Radiation Tails In 89-044

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Abstract

Example simulations are shown for one of the proposed kinematics points for expt. 89-044. A graduate student at Georgia is working on a program of more complete simulations.

Simulation Setup

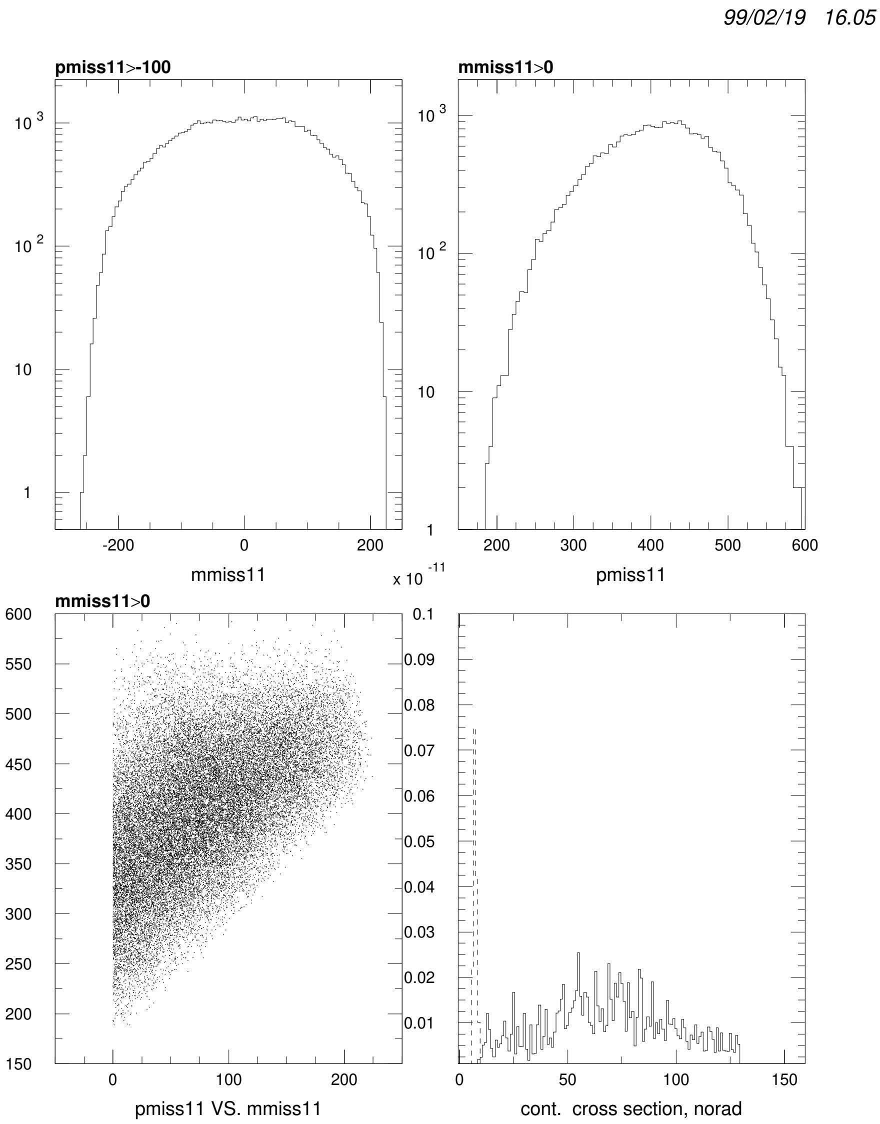
- Kinematics:
  - $E_0 = 5045$ MeV
  - $\theta_e = 20.34$ deg
  - $\theta_p = 49.55$ deg (8 deg off parallel)
  - $(q, \omega) = (2.0, 1.28)$ GeV
  - Claimed p_m setting 300 MeV/c
- Spectrometers: 6 msr collimators (no optics, WWW resolution numbers)
- target:
  - 10.0 cm diameter (tuna can axis points toward roof?)
  - target density 0.153 g/cm^3
  - target walls (for external bremsstrahlung) 330 μm aluminum
  - Sim includes ionization energy losses in target (but not walls)

Physics Input

- Nuclear Reaction
  - Simon parameterization of proton form factors
  - σ_{ep}^{cc1} from de Forest
  - ^{3}He spectral function from Salmè (stops at $E_m =$ 125 MeV)

- Radiation Tail
  - Tsai's thin-radiator distribution for external bremsstrahlung (target gas and cell walls)
  - Borie-Drechsel cross section for internal bremsstrahlung
  - Schwinger Correction for "unradiated" strength

Detection Volume



Spectrum shown (LRP) is for $p_m = 512.5 \pm 12.5$ MeV/c, for case of no radiation (neither external nor internal bremsstrahlung)

Results of Radiation-Tail Simulations

- Show results as spectra vs. E_m for various bites (25 MeV/c wide) of p_m

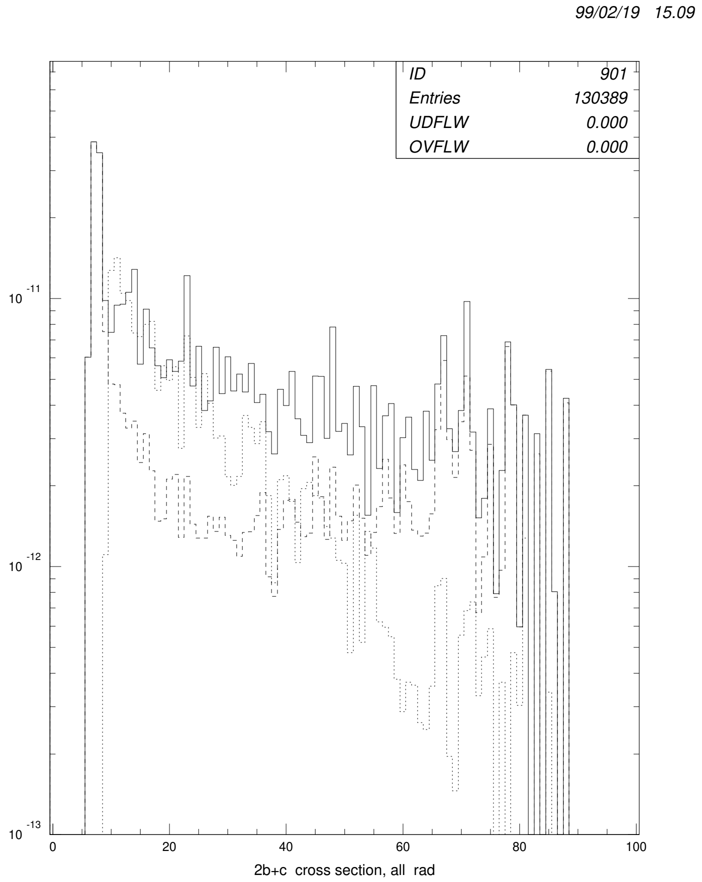
- Show three histograms per result

  1. full simulation (two-body and continuum breakup with all possible bremsstrahlung types)
  2. full simulation (all types of bremsstrahlung) but for two-body "vertex" reactions only
  3. simulation for continuum breakup with radiation turned off

- Why these choices?

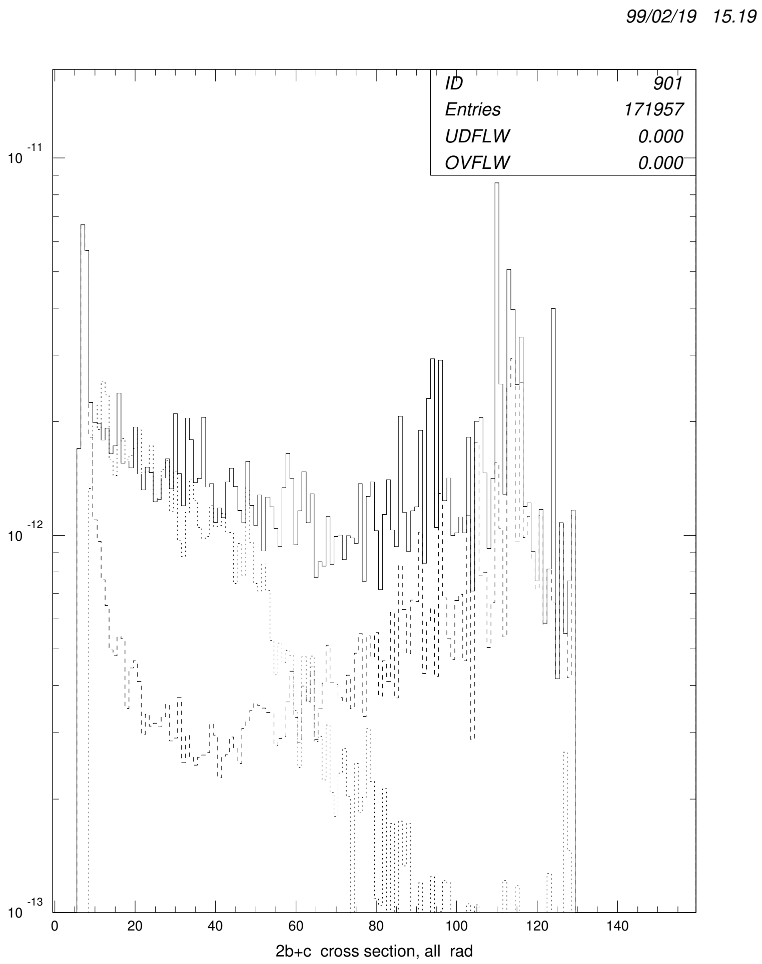
  1. correction of two-body *peak* is relatively trivial
  2. large radiated two-body strength is usually the culprit when can't correct
  3. if strength in continuum region is much different than "unradiated" strength, no hope of correcting spectrum to find true strength

Results for $p_m = 262$ MeV$/c$



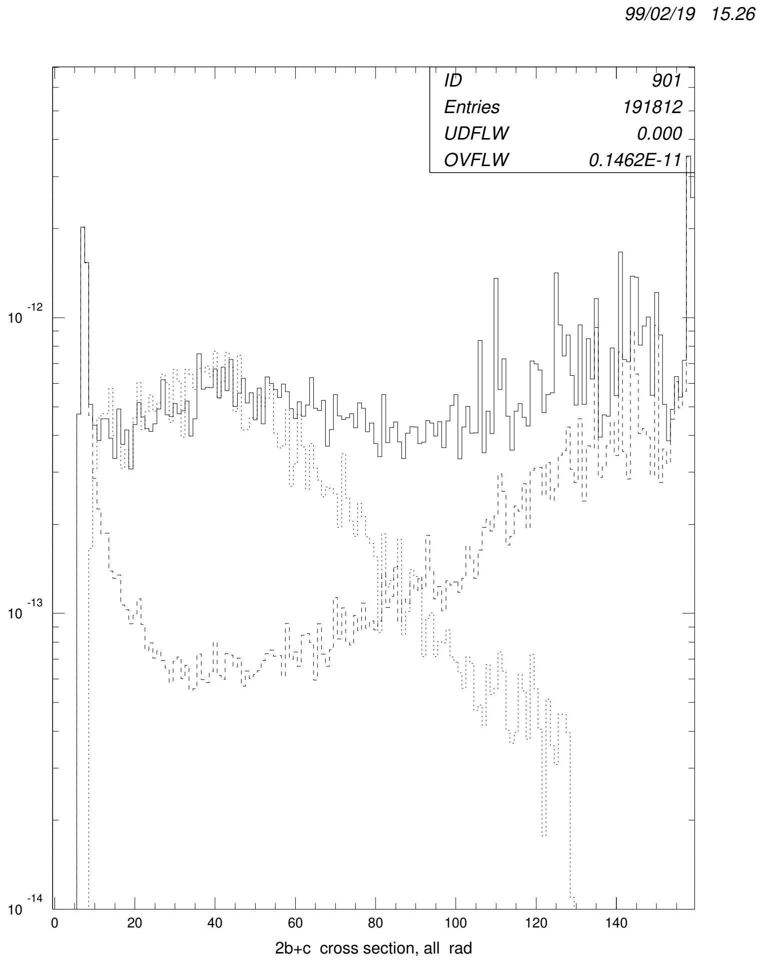
- 2-body starts down and then comes back up at about 50 MeV
- continuum monotonically decreases
- can make reasonable measurement to $E_m \sim 30$ MeV

Results for $p_m = 312$ MeV/c



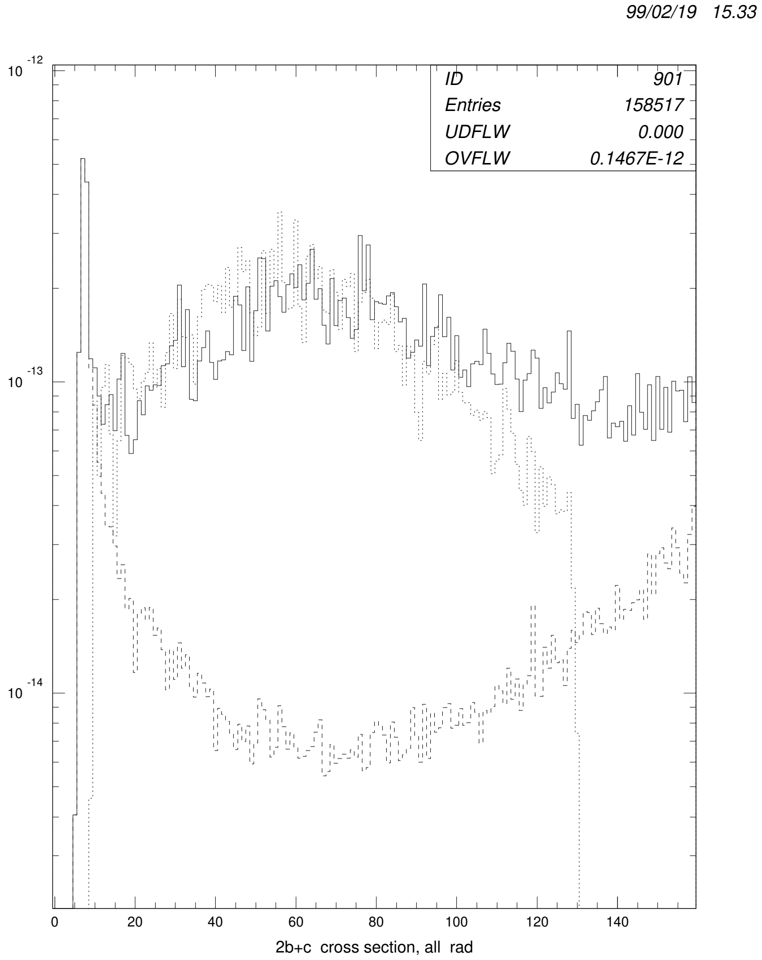
- Same features as before, but more pronounced
- can make measurement to $E_m \sim 50$ MeV

Results for $p_m = 375$ MeV$/c$



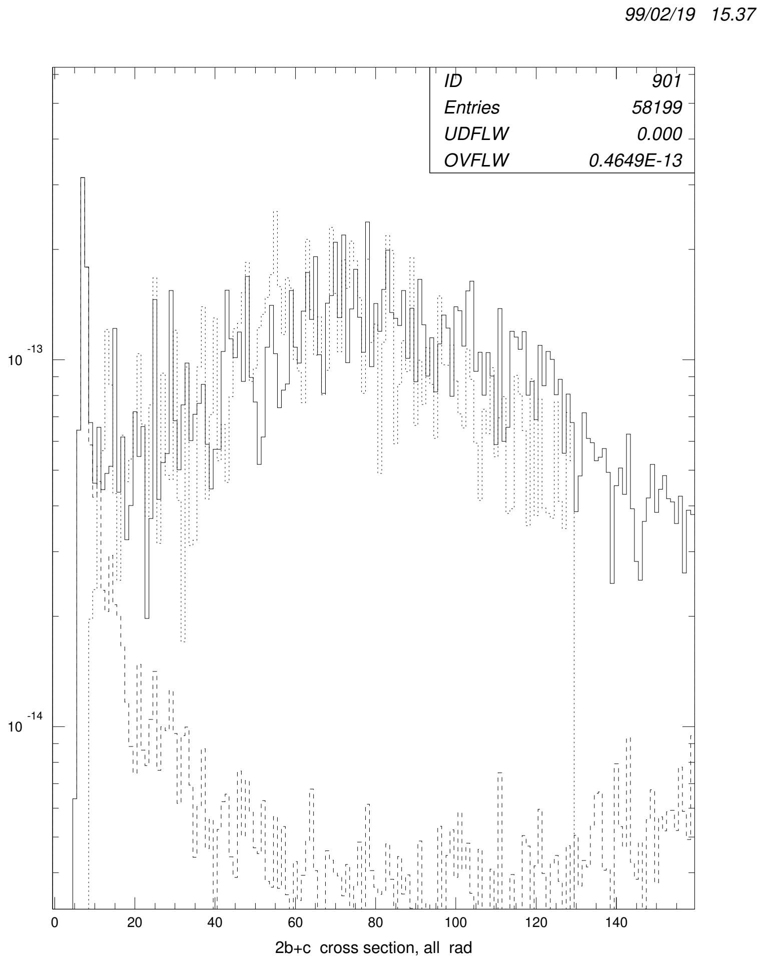
- Even better, measure to about 60 MeV
- clear indication of SRC bump; $E_m = \frac{A-2}{A-1}\frac{p_m^2}{2m_N}$ with $p_m = 375$ MeV$/c$ gives $E_m = 37.5$ MeV!!

Results for $p_m = 462$ MeV$/c$



Cutoff at 130 MeV due to spectral function. Total simulation, however, doesn't stop (bremsstrahlung distributes strength).

Results for $p_m = 512$ MeV$/c$



Hard to tell at large E_m (poor statistics) but looks OK to at least 100 MeV!

Closing Thoughts

- Borie-Drechsel maybe not adequate
  - uses single-photon peaking approximation
  - final radiated cross section is an incoherent sum of two terms, but RADCOR assumes a product in correction factor
- how to "correct the correction" for soft photon emission? unclear
- proton momentum getting big; at some point need to worry about proton radiation, especially interference effects
- never trust radiative correction to be better than 20%!