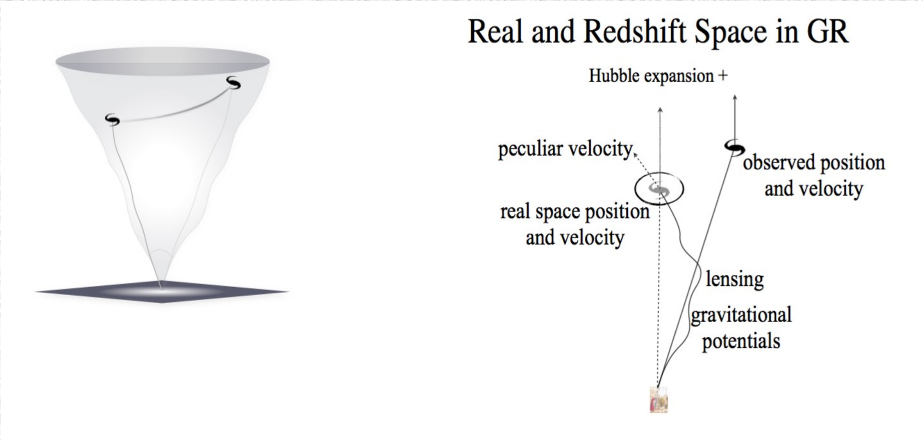
AYA2015-66211-C2-2P MINECO FEDER, EU

Relativistic corrections in angular galaxy – ISW cross-correlations



Raccanelli et al. 2011

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[CEFCA]

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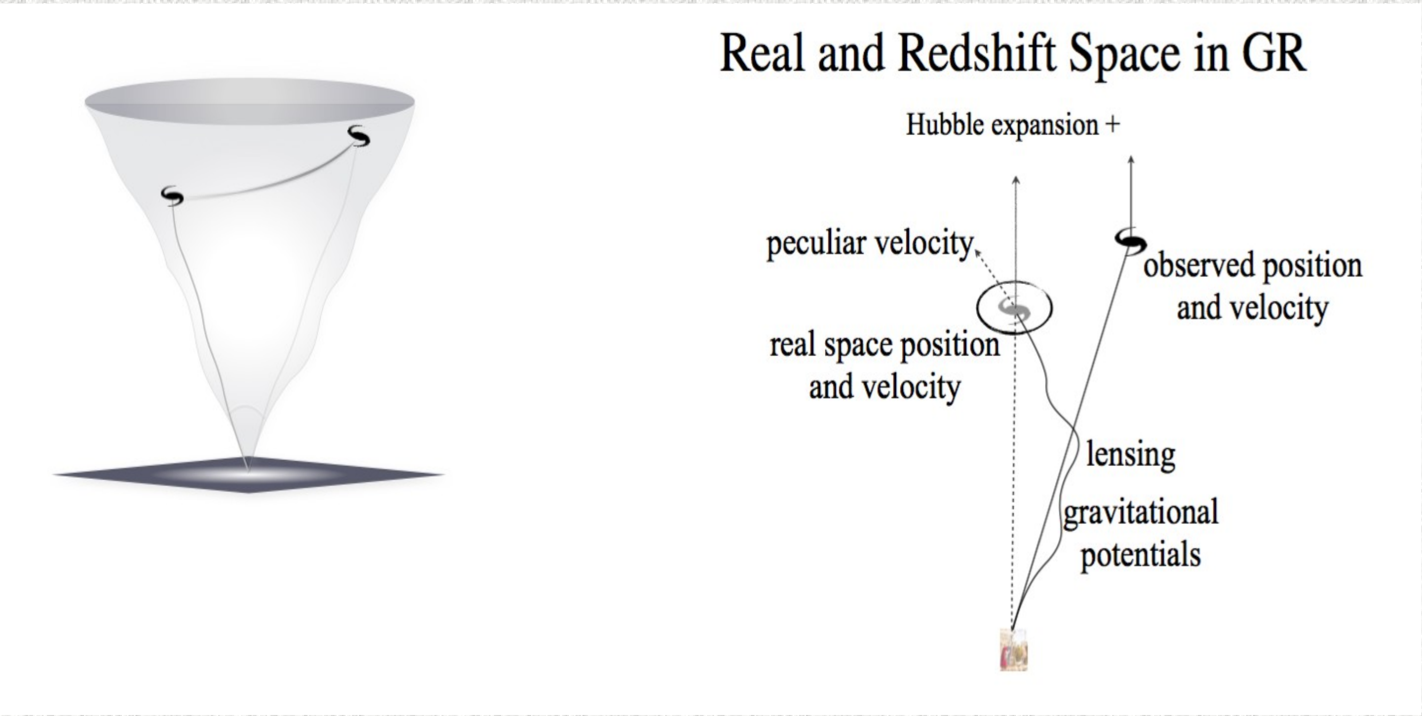
Relativistic corrections to the observed angular number density of sources ...

- I will be showing results with my *post-Newtonian* approximation to the problem: *qualitatively* they seem to coincide with full, relativistic corrections, but we have not yet performed a detailed comparison from the *quantitative* point of view.

- The angular power spectra will be computed as an integral over Fourier modes of *transfer* functions of increasing complexity:

$$C_l = \frac{2}{\pi} \int dk\, k^2 P_m(k) |\Delta_l^X(k)|^2$$



Raccanelli et al. 2011

Relativistic corrections to the observed angular number density of sources ...

- Our starting point will be the real-space density fluctuations:

$$\Delta_l^{\rm RS}(k) = \int d\eta\, \eta^2 \bar{n}(\eta) b(k,\eta) \mathcal{D}_\delta(\eta)\, j_l(k\eta)/n_{\rm ang}$$

- The first correction is due to the peculiar motion of sources, that impacts their observed redshift (the so-called "velocity gradient" term):

$$\Delta_l^{\rm Doppler}(k) = \int d\eta\, \eta^2 \frac{d\bar{n}(\eta)}{d\eta} \mathcal{D}_{vlos}(\eta)(1+z[\eta])\, j_l'(k\eta)/(k\, n_{\rm ang})$$

Relativistic corrections to the observed angular number density of sources ...

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- The next leading term is the modulation of the observed number of sources due to lensing induced by transversal gravitational potentials:

$$\Delta_l^{\mathrm{Lensing}}(k) = -\int d\eta\, (2-5s)\, \frac{3\Omega_m H_0^2}{c^2}(1+z[\eta]) \mathcal{D}_\delta(\eta) \Psi(\eta) j_l(k\eta) \frac{l(l+1)}{2\, k^2}$$

$$\Psi(\eta) = \int_\eta^{\eta_{lss}} d\xi\, \xi^2 \frac{\bar{n}(\xi)}{n_{\mathrm{ang}}} \frac{\xi - \eta}{\xi \eta}.$$

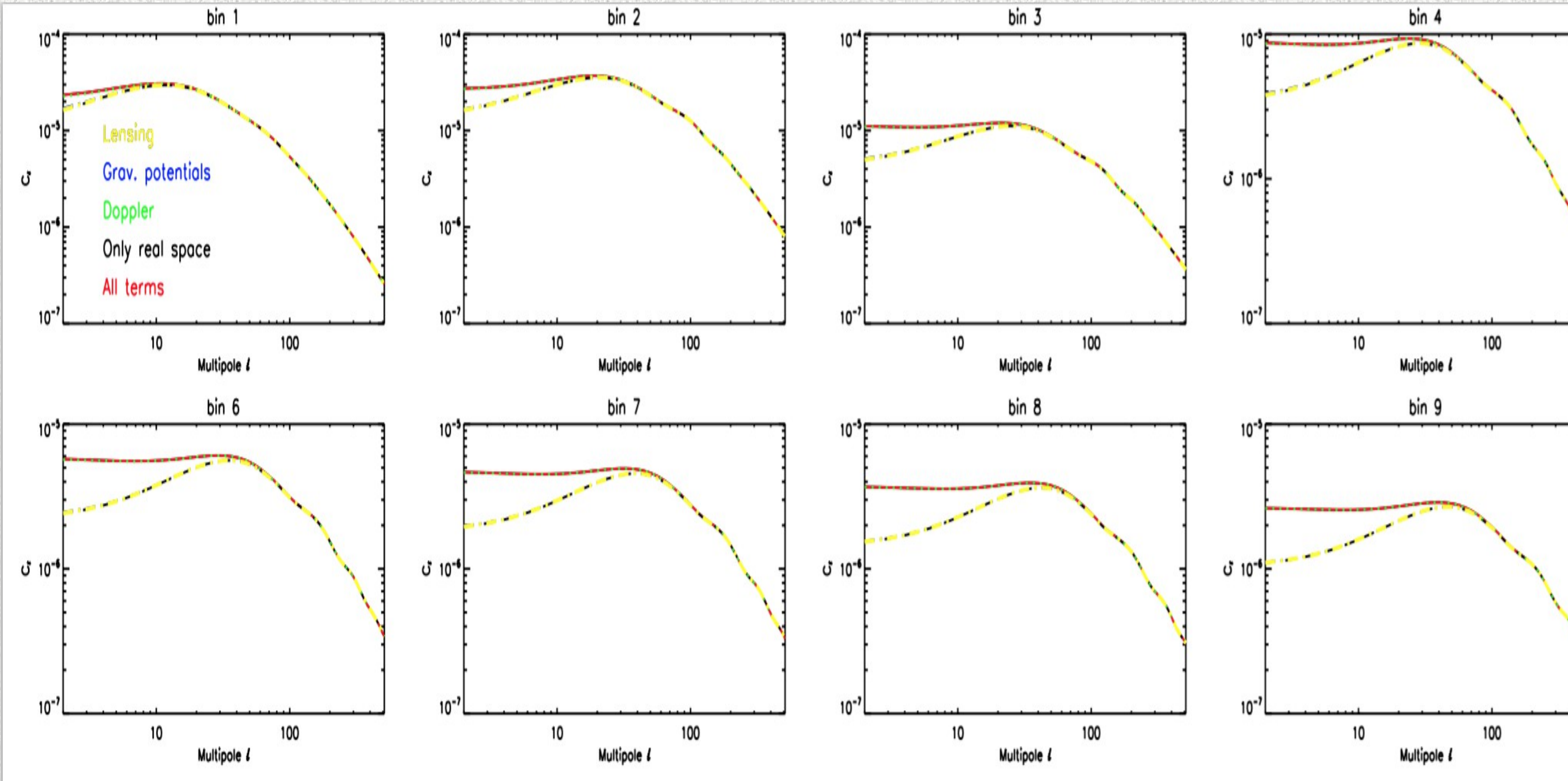
Relativistic corrections to the observed angular number density of sources ...

- Finally, one has to account also for the impact, on the observed source's redshift, of the local and LOS-integrated gravitational potentials:

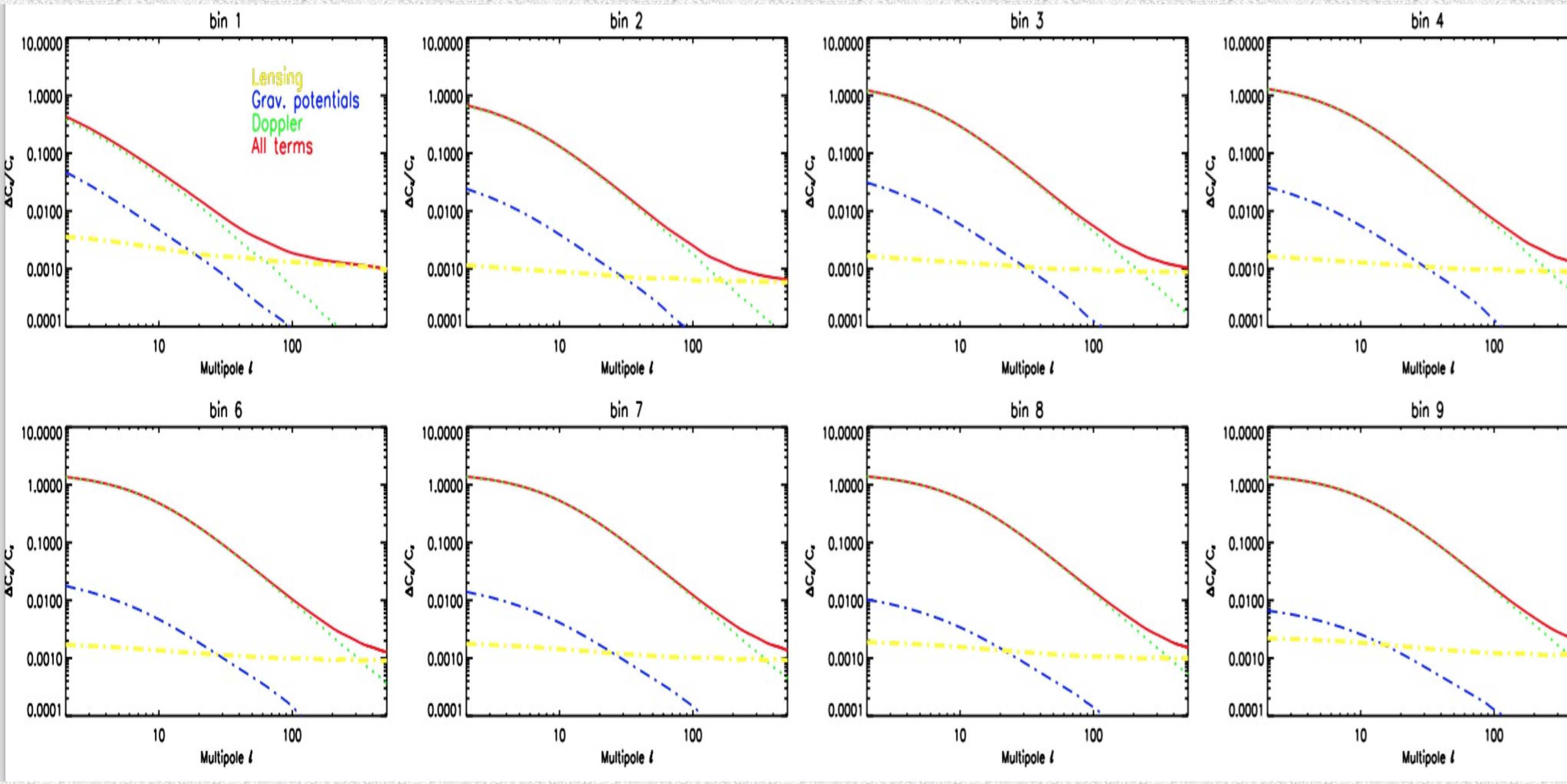
$$\Delta_l^{\rm Grav.pot.}(k) = \int d\eta\, \eta^2 \frac{d\bar{n}(\eta)}{d\eta} \left(-\frac{3\Omega_m}{2c^2}(1+z[\eta])\mathcal{D}_\delta + \Phi_{ISW}(\eta) \right) j_l(k\eta)/(k^2\, n_{\rm ang})$$

$$\Phi_{ISW}(\eta) = -\int_0^\eta d\xi\, \frac{3\Omega_m}{c^2}(1+z[\xi])\mathcal{D}_\delta(\xi) \times \left(\frac{1}{1+z[\xi]} + \frac{d\log \mathcal{D}_\delta}{dz} \right) \frac{c}{H(\xi)}$$

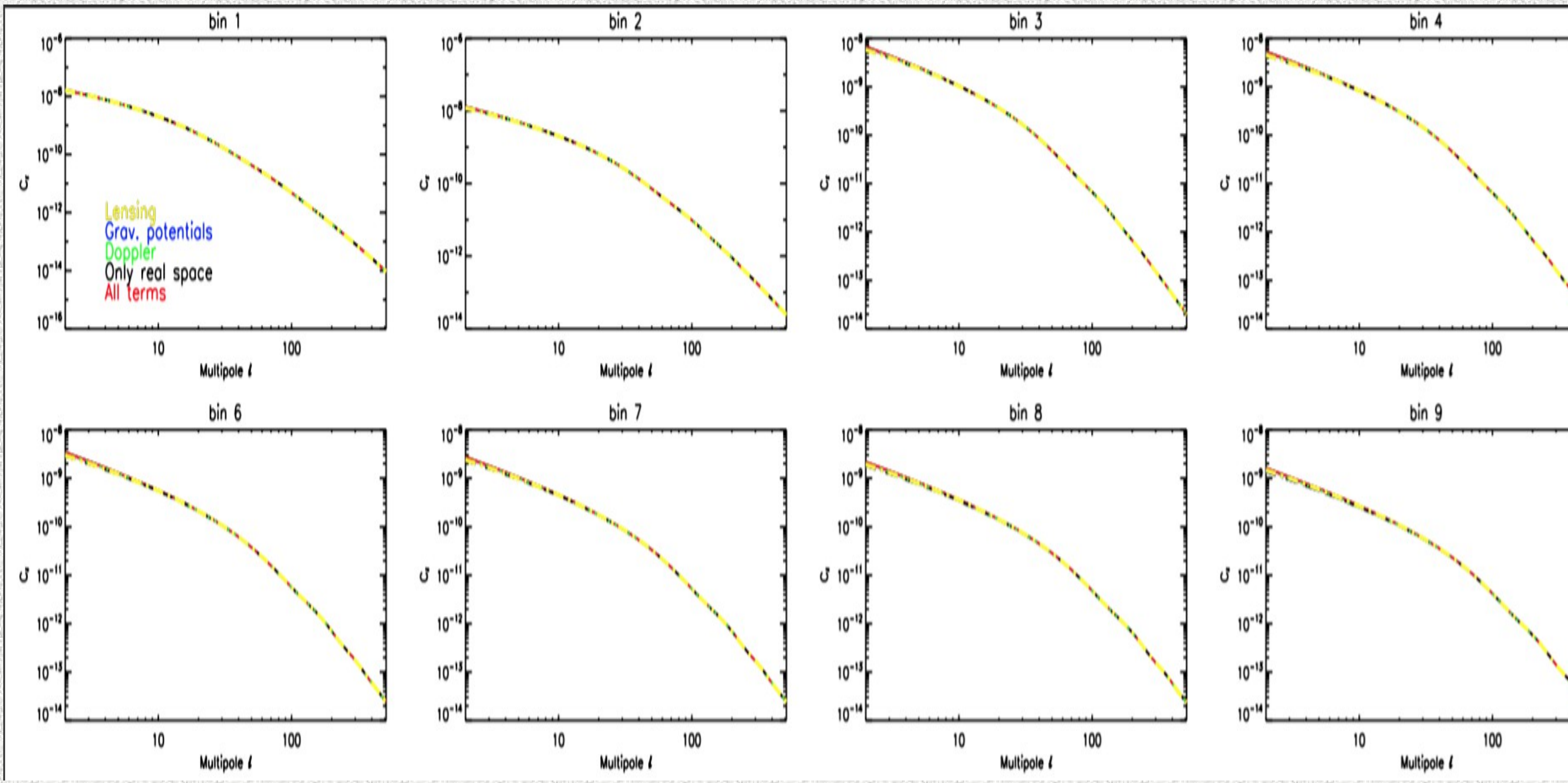
Corrections to GG AUTO spectra



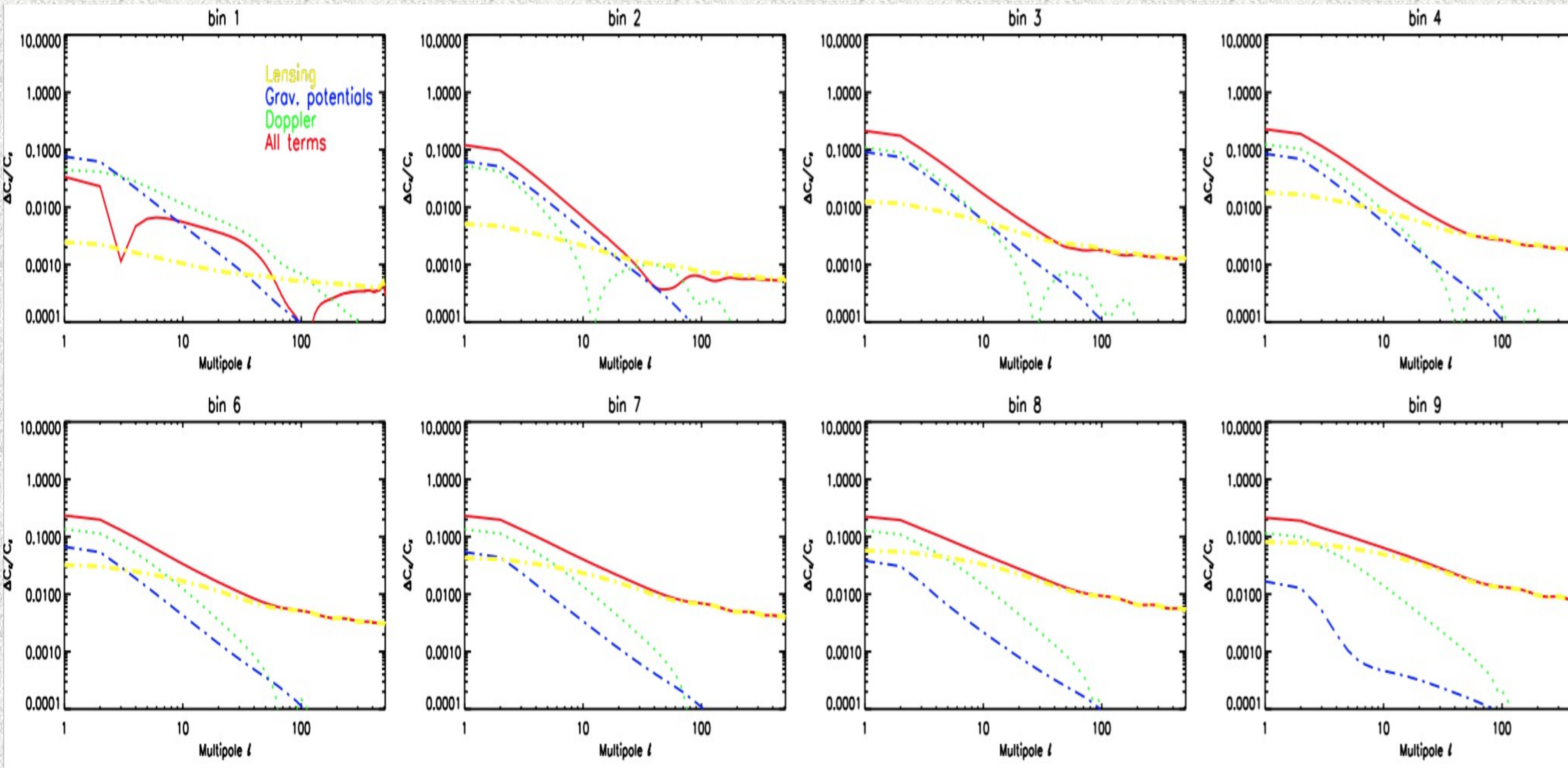
Corrections to GG AUTO spectra



Corrections to TG CROSS spectra



Corrections to TG CROSS spectra

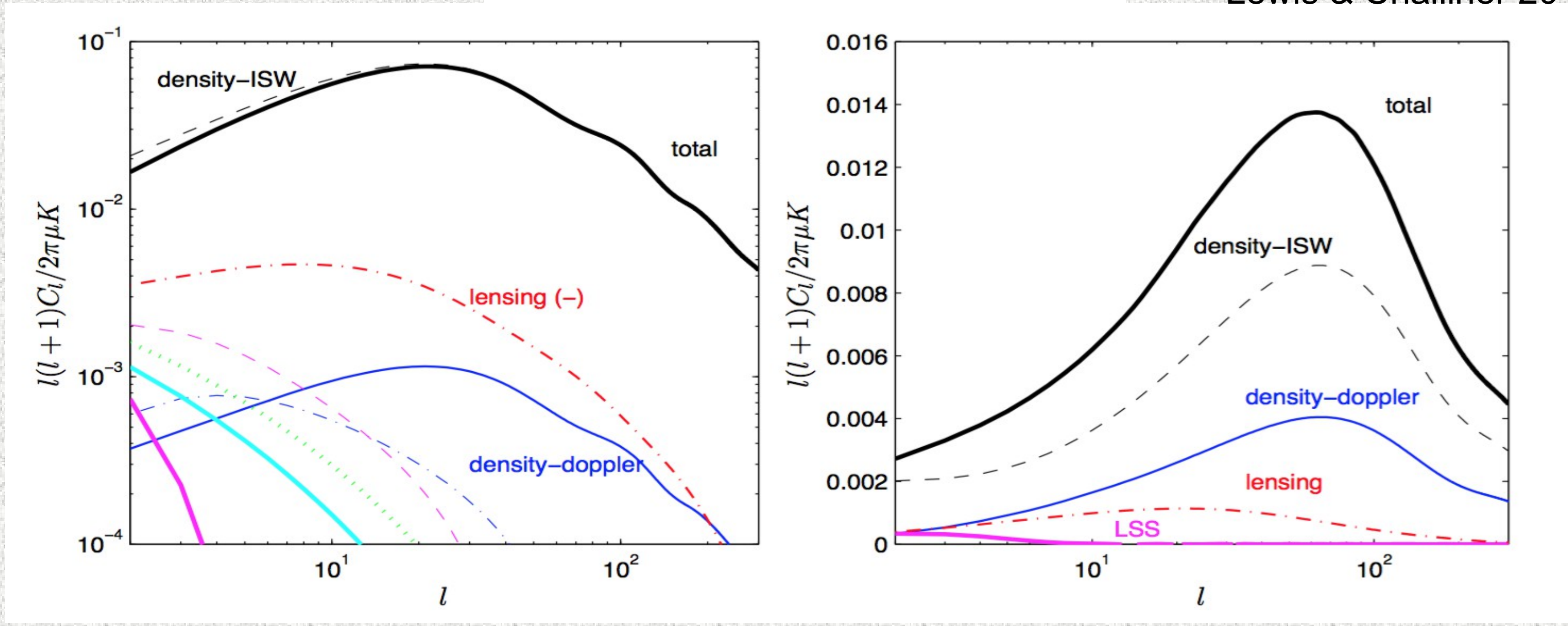


Extra contributions to CMB temperature anisotropies (on top of ISW ones):

- Doppler kSZ anisotropies from reionization and Sachs-Wolfe effect contribution from recombination (for high-z source populations):

$$\Delta_T(\hat{\mathbf{n}}) \approx \int^{\eta_A} \mathrm{d}\eta\, e^{-\tau} \left(\dot{\tau}\hat{\mathbf{n}} \cdot \mathbf{v} + \dot{\psi} + \dot{\phi} \right)$$

Lewis & Challinor 2011



Extra contributions from CMB (on top of ISW) might be the cause for part of the differences in TG spectra of my code versus CAMB-based estimations ...