Fit results of mock average

1 Data

We can use mock 6dFGS hemispheric redshift and peculiar velocity catalogues built from COLA N-body simulations. The key properties of these simulations are:

- Simulations use $(1728)^3$ particles in a $1200\,h^{-1}$ Mpc box, originally generated on Raijin (NCI) – credit to F.Marin and J.Koda for originally generating these simulations.
- Fiducial cosmology: $\Omega_m = 0.3$, $\Omega_b = 0.0478$, $h = 0.68$, $\sigma_8 = 0.82$, $n_s = 0.96$.
- 1180 mocks are available.
- Snapshots output at $z = 0.1$.
- Mass resolution $2.8 \times 10^{10}\,h^{-1}M_\odot$, and FoF haloes located containing a minimum of 32 dark matter particles.
- Halos populated by galaxies using central+satellite halo occupation distribution calibrated by the observed 6dFGS clustering and number density versus redshift (see Carter et al. 2018), with a caveat that the simulation mass resolution was not sufficient to replicate all 6dFGS galaxies at the lowest redshifts.
- Mocks are restricted to a hemisphere.
- These mocks have been used in the following papers:
  - `https://arxiv.org/pdf/1606.03092.pdf`
  - `https://arxiv.org/pdf/1801.04969.pdf`
  - `https://arxiv.org/pdf/1803.01746.pdf`
  - `https://arxiv.org/pdf/2004.06399.pdf`

Suggested mocks for the initial analysis in this project:

- 600 mock catalogues will be provided.
- Generate galaxy redshift catalogue for $z < 0.1$ containing central+satellite galaxies, i.e. $\sim$ 100,000 objects.
- Generate peculiar velocity catalogue for $z < 0.057$ (maximum redshift of 6dFGS sample) by selecting the 8,885 most massive central galaxies (number of PVs in 6dFGS sample)
- These are curved-sky mocks across the complete southern hemisphere, Dec $< 0°$.
- Do not apply any additional angular selection map at this stage.
- Use galaxy positions in real-space at this stage (i.e., no redshift-space distortion applied), to focus on growth information in the velocity field.
- Apply Gaussian noise to each peculiar velocity with standard deviation $\sigma_v = 0.05\,c\,z$ in terms of redshift z, i.e. approximately corresponding to a 5% error in log-distance.
- Do not include the Fundamental Plane observational parameters at this stage, i.e. input data is peculiar velocities rather than (r, s, i).

The following data files are currently provided on the OzSTAR supercomputer in the directory `/fred/oz074/pecvel_comparison_project/6dfgs_mocks/`:

- A data redshift catalogue for each of the 600 6dFGS hemisphere mocks for $z < 0.1$ with file name `6dfgsmockNNN_redshift_data_norsd.dat` (where `NNN` = mock number) and columns (R.A., Dec., redshift, x[Mpc/h], y[Mpc/h], z[Mpc/h]), where the (x, y, z) co-moving co-ordinates have been generated using the fiducial cosmological model of the simulation. Positions do not include RSD.
- A data peculiar velocity catalogue for each of the 600 hemisphere mocks for $z < 0.057$ with file name `6dfgsmockNNN_velocity_data_norsd.dat` and columns (R.A., Dec., redshift, PV-nonoise [km/s], PV-sig [km/s], PV-noisy [km/s], x[Mpc/h], y[Mpc/h], z[Mpc/h]), which includes the noise-free peculiar velocity, standard deviation of the measurement noise at this redshift, and noisy peculiar velocity. Positions do not include RSD.
- A random redshift catalogue of 1,000,000 objects matching the selection function and format of the data redshift catalogue: `6dfgsmock_redshift_random_norsd.dat`.
- A random PV catalogue of 88,850 objects matching the selection function and format of the data PV catalogue: `6dfgsmock_velocity_random_norsd.dat`, with random radial velocities drawn from a Gaussian of mean zero and standard deviation matching the data.

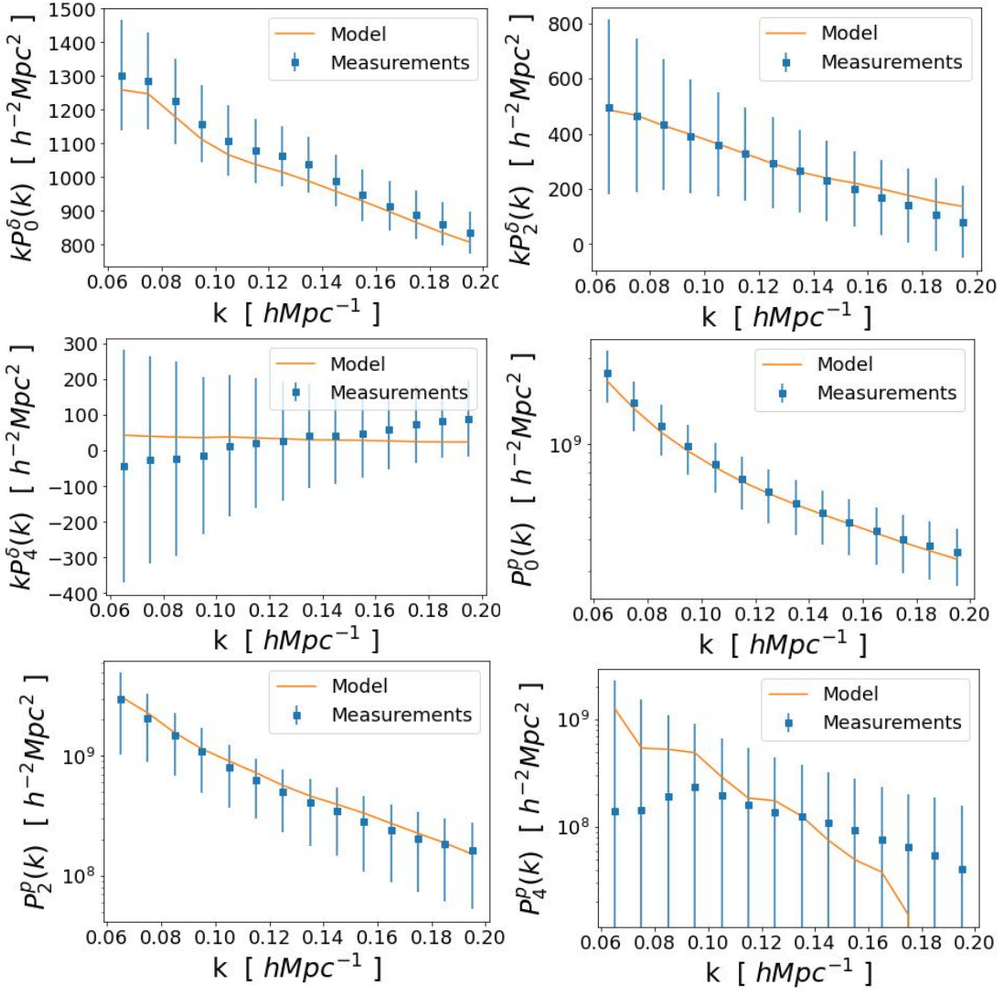
1: den-024 mom-024

Optimization:

$f\sigma_8$= 0.439542677875669, χ^2= 3.078098480501324

$b_1^\delta\sigma_8$=1.10494619, $b_2^\delta\sigma_8$= 1.31405939, $b_{3nl}^\delta\sigma_8$= -0.31700058, $b_1^p\sigma_8$=0.969762,

$\sigma^2_{\delta,vT}$=71.89078102, $\sigma^2_{\delta,vS}$=148.19691058, $\sigma^2_{p,vT}$=16.07856453, $\sigma^2_{p,vS}$=88.91461177 ,



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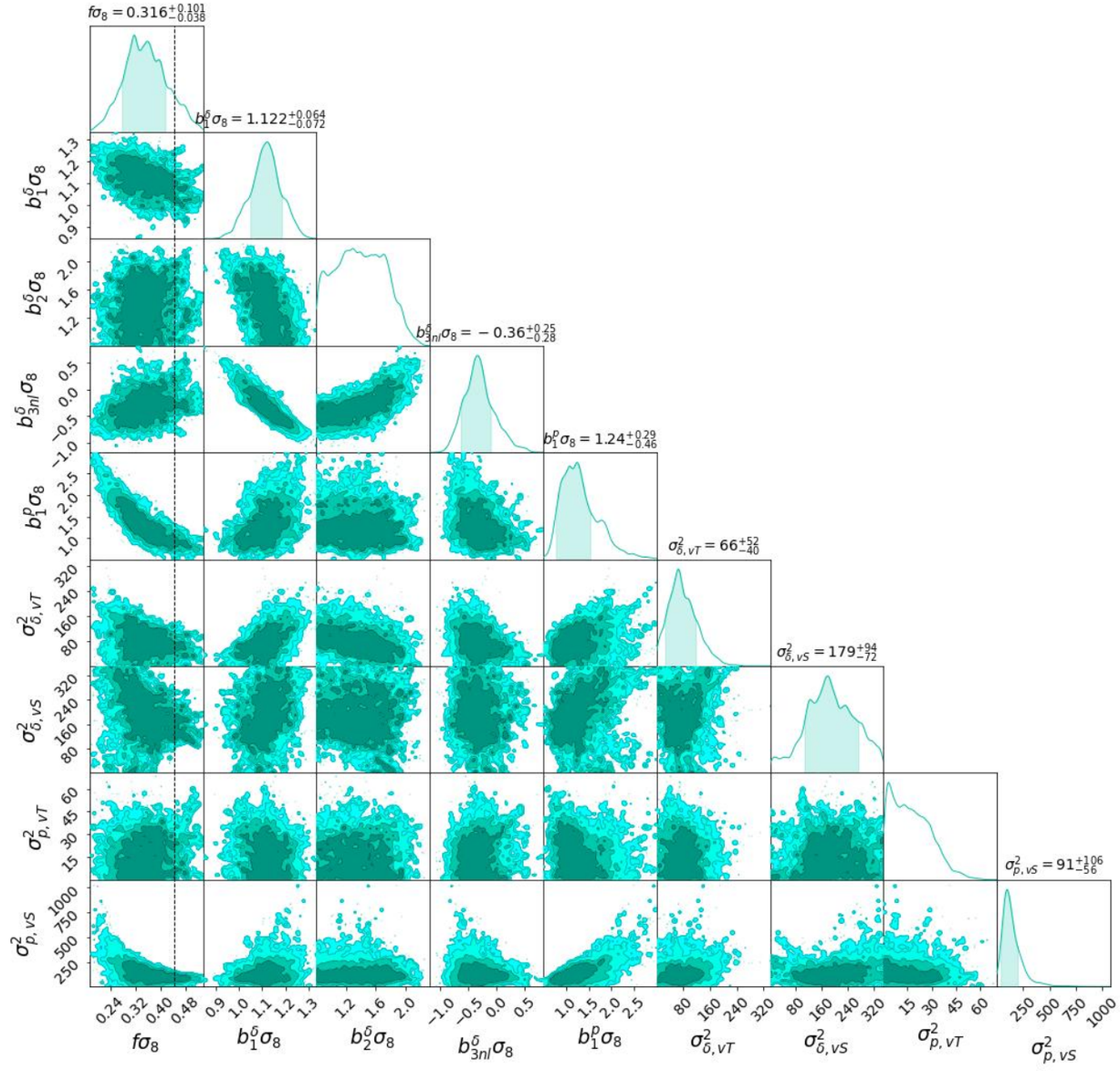


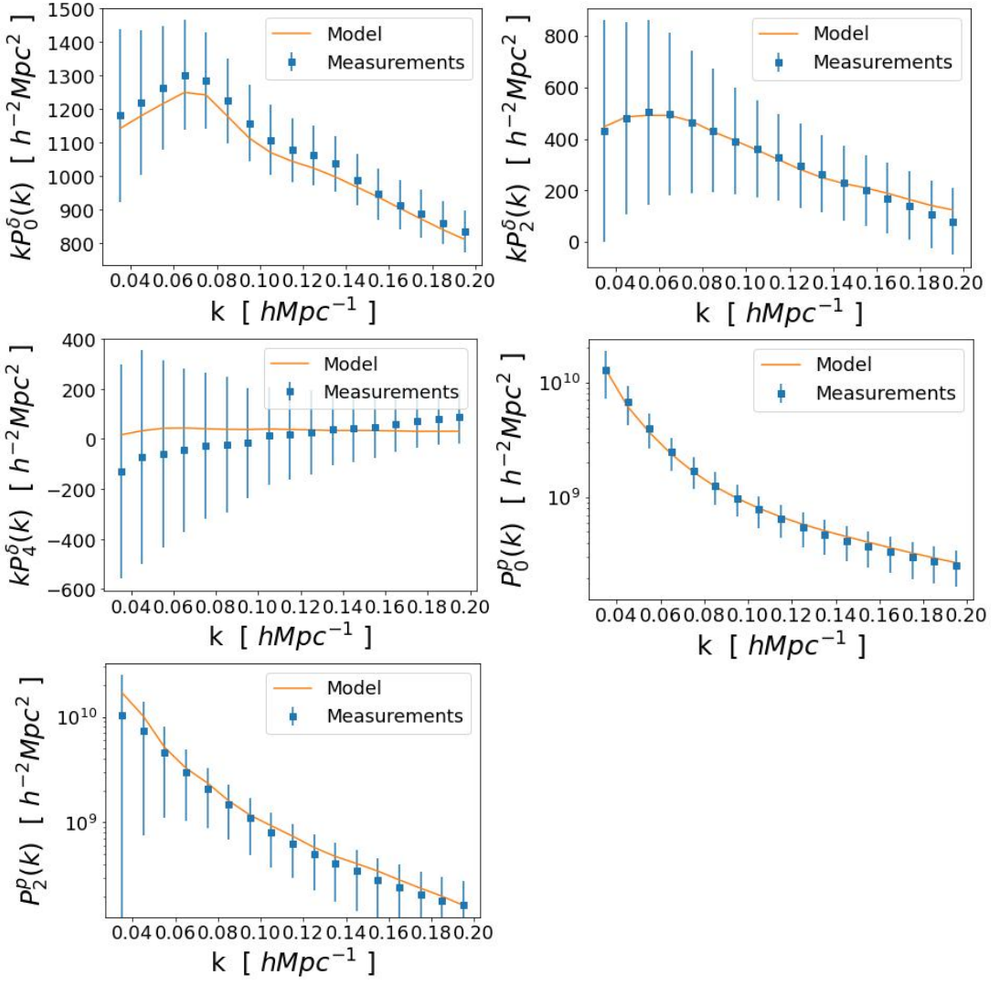
2: den-024 mom-02

Optimization:

$f\sigma_8$= 0.46194958668220065, χ^2= 4.4573234310531396

$b_1^\delta\sigma_8$=1.0818898, $b_2^\delta\sigma_8$= 1.42494688, $b_{3nl}^\delta\sigma_8$= -0.20867964, $b_1^p\sigma_8$=0.97682231,

$\sigma^2_{\delta,vT}$=62.02398433, $\sigma^2_{\delta,vS}$=144.0757365, $\sigma^2_{p,vT}$=24.43536048, $\sigma^2_{p,vS}$=89.1684927 ,



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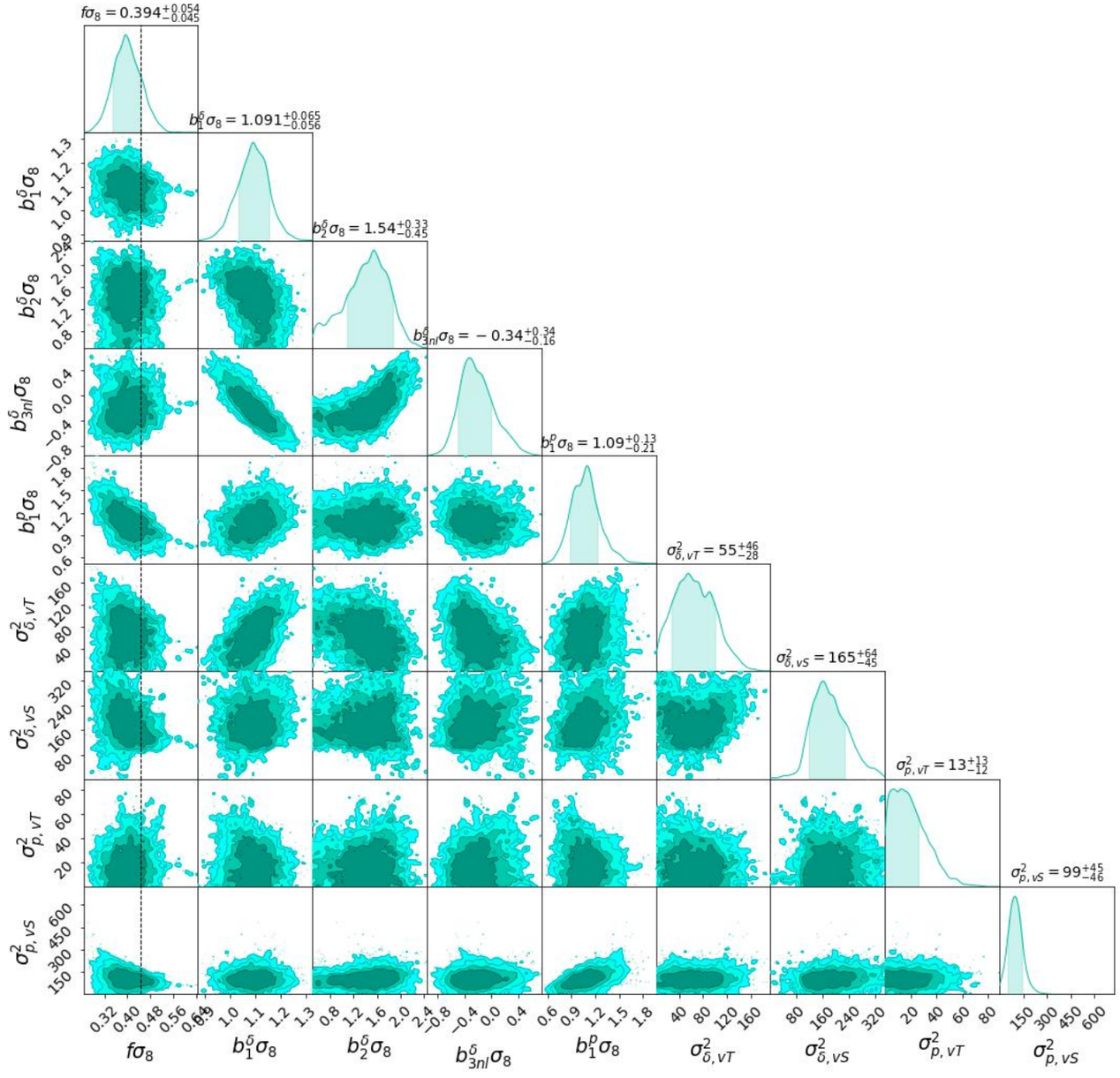


3: den-02 mom-02

Optimization:

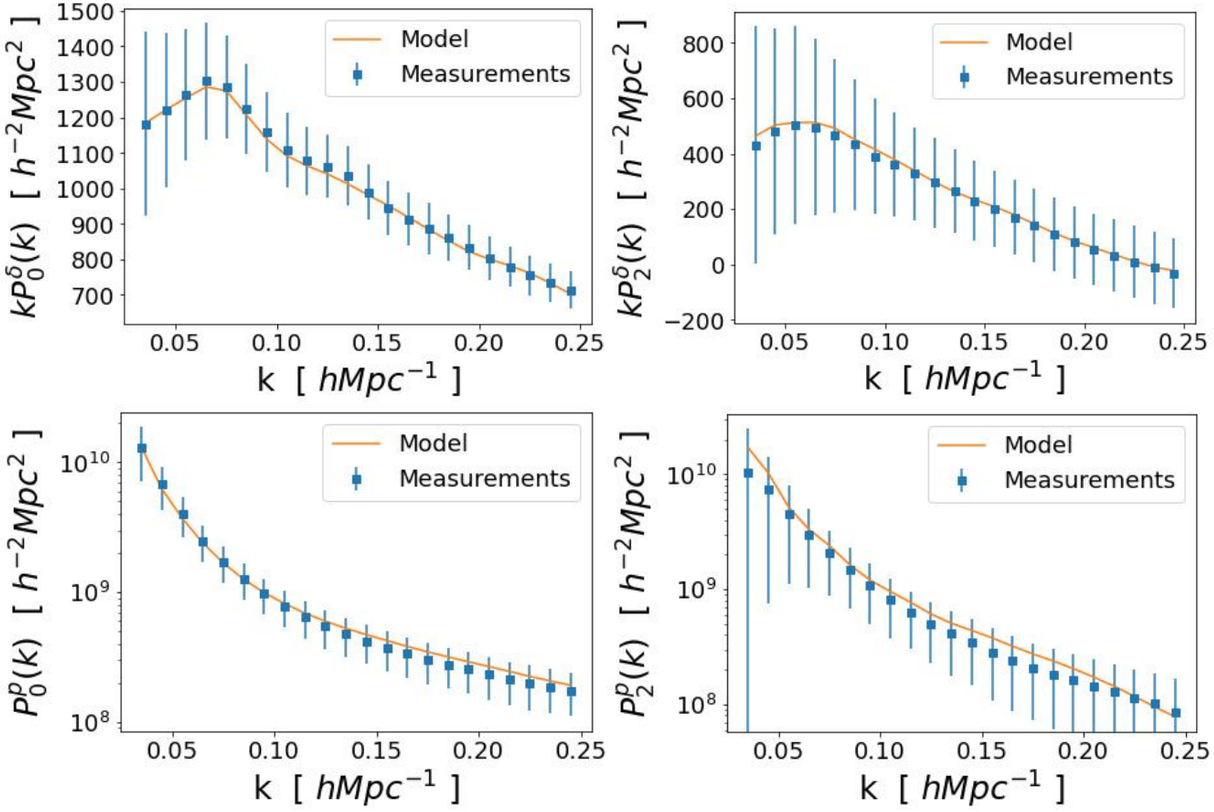
$f\sigma_8$= 0.46483987998856124

$b_1^{\delta}\sigma_8$=1.10776212, $b_2^{\delta}\sigma_8$=1.27895003, $b_{3nl}^{\delta}\sigma_8$= -0.2937557,

$b_1^{p}\sigma_8$=0.97119593,

$\sigma^2_{\delta,vT}$=60.3490824, $\sigma^2_{\delta,vS}$=156.04794073,

$\sigma^2_{p,vT}$=27.53693525, $\sigma^2_{p,vS}$=82.57018673, χ^2= 3.402496412550891



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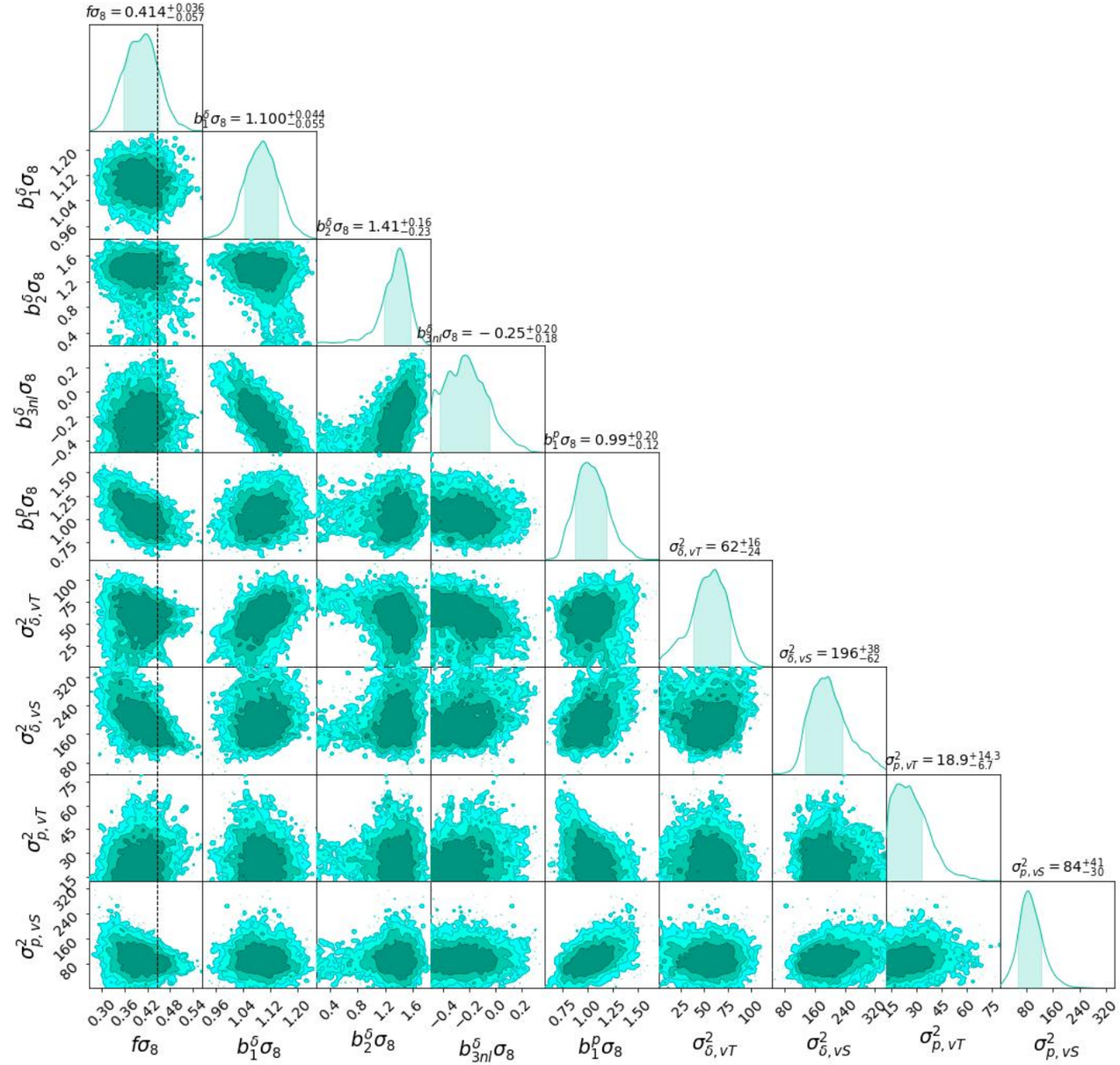


4: den-024 mom-0

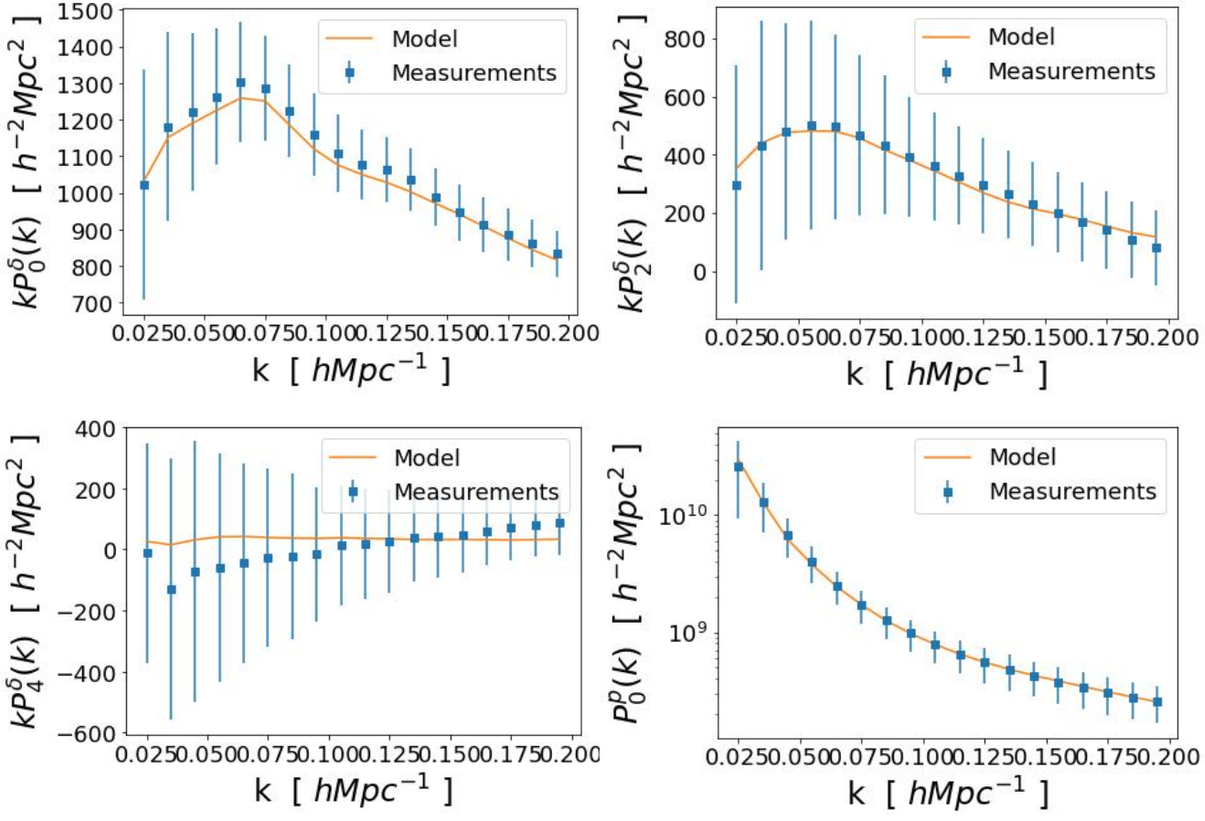
Optimization:

$f\sigma_8$= 0.45129526344667703, χ^2= 1.7776911880883668

$b_1^\delta\sigma_8$=1.09154576, $b_2^\delta\sigma_8$= 1.42120134, $b_{3nl}^\delta\sigma_8$= -0.224192987,

$b_1^p\sigma_8$=0.68339816,

$\sigma^2_{\delta,vT}$=67.3137337, $\sigma^2_{\delta,vS}$=151.320444, $\sigma^2_{p,v}$=2.19266967e-12



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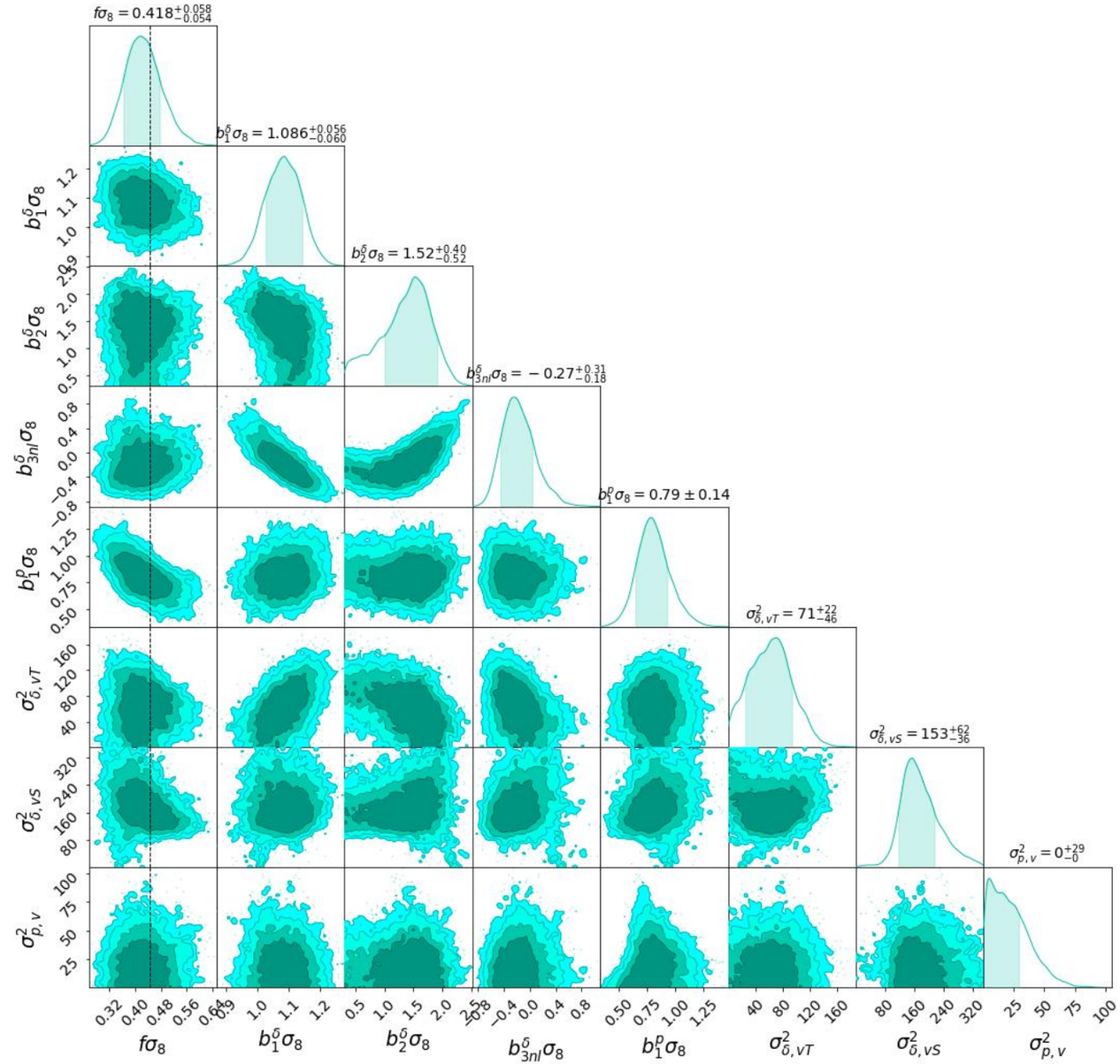


5: den-02 mom-0

Optimization:

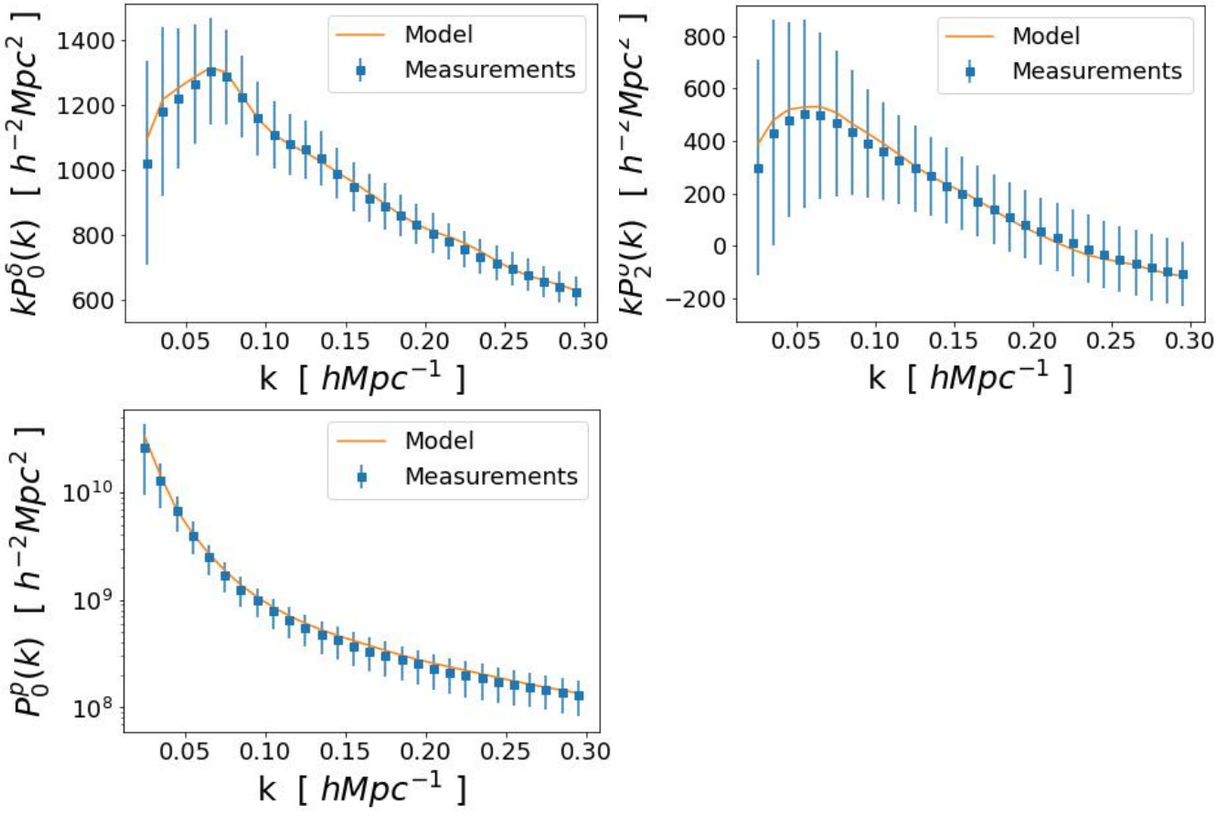
$f\sigma_8$= 0.47271304897480326

$b_1^\delta\sigma_8$=1.12415886, $b_2^\delta\sigma_8$=1.19780907, $b_{3nl}^\delta\sigma_8$= -0.334962492,

$b_1^p\sigma_8$=0.67087728,

$\sigma^2_{\delta,vT}$=62.819785, $\sigma^2_{\delta,vS}$=158.176141, $\sigma^2_{p,v}$=2.12739126e-12

χ^2= 1.7982143445418948



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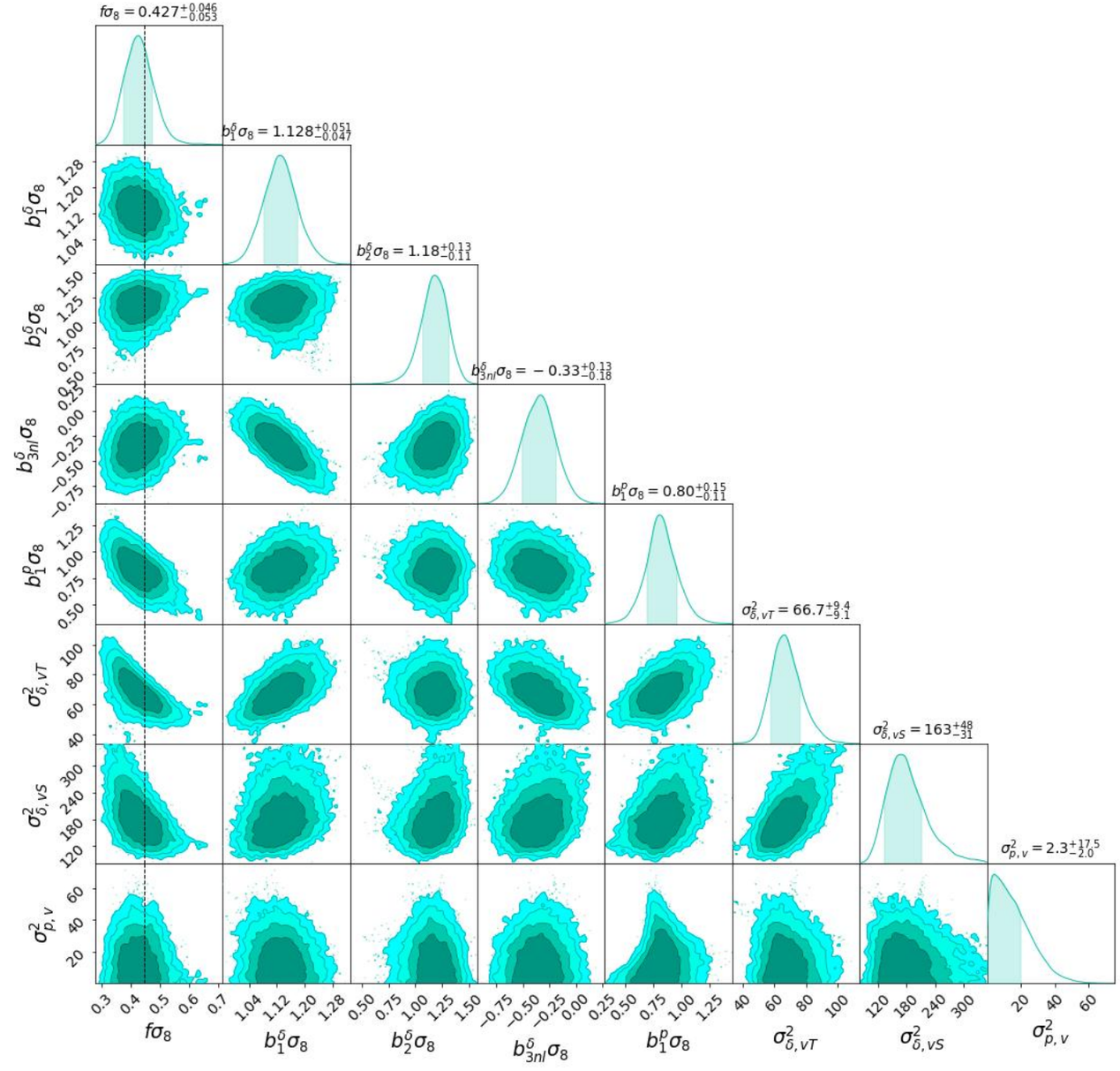


6: den-0 mom-0

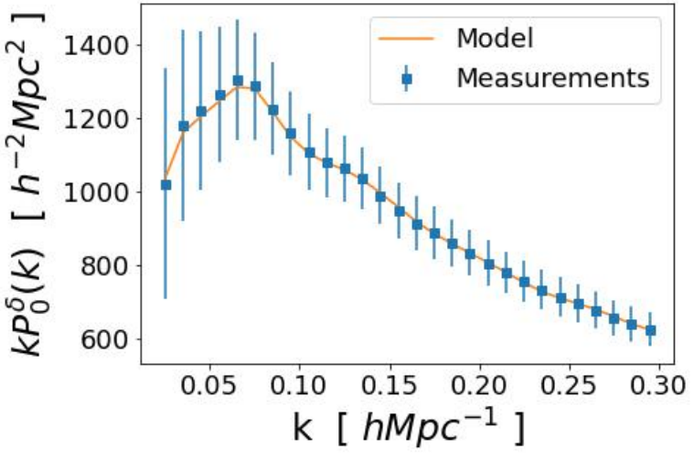
Optimization:

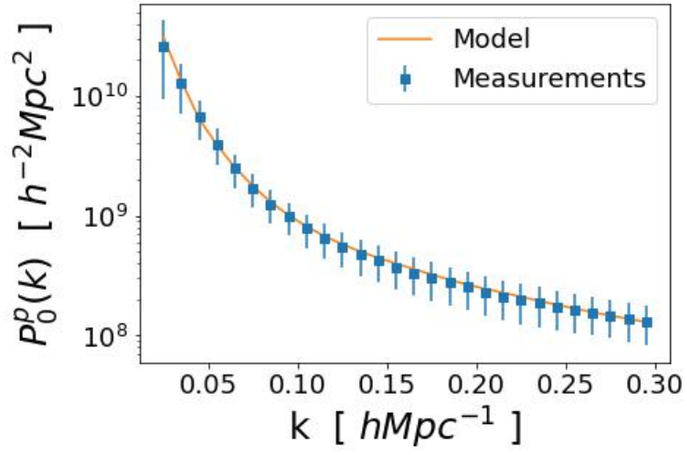
$f\sigma_8$= 0.4577611360407576

$b_1^\delta\sigma_8$=1.08910984, $b_2^\delta\sigma_8$= 1.37388585, $b_1^p\sigma_8$=0.690666885,

$\sigma^2_{\delta,vT}$=75.9567883, $\sigma^2_{\delta,vS}$=339.667358, $\sigma^2_{p,v}$=9.0689902e-13

χ^2= 0.6355586341071735





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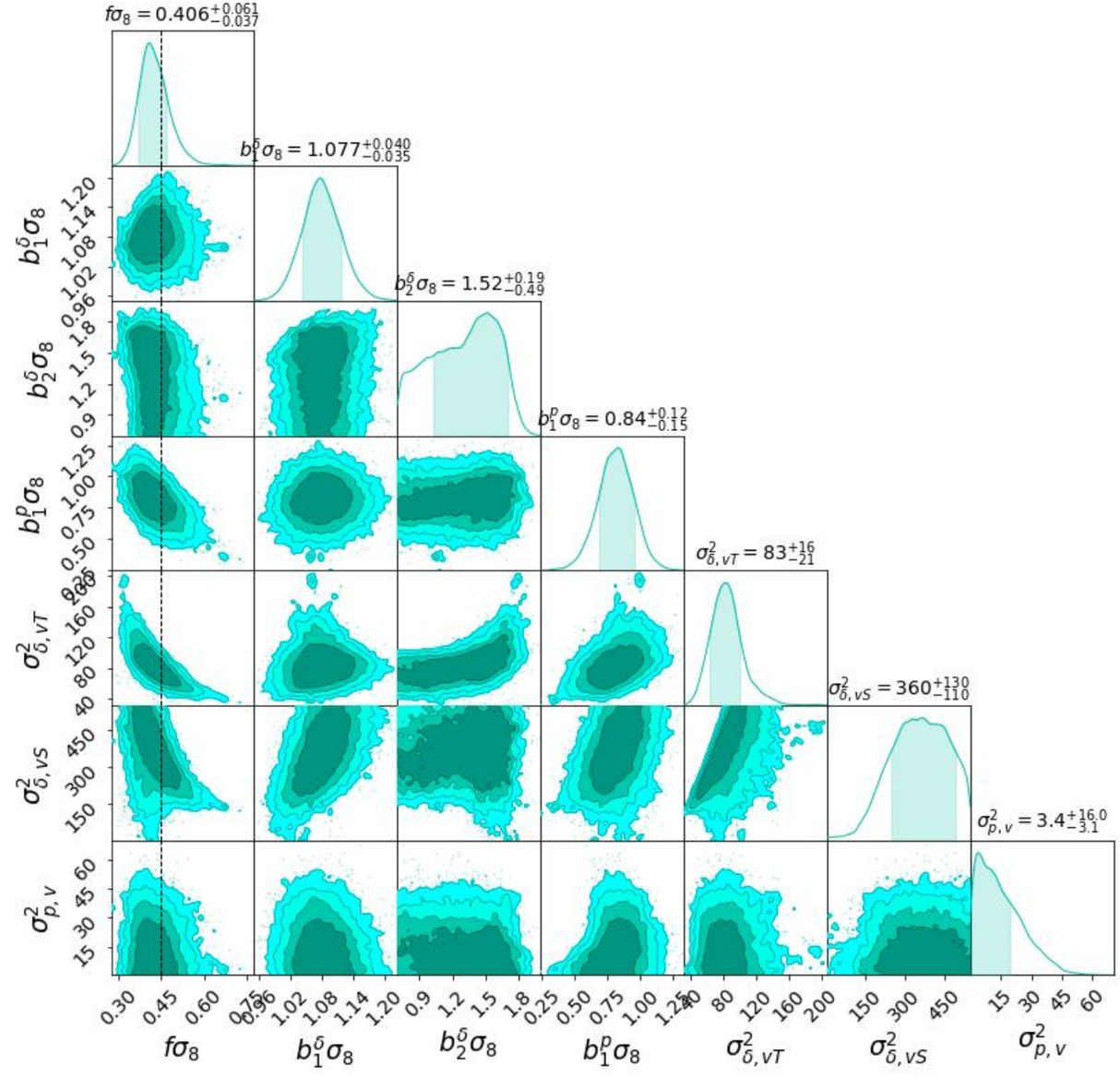


7: den-0 mom-0 crs-1

Optimization:

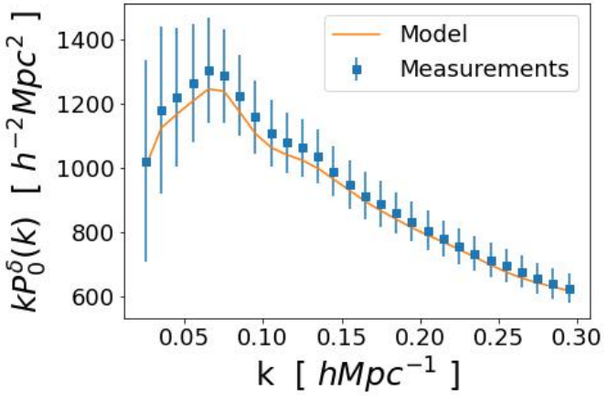
$f\sigma_8$= 0.46698039223264937

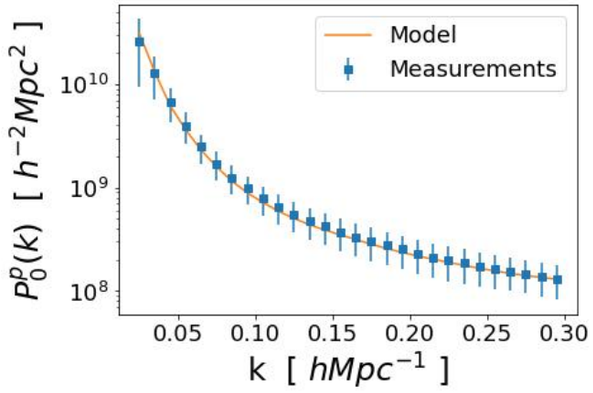
$b_1^\delta\sigma_8$=1.06128856, $b_2^\delta\sigma_8$= -0.173628338, $b_{3nl}^\delta\sigma_8$=0.0846923611,

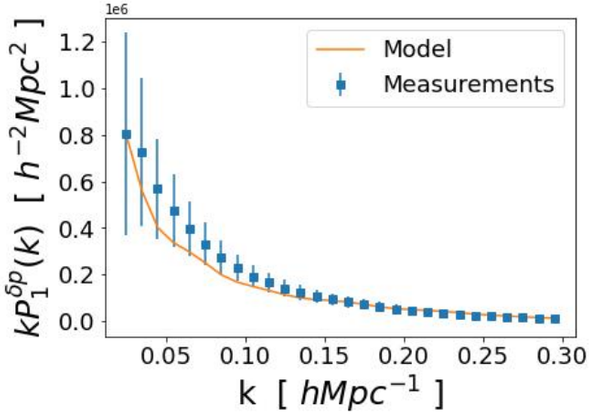
$b_1^p\sigma_8$=0.809014496,

$\sigma^2_{\delta,vT}$=66.9961309, $\sigma^2_{\delta,vS}$=137.658884, $\sigma^2_{p,v}$=37.262799

χ^2= 4.4573234310531396







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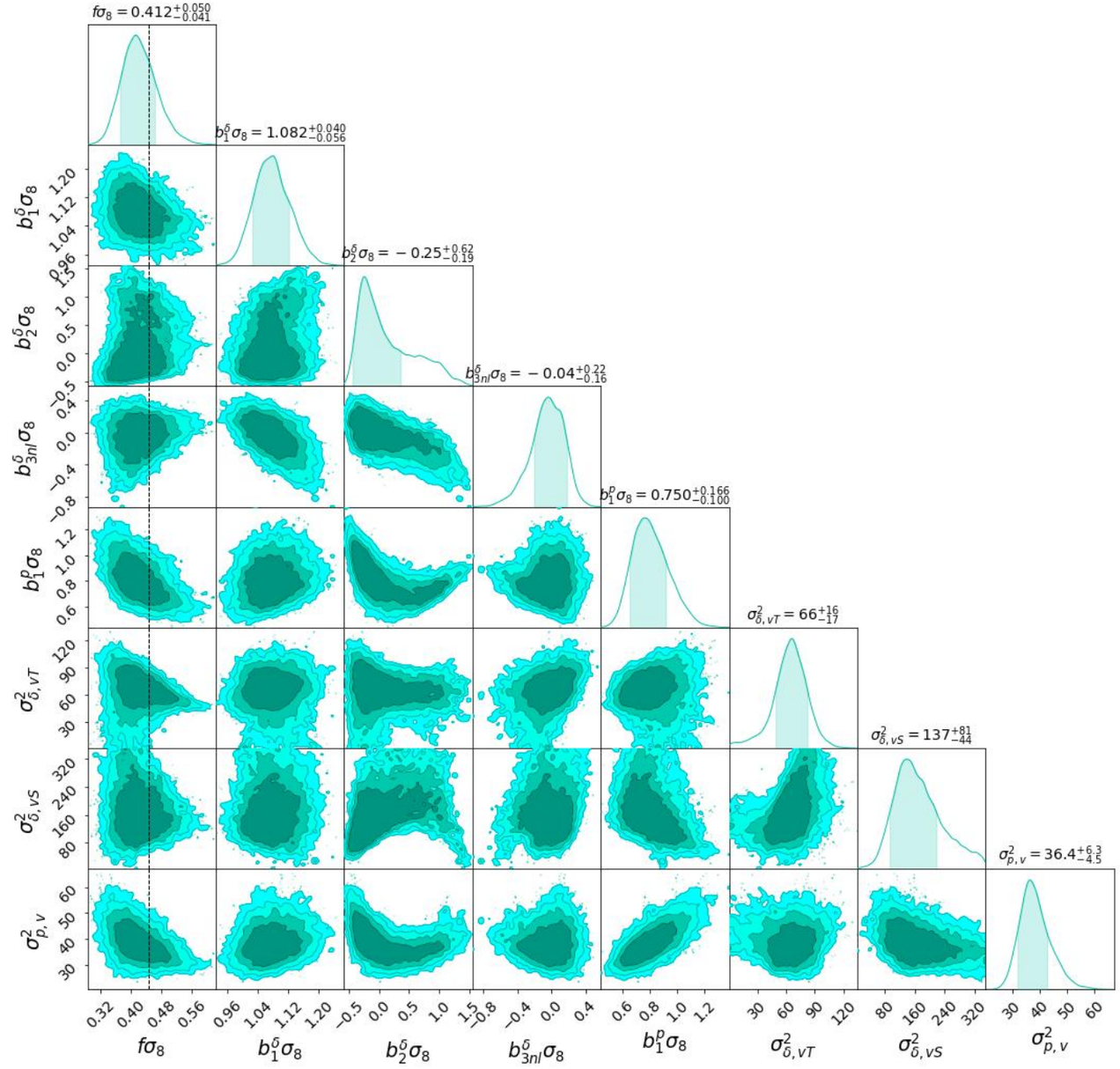


8: den-02 mom-0 crs-1

Optimization:

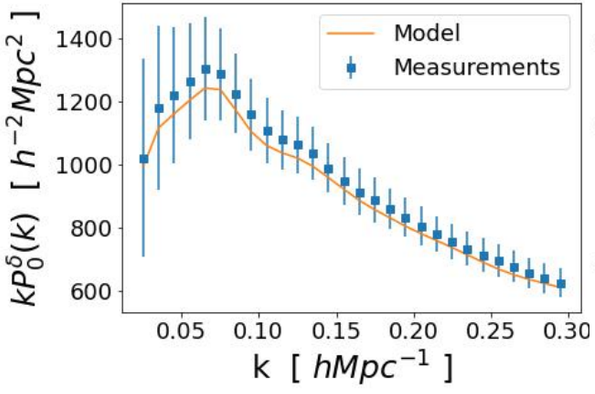
$f\sigma_8$= 0.4592498982178683

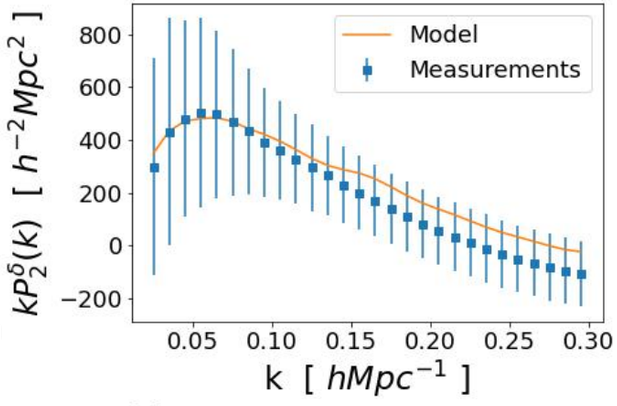
$b_1^\delta\sigma_8$=1.0559215, $b_2^\delta\sigma_8$= -0.3860657, $b_{3nl}^\delta\sigma_8$=0.18312626,

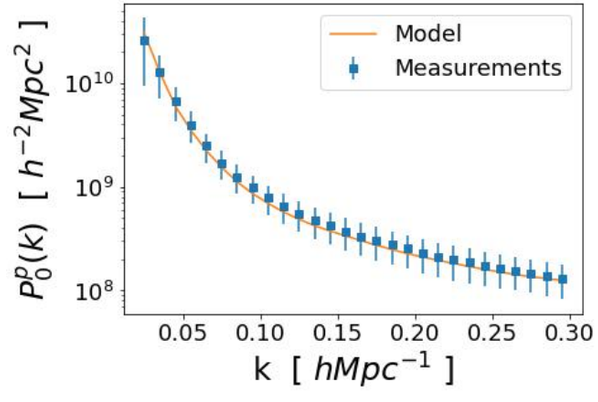
$b_1^p\sigma_8$=0.80376555, $b_2^p\sigma_8$= -0.16143919

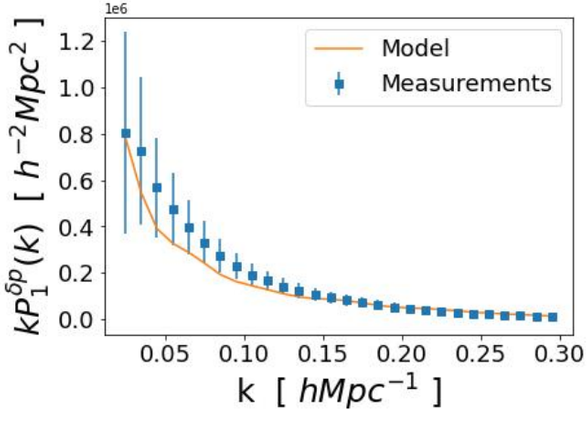
$\sigma^2_{\delta,vT}$=76.28644581, $\sigma^2_{\delta,vS}$=120.66419706, $\sigma^2_{p,v}$=36.80603109

χ^2= 5.168879616886789









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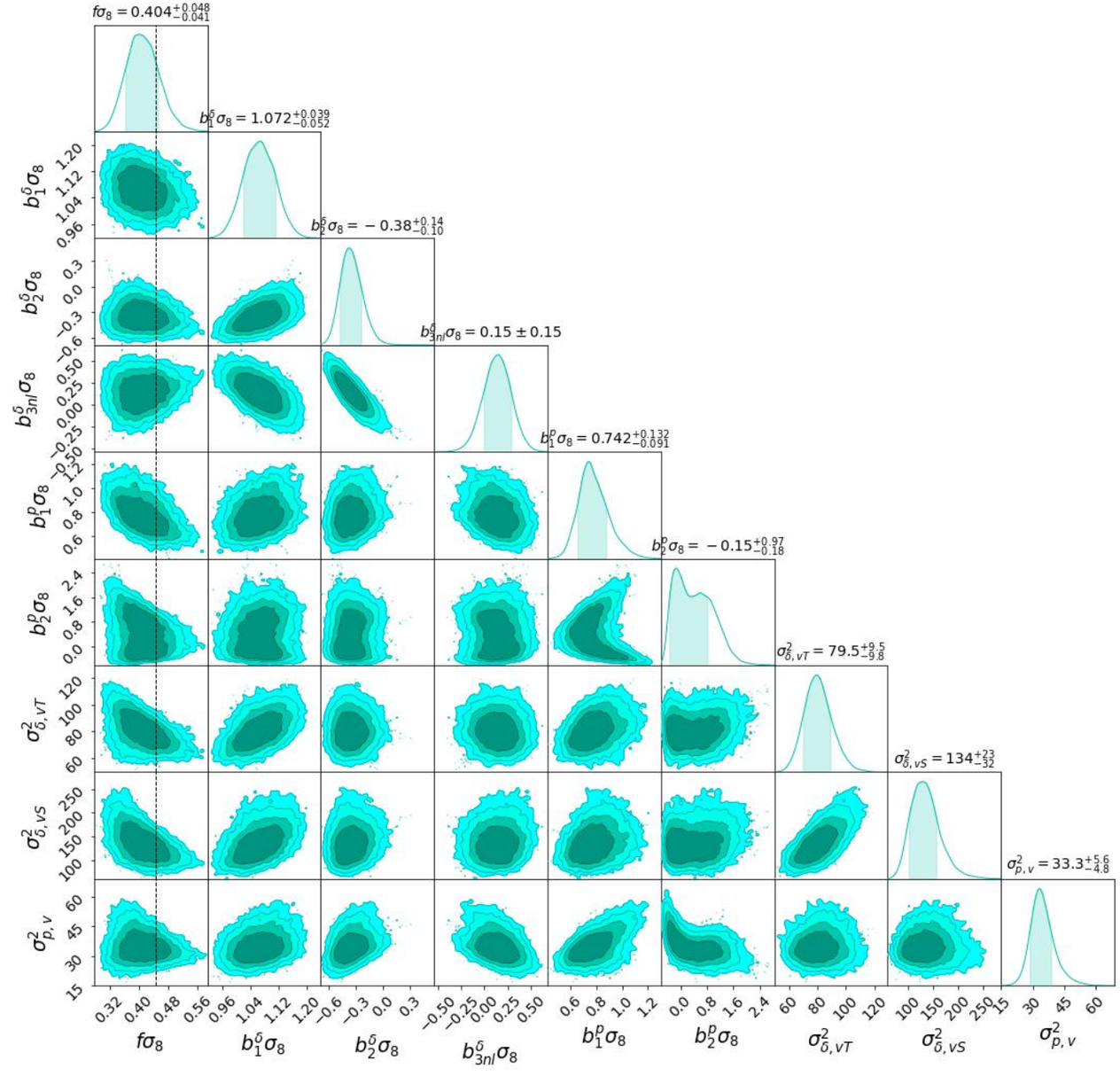


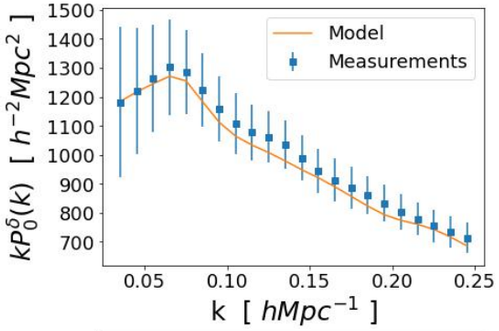
9: den-02 mom-02 crs-1

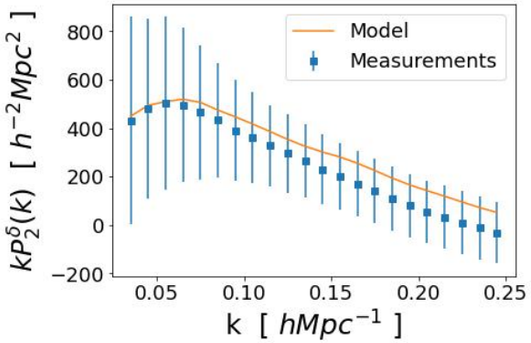
Optimization:

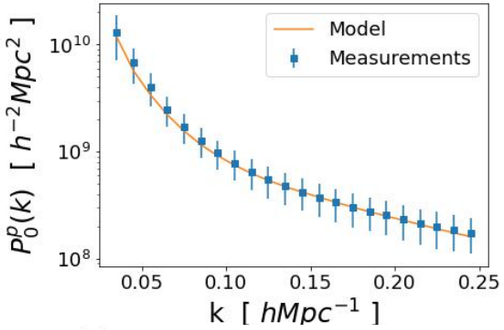
$f\sigma_8$= 0.4387031100824951 χ^2= 8.047314644318428

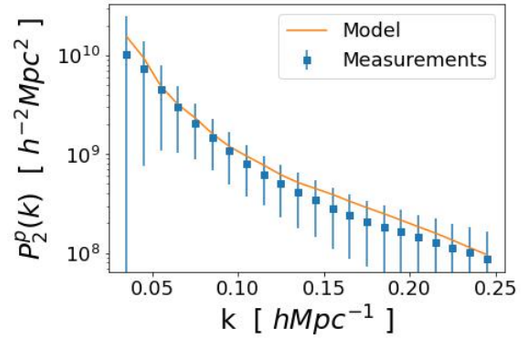
$b_1^\delta\sigma_8$=1.12268726, $b_2^\delta\sigma_8$= 1.164955014, $b_{3nl}^\delta\sigma_8$= -0.43981546, $b_1^p\sigma_8$=0.93692658,

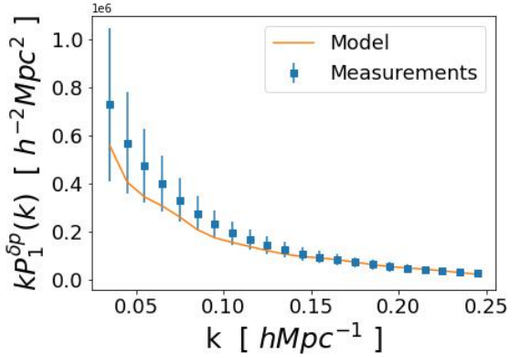
$\sigma^2_{\delta,vT}$=63.43586854, $\sigma^2_{\delta,vS}$=140.16255642, $\sigma^2_{p,vT}$=21.41799111, $\sigma^2_{p,vS}$=69.13139211



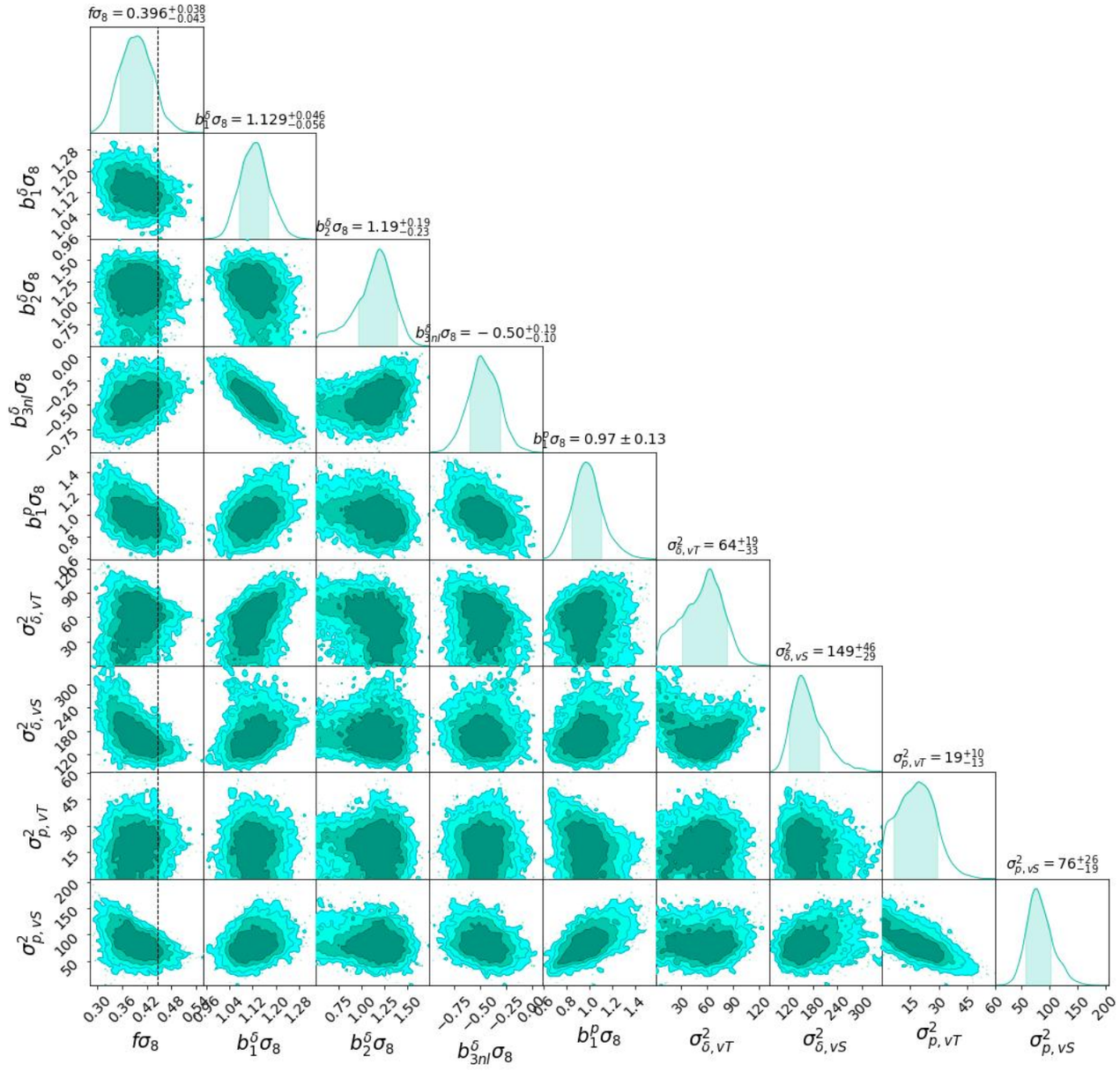








MCMC:



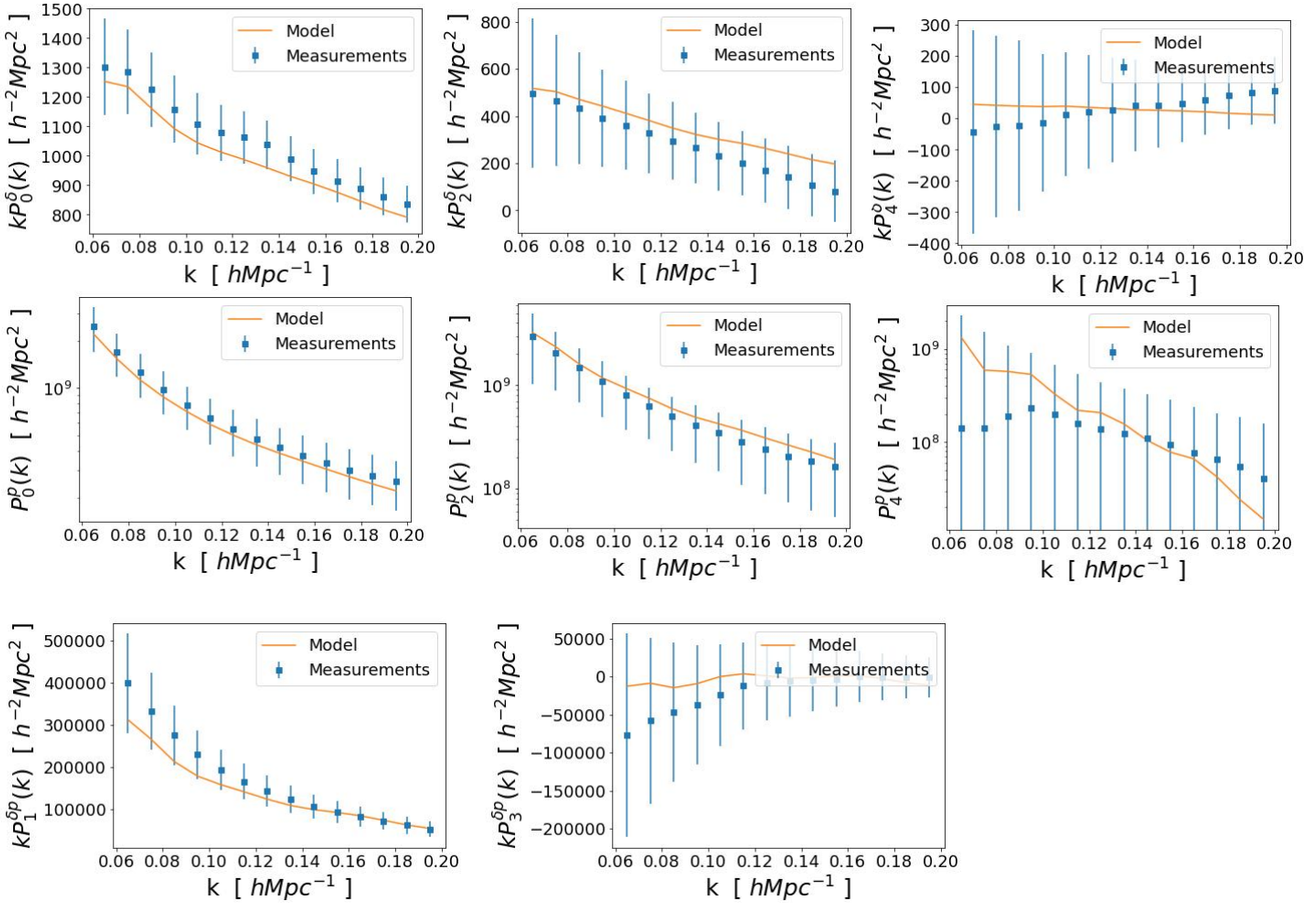
10: den-024 mom-024 crs-13

Optimization:

$f\sigma_8$= 0.44464841329182053 χ^2= 6.56178177230184

$b_1^\delta\sigma_8$=1.11494189, $b_2^\delta\sigma_8$= 1.0526154, $b_{3nl}^\delta\sigma_8$= -0.43773109, $b_1^p\sigma_8$=0.87376973,

$\sigma^2_{\delta,vT}$=77.03001467, $\sigma^2_{\delta,vS}$=129.15953933, $\sigma^2_{p,vT}$=18.16552981, $\sigma^2_{p,vS}$=70.593913



MCMC: