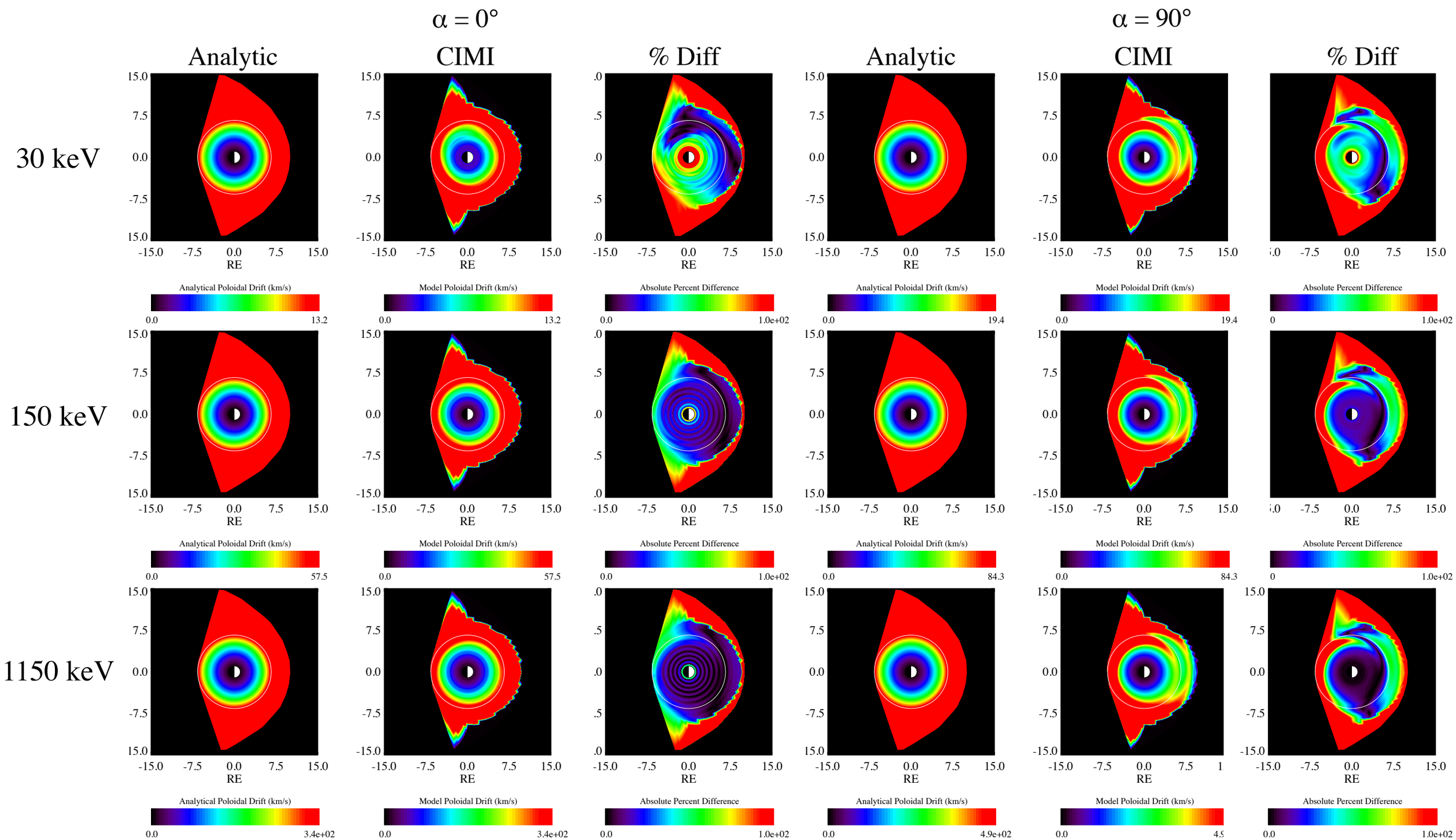
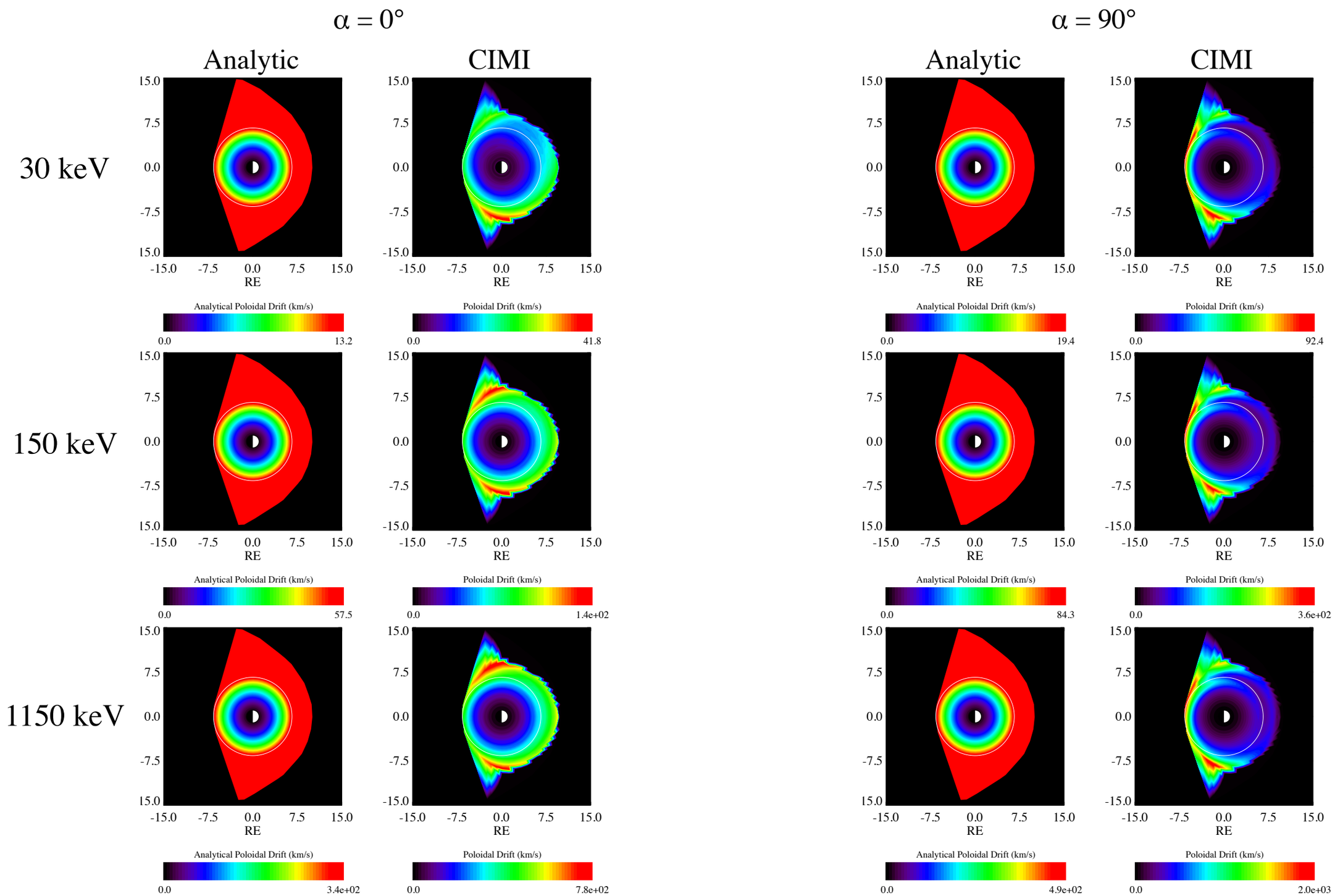


- The largest response in RBE should be: at energies between roughly 0.8 and 1.2 MeV near geostationary orbit.
- First demonstration that bounce averaged RB model can capture drift resonant interaction.
- Limitations
  - Several approximations were made: dipole drift period equation (Schulz and Lanzerotti), frequency and m assumed constant in drift orbit (Degeling et al 2014 use a technique for getting m locally that we can try later)
  - Local |**B**| is used (somewhat inconsistent with dipole expression for drift period)

RB electron azimuthal drift: Dipole



RB electron azimuthal drift: TS04



RB electron azimuthal drift: TS04