Isotope Fluxes Measurements Progress Report

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INFN Perugia

1 Data Base & Events Counts

ISS B1236 pass8(12.5 years) MC B1308 pass8

Track Cuts

Standard cuts

- good RTI & good run & Physical trigger
- Above geometry cutoff

Tracker

- Within L1Inner Fiducial volume
- L1XY & N_InnerHitsY>=5&L2&(L3|L4)&(L5|L6)&(L7|L8)& InnerNormChisY<10
- charge:
  q_inner ∈ [2.55, 3.45] [3.55, 4.45]
  qL1(unbias) ∈ [2.54, 3.65] [3.38, 4.65]
  good qL1 status

BG reduction

- 1 track || no good 2nd track || rigidity2nd<0.5GV

TOF

- beta > 0.4
- charge: q_uptof ∈ [2.4, 4.5] [3.4, 5.5]

Beta Reconstruction Cuts

TOF

- tof_beta > 0.4 & betah BuildType < 10
- coo_chis < 5 & time_chis < 10
- Not passing TOF edges
- q_lowtof ∈ [2.4, 4.5] [3.4, 5.5]

RICH general (pos correction accoding z)

- good status & clean
- Kolmogorov test probability > 0.01
- N_pmt > 2
- charge: q_rich ∈ [2, 5] [3, 6]

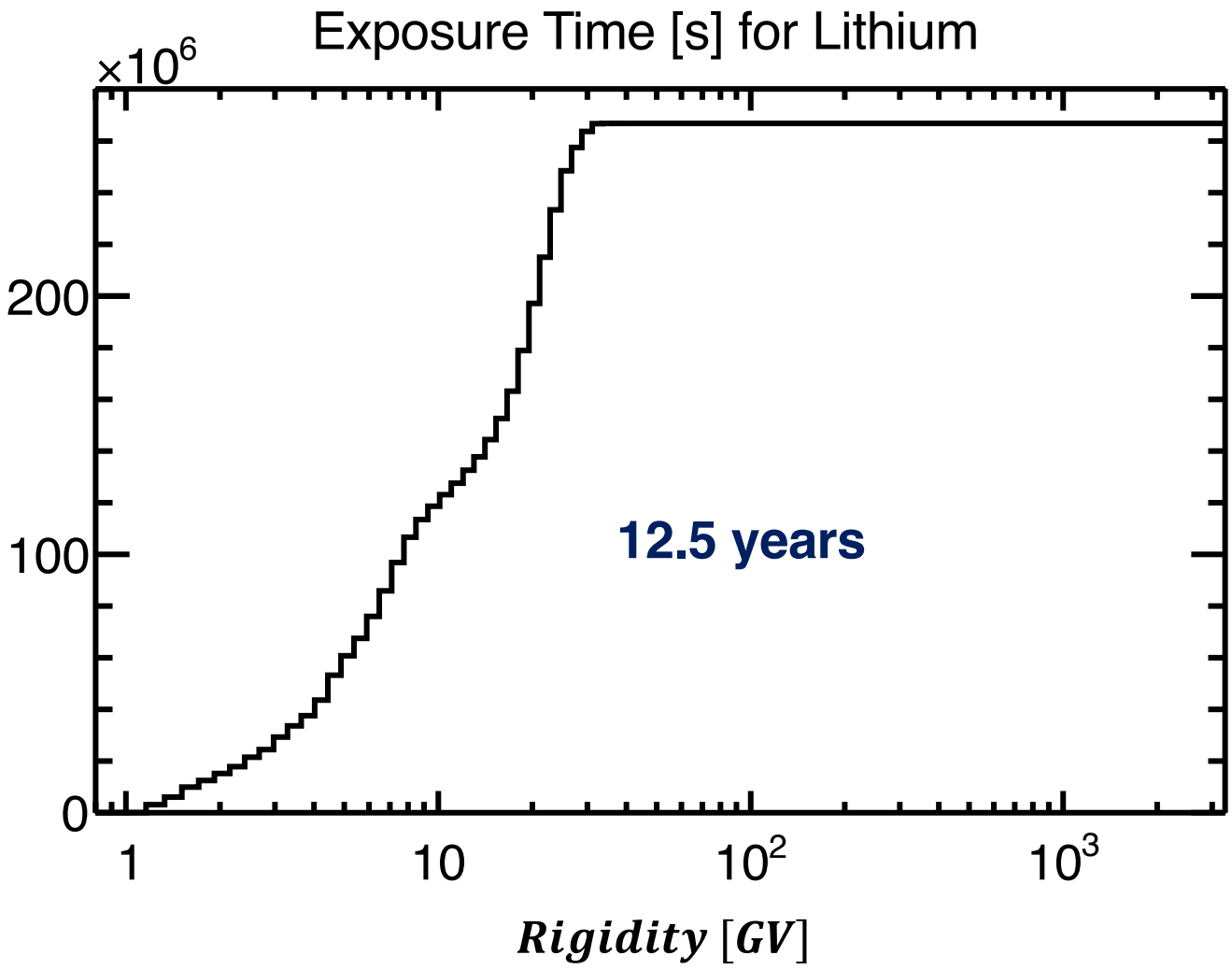
NaF

- Good NaF status Region
- N_pe(ring)/N_pe(total)>0.45

NaF

- Good AgI status Region & remove bad tiles
- N_pe(ring)/N_pe(total)>0.4

1 Exposure Time in Rigidity

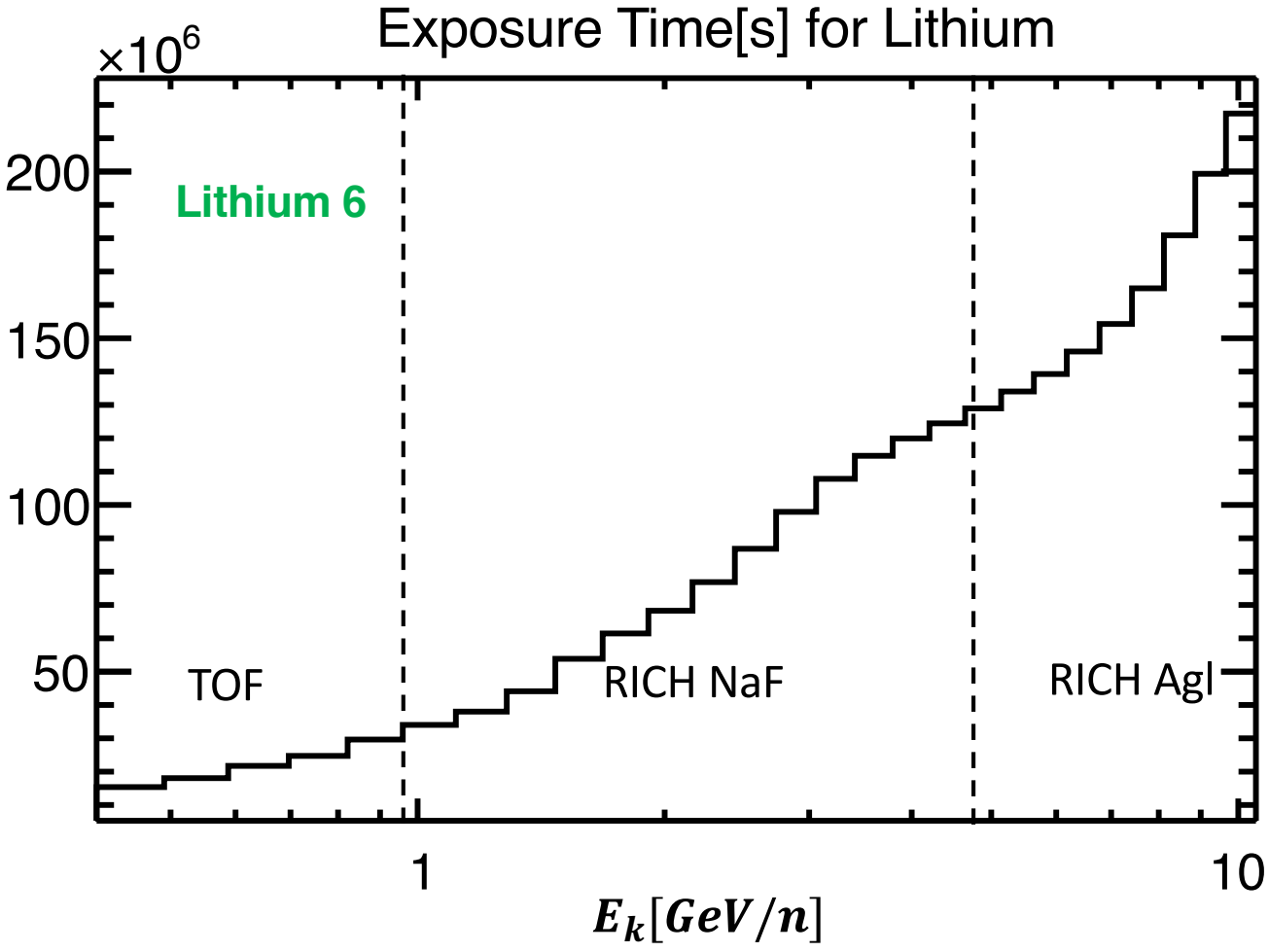


Safety Factor: 1.2

1

Exposure Time

Convert to Kinetic Energy (Only Regions in Use)



$$\beta_{co}(m) = \frac{R_{co}Z}{\sqrt{(R_{co}Z)^2 + m^2}}$$

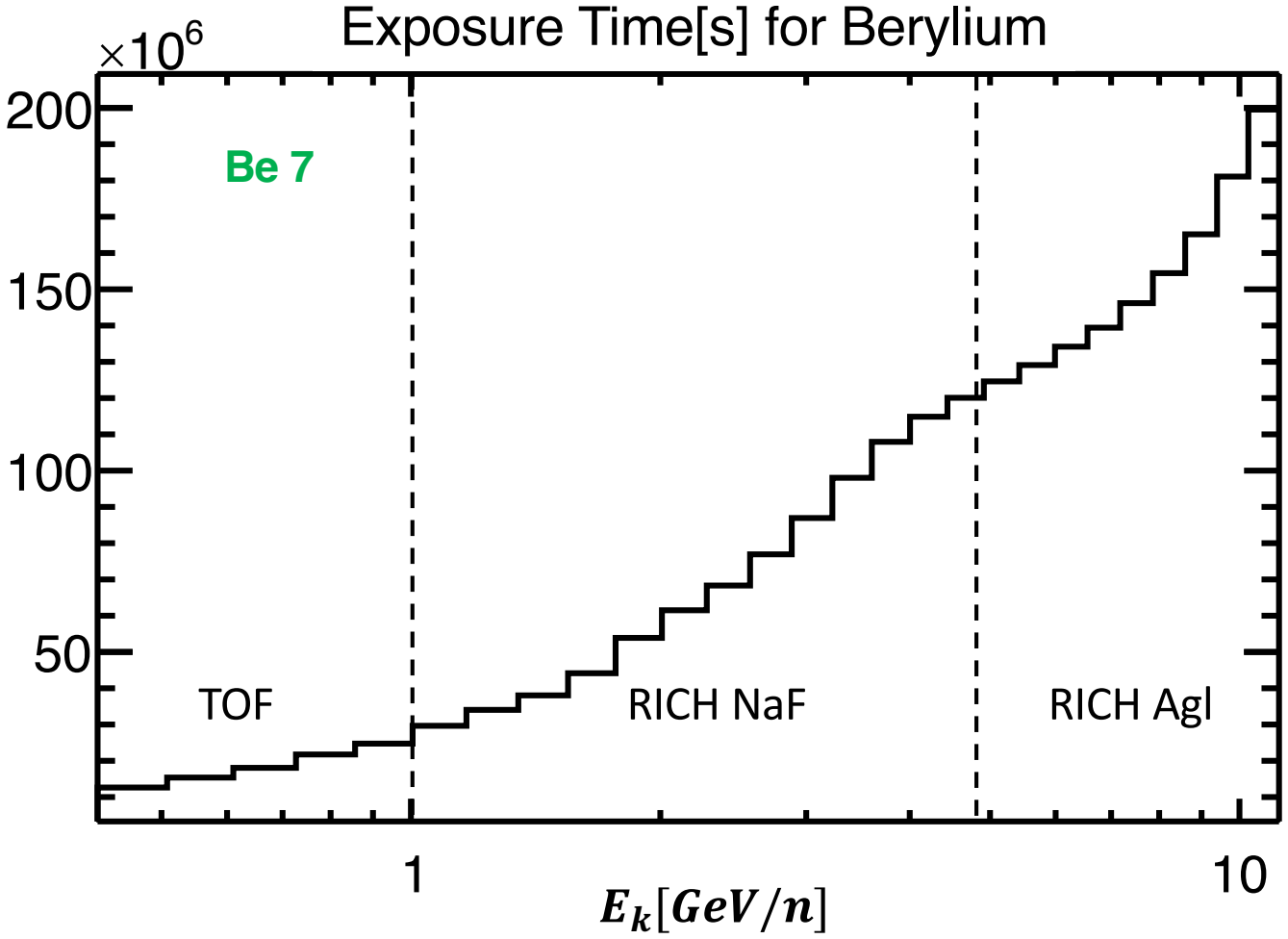
Safety Factor:

TOF: 1.2 NaF: 1.2 Aerogel: 1.2

1

Exposure Time

Convert to Kinetic Energy (Only Regions in Use)

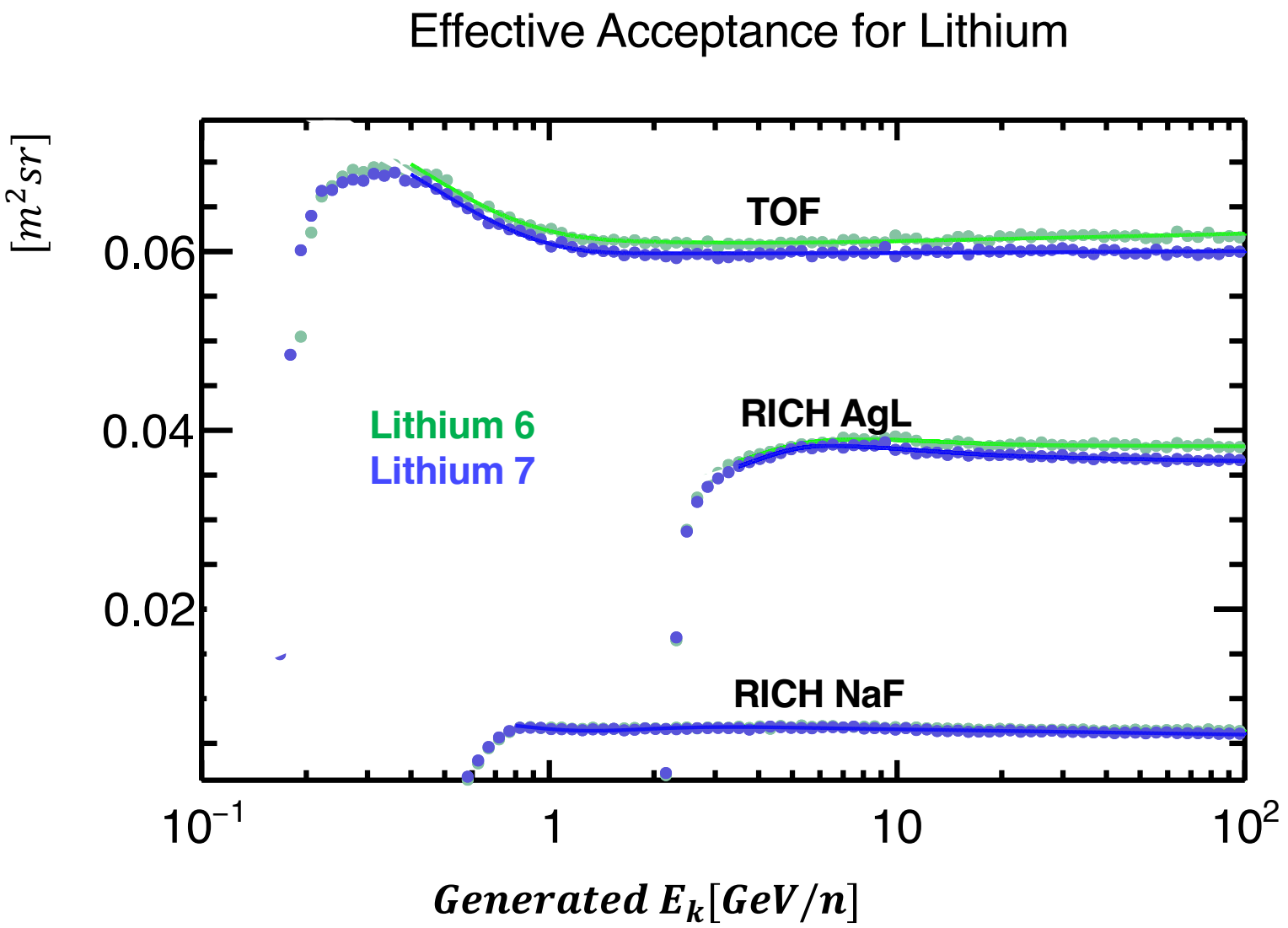


$$\beta_{co}(m) = \frac{R_{co}Z}{\sqrt{(R_{co}Z)^2 + m^2}}$$

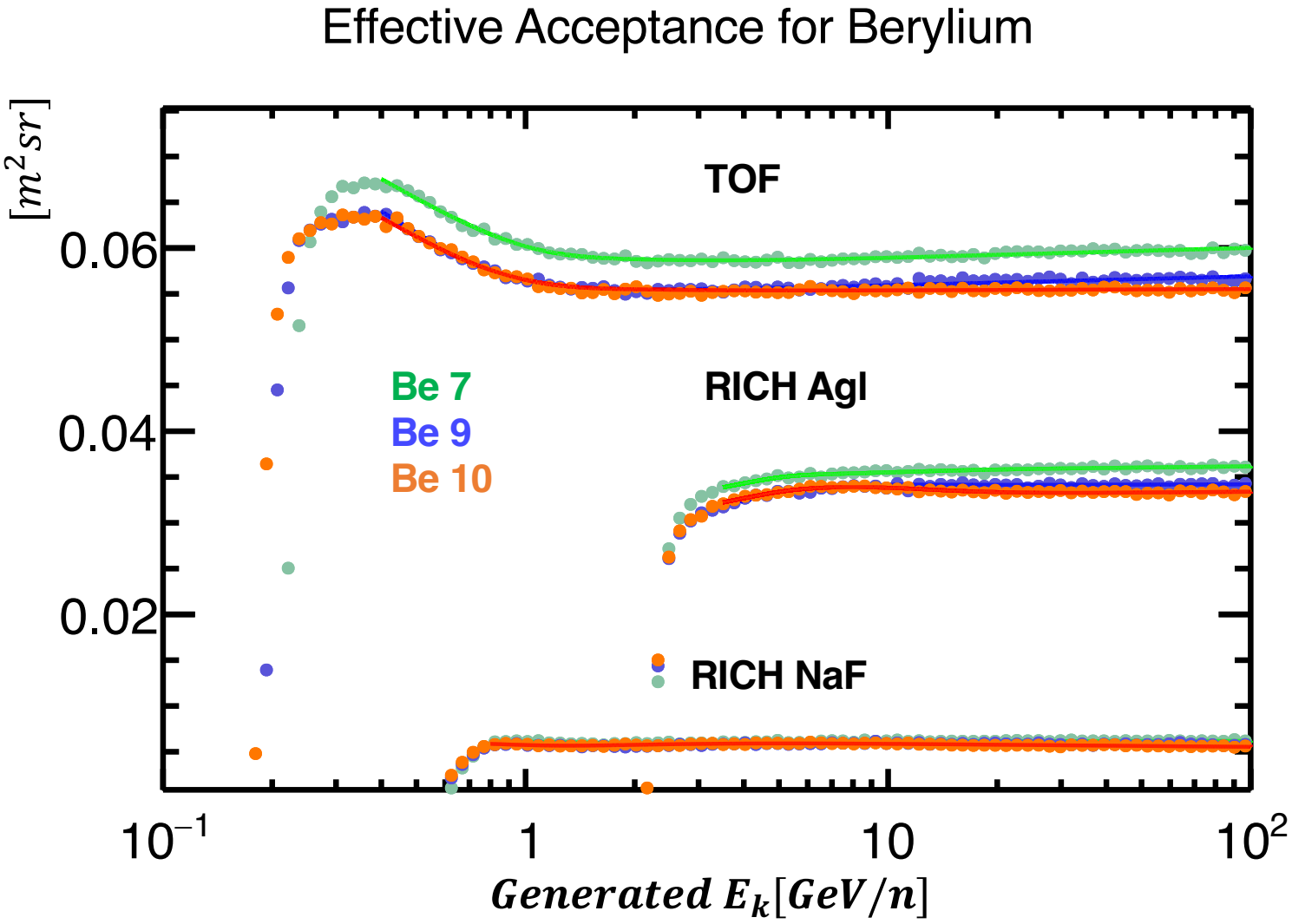
Safety Factor:

TOF: 1.2 NaF: 1.2 Aerogel: 1.2

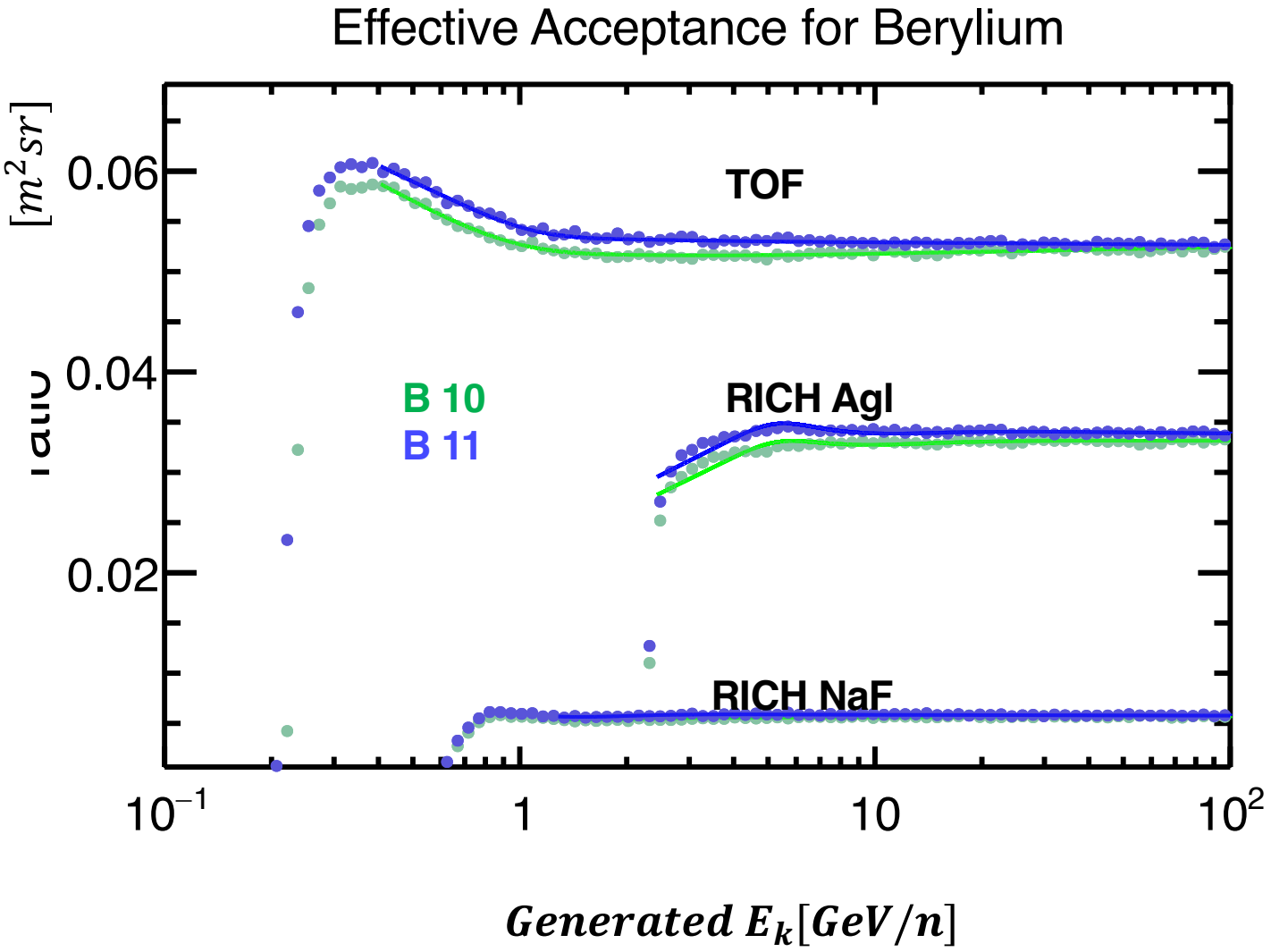
1 Acceptance



1 Acceptance



1 Acceptance



2 Selections Efficiencies: L1 unbias cuts

Sample:

Standard cuts

- good RTI & good run & Physical trigger

Tracker

- Within L1Inner Fiducial volume
- N_InnerHitsY>=5&L2&(L3|L4)&(L5|L6)&(L7|L8)& InnerNormChisY<10
- charge:
  q_inner ∈ [2.55, 3.45] [3.55, 4.45]

BG reduction

- 1 track || no good 2nd track || rigidity2nd<0.5GV

TOF

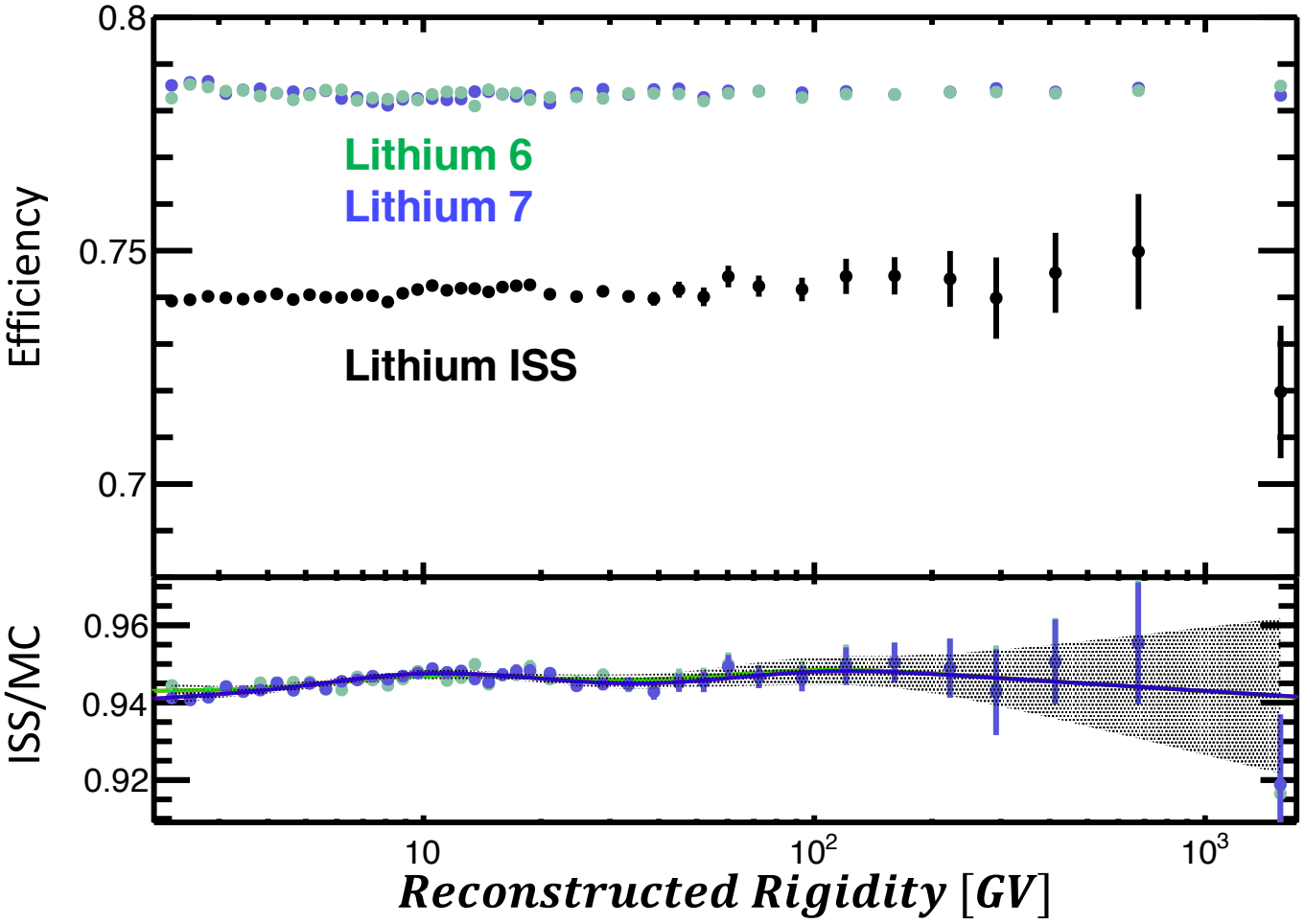
- beta > 0.4
- charge: q_uptof ∈ [2.4, 4.5] [3.4, 5.5]

Selections:

- qL1(unbias) ∈ [2.54, 3.65] [3.38, 4.65]
- good qL1 status

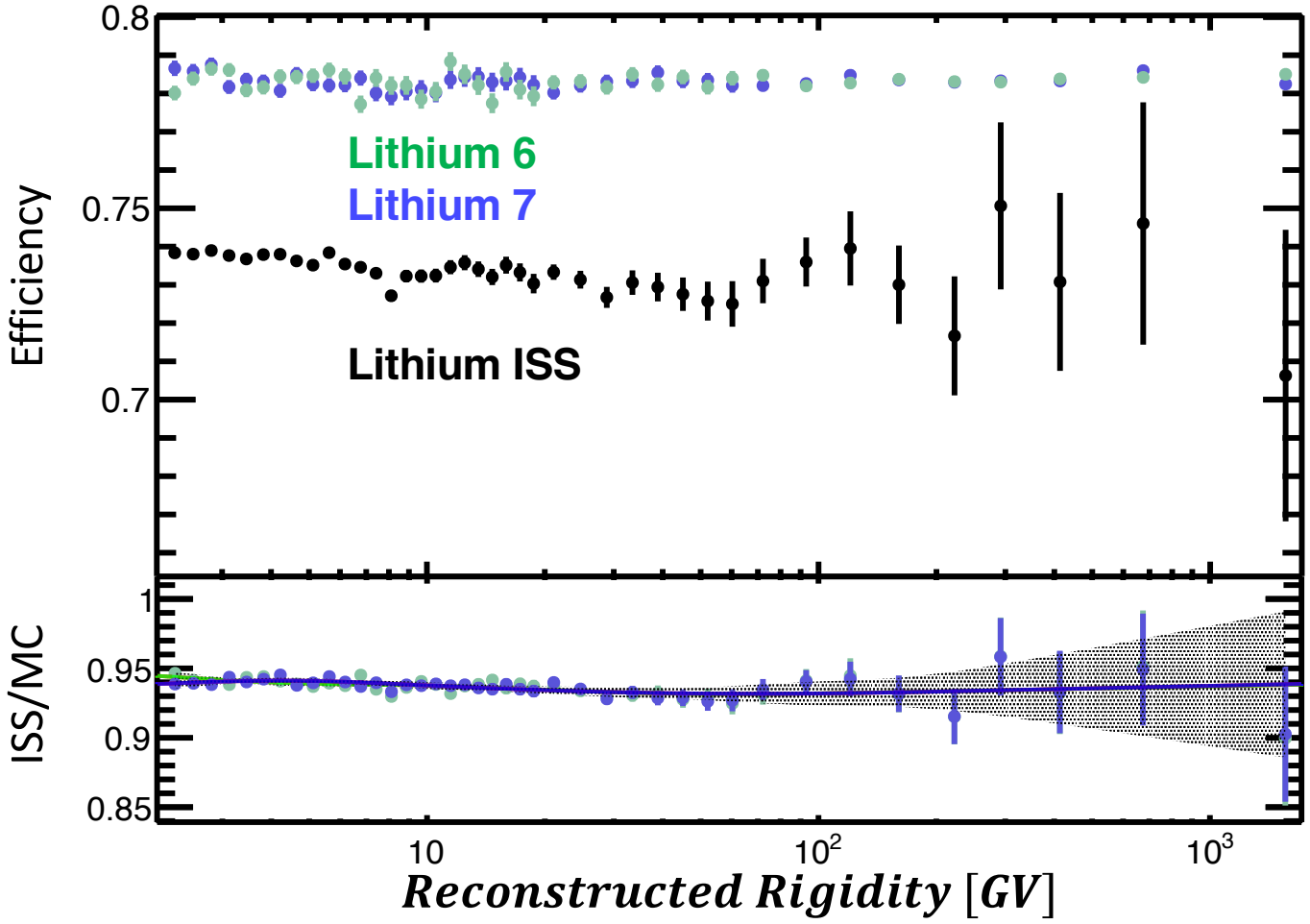
The incident angle of particles have a slight effect on the reconstruction.
To study the efficiency, the samples will be categorized based on three geometries. (track extrapolation)

2 Selections Efficiencies: L1 unbias cuts (InnerL1 Li)



2

Selections Efficiencies:
L1 unbias cuts (NaF Li)



2

Selections Efficiencies:
UTOF charge cuts

Sample:

Standard cuts

- good RTI & good run & Physical trigger

Tracker

- Within L1Inner Fiducial volume
- N_InnerHitsY>=5&L2&(L3|L4)&(L5|L6)&(L7|L8)& InnerNormChisY<10
- charge:
  q_inner ∈ [2.55, 3.45] [3.55, 4.45]

BG reduction

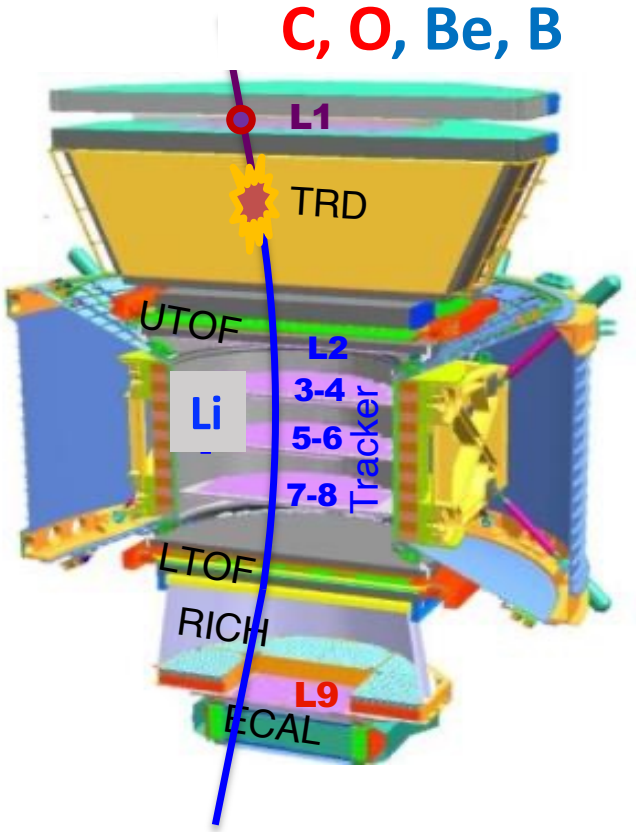
- 1 track || no good 2nd track || rigidity2nd<0.5GV

TOF

- beta > 0.4

Selections:

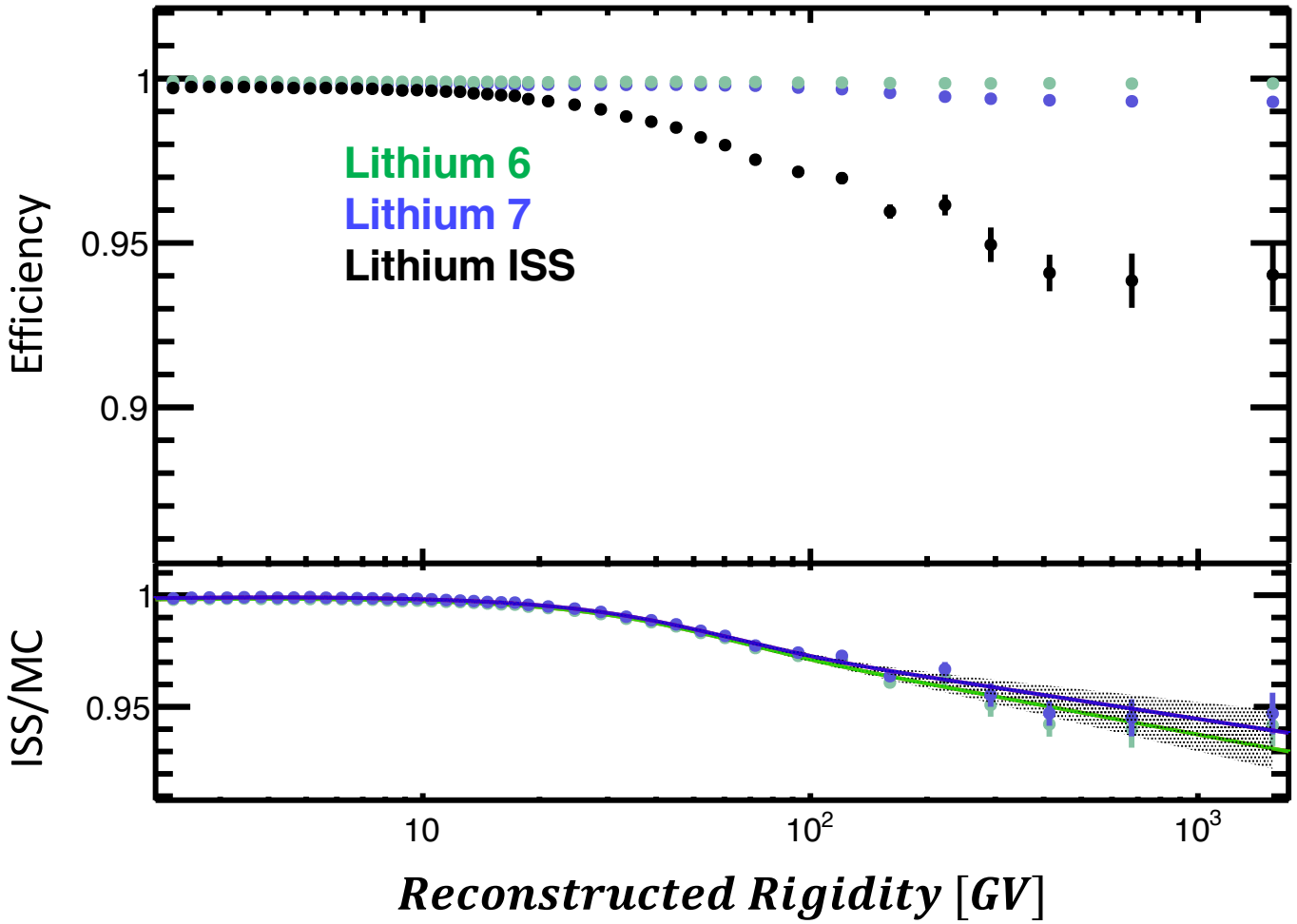
charge: q_uptof ∈ [2.4, 4.5] [3.4, 5.5]



Li Be B are Secondary-Dominated , should use He, C, O…

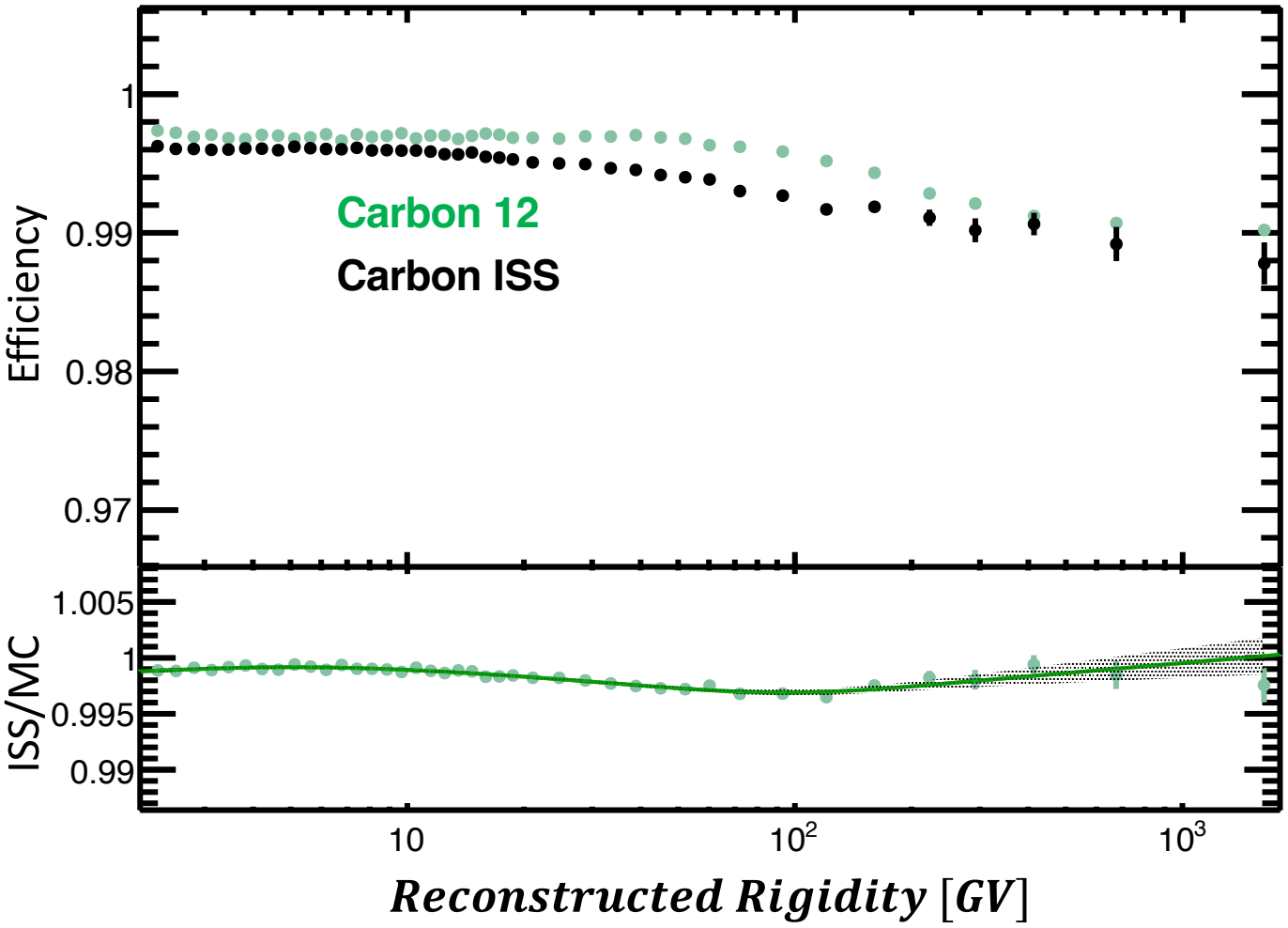
2

Selections Efficiencies:
UTOF charge cut (InnerL1 Lithium)



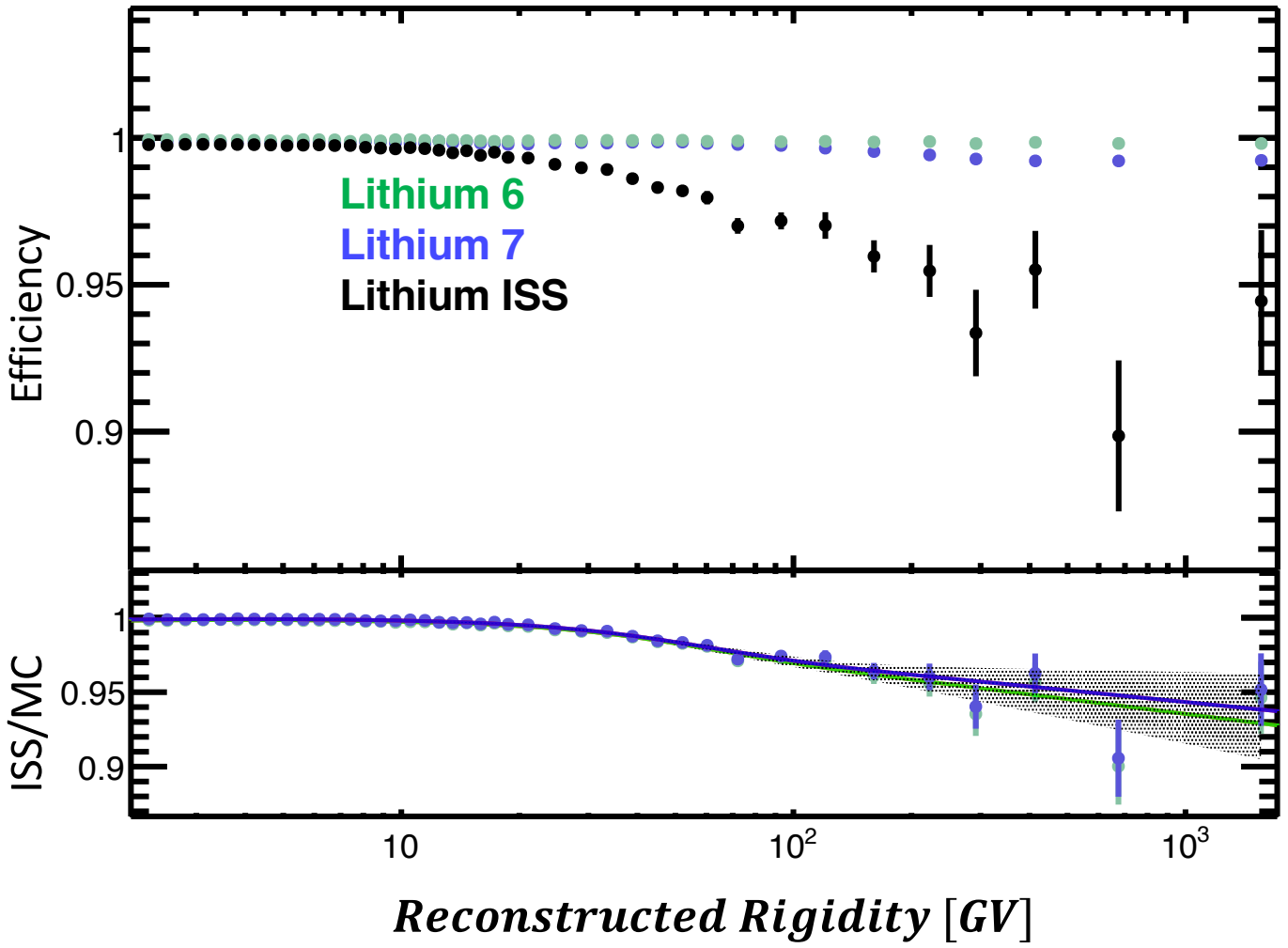
2

Selections Efficiencies:
UTOF charge cut (InnerL1 Carbon)



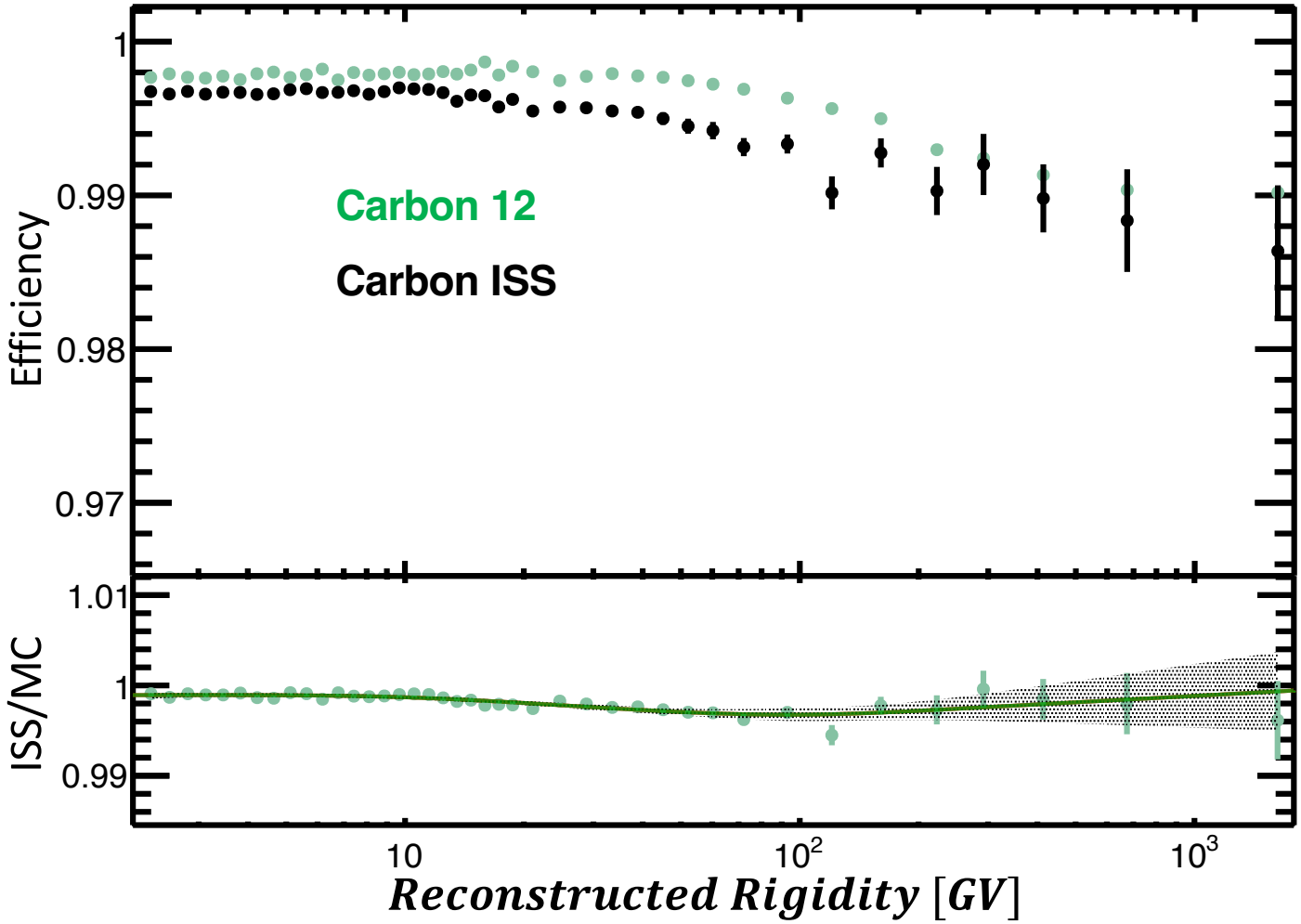
2

Selections Efficiencies:
UTOF charge cut (NaF Lithium)

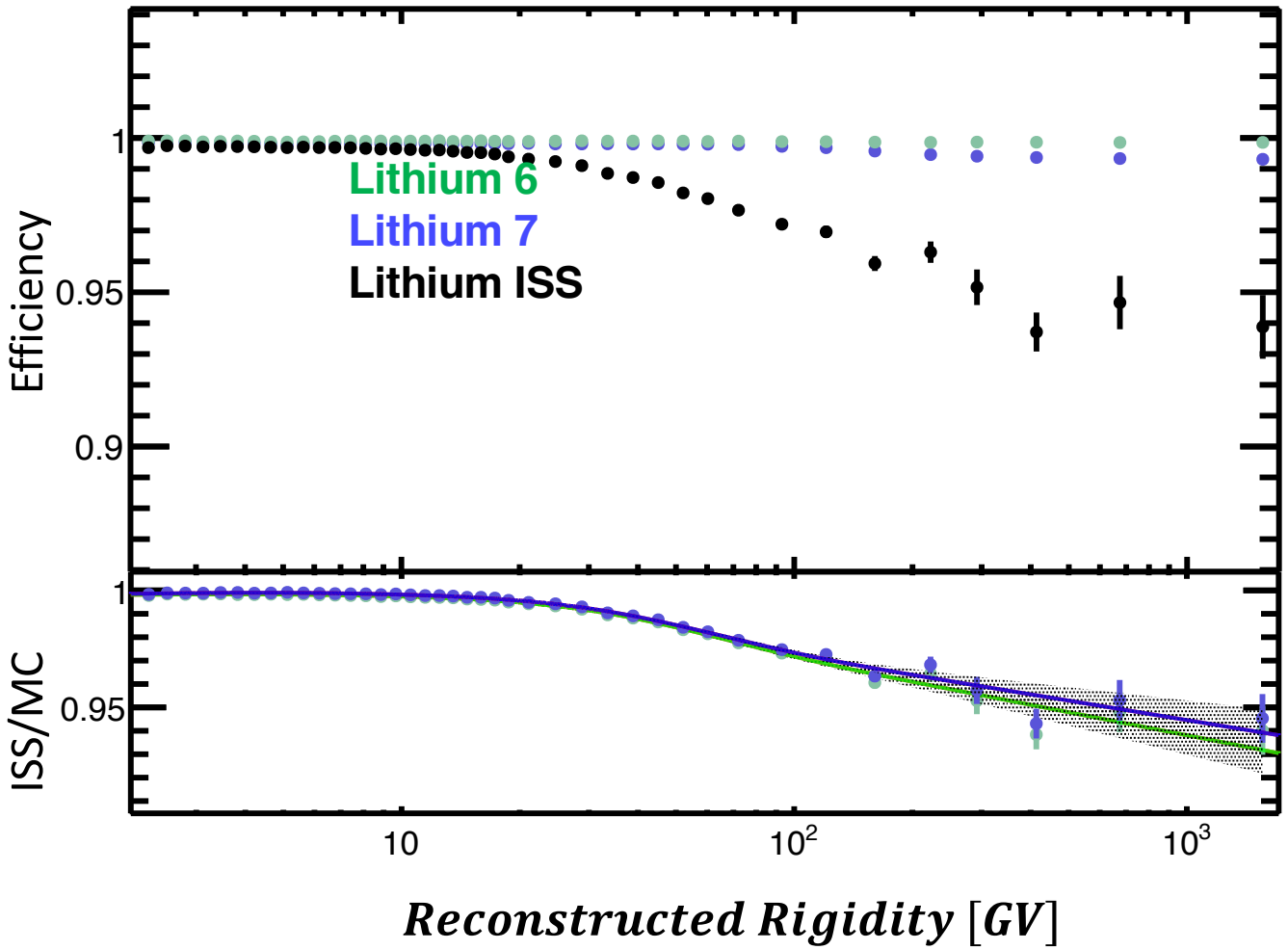


2

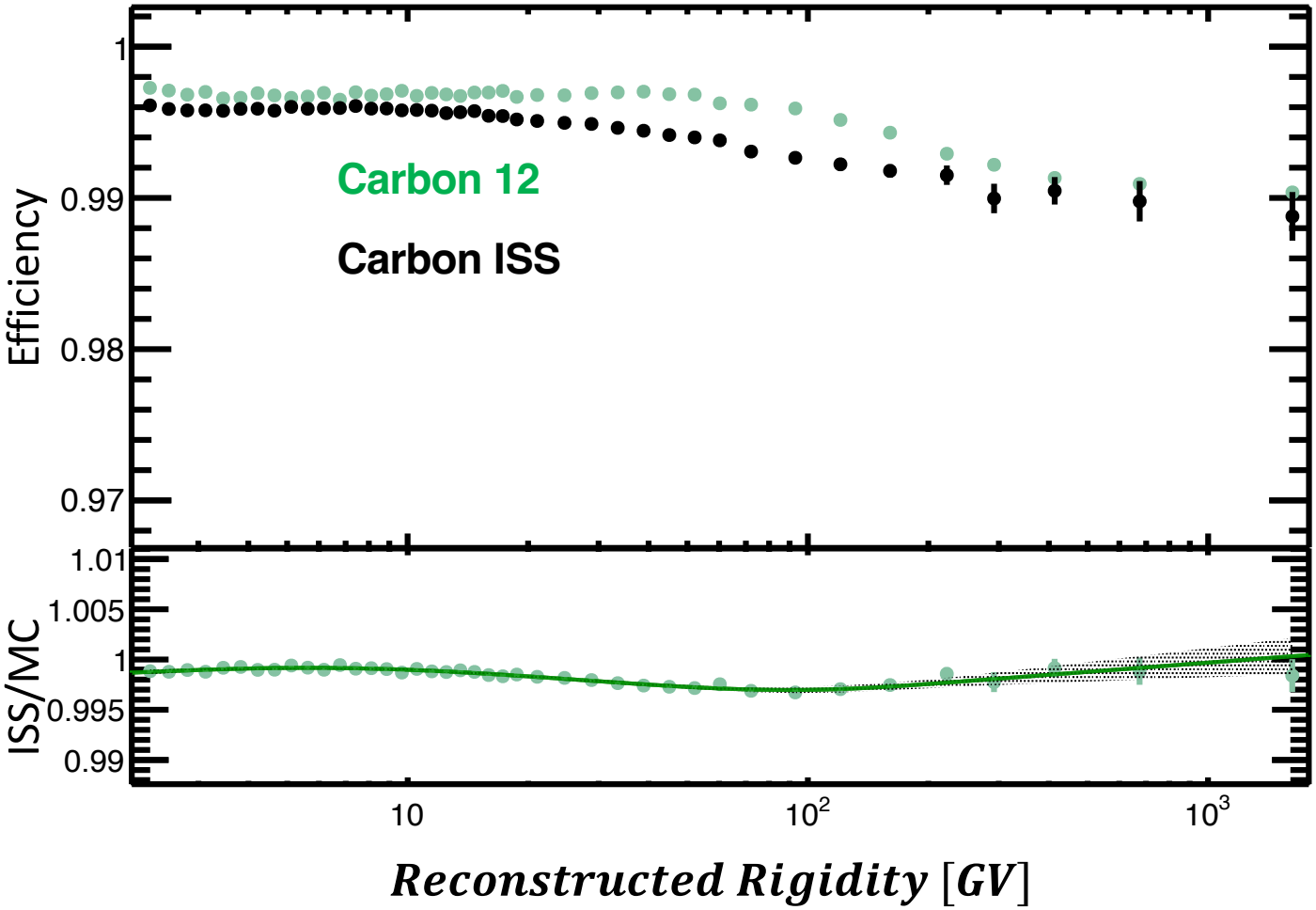
Selections Efficiencies:
UTOF charge cut (NaF Carbon)



2 Selections Efficiencies: UTOF charge cut (Agl Lithium)



2 Selections Efficiencies: UTOF charge cut (Agl Carbon)



2

Selections Efficiencies:
Inner Tracker: Track

When assessing inner tracking efficiency, cannot utilize information about the track itself for sample selection. Alternatively, the unbiased TOF track is applied.
Unbiased TOF Track: TOF clusters connected using the TRD track (if exists), referring to the BetaS class.

Sample:

- good RTI & good run & Physical trigge
- Good unbiased track, betas>0.4, the interpolation within InnerL1 fiducial volume
- Good unbiased time and charge reconstruction on TOF
- Unbiased charge cut on 4 layers TOF [Z-0.4,Z+0.55]
- qL1(unbias) ∈ [2.54, 3.65] [3.38, 4.65] && good qL1 status
- Background reduction

Selections:

- Inner Hits>=5, L2&(L3|L4)&(L5|L6)&(L7|L8), InnerNormChisqY<10
- Reconstructed Tracker and TOF Track,
- Within InnerL1 fiducial volume
- Interpolation to TOF: tof_btype<10 & tof_betah>0.4

Unbiased TOF/RICH Geometry for different geometry, (ECAL and LTOF)

2

Selections Efficiencies:
Inner Tracker: Track

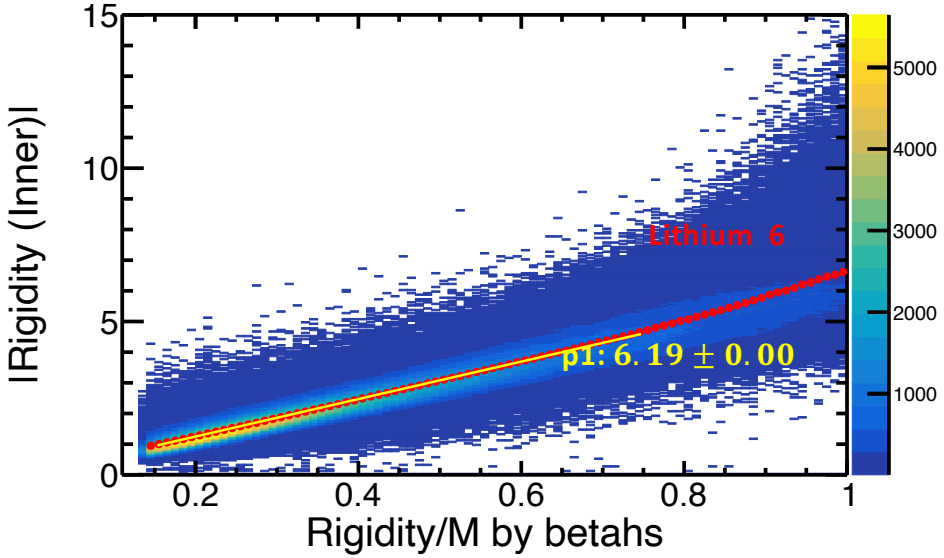
When assessing inner tracking efficiency, Rigidity cannot be used as a measure of the particle's energy.

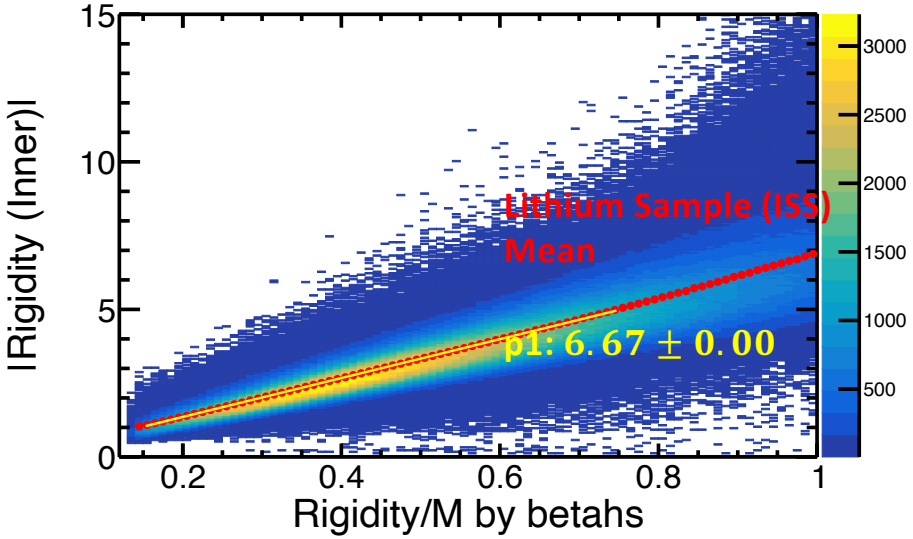
Rigidity Estimator:

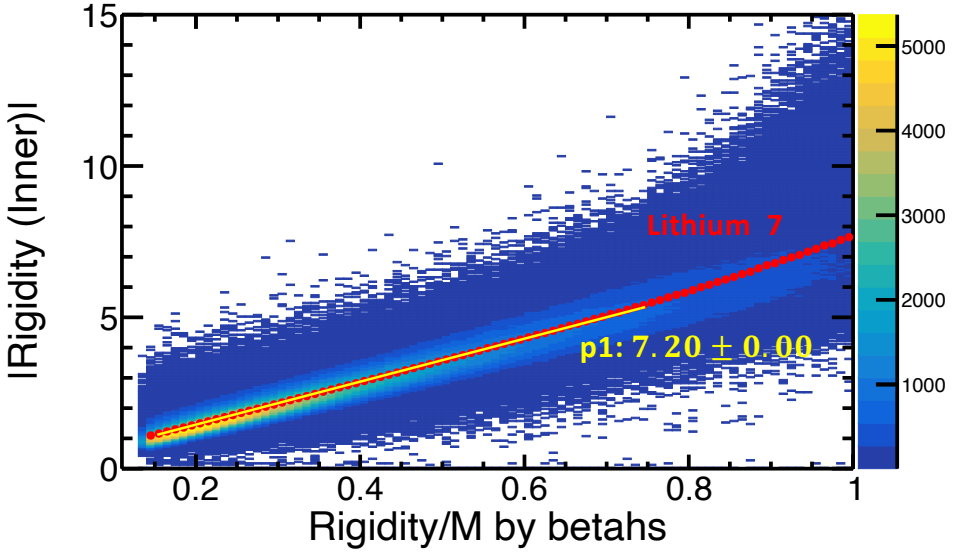
- **< 5.9GV**: use the unbias beta measurements

  $|R|/M = \frac{\beta}{Z\sqrt{1-\beta^2}}$

- 5.9GV to ~ 19.5GV: use the geomagnetic cutoff estimation
- > 20GV: use energy measured by ECAL



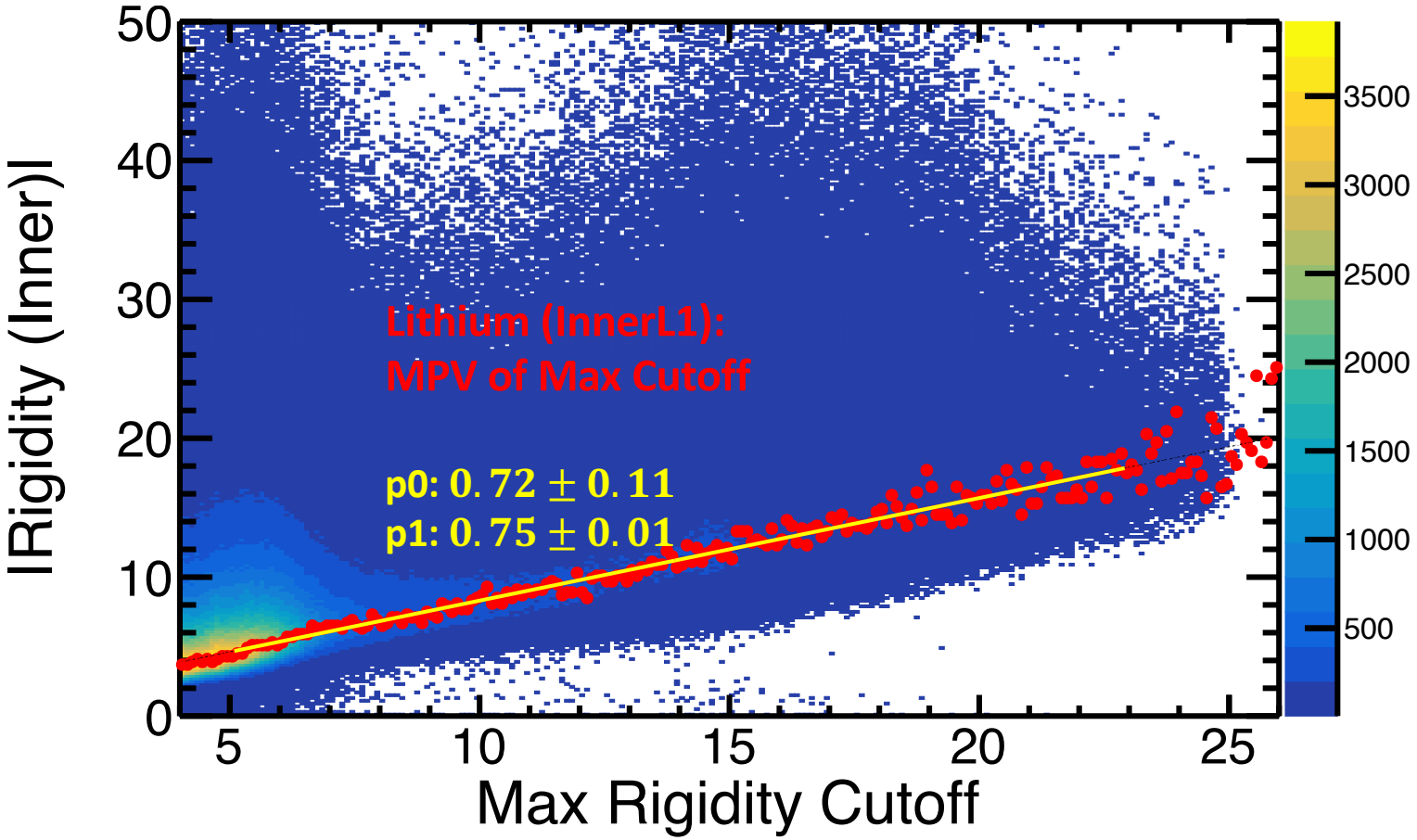




2

Selections Efficiencies:
Inner Tracker: Track

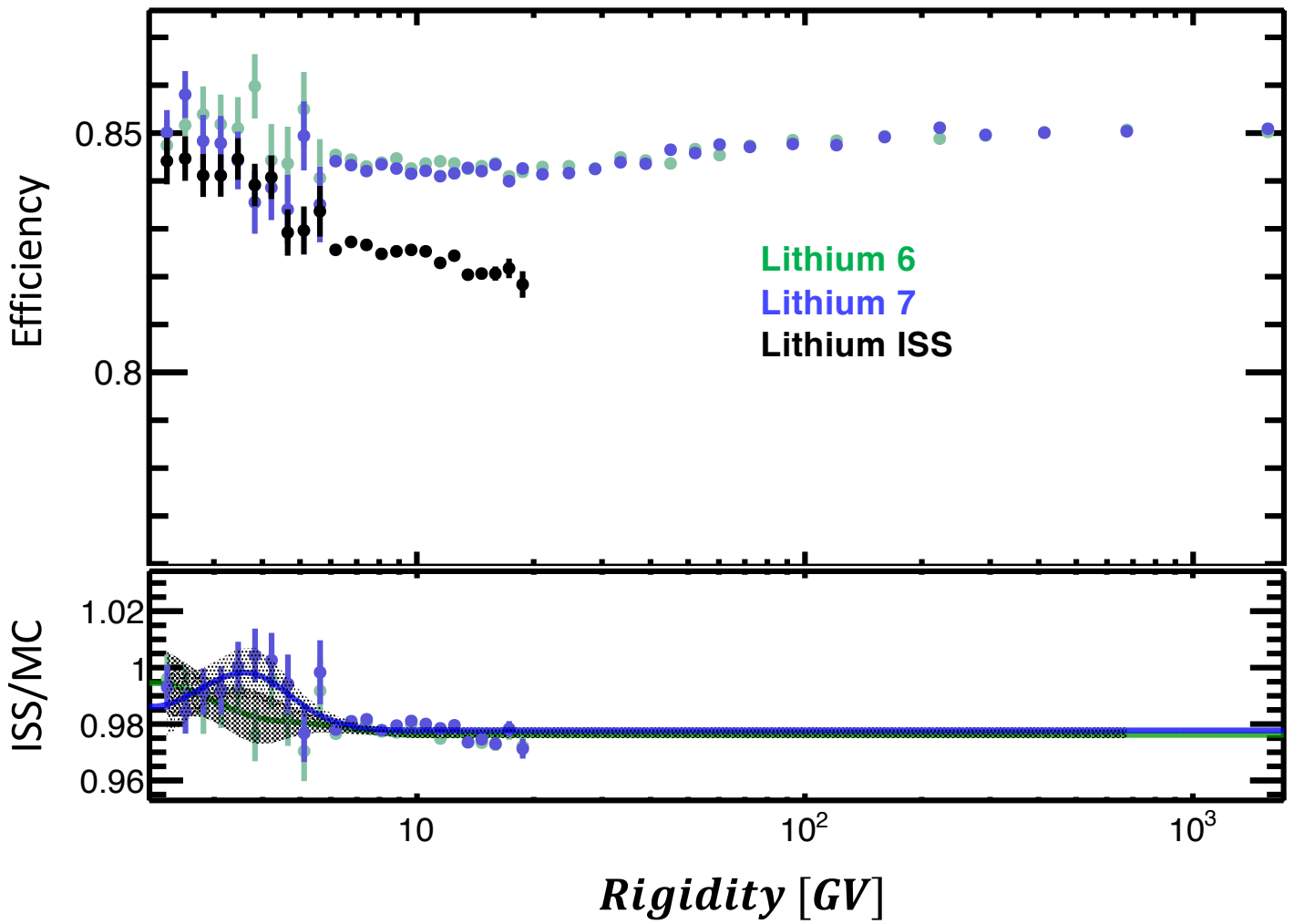
5.9 ~ 19.5GV:



- Error: sqrt(fit error*fit error + half bin with*half bin width)

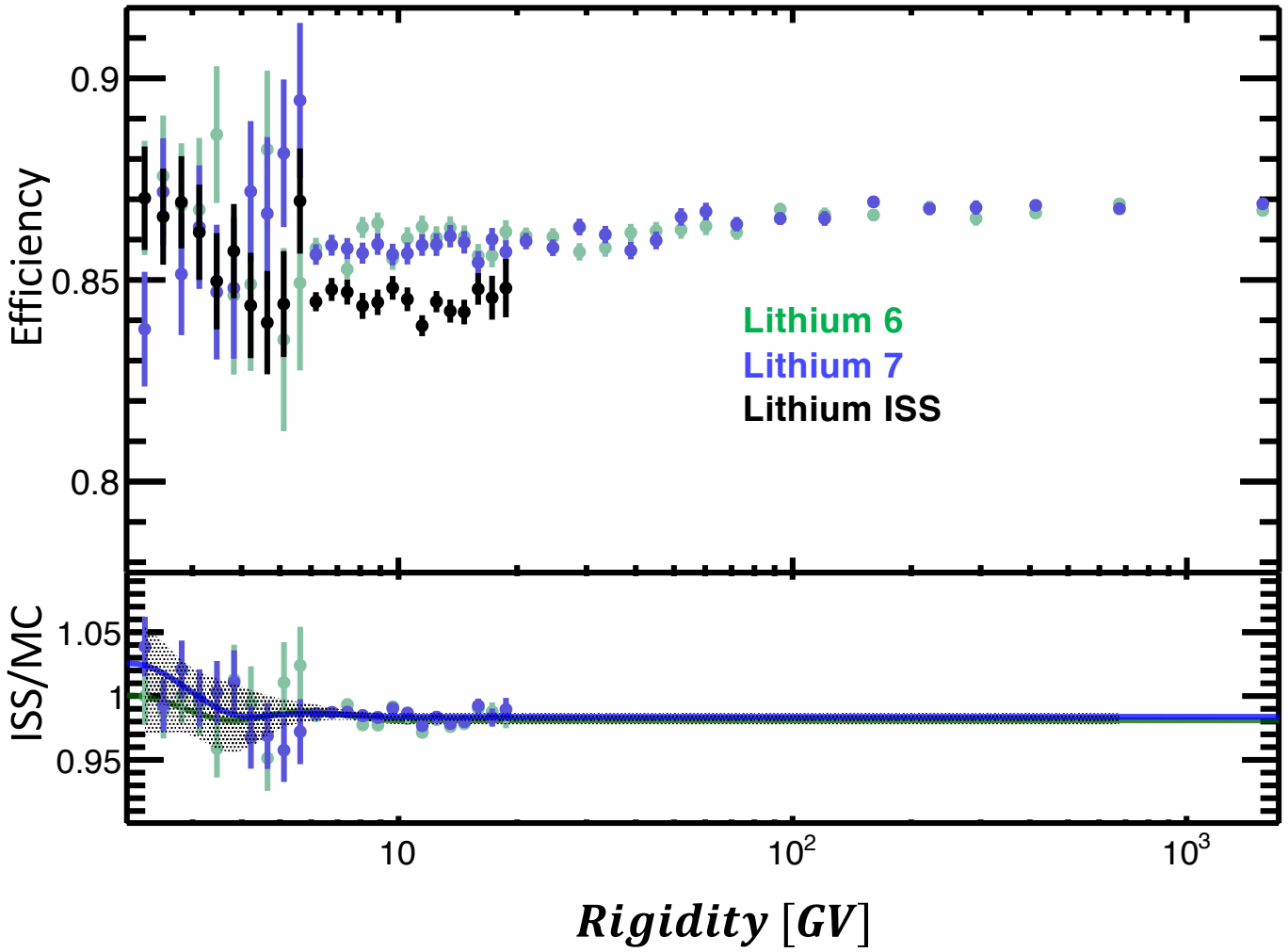
2

Selections Efficiencies:
Inner Tracker: Track (InnerL1)



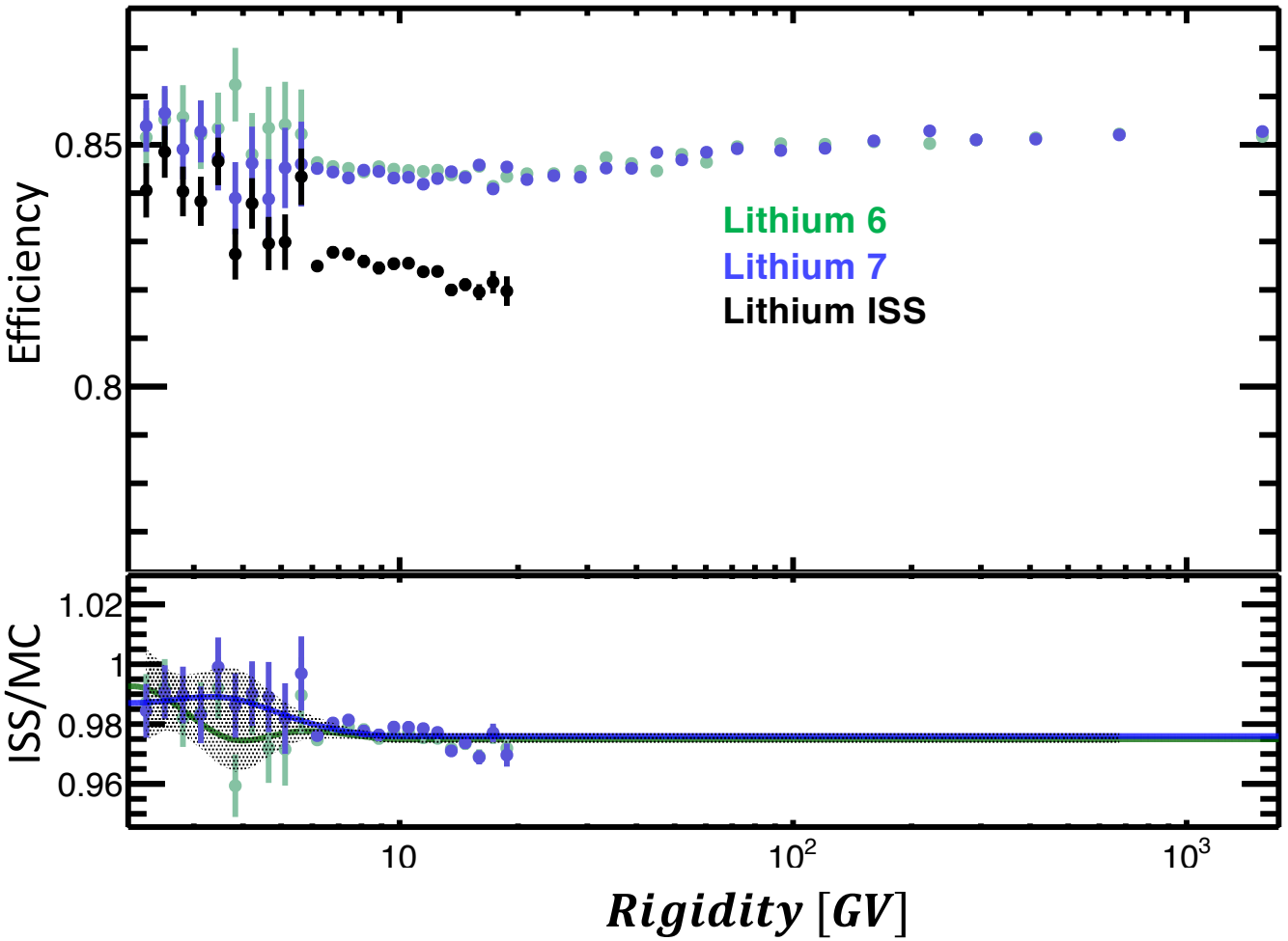
2

Selections Efficiencies:
Inner Tracker: Track (NaF)



2

Selections Efficiencies:
Inner Tracker: Track (AgI)



2

Selections Efficiencies:
Inner Tracker charge cuts

Sample:

Standard cuts
- good RTI & good run & Physical trigger

Tracker
- Within L1Inner Fiducial volume
- N_InnerHitsY>=5&L2&(L3IL4)&(L5IL6)&(L7IL8)& InnerNormChisY<10

BG reduction
- 1 track II no good 2nd track II rigidity2nd<0.5GV

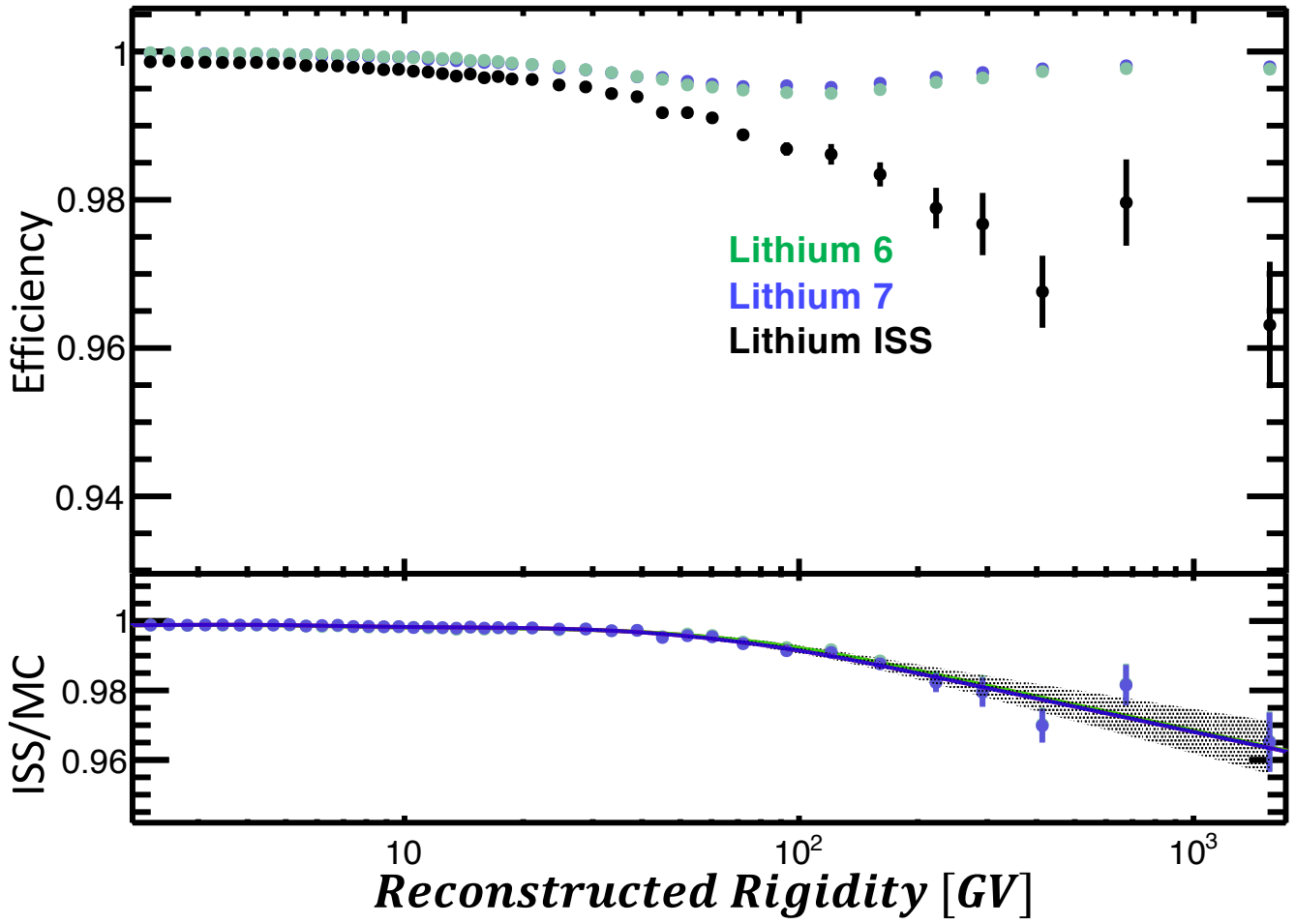
TOF
- beta > 0.4
- Charge [Z-0.4,Z+0.55]

Selections:

q_inner ∈ [2.55, 3.45]
[3.55, 4.45]

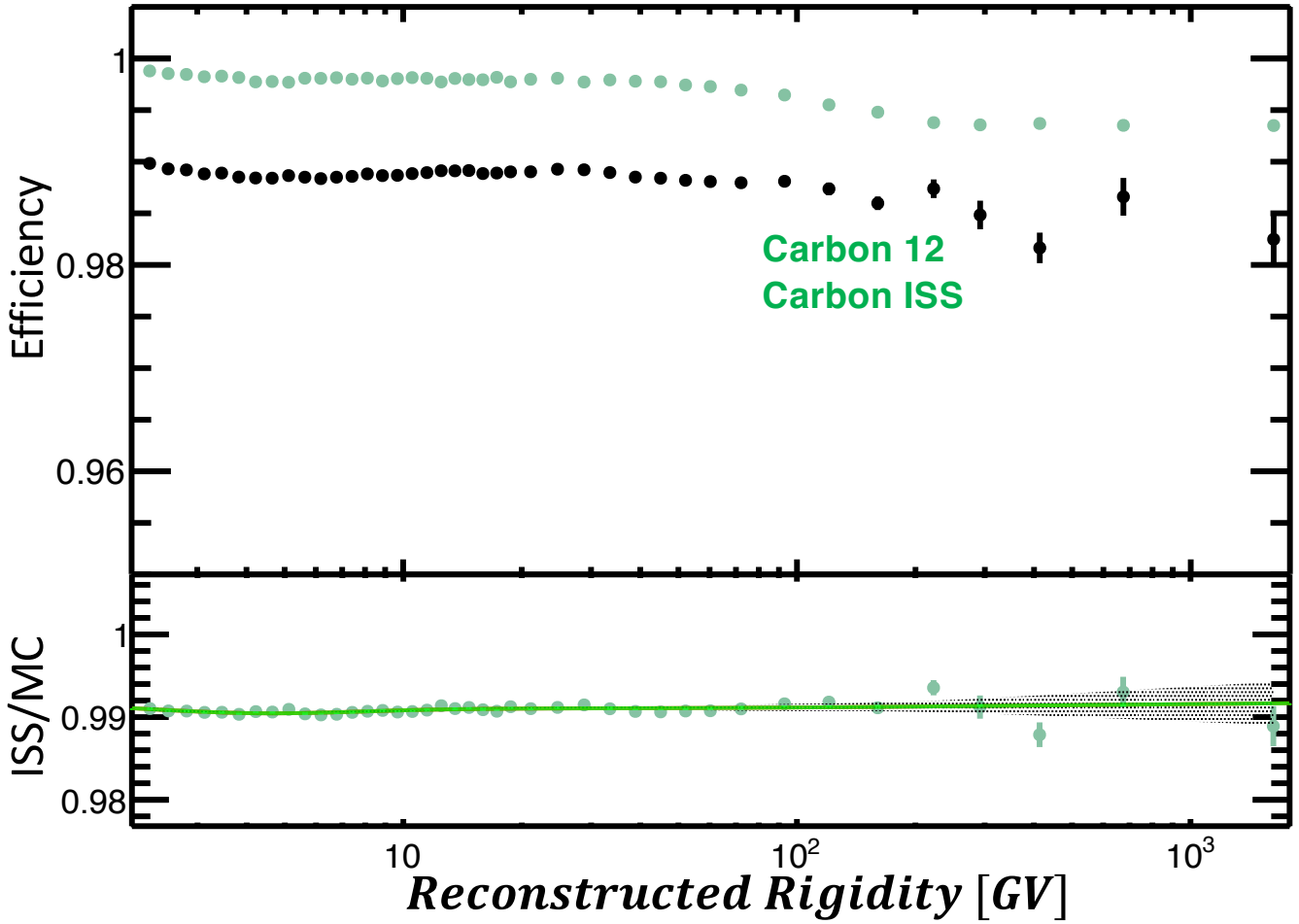
2

Selections Efficiencies:
Inner Tracker: Charge (Li InnerL1)



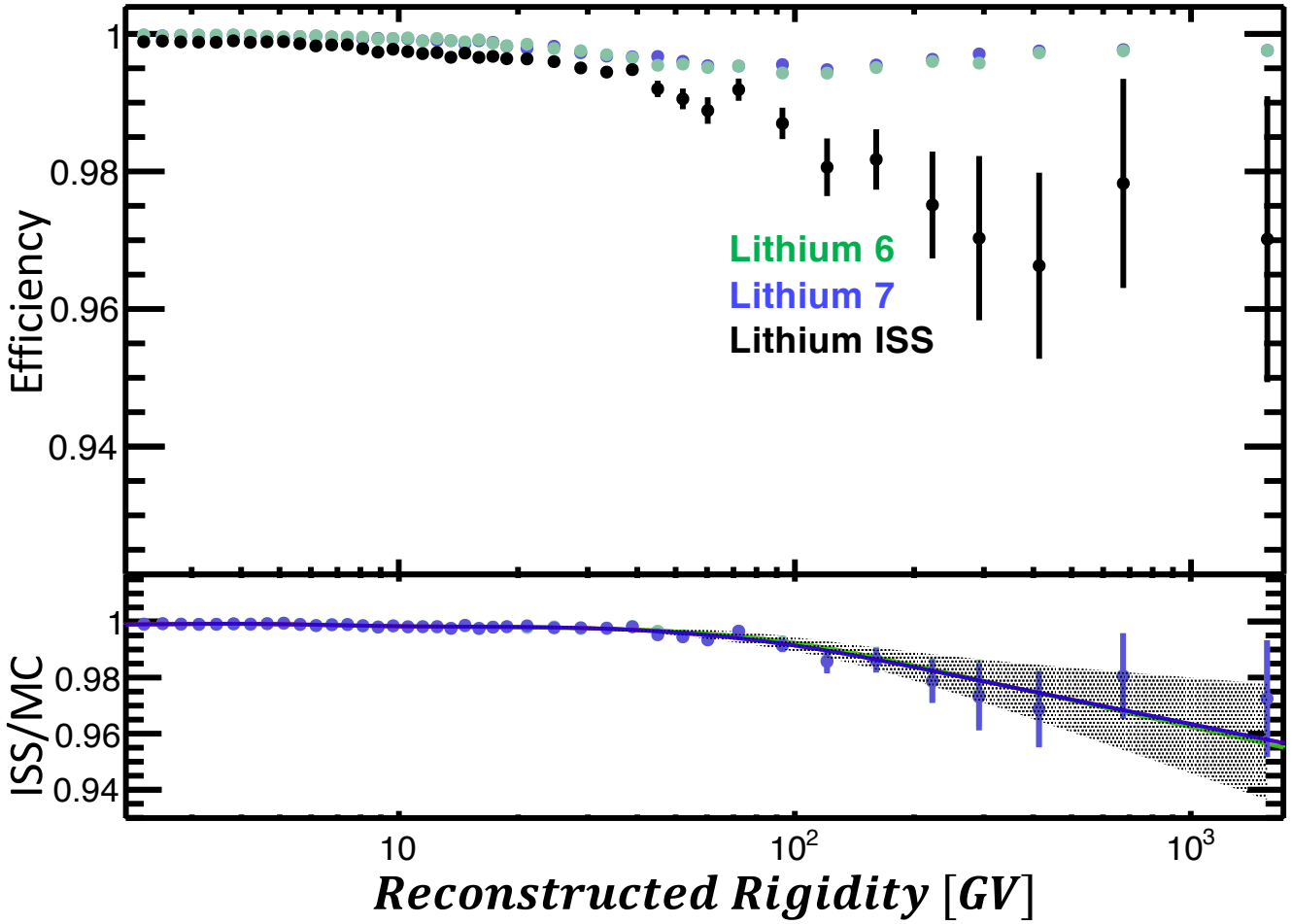
2

Selections Efficiencies:
Inner Tracker: Charge (Carbon InnerL1)



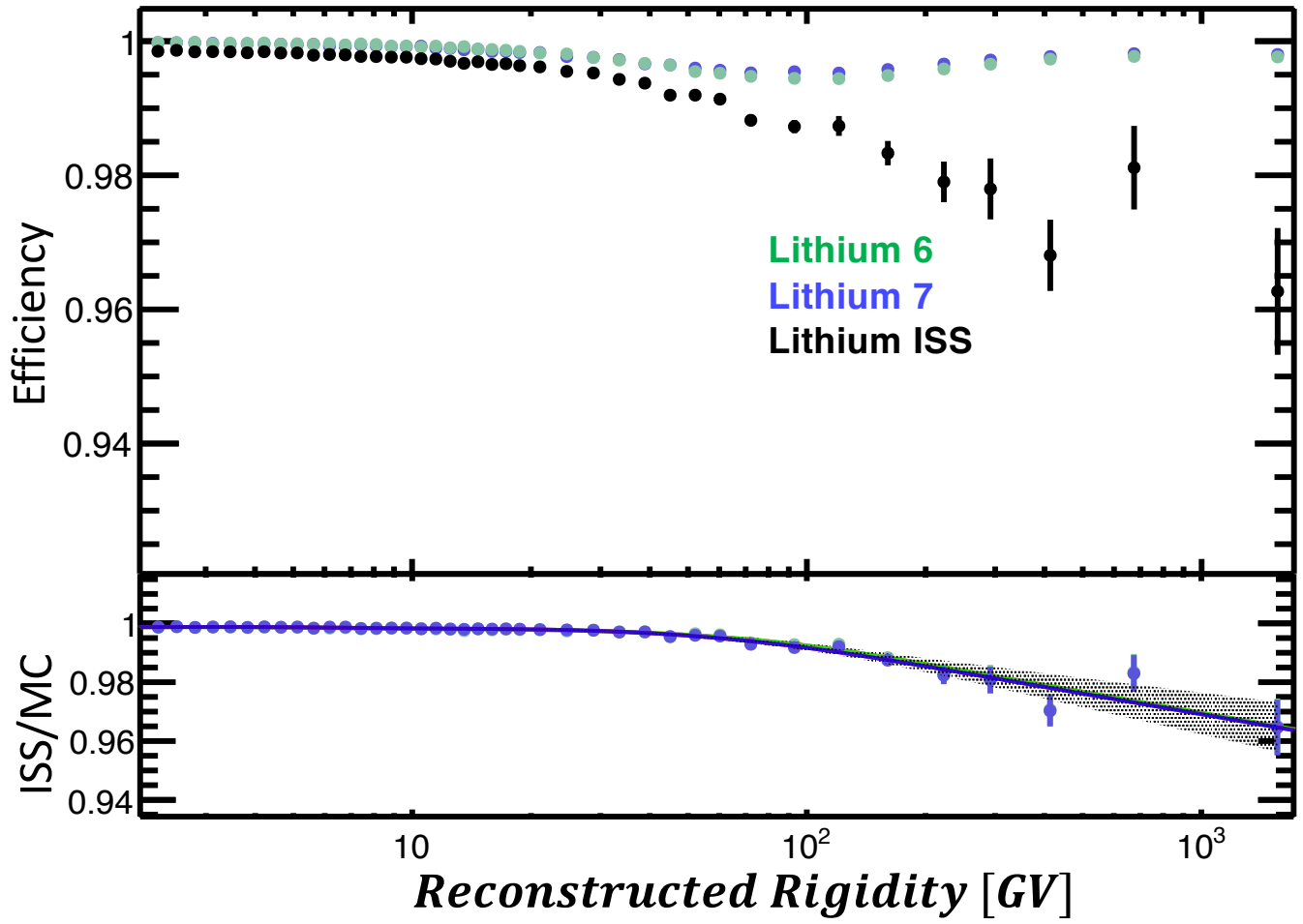
2

Selections Efficiencies:
Inner Tracker: Charge (Li NaF)



2

Selections Efficiencies:
Inner Tracker: Charge (Li AgI)



2 Selections Efficiencies: **Background reduction**

Sample:

Standard cuts

- good RTI & good run & Physical trigger
- Above geometry cutoff

Tracker

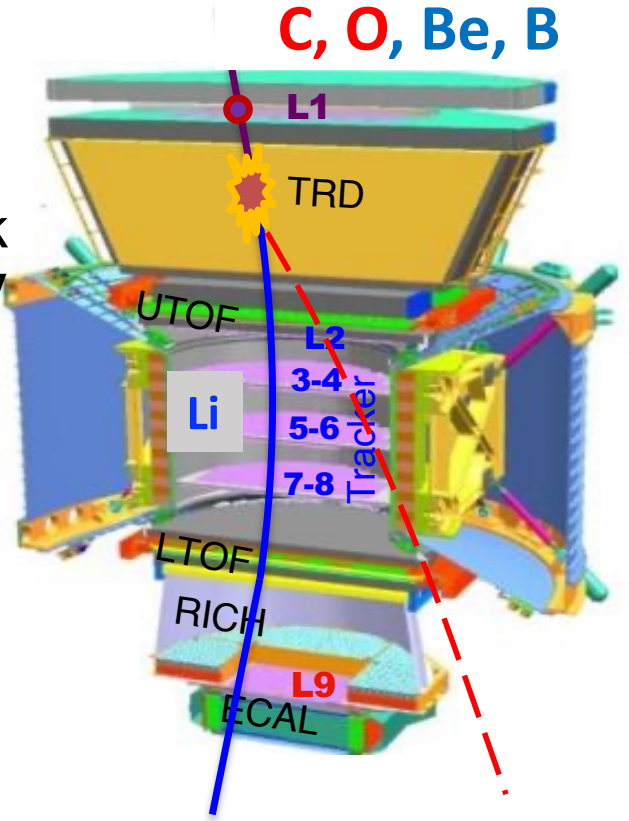
- Within L1Inner Fiducial volume
- L1XY & N_InnerHitsY>=5&L2&(L3|L4)&(L5|L6)&(L7|L8)& InnerNormChisY<10
- charge:
  - q_inner charge cuts
  - qL1(unbias) charge cuts
  - good qL1 status

TOF

- beta > 0.4
- charge: q_uptof ∈ [2.4, 4.5] [3.4, 5.5]

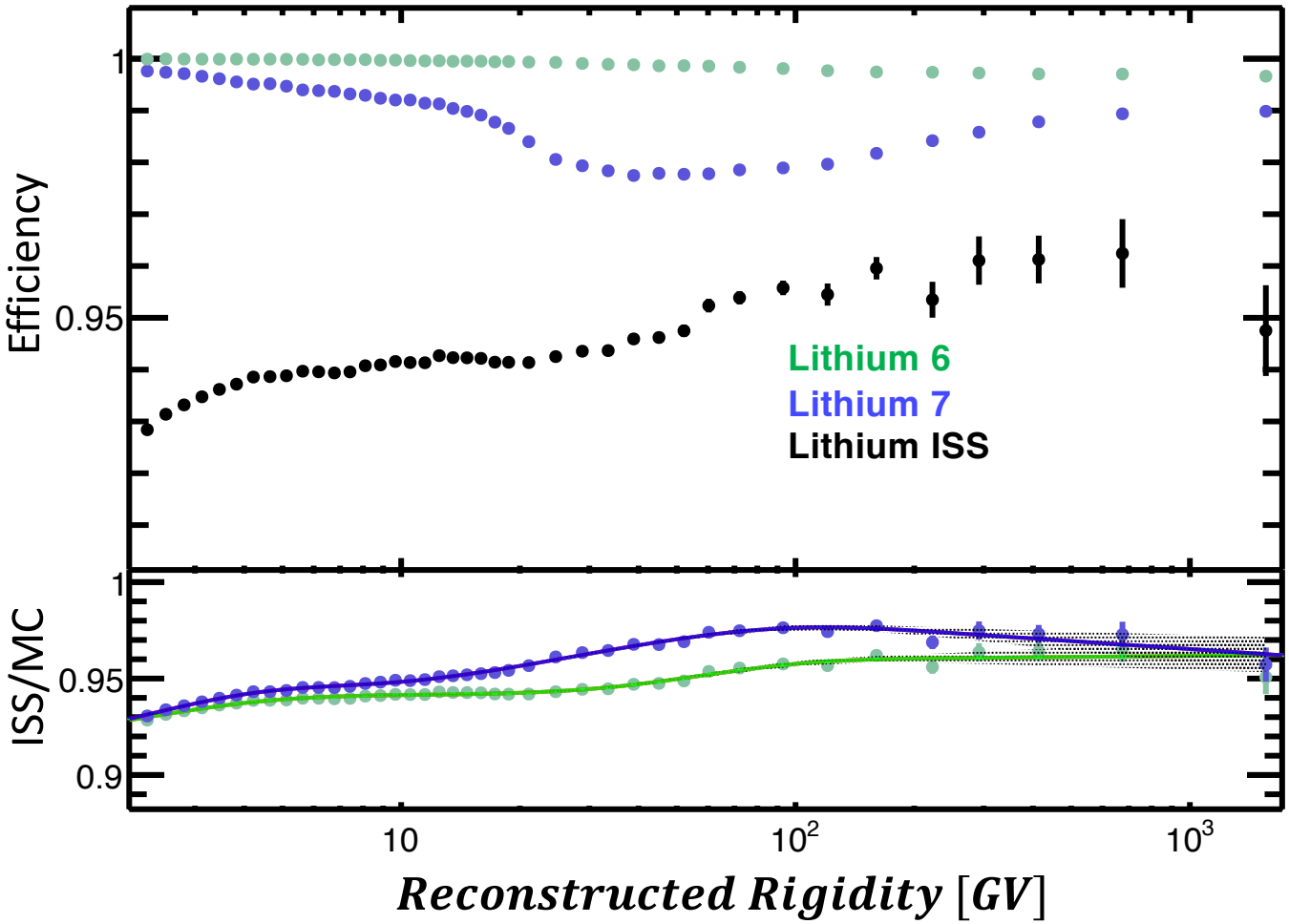
Selections:

Only 1 track
Or no good 2nd track
Or rigidity2nd<0.5GV



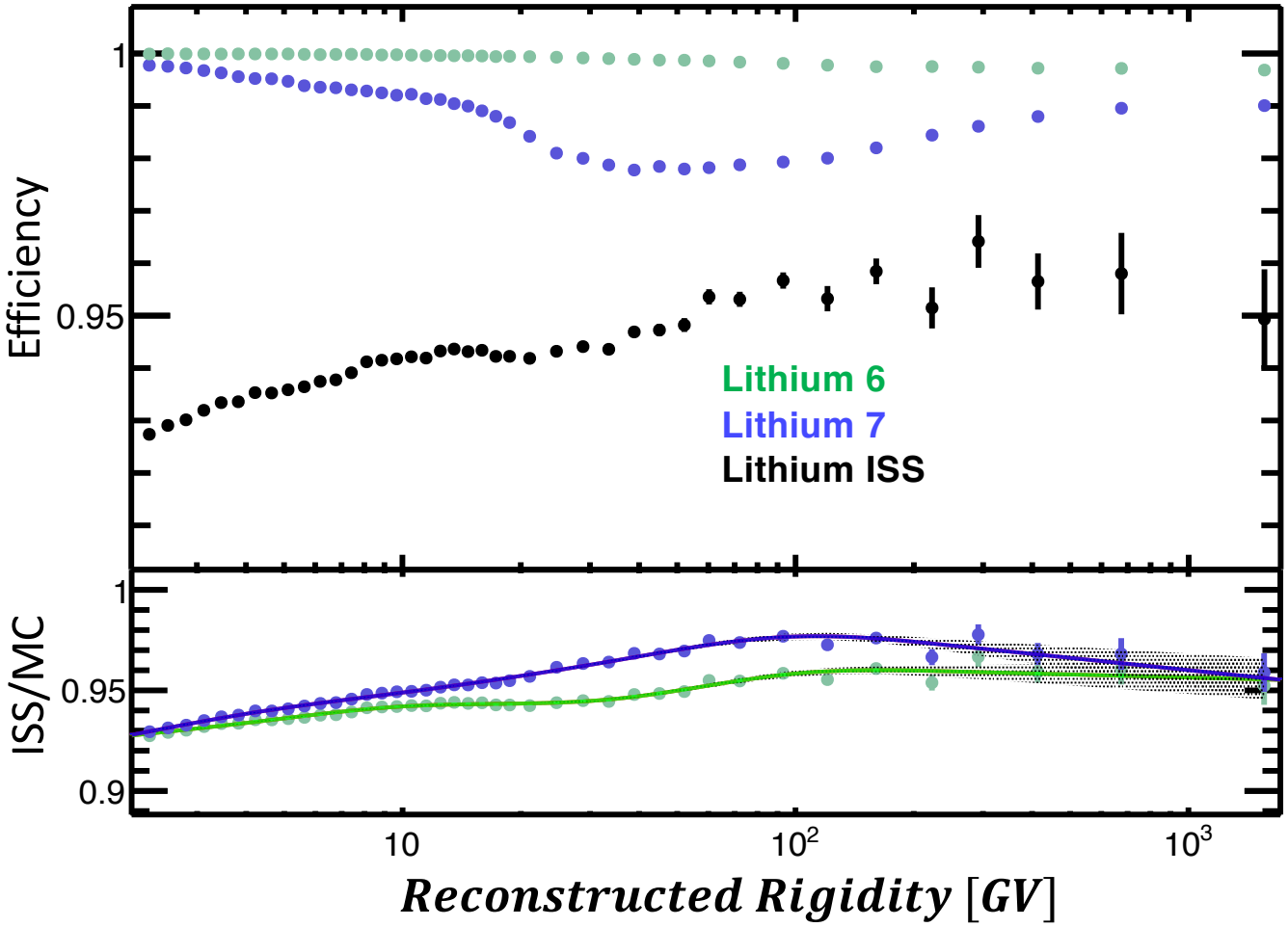
2

Selections Efficiencies:
Background reduction (Li InnerL1)



2

Selections Efficiencies: Background reduction (Li Agl)



2

Selections Efficiencies:
TOF Velocity Quality Cut

Sample:

L1MaxQInner Cuts
&& only 1 track (To eliminate BG).

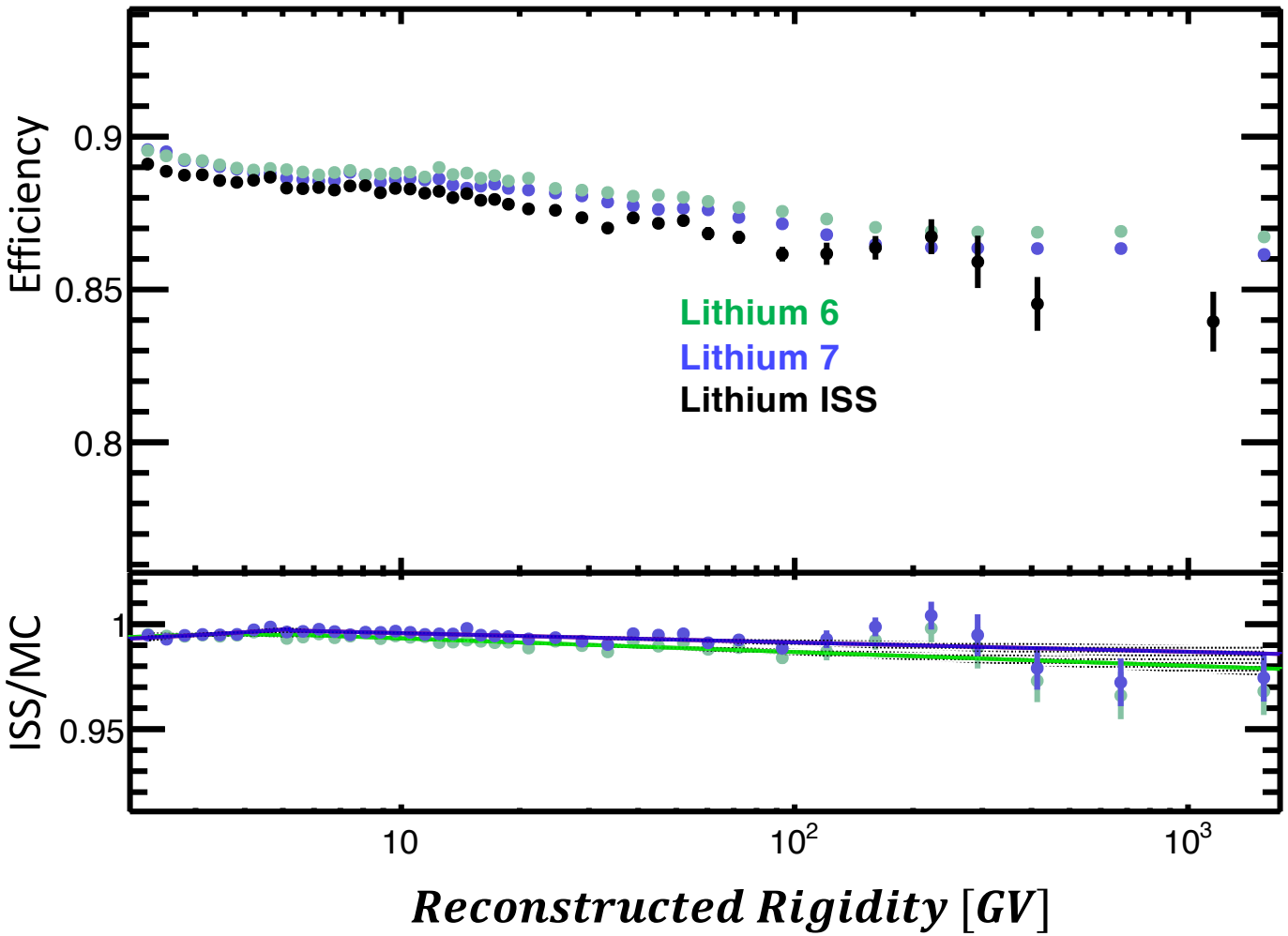
Selections:

Exclude edges of trapezoid paddles on TOF S3 and S4

Chisq_coo<5, Chisq_time<10

2

Selections Efficiencies:
TOF Velocity Quality Cut



2 Trigger Efficiency

Sample:
Nuclei Event selections in different geometries.

Efficiencies Estimation (ISS), using the data of different DAQ configurations

- $\varepsilon_{Trigger}^{NACC<5} = \frac{N_{t>2016.02}^{NACC<5}}{N_{t>2016.02}}$

Can be estimated by both NACC<8 period and No constraint Period.

- $\varepsilon_{Trigger}^{total} = \frac{N_{t<2016.02}+N_{t>2016.02}}{N_{t<2016.02}/E_{Trigger}^{NACC<5}+N_{t>2016.02}}$

$$\sigma_{Trigger}^{1} = \left(N_{NACC<5}/N_{Total}{}^{2} \cdot (1-N_{NACC<5}/N_{Total})\right)^{1/2}$$

$$\sigma_{Trigger}^{total} = \varepsilon_{Trigger}^{total}\left\{ (1/N_{t>2016.02}+1/N_{t<2016.02})/\left(1+N_{t>2016.02}/N_{t<2016.02}\right)^{2} + \left[\sigma_{Trigger}^{1}{}^{2}/\varepsilon_{Trigger}^{1}{}^{4}+(1/N_{t>2016.02}+1/N_{t<2016.02})\right]/\left(1/\varepsilon_{Trigger}^{1}+N_{t>2016.02}/N_{t<2016.02}\right)^{2} - 2(1/N_{t>2016.02}+1/N_{t<2016.02})/\left[(1+N_{t>2016.02}/N_{t<2016.02})(1/\varepsilon_{Trigger}^{1}+N_{t>2016.02}/N_{t<2016.02})\right] \right\}^{\frac{1}{2}}$$

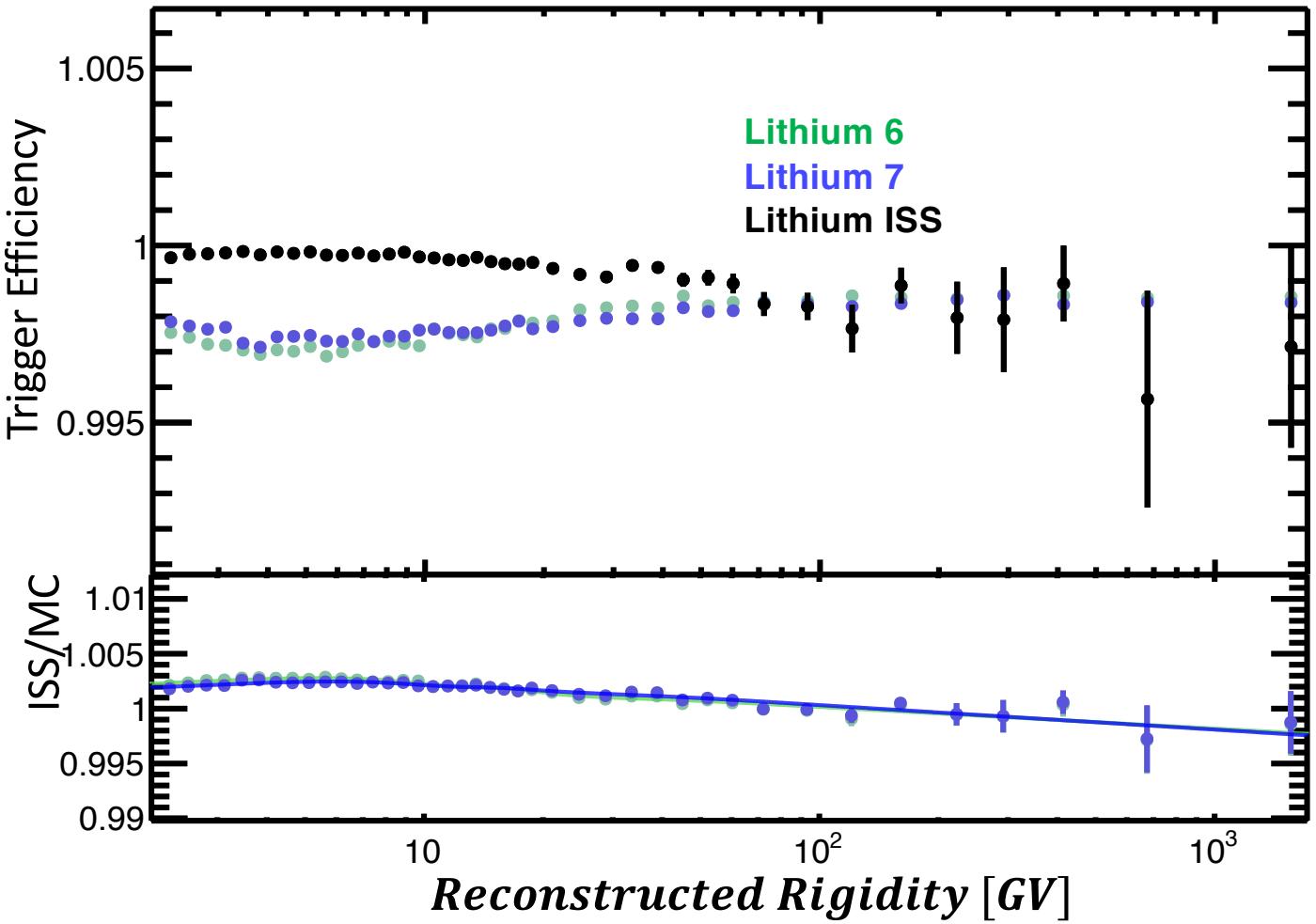
2

Trigger Efficiency
AMS DAQ Configuration

Start Run	Date	Configurations
1305853512	May 20/2011	**1JINJ, ACC<5**
1447346927	Nov 12/2015	**1JINJ->2JINJs, ACC<5**
1454843847	Feb 26/2016	**2 JINJs**, **ACC<8**
1582034309	Feb 18/2020	**4 JINJs** (all Tracker nodes in B side), **ACC<8**
1582037855	Feb 18/2020	**4 JINJs** (found LV3 error in pole region caused by one TDR; JINJ-T3 can't be at B side), **no ACC constraints**
1582046227	Feb 18/2020	**4 JINJs** (JINJ-T3 move back to A side, nominal), **no ACC constraints**
1620025528	May 3/2021	**4 JINJs, photon trigger** (2of4 LTOF HT), **ACC<8**
1635856717	Nov 2/2021	**4 JINJs, remove photon trigger**, **no ACC constraints**
1675341999	Feb 2/2023	**4 JINJs, photon trigger**, **ACC<8**

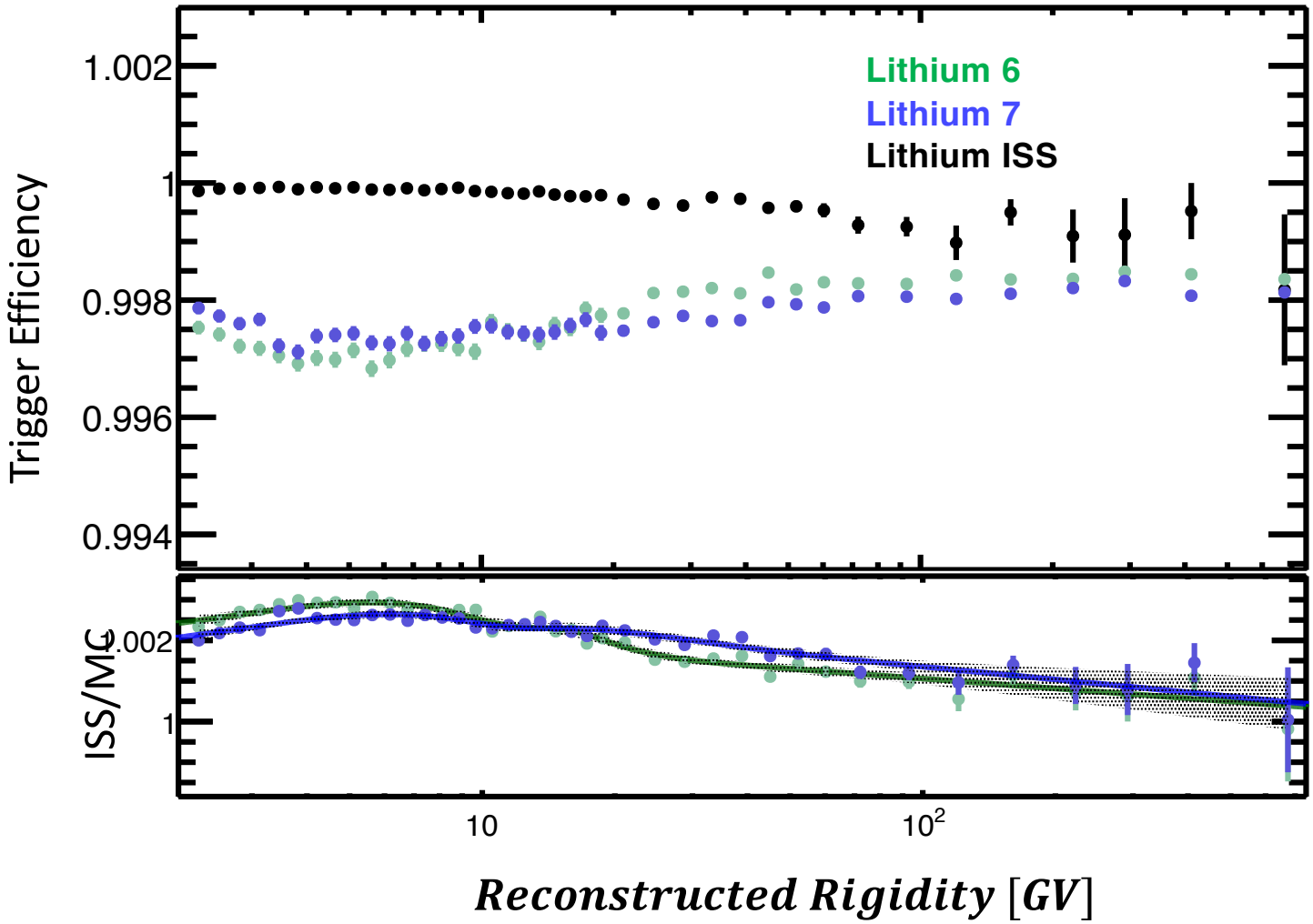
2

Trigger Efficiency
NACC <= 4 Period (InnerL1 Geometry)



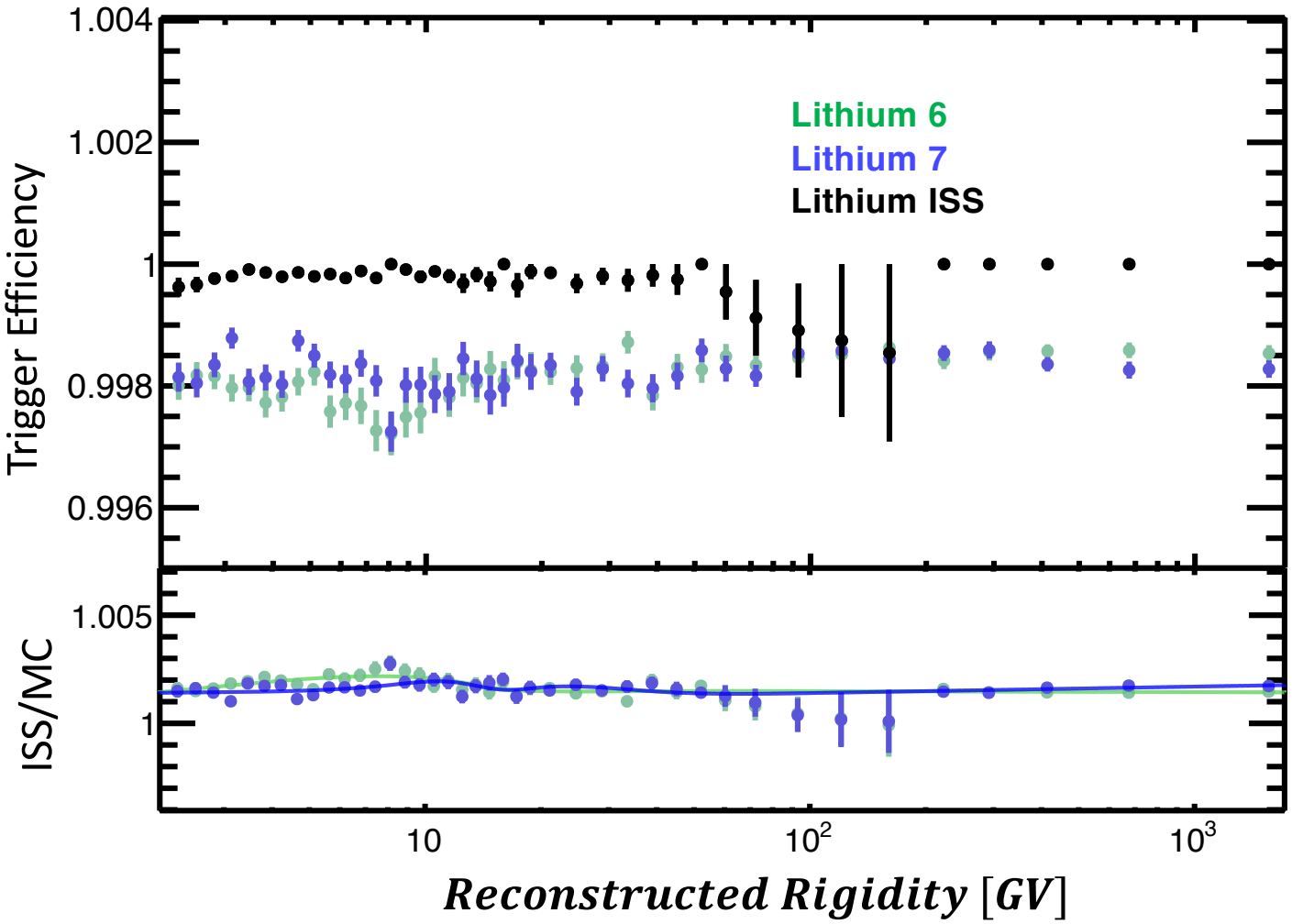
2

Trigger Efficiency
General (InnerL1 Geometry)



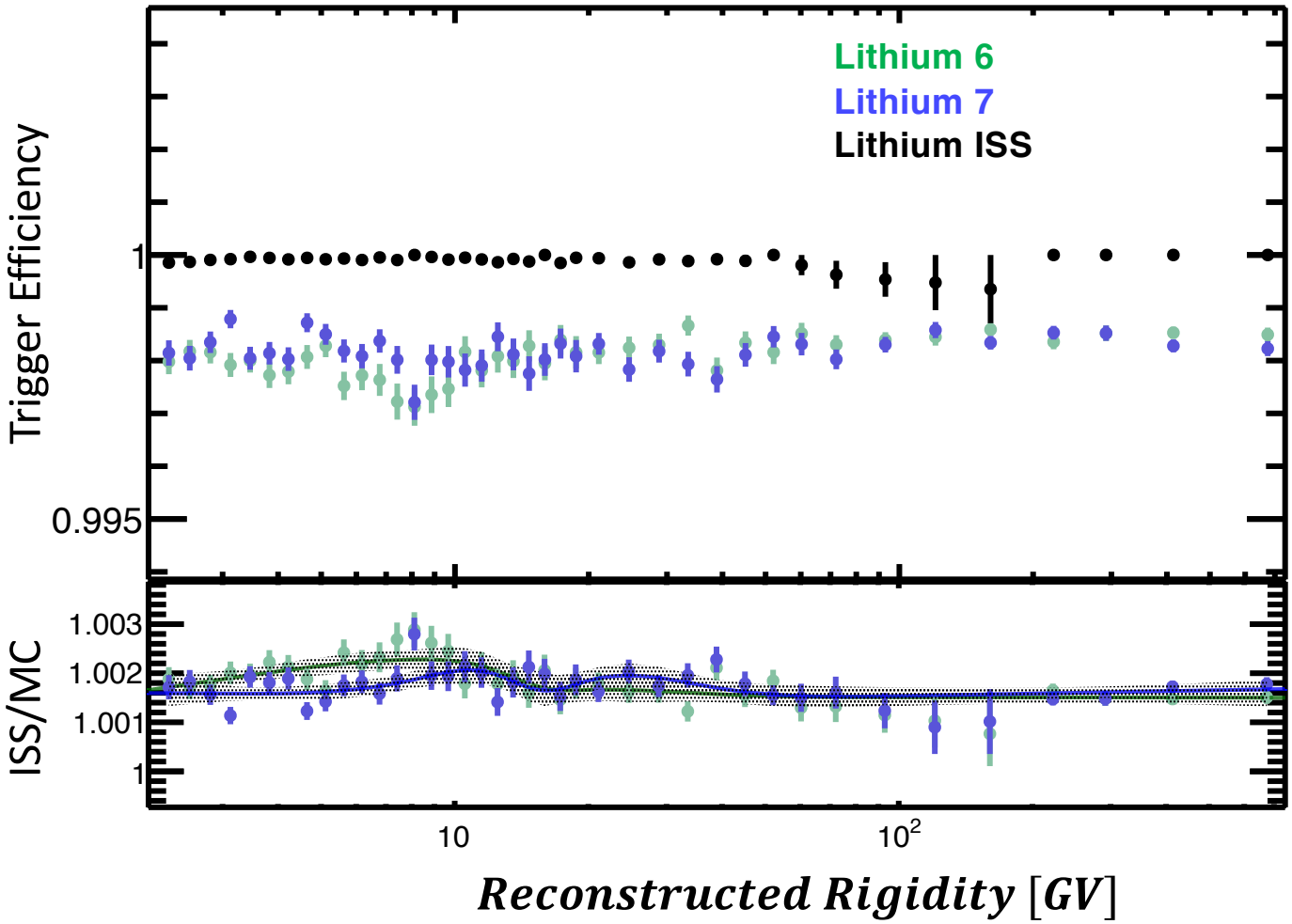
2

Trigger Efficiency
NACC <= 4 Period (NaF Geometry)



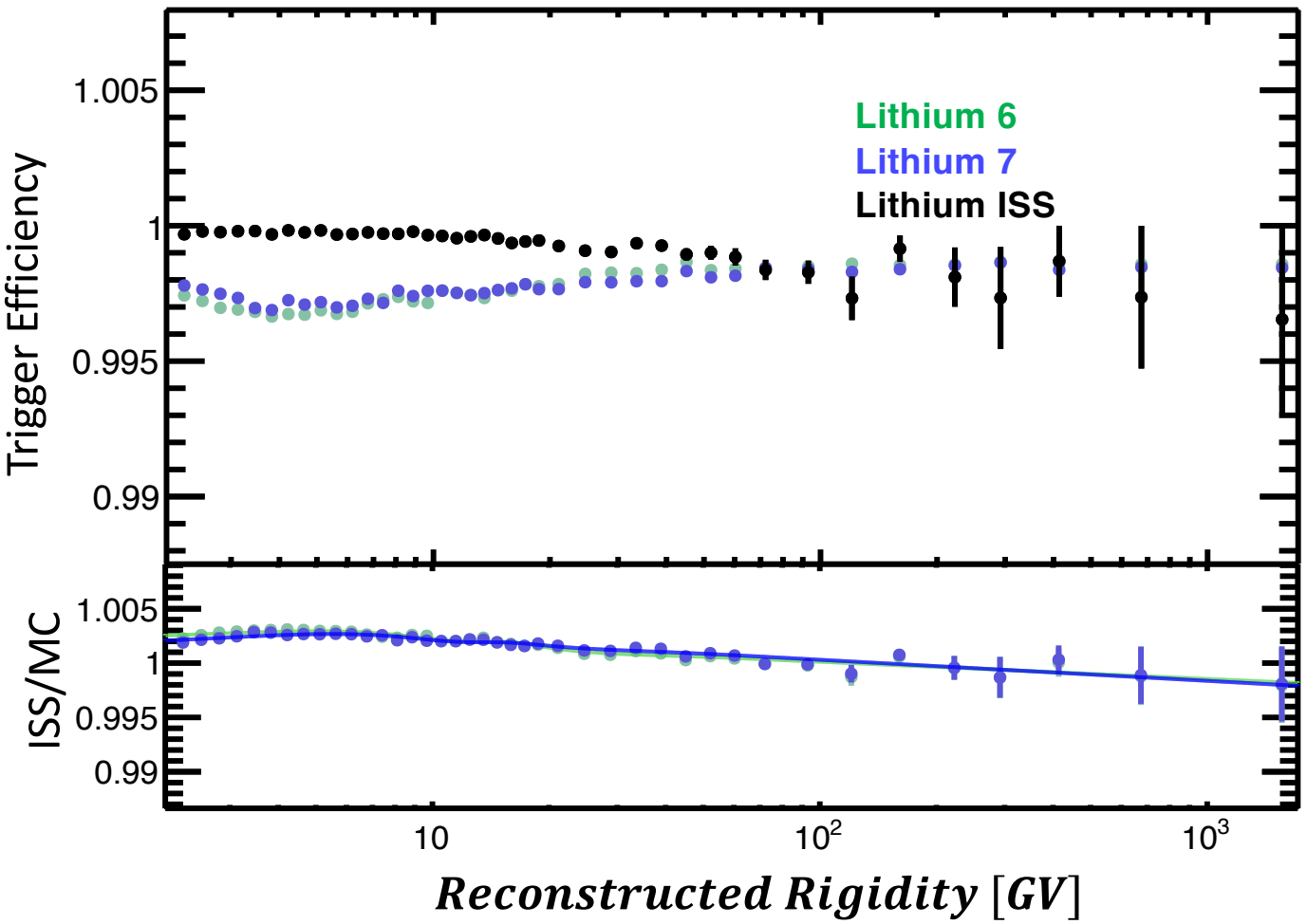
2

Trigger Efficiency
General (NaF Geometry)



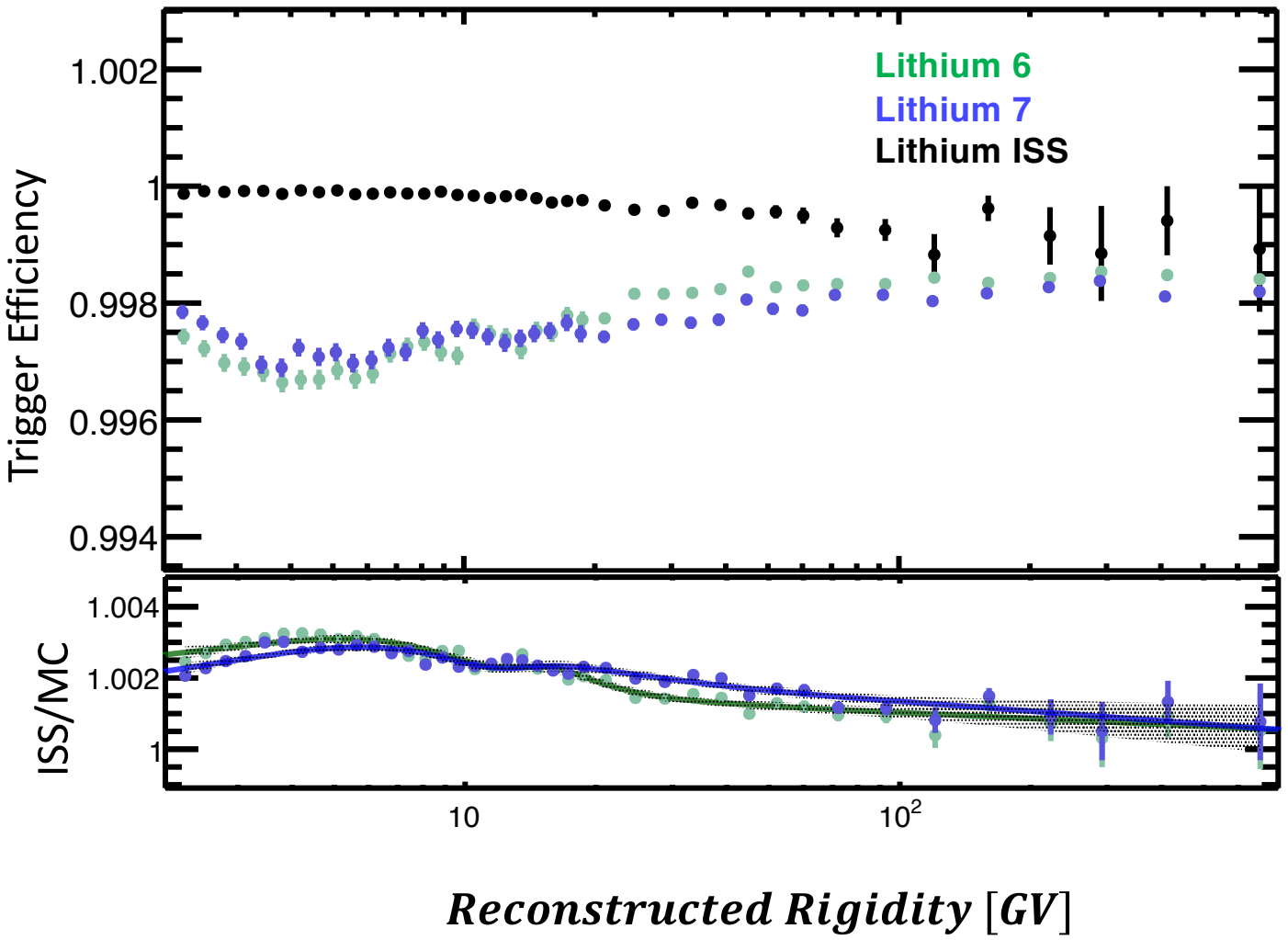
2

Trigger Efficiency
NACC <= 4 Period (Agl Geometry)



2

Trigger Efficiency
General (Agl Geometry)



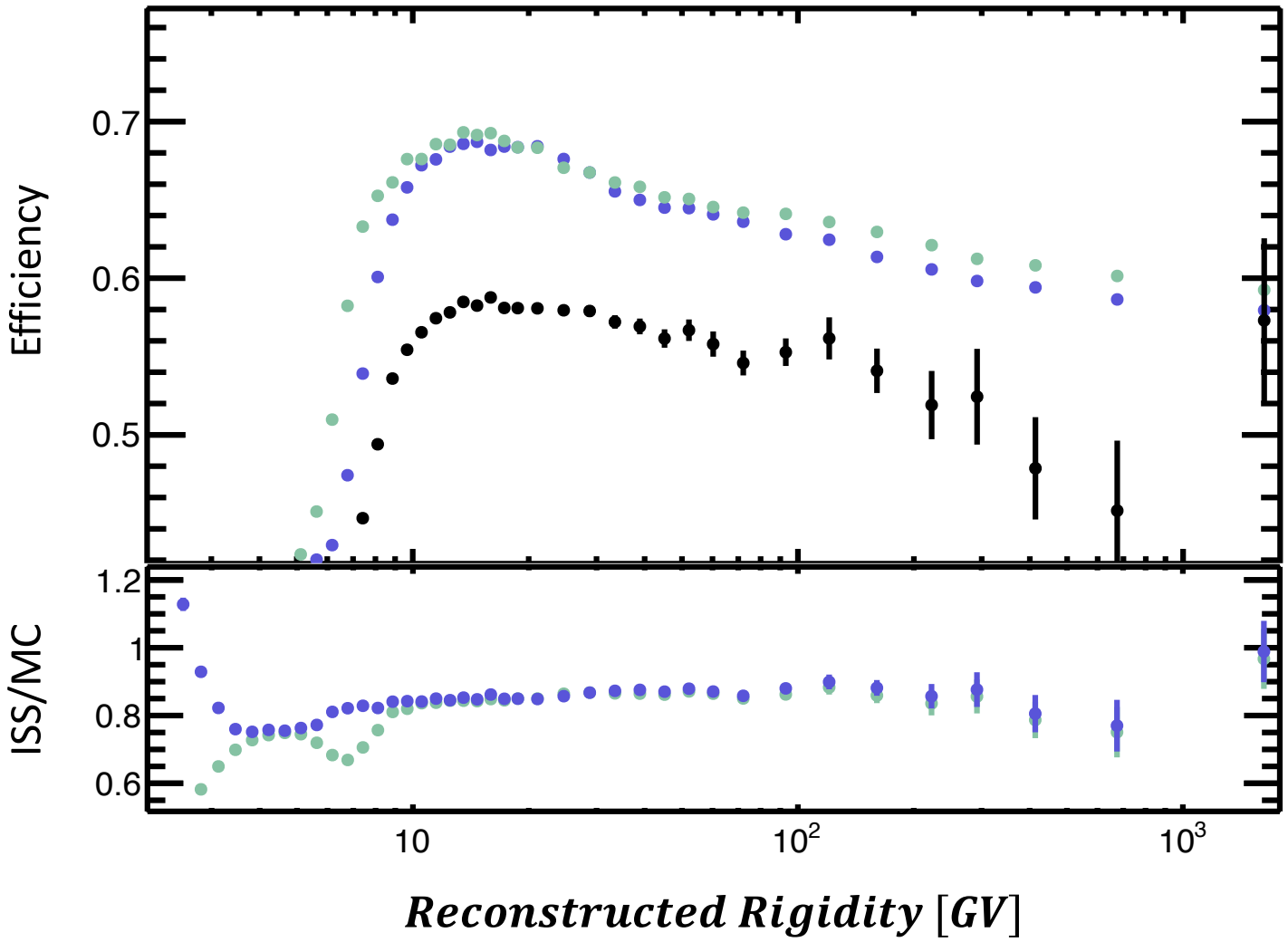
2

Selections Efficiencies: RICH Reconstruction

Sample:

- L1MaxQInner Track Cuts
- NaF/Aerogel geometry (extrapolation from inner track)
- Position correction of the RICH NaF and Agl…

Selections:

- NaF or AGL geometry
- Good Rich Tiles (AGL only)
- Good & clean
- P_Kolmogorov >0.01
- q_ltof>Z-0.6
- Z-1<q_rich < Z+2
- N_pmt>2
- N_pe(ring)/N_pe(total)>0.45 (NaF), >0.4

2 Selections Efficiencies: RICH Reconstruction (checking…)