

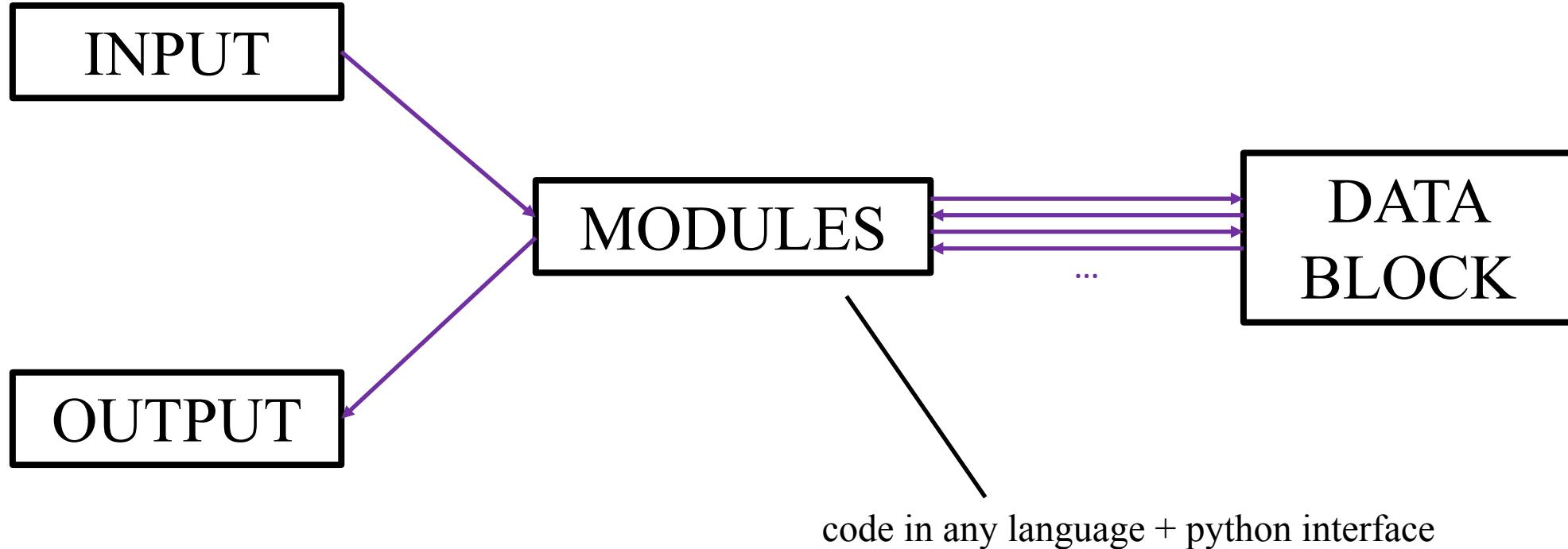
Using CosmoSIS: an example with DES

Agnès Ferté (JPL/Caltech)

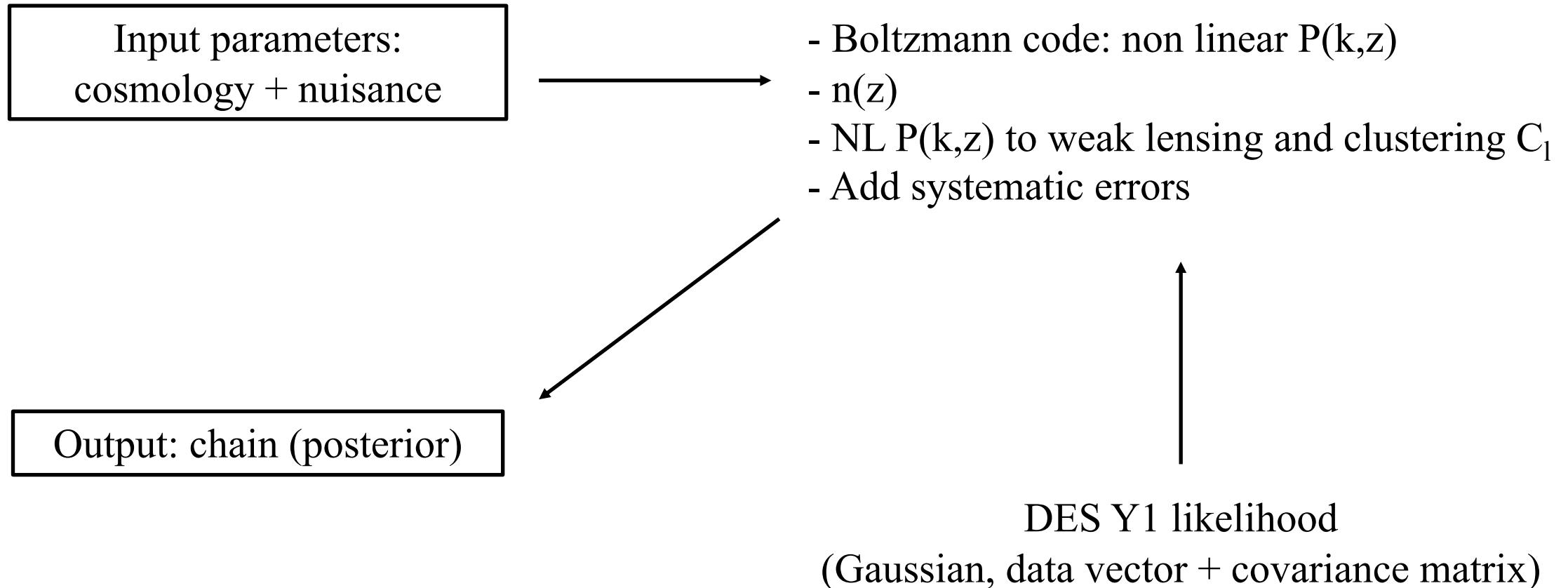
Developed by Joe Zuntz et al:

- Repository: <https://bitbucket.org/joezuntz/cosmosis/wiki/Home>
- Paper: <http://arxiv.org/abs/1409.3409>

CosmoSIS: a modular cosmological parameter estimation code.



Cosmological constraints with DES Y1



Install CosmoSIS

In examples/des-y1: ini files used for the analysis.

Typically, there are three configuration files:

- Pipeline
- Cosmological and nuisance parameters
- Priors

1. Samplers:

- ‘Test’: run the pipeline for one set of parameters
- Standard MCMC or nested sampling methods: metropolis hasting, multinest, emcee, importance sampling, etc.
- Fast/slow separation possible.

```
[runtime]
sampler = test
root = ${COSMOSIS_SRC_DIR}
```

Default sampler in DES Y1: multinest – to compute posterior and Bayesian evidence.

2. Pipeline:

list the modules to use and the list of likelihoods.
Possibility to output derived parameter or quantity
for each sample (computed data vector or χ^2 ,...)

NL $P(k,z)$

$n(z)$

3x2pt

```
[pipeline]
values = ${COSMOSIS_SRC_DIR}/examples/des-y1/values.ini
priors = ${COSMOSIS_SRC_DIR}/examples/des-y1/priors.ini
modules =
; Computes the full set of cosmological parameter, e.g. h->H_0, Omega_m->Omega_m h^2
consistency
; Computes the CMB and linear matter power spectra
camb
; Computes the nonlinear matter spectrum
halofit
; Computes the growth rate
growth
; Extrapolates the matter power spectra to high k
extrapolate
; Loads the number density of the survey from file
fits_nz
; Biases the Lens photo-z values
lens_photoz_bias
; Biases the source photo-z values
source_photoz_bias
; Computes the galaxy power spectrum (pretending for the moment that b is 1
unbiased_galaxies
; Computes the NLA intrinsic alignment model
IA
; Applies an additional redshift dependence to the NLA model
ia_z_field
; Computes C_ell values using the Limber integral
pk_to_cl
; Applies per-bin bias values to the galaxy-galaxy lensing and galaxy spectra
bin_bias
; Adds the intrinsic alignment contribution to the lensing
add_intrinsic
; Applies a shear calibration bias
shear_m_bias
; Computes the galaxy correlation function from the C_ell
2pt_gal
; Computes the galaxy-shear correlation function from the C_ell
2pt_gal_shear
; Computes the shear correlation function from the C_ell
2pt_shear
; Computes the 2pt function likelihood
2pt_like

likelihoods = 2pt
extra_output = cosmological_parameters/sigma_8 ; Derived parameter to save
```

3. Settings of the modules used in the pipeline

```
[camb]
file = cosmosis-standard-library/boltzmann/camb/camb.so
mode=all
lmax=2500
feedback=0
kmin=1e-5
kmax=10.0
nk=200
```

```
[pk_to_cl]
file = cosmosis-standard-library/structure/projection/project_2d.py
ell_min = 0.1
ell_max = 5.0e5
n_ell = 400
position-shear = lens-source
shear-shear = source-source
position-position = lens-lens
intrinsic-intrinsic = source-source
shear-intrinsic = source-source
position-intrinsic = lens-source
verbose = F
get_kernel_peaks=F
```

4. Parameters and priors

```
[cosmological_parameters]
omega_m      = 0.1      0.295      0.9
h0           = 0.55     0.6881     0.9
omega_b       = 0.03     0.0468     0.07
n_s           = 0.87     0.9676     1.07
A_s           = 0.5e-09  2.260574e-09 5.e-09
omnuh2        = 0.0006   0.0006155   0.01
w              = -1.0
massive_nu    = 1
massless_nu   = 2.046
omega_k        = 0.0
tau            = 0.08
wa             = 0.0

;Helium mass fraction. Needed for Planck
yhe           = 0.245341
```

```
[bin_bias]
b1 = 0.8 1.45 3.0
b2 = 0.8 1.55 3.0
b3 = 0.8 1.65 3.0
b4 = 0.8 1.8 3.0
b5 = 0.8 2.0 3.0
```

```
[shear_calibration_parameters]
m1 = -0.1 0.012 0.1
m2 = -0.1 0.012 0.1
m3 = -0.1 0.012 0.1
m4 = -0.1 0.012 0.1
```

```
[wl_photoz_errors]
bias_1 = gaussian -0.001 0.016
bias_2 = gaussian -0.019 0.013
bias_3 = gaussian 0.009 0.011
bias_4 = gaussian -0.018 0.022
```

```
[shear_calibration_parameters]
m1 = gaussian 0.012 0.023
m2 = gaussian 0.012 0.023
m3 = gaussian 0.012 0.023
m4 = gaussian 0.012 0.023
```

```
[lens_photoz_errors]
bias_1 = gaussian 0.008 0.007
bias_2 = gaussian -0.005 0.007
bias_3 = gaussian 0.006 0.006
bias_4 = gaussian 0.00 0.01
bias_5 = gaussian 0.0 0.01
```

```
[planck]
a_planck = gaussian 1.0 0.0025
```

5. Run chains. Plotting possible within CosmoSIS but we used getdist in DES.

Easier to add new modules or to modify existing modules. E.g. for modified gravity:

MGCamb

Modified MGCamb and the interface to
add (Σ, μ) parameters to the
modified_gravity datablock

Lensing predictions

Read Σ from the datablock and add it to the
lensing kernel

