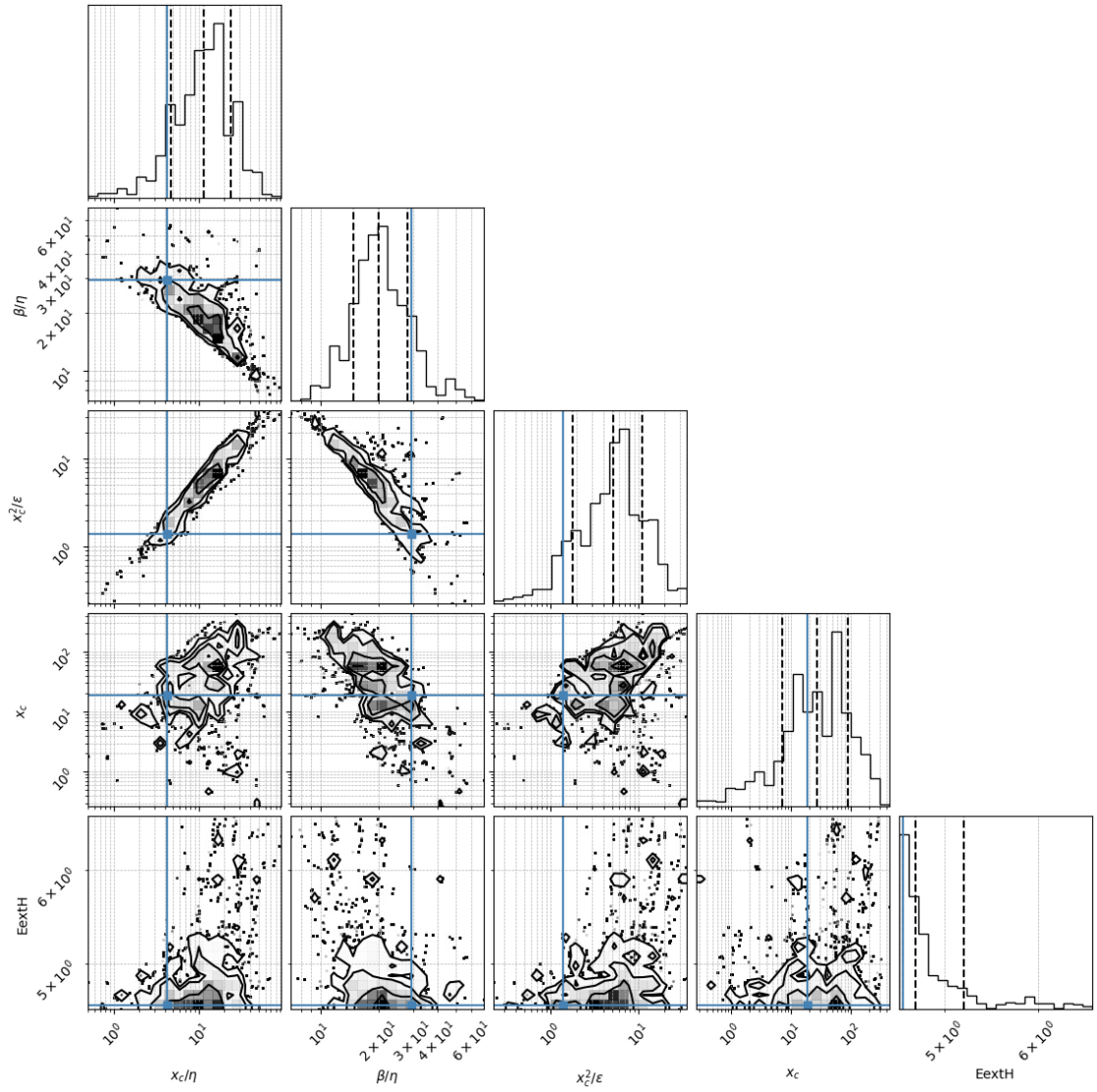
mcmc_analysis_cats_vp_M_baysian

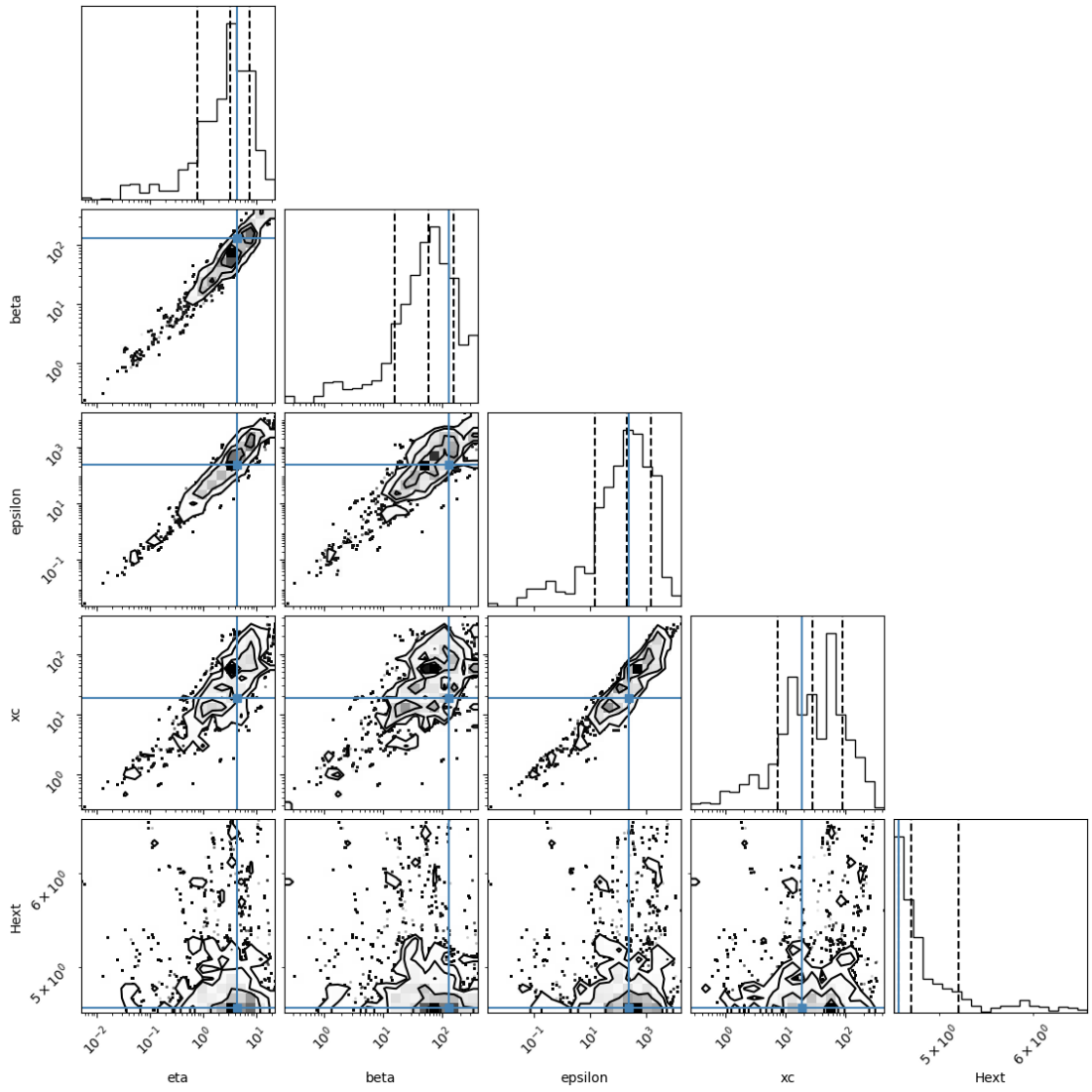
November 24, 2025

1 # 1. Density coner plot

A sample is 1 parameter set scanned. For the corner plot below, the quantiles (represented by the solid lines) are 0.16,0.5,0.84 of the samples. Dots represent individual samples (outside the line surrounding 0.84 of the samples) The parameter search is performed in the transformed space of x_c/η, β/η, x_c^2/ϵ, x_c but we also show the regular parameters

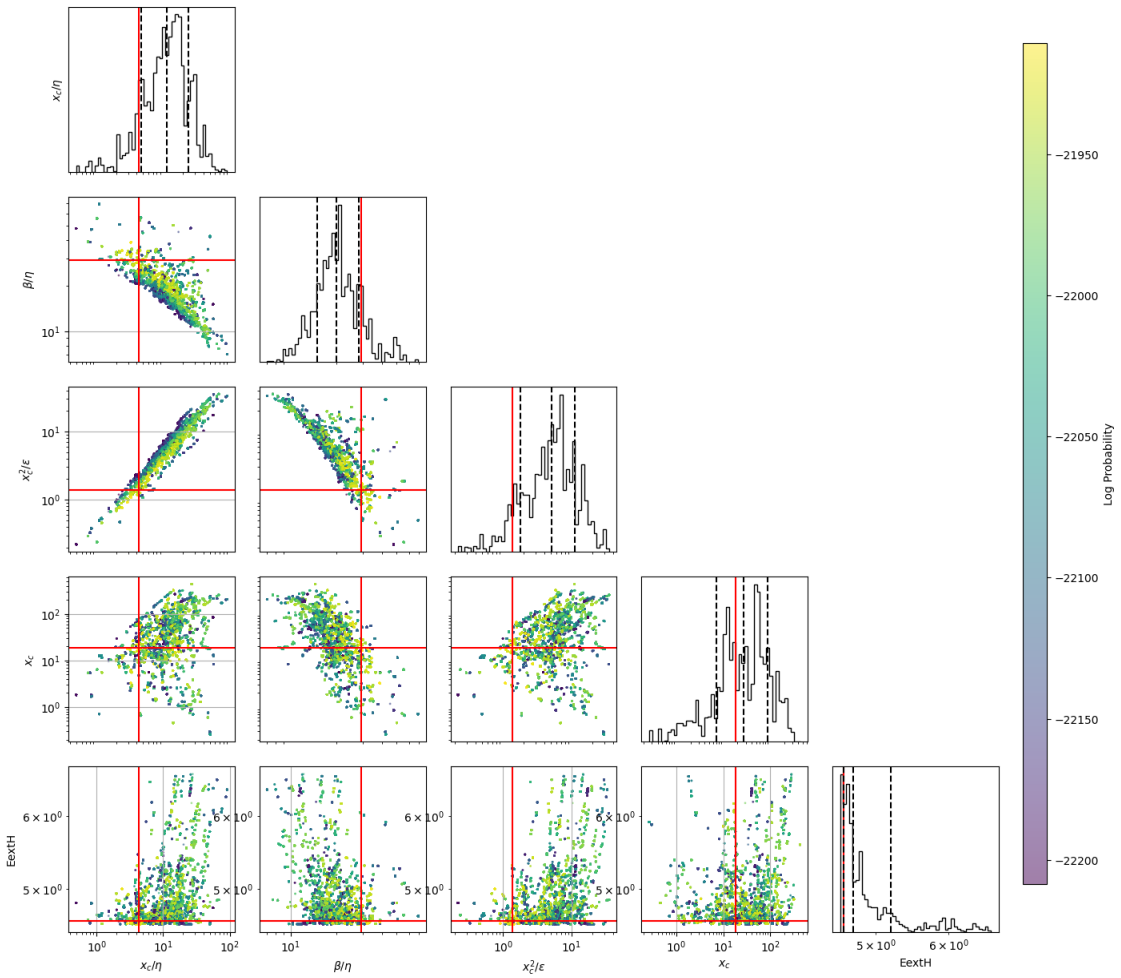
```
(25,)
```


x_c/η
β/η
x_c^2/ε
x_c
EextH



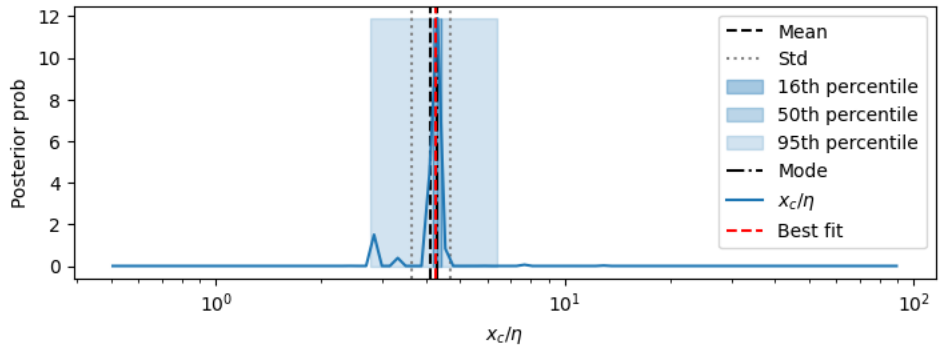
2 2. Heat map corner plot of raw samples

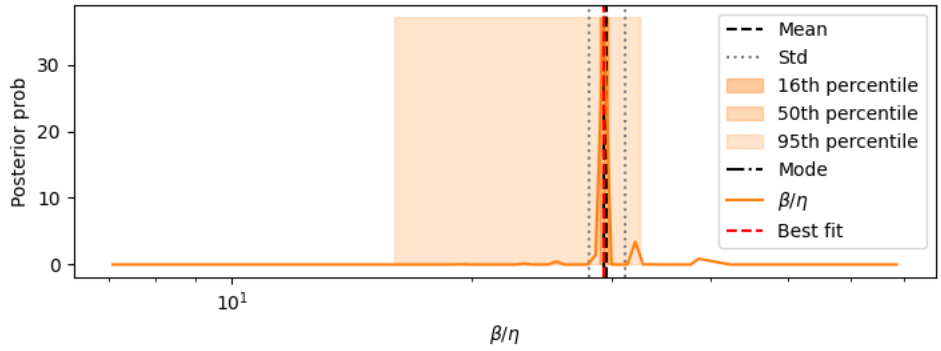
This plot shows all the raw sample points and their lnprobability

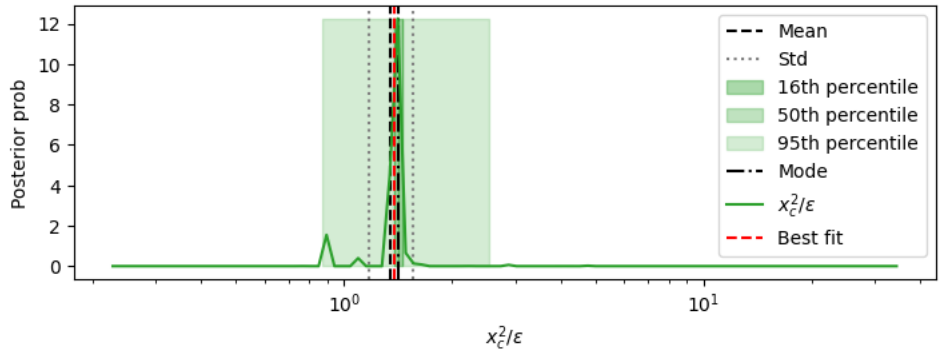


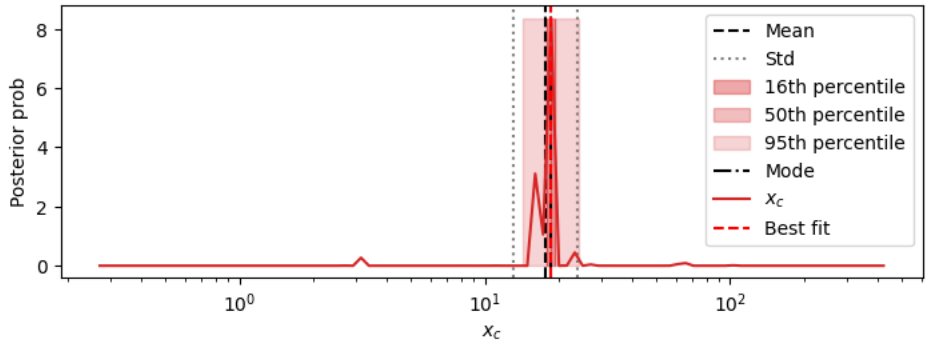
3 3. Posterior distributions of parameters

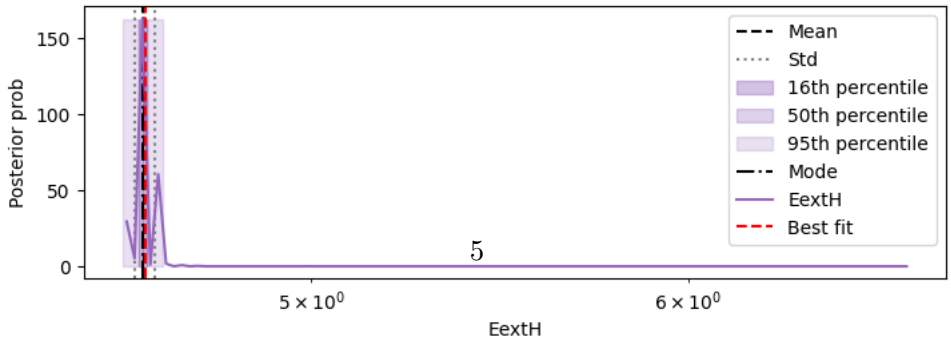
1d marginalizations of posterior distributions. we use a grid of size nbins=100-150


Posterior prob
x_c/η
Mean
Std
16th percentile
50th percentile
95th percentile
Mode
x_c/η
Best fit


Posterior prob
β/η
Mean
Std
16th percentile
50th percentile
95th percentile
Mode
β/η
Best fit

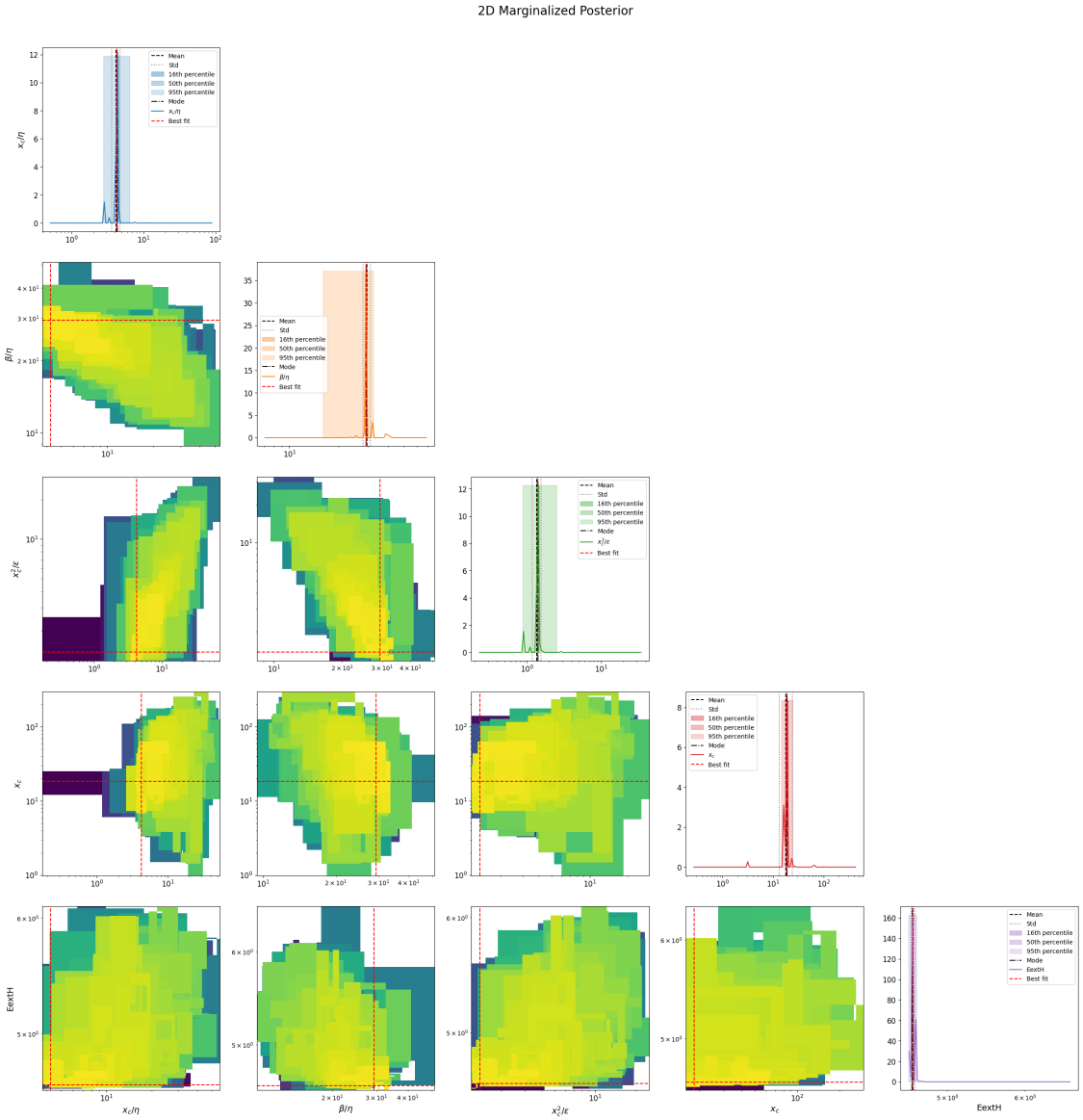

Posterior prob
x_c^2/ε
Mean
Std
16th percentile
50th percentile
95th percentile
Mode
x_c^2/ε
Best fit


Posterior prob
x_c
Mean
Std
16th percentile
50th percentile
95th percentile
Mode
x_c
Best fit


Posterior prob
EextH
Mean
Std
16th percentile
50th percentile
95th percentile
Mode
EextH
Best fit

2D marginalizations of posterior distributions

```
/Volumes/alon/navehr/SRtools/SRtools/samples_utils.py:474: UserWarning: The
input coordinates to pcolormesh are interpreted as cell centers, but are not
monotonically increasing or decreasing. This may lead to incorrectly calculated
cell edges, in which case, please supply explicit cell edges to pcolormesh.
  ax.pcolormesh(X, Y, Z, **kwargs)
```




```
Rescaling the samples TIME by 365
```

4 4. Table of results

mode is the marginalized mode, max_likwlihood is the sample with highest likelihood mode_overall is the 4D posterior mode

	mean	\
xc/eta	4.125	
beta/eta	29.622	
xc^2/epsilon	1.348	
xc	17.677	
ExtH	4.613	
eta	4.328	
beta	125.895	
epsilon	242.642	
sqrt(xc/eta)	2.031	
s= eta^0.5*xc^1.5/epsilon	0.65	
beta*xc/epsilon	9.604	
eta*xc/epsilon	0.322	
Fx=beta^2/eta*xc	213.549	
Dx =beta*epsilon/eta*xc^2	21.993	
Pk=beta*k/epsilon	0.272	
Fk=beta^2/eta*k	7439.535	
Dk =beta*epsilon/eta*k^2	29168.8	
Fk^2/Dk=beta^3/eta*epsilon	2008.685	
epsilon/beta^2	0.0145	
k/beta	0.00397	
k^2/epsilon	0.00103	
eta/xc	0.242	
beta/xc	7.067	
epsilon/xc^2	0.742	
k/xc	0.0283	
best fit no ext hazard_MedianLifetime	13.24	
best fit no ext hazard_MaxLifetime	25.0	
best fit_MedianLifetime	12.48	
best fit_MaxLifetime	25.0	
data_MedianLifetime	12.54	
data_MaxLifetime	26.5	
ML_lnprob	-21910.355072	

std \	
xc/eta	[0.495,
0.562]	
beta/eta	[1.495,
1.574]	
xc^2/epsilon	[0.177,
0.204]	
xc	[4.567,

```
6.157]
ExtH                                                    [0.0222,
0.0223]
eta                                                       [1.014,
1.324]
beta                                                    [27.412,
35.042]
epsilon                                               [104.184,
182.578]
sqrt(xc/eta)                                              [0.126,
0.134]
s= eta^0.5*xc^1.5/epsilon                               [0.0435,
0.0467]
beta*xc/epsilon                                           [0.433,
0.454]
eta*xc/epsilon                                        [0.00508,
0.00516]
Fx=beta^2/eta*xc                                        [40.424,
49.863]
Dx =beta*epsilon/eta*xc^2                                 [3.495,
4.155]
Pk=beta*k/epsilon                                        [0.0775,
0.108]
Fk=beta^2/eta*k                                       [1544.078,
1948.486]
Dk =beta*epsilon/eta*k^2                             [11679.12,
19478.111]
Fk^2/Dk=beta^3/eta*epsilon                              [468.353,
610.761]
epsilon/beta^2                                          [0.00269,
0.0033]
k/beta                                                 [0.000858,
0.00109]
k^2/epsilon                                           [0.000442,
0.000774]
eta/xc                                                   [0.0291,
0.033]
beta/xc                                                   [1.104,
1.308]
epsilon/xc^2                                             [0.0974,
0.112]
k/xc                                                    [0.0073,
0.00985]
best fit no ext hazard_MedianLifetime
0.51
best fit no ext hazard_MaxLifetime
0
```

```
best fit_MedianLifetime
0.51
best fit_MaxLifetime
0
data_MedianLifetime
0.52
data_MaxLifetime
0
ML_lnprob                                [-21910.355072076876,
-21910.355072076876]

                                                    mode  \
xc/eta                                             4.314
beta/eta                                          29.347
xc^2/epsilon                                       1.411
xc                                                18.636
ExtH                                               4.608
eta                                                4.364
beta                                             124.741
epsilon                                          262.179
sqrt(xc/eta)                                       2.077
s= eta^0.5*xc^1.5/epsilon                          0.659
beta*xc/epsilon                                    9.527
eta*xc/epsilon                                     0.321
Fx=beta^2/eta*xc                                 203.817
Dx =beta*epsilon/eta*xc^2                         20.798
Pk=beta*k/epsilon                                  0.254
Fk=beta^2/eta*k                                 7304.643
Dk =beta*epsilon/eta*k^2                       31392.832
Fk^2/Dk=beta^3/eta*epsilon                      1834.901
epsilon/beta^2                                   0.0155
k/beta                                          0.00401
k^2/epsilon                                    0.000952
eta/xc                                            0.232
beta/xc                                           6.661
epsilon/xc^2                                      0.709
k/xc                                             0.0268
best fit no ext hazard_MedianLifetime             13.24
best fit no ext hazard_MaxLifetime                 25.0
best fit_MedianLifetime                           12.48
best fit_MaxLifetime                               25.0
data_MedianLifetime                               12.54
data_MaxLifetime                                   26.5
ML_lnprob                                  -21910.355072

percentile_16  \
xc/eta                                                          [4.203,
```

```
4.428]
beta/eta                                                    [29.012,
29.685]
xc^2/epsilon                                                  [1.376,
1.448]
xc                                                          [17.956,
19.341]
ExtH                                                            [4.6,
4.617]
eta                                                           [4.185,
4.551]
beta                                                        [120.138,
129.521]
epsilon                                                     [242.199,
283.807]
sqrt(xc/eta)                                                    [2.05,
2.104]
s= eta^0.5*xc^1.5/epsilon                                     [0.649,
0.669]
beta*xc/epsilon                                               [9.408,
9.647]
eta*xc/epsilon                                                [0.319,
0.323]
Fx=beta^2/eta*xc                                            [194.79,
213.263]
Dx =beta*epsilon/eta*xc^2                                   [20.082,
21.539]
Pk=beta*k/epsilon                                             [0.243,
0.266]
Fk=beta^2/eta*k                                            [7025.506,
7594.871]
Dk =beta*epsilon/eta*k^2                                   [29129.061,
33832.531]
Fk^2/Dk=beta^3/eta*epsilon                                  [1732.262,
1943.621]
epsilon/beta^2                                                [0.0148,
0.0163]
k/beta                                                      [0.00386,
0.00416]
k^2/epsilon                                                 [0.00088,
0.00103]
eta/xc                                                        [0.226,
0.238]
beta/xc                                                       [6.427,
6.903]
epsilon/xc^2                                                  [0.691,
0.727]
```

```
k/xc                                                    [0.0258,
0.0278]
best fit no ext hazard_MedianLifetime                     [12.75,
13.75]
best fit no ext hazard_MaxLifetime                          [25.0,
25.0]
best fit_MedianLifetime                                   [11.99,
12.99]
best fit_MaxLifetime                                        [25.0,
25.0]
data_MedianLifetime                    [12.059999999999999,
13.059999999999999]
data_MaxLifetime                                            [26.5,
26.5]
ML_lnprob                           [-21910.355072076876,
-21910.355072076876]

percentile_50  \
xc/eta                                                    [4.203,
4.428]
beta/eta                                                [29.012,
29.685]
xc^2/epsilon                                              [1.376,
1.448]
xc                                                      [17.956,
19.341]
ExtH                                                        [4.6,
4.617]
eta                                                       [4.185,
4.551]
beta                                                    [120.138,
129.521]
epsilon                                                 [242.199,
283.807]
sqrt(xc/eta)                                               [2.05,
2.104]
s= eta^0.5*xc^1.5/epsilon                                 [0.649,
0.669]
beta*xc/epsilon                                           [9.408,
9.647]
eta*xc/epsilon                                            [0.319,
0.323]
Fx=beta^2/eta*xc                                        [194.79,
213.263]
Dx =beta*epsilon/eta*xc^2                               [20.082,
21.539]
Pk=beta*k/epsilon                                         [0.243,
```

```
0.266]
Fk=beta^2/eta*k                                          [7025.506,
7594.871]
Dk =beta*epsilon/eta*k^2                                [29129.061,
33832.531]
Fk^2/Dk=beta^3/eta*epsilon                               [1732.262,
1943.621]
epsilon/beta^2                                              [0.0148,
0.0163]
k/beta                                                    [0.00386,
0.00416]
k^2/epsilon                                               [0.00088,
0.00103]
eta/xc                                                       [0.226,
0.238]
beta/xc                                                      [6.427,
6.903]
epsilon/xc^2                                                 [0.691,
0.727]
k/xc                                                      [0.0258,
0.0278]
best fit no ext hazard_MedianLifetime                        [12.75,
13.75]
best fit no ext hazard_MaxLifetime                             [25.0,
25.0]
best fit_MedianLifetime                                      [11.99,
12.99]
best fit_MaxLifetime                                           [25.0,
25.0]
data_MedianLifetime                    [12.059999999999999,
13.059999999999999]
data_MaxLifetime                                             [26.5,
26.5]
ML_lnprob                             [-21910.355072076876,
-21910.355072076876]

percentile_95  \
xc/eta                                                       [2.767,
6.383]
beta/eta                                                  [15.984,
32.536]
xc^2/epsilon                                                 [0.872,
2.529]
xc                                                        [14.369,
24.169]
ExtH                                                         [4.565,
4.652]
```

```
eta                                                    [3.848,
6.365]
beta                                                  [52.536,
203.368]
epsilon                                              [150.528,
389.697]
sqrt(xc/eta)                                           [1.663,
2.526]
s= eta^0.5*xc^1.5/epsilon                              [0.527,
3.742]
beta*xc/epsilon                                       [6.787,
10.144]
eta*xc/epsilon                                         [0.314,
0.328]
Fx=beta^2/eta*xc                                     [1.461,
367.287]
Dx =beta*epsilon/eta*xc^2                             [0.604,
35.175]
Pk=beta*k/epsilon                                      [0.203,
0.318]
Fk=beta^2/eta*k                                    [5144.065,
13104.485]
Dk =beta*epsilon/eta*k^2                          [21592.875,
53010.086]
Fk^2/Dk=beta^3/eta*epsilon                           [24.473,
3877.929]
epsilon/beta^2                                         [0.0085,
1.27]
k/beta                                               [0.00246,
0.00951]
k^2/epsilon                                         [0.000641,
0.00166]
eta/xc                                                 [0.157,
0.361]
beta/xc                                                [0.702,
11.38]
epsilon/xc^2                                           [0.395,
1.147]
k/xc                                                  [0.0207,
0.0348]
best fit no ext hazard_MedianLifetime                  [12.75,
13.75]
best fit no ext hazard_MaxLifetime                       [25.0,
25.0]
best fit_MedianLifetime                                [11.99,
12.99]
best fit_MaxLifetime                                     [25.0,
```

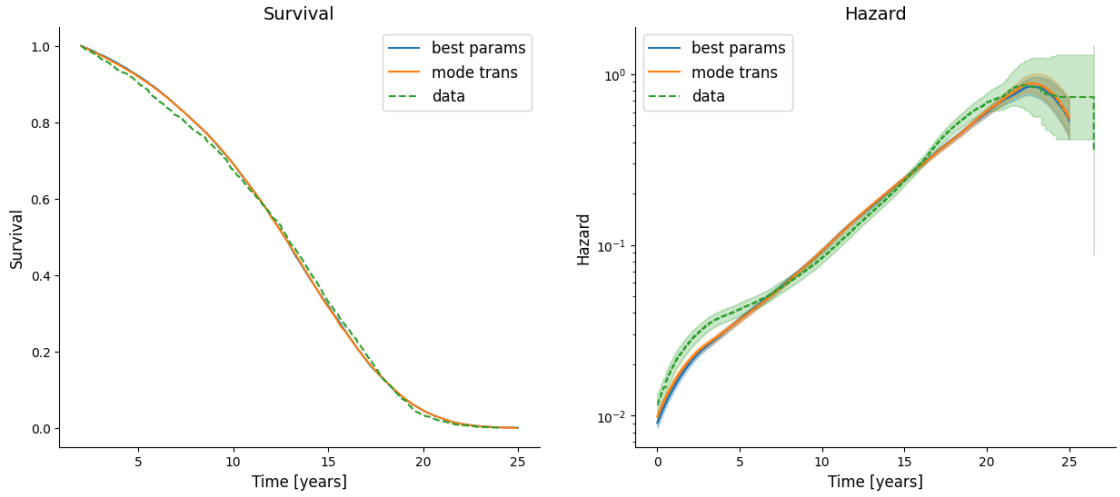
25.0]
data_MedianLifetime [12.059999999999999,
13.059999999999999]
data_MaxLifetime [26.5,
26.5]
ML_lnprob [-21910.355072076876,
-21910.355072076876]

	max_likelihood	mode_overall
xc/eta	4.273	4.273
beta/eta	29.343	29.343
xc^2/epsilon	1.379	1.379
xc	18.533	18.533
ExtH	4.614	4.614
eta	4.338	4.338
beta	127.281	127.281
epsilon	249.173	249.173
sqrt(xc/eta)	2.067	2.067
s= eta^0.5*xc^1.5/epsilon	0.667	0.667
beta*xc/epsilon	9.467	9.467
eta*xc/epsilon	0.323	0.323
Fx=beta^2/eta*xc	201.52	201.52
Dx =beta*epsilon/eta*xc^2	21.286	21.286
Pk=beta*k/epsilon	0.255	0.255
Fk=beta^2/eta*k	7469.705	7469.705
Dk =beta*epsilon/eta*k^2	29246.357	29246.357
Fk^2/Dk=beta^3/eta*epsilon	1907.81	1907.81
epsilon/beta^2	0.0154	0.0154
k/beta	0.00393	0.00393
k^2/epsilon	0.001	0.001
eta/xc	0.234	0.234
beta/xc	6.868	6.868
epsilon/xc^2	0.725	0.725
k/xc	0.027	0.027
best fit no ext hazard_MedianLifetime	13.24	NaN
best fit no ext hazard_MaxLifetime	25.0	NaN
best fit_MedianLifetime	12.48	NaN
best fit_MaxLifetime	25.0	NaN
data_MedianLifetime	12.54	NaN
data_MaxLifetime	26.5	NaN
ML_lnprob	-21910.355072	-21910.355072

5 5. Fits of simulations to data

best params is the sample with highest likelihood. mode trans is the 4D posterior mode in the transformed space of x_c/η, β/η, x_c^2/ϵ, x_c

```
Text(0, 0.5, 'Hazard')
```




```
Text(0, 0.5, 'Prob density')
```