

Technical Note

EM Resonant Production

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Abstract

This technical note proposes solutions for two identified issues for the electron side of GENIE in the resonant channel, namely the slow production of the relevant spline and an identified bug in the event generation.

IMPORTANT: Whenever electron scattering events are produced, the minimum Q2 is set to be equal to 0.02, while, for neutrino scattering, the Q2 threshold is 10^{-4} .

1 Existing Issues

Two issues have been identified for the electron side of GENIE in the resonant channel, namely the slow production of the relevant spline as shown in figure 1 and an identified bug in the event generation, which significantly reduces the contribution of the interaction channel as shown in figure 2.

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1549211743 INFO ReinSehgalResCF : [n] <ReinSehgalRESXSecWithCacheFast.cxx:CacheResExcitationXSec (171)> : {Q^2} = 0, 1
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1549211743 INFO ReinSehgalResCF : [n] <ReinSehgalRESXSecWithCacheFast.cxx:CacheResExcitationXSec (166)> : *** Integrating d^2 XSec/dwdQ^2 for R: P33(1232) at Ev = 0.169682
1549211743 INFO ReinSehgalResCF : [n] <ReinSehgalRESXSecWithCacheFast.cxx:CacheResExcitationXSec (169)> : {W} = 0, 1
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Figure 1: The spline production for EMRES events is really slow.

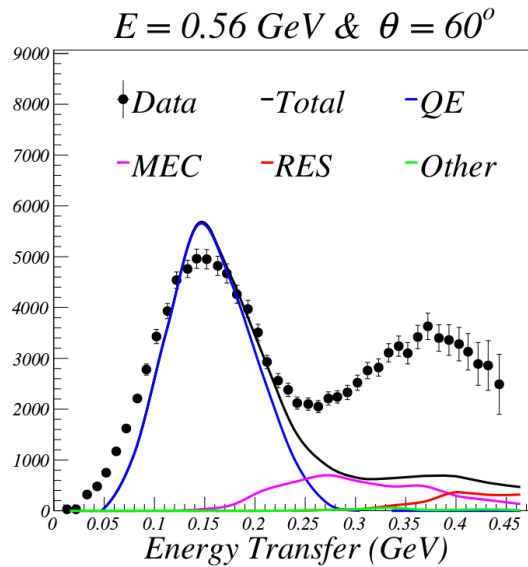


Figure 2: Data - simulation comparisons based on the energy transfer without the multiplication by the jacobian for EMRES events on ^{12}C @ $E = 0.56 \text{ GeV}$. The contribution of the EMRES interaction channel is really small due to the identified bug in the event generation.

2 Proposed Solution

- 1 To address the issue related to the slow production, a new configuration has been defined where the
- 2 integration algorithm for EM scattering has been switched to "vegas", as opposed to the current
- 3 one ("adaptive"), which remains the default one for neutrino scattering. When it comes to the
- 4 issue related to the event generator, the charged lepton and neutrino scattering cases have been
- 5 merged by using the sampling envelope and the multiplication by the jacobian in both cases.

3 Modified Files

7 The modified files are included below:

- 8 • src/Physics/Resonance/EventGen/RESKinematicsGenerator.cxx
- 9 • config/BergerSehgalRESPXSec2014.xml
- 10 • config/ReinSehgalRESPXSec.xml
- 11 • config/G00_00a/ModelConfiguration.xml
- 12 • config/G00_00b/ModelConfiguration.xml
- 13 • config/G00_00z/ModelConfiguration.xml
- 14 • config/G18_01a/ModelConfiguration.xml
- 15 • config/G18_01b/ModelConfiguration.xml
- 16 • config/G18_02a/ModelConfiguration.xml
- 17 • config/G18_02b/ModelConfiguration.xml
- 18 • config/G18_10a/ModelConfiguration.xml
- 19 • config/G18_10b/ModelConfiguration.xml
- 20 • config/G18_10i/ModelConfiguration.xml
- 21 • config/G18_10j/ModelConfiguration.xml

22 4 Validation

23 Theoretical calculations shown in figure 3 imply that the contribution of the delta resonance should
 24 peak around 0.4 GeV. Figure 4 shows that this is the case for our modified v3 prediction (which uses
 25 both the sampling envelope and the jacobian) gives results that are both closer to the expected
 26 value and are in better agreement when it comes to the shape and height of the resonant peak.

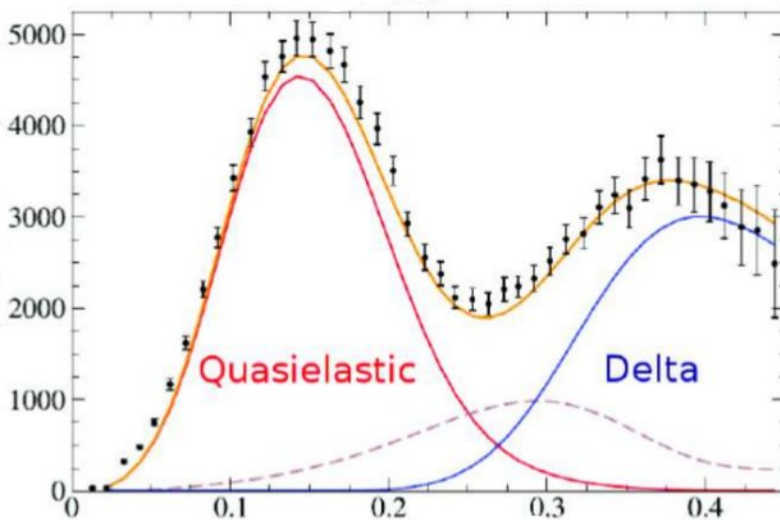


Figure 3: Theoretical calculations for the energy transfer for EM events @ $E = 0.56$ GeV on ^{12}C .

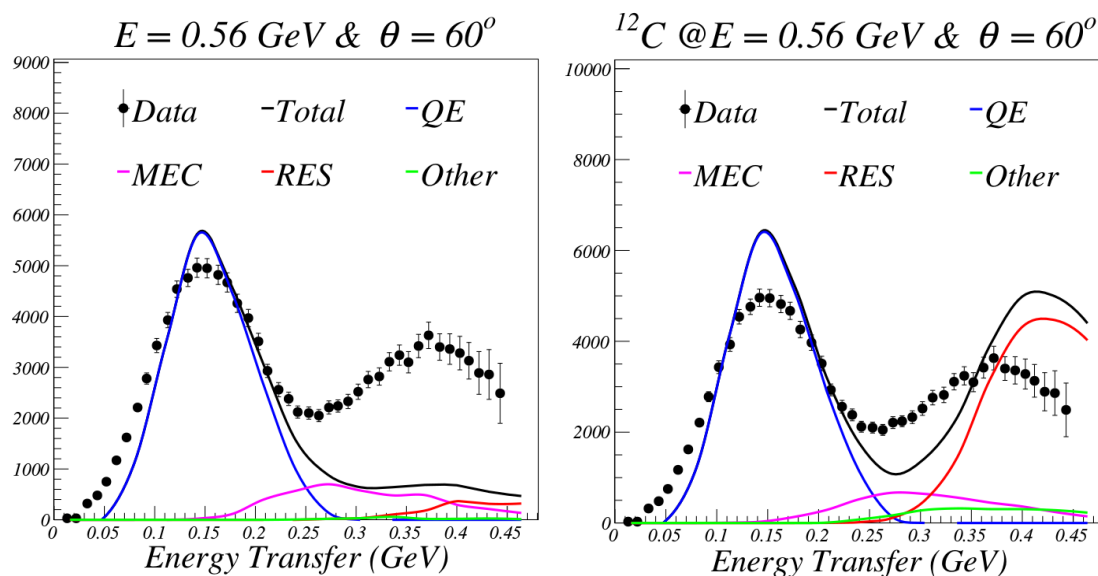


Figure 4: Data - simulation comparisons based on the energy transfer without the multiplication by the jacobian (left) and with the multiplication by the jacobian (right) for EMRES events on ^{12}C @ $E = 0.56$ GeV.

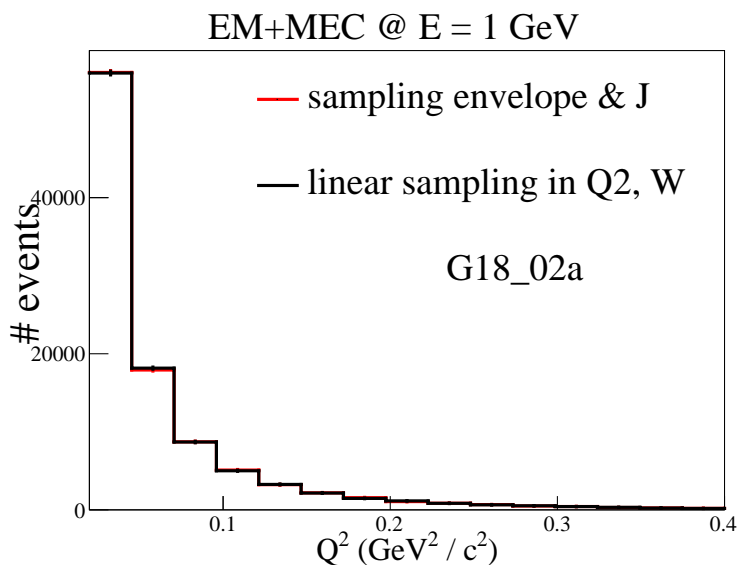


Figure 5: Q^2 distribution for EM+MEC events @ $E = 1$ GeV, showing that the sampling envelope and the linear sampling in Q^2, W are equivalent.

27 5 Github

28 The relevant code modifications can be located in the following Github repository

29

30

<https://github.com/afropapp13/Generator.git>

31 The corresponding branch is

32

devel_res

33 and the corresponding pull request has already been submitted.

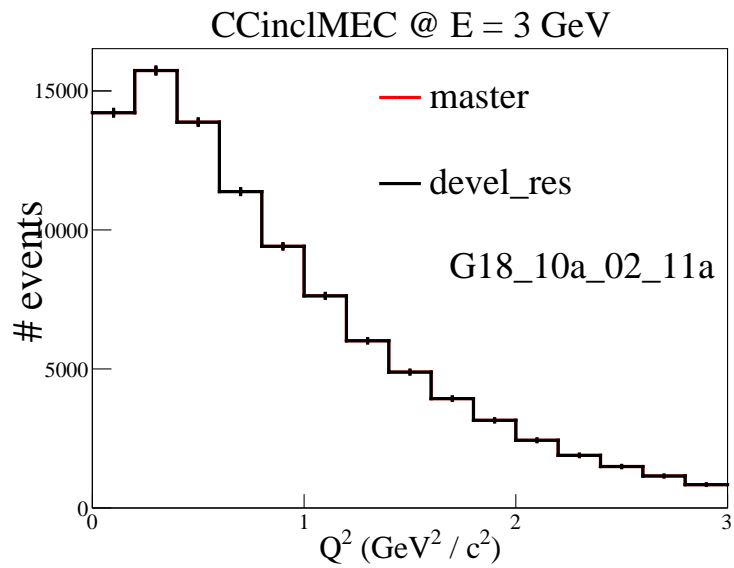


Figure 6: Q^2 distribution for CCinclMEC events @ E = 3 GeV, showing that the neutrino side has not been altered.

