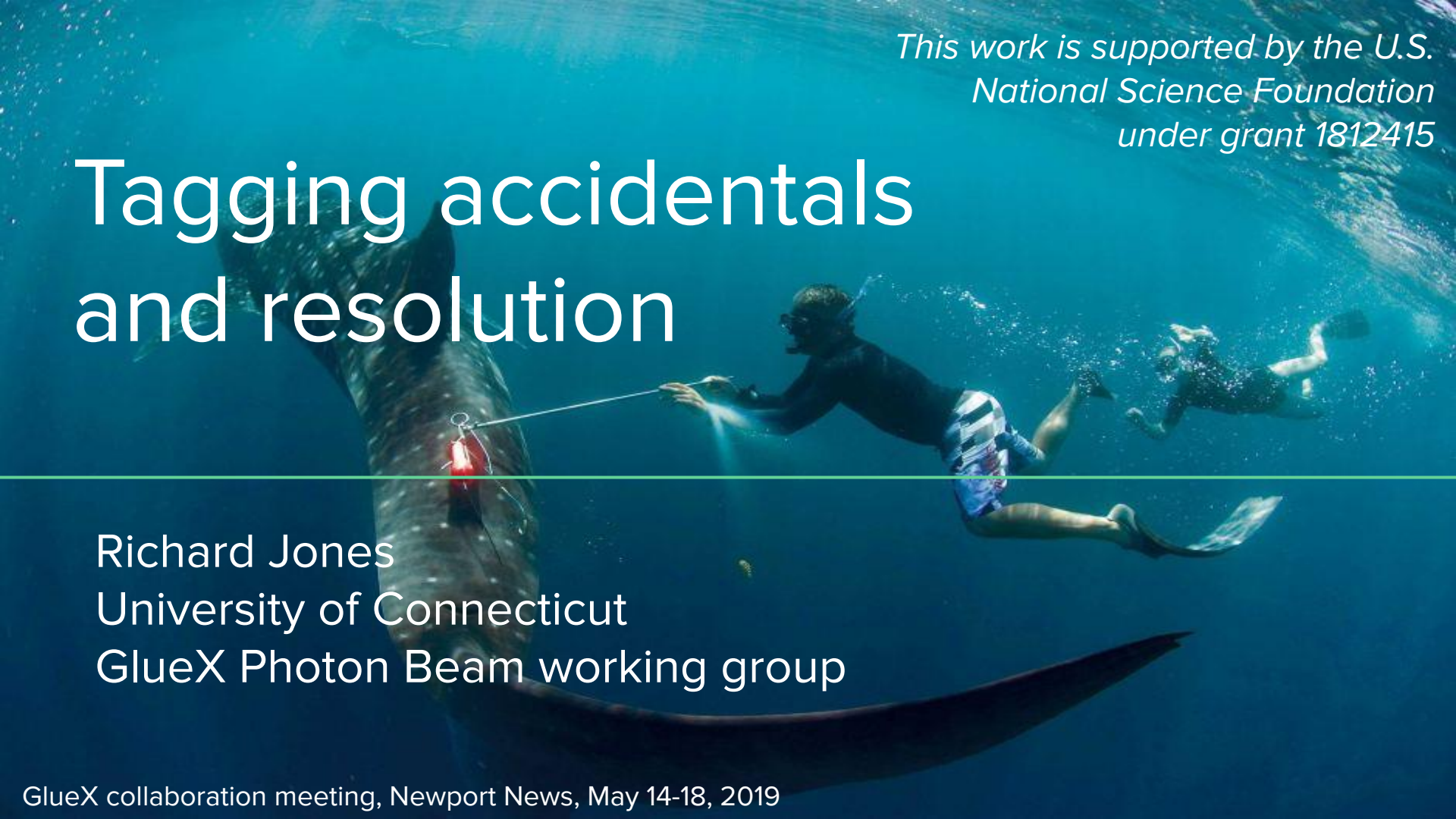
This work is supported by the U.S. National Science Foundation under grant 1812415

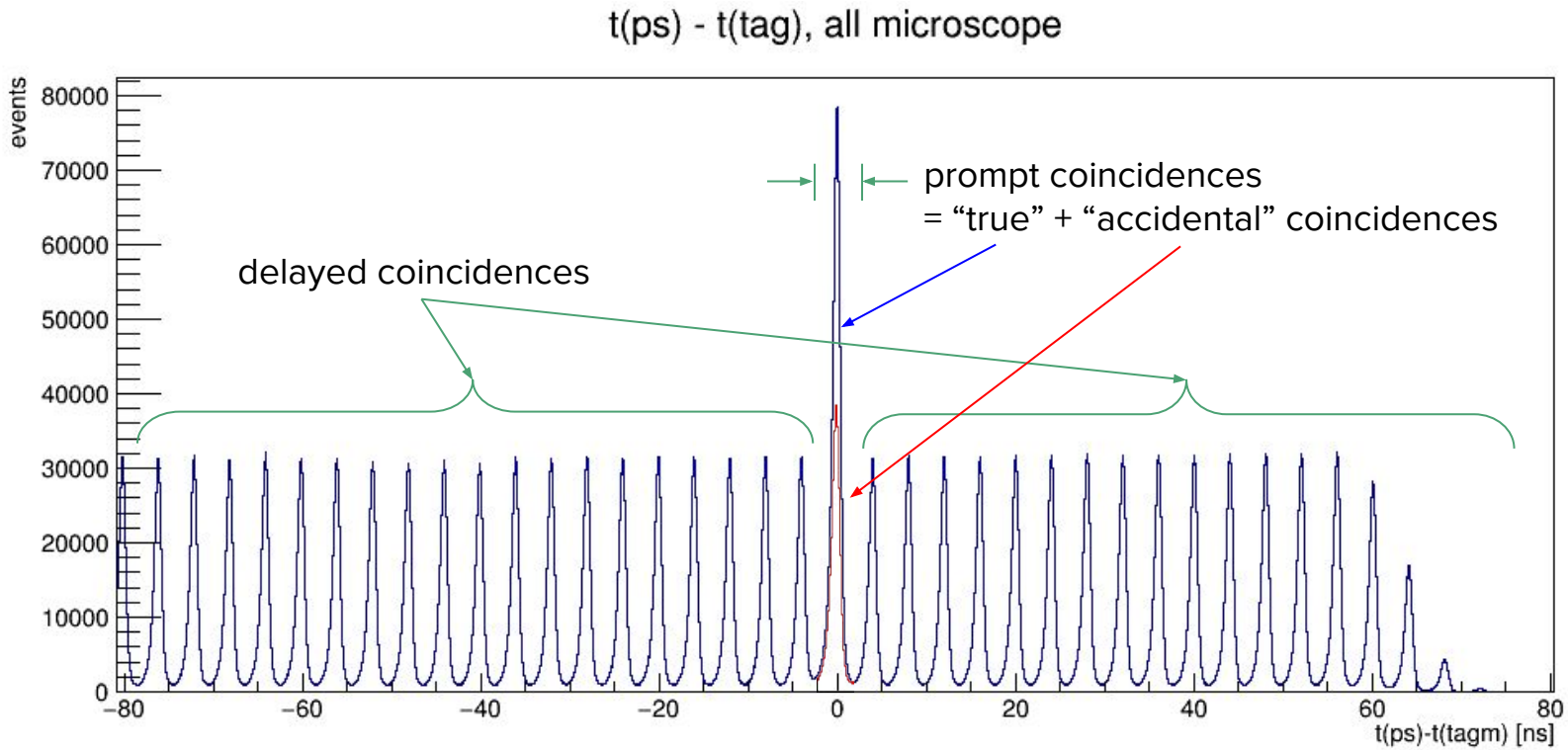
Tagging accidentals and resolution



Richard Jones
University of Connecticut
GlueX Photon Beam working group

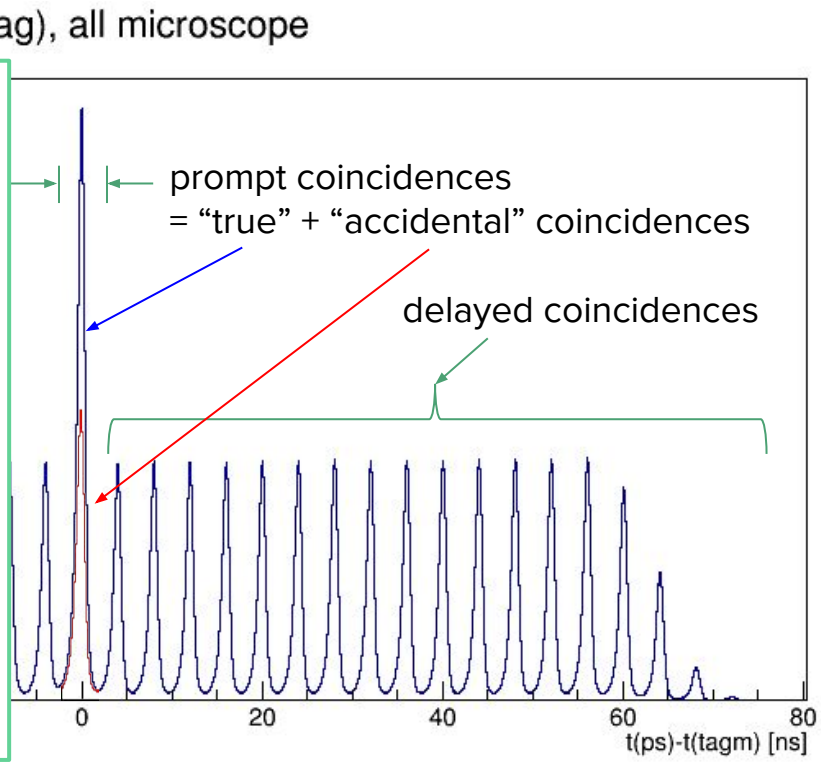
GlueX collaboration meeting, Newport News, May 14-18, 2019

Tagger accidentals: *definitions*



Tagger accidentals: *assumptions*

1. ***All events*** in the delayed peaks are identical <u>in character</u> to the ***accidentals*** in the prompt peak.
2. They need not be identical <u>in counts</u> -- *in general, they are not.*
3. Ratio of counts in delayed peaks to accidentals in the prompt peak is determined empirically.



Tagger accidentals: *derivation*

- *ignoring electronics dead time,*

$$T_i(E) = N_i\ p(E)$$

number of trues in beam pulse i, tagger energy E, for N_i tagged photons, trigger probability $p(E)$.

$$A_i(E) = N_i^2\ p(E)\,\epsilon(E)$$

number of accidentals in beam pulse i, for given tagger detection efficiency $\epsilon(E)$.

$$D_{ij}(E) = N_i N_j\ p(E)\,\epsilon(E)$$

number of delayed coincidences in beam pulse j associated with a trigger whose true coincidence was actually in pulse i.

- *simple assumption* $A_i = D_{ij}$ *requires the* $\langle N_i^2 \rangle = \langle N_i\, N_j \rangle$, $i \neq j$

Tagger accidentals: *derivation*

- *But isn't CEBAF supposed to have duty factor = 1?*

$$f_D = \frac{<I>^2}{<I^2>} = \frac{\langle N_i\ N_j \rangle}{\langle N_i^2 \rangle}$$

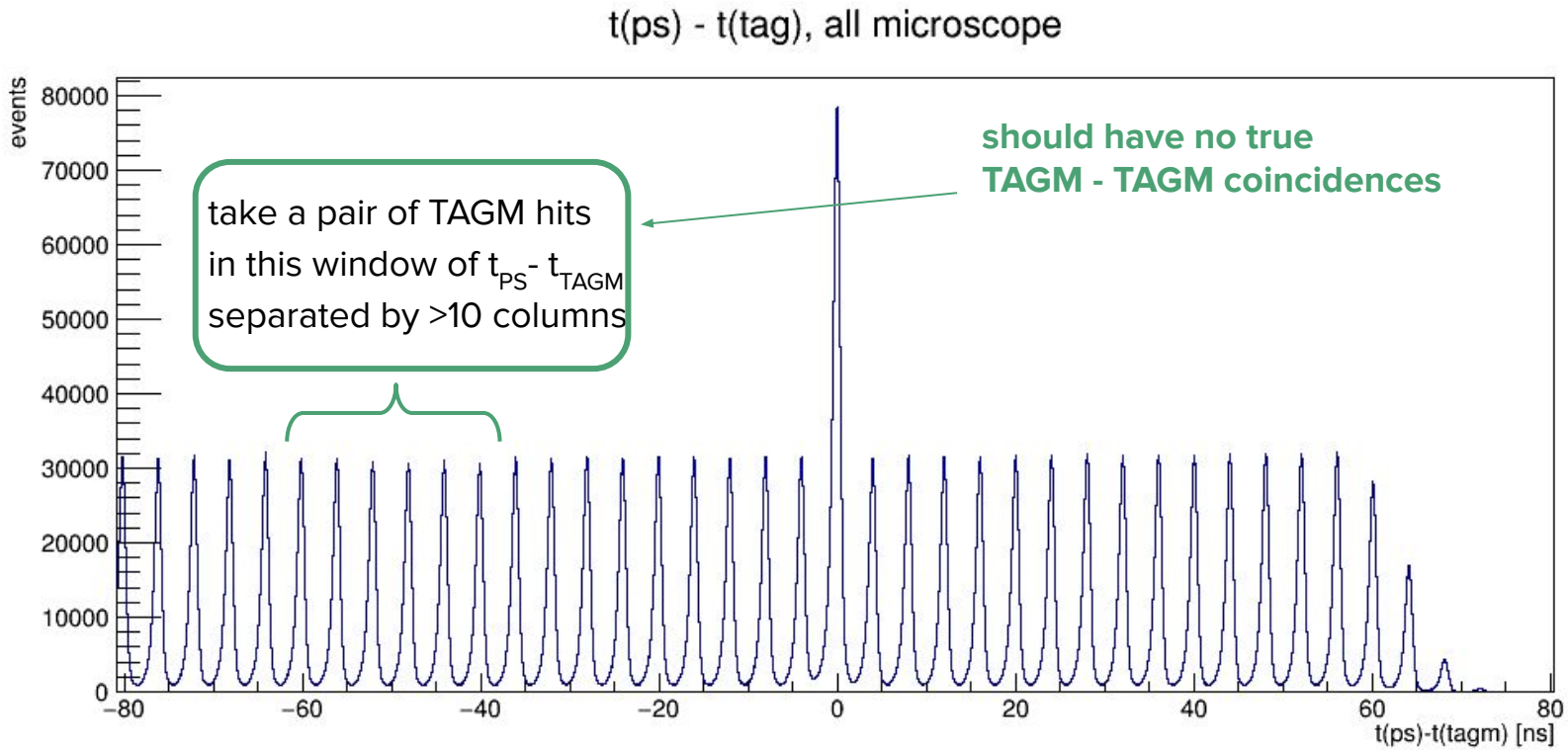
- $f_D \leq 1$, can vary depending on conditions at the source.
- $f_D < 1$ is associated with fluctuations in laser pulse intensity.
- *simple assumption* $A_i = D_{ij}$ *requires the* $<N_i^2> = <N_i\ N_j>$, $i \neq j$

Tagger accidentals: *a correct prescription*

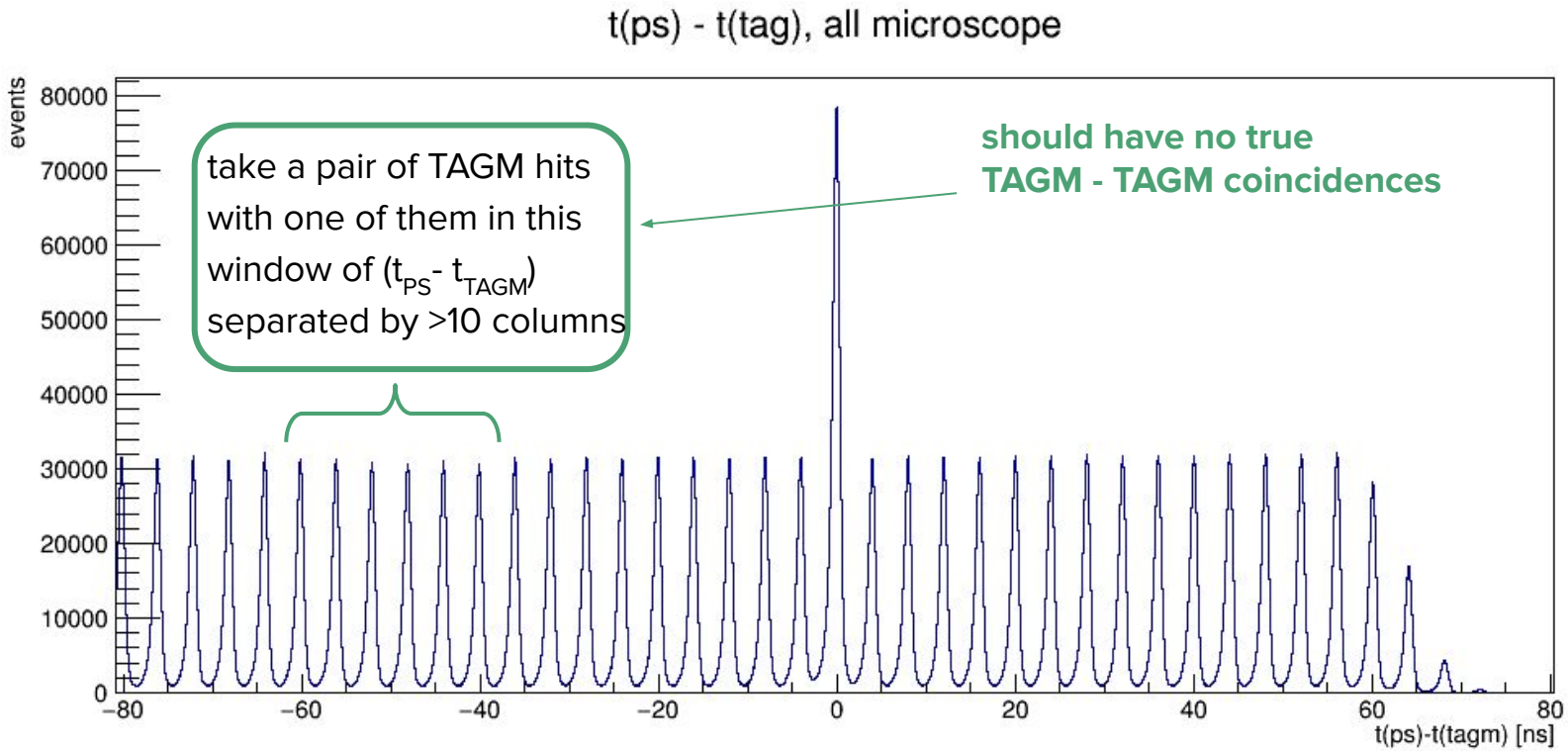
$$\hat{A}_i = \frac{1}{f_D\, S} \sum_{j=1}^{S} D_{ij}$$

- f_D should be measured using a pair of high-rate counters whose true coincidence rate can be assumed to be negligible.
- Example 1: **one tagging counter vs another tagging counter**
  - widely separated from one another on the focal plane
  - chosen such that $E_1 + E_2$ is far from the endpoint energy E_0
- Example 2: **PS coincidences vs one tagging counter**
  - chosen with E_{tag} far from $E_{\text{PSleft}} + E_{\text{PSright}}$

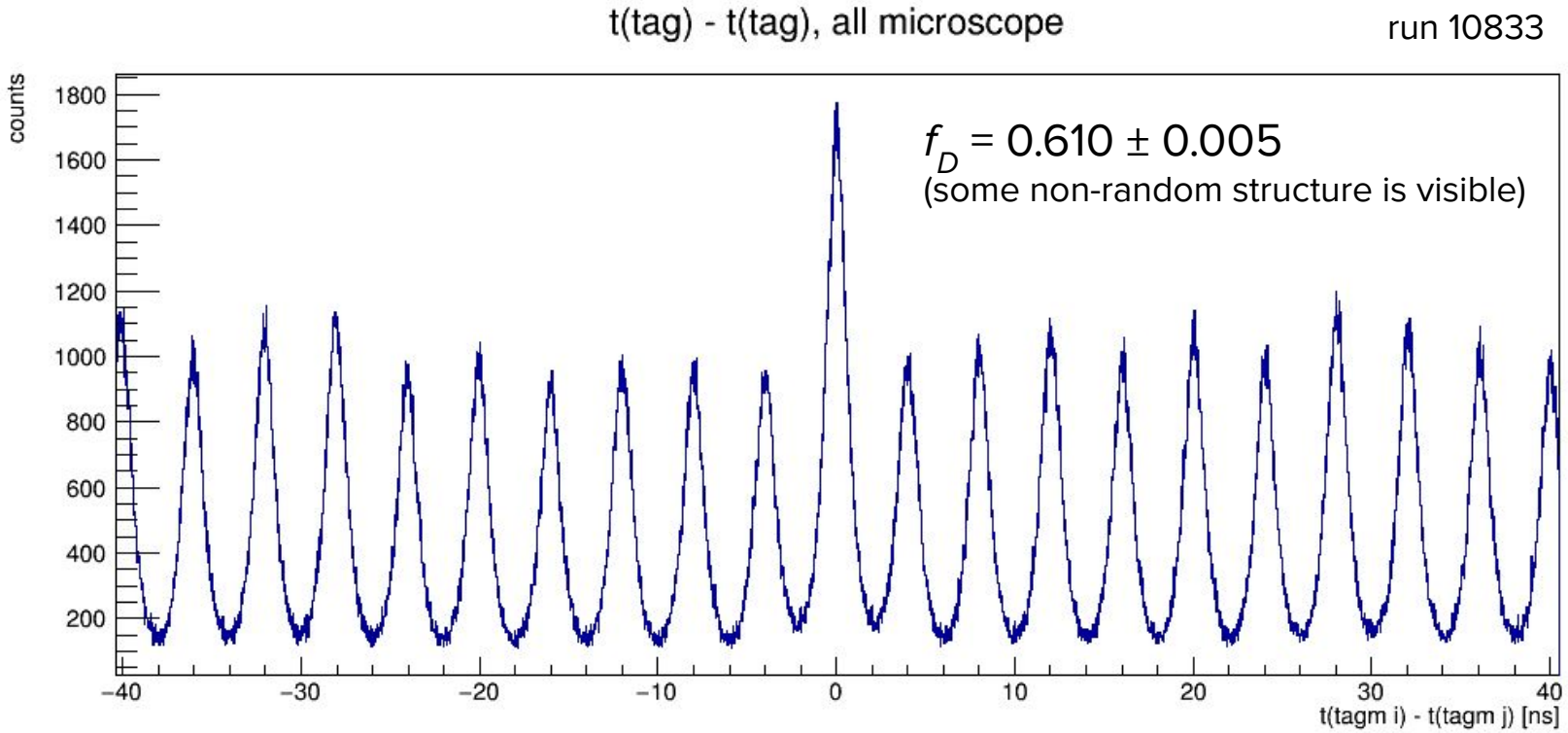
Tagger accidentals: f_D *by method 1*



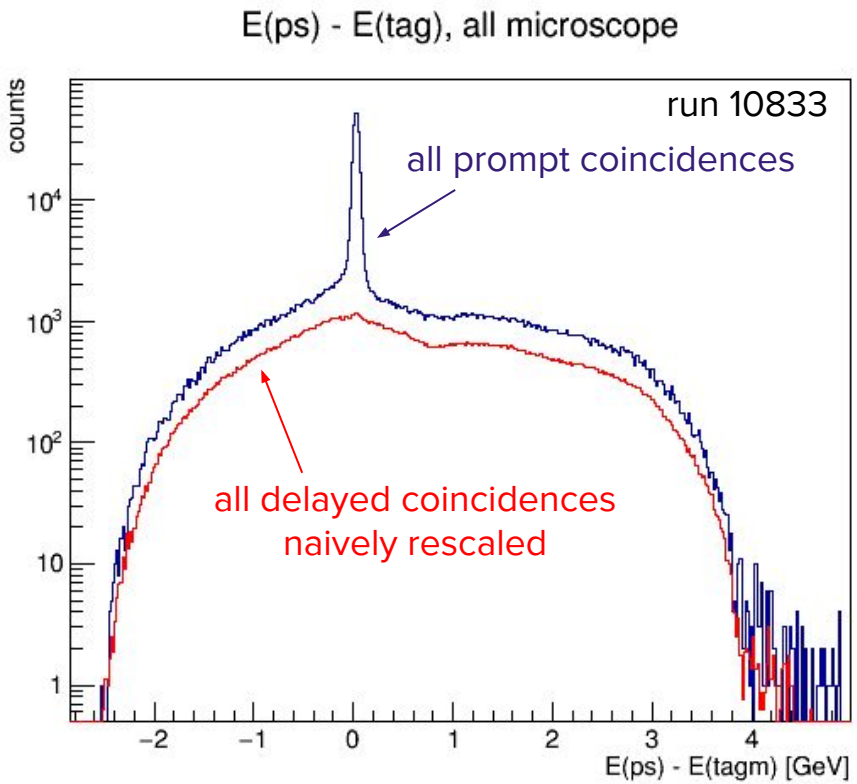
Tagger accidentals: f_D *by method 1*

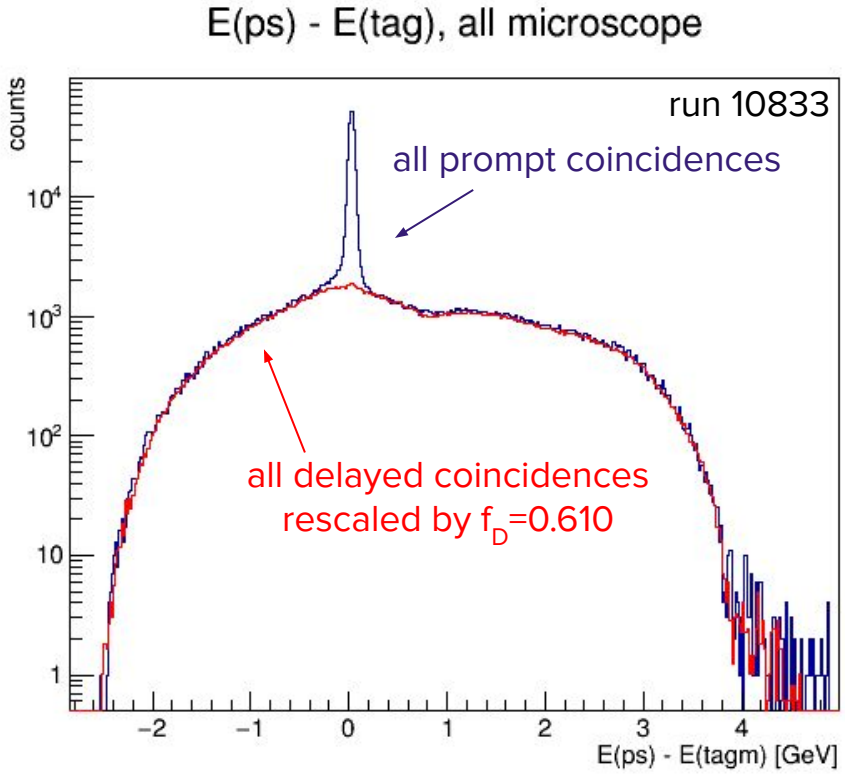


Tagger accidentals: f_D *by method 1*

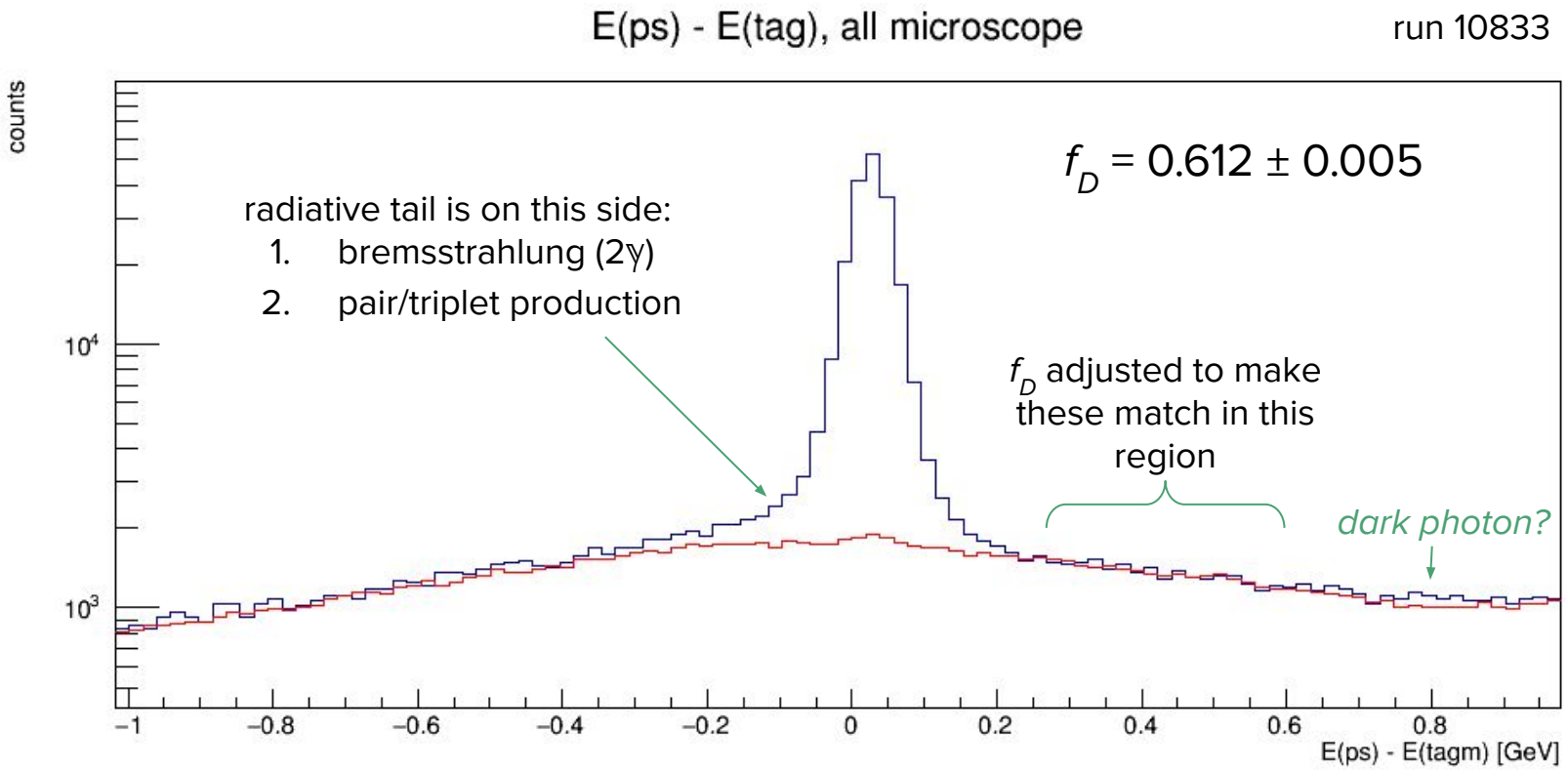


Tagger accidentals: f_D *by method 2*





Tagger accidentals: f_D by method 2

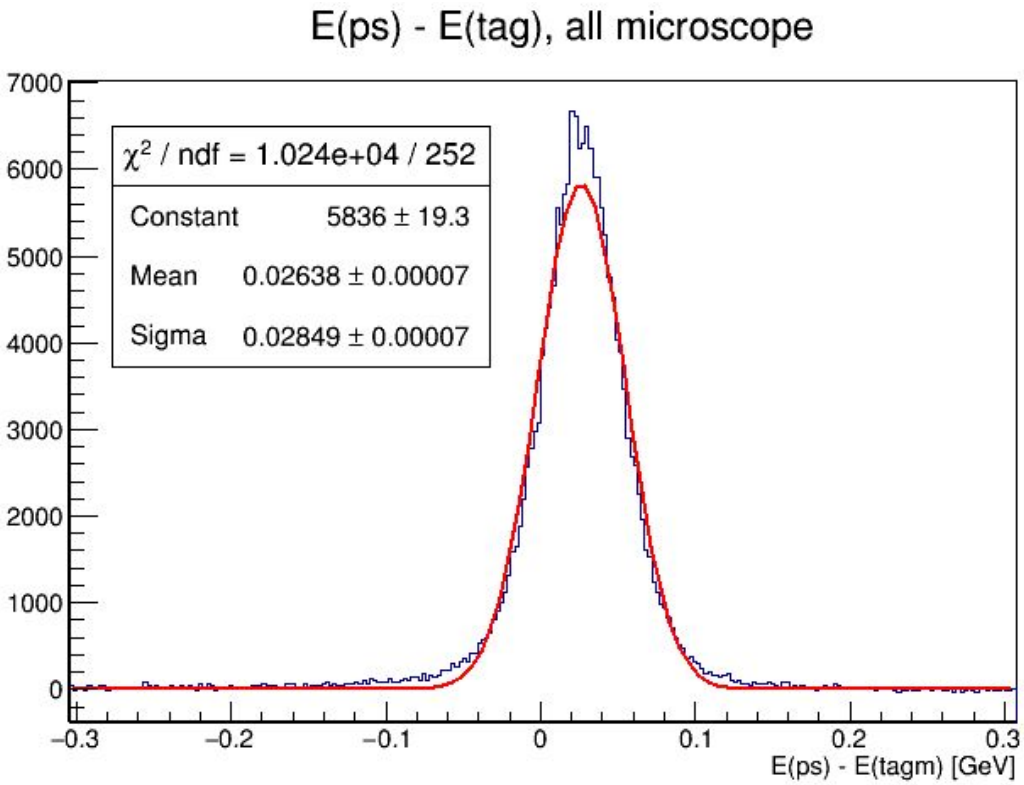


Tagger accidentals: *the path forward*

- A lot is still unknown about this:
  a. How much does f_D vary over our physics running? *probably by a lot*
  b. Does it vary significantly within a single run period? *maybe not*
  c. Does it vary significantly with a single run? *probably not*
- Photon Beam working group will study this and issue a report within the next 3-4 weeks with a recommendation.
- At the very least we will need to:
  a. run over the existing data (PS skims) and measure f_D, save in ccdb
  b. add a watch on f_D to our online monitoring

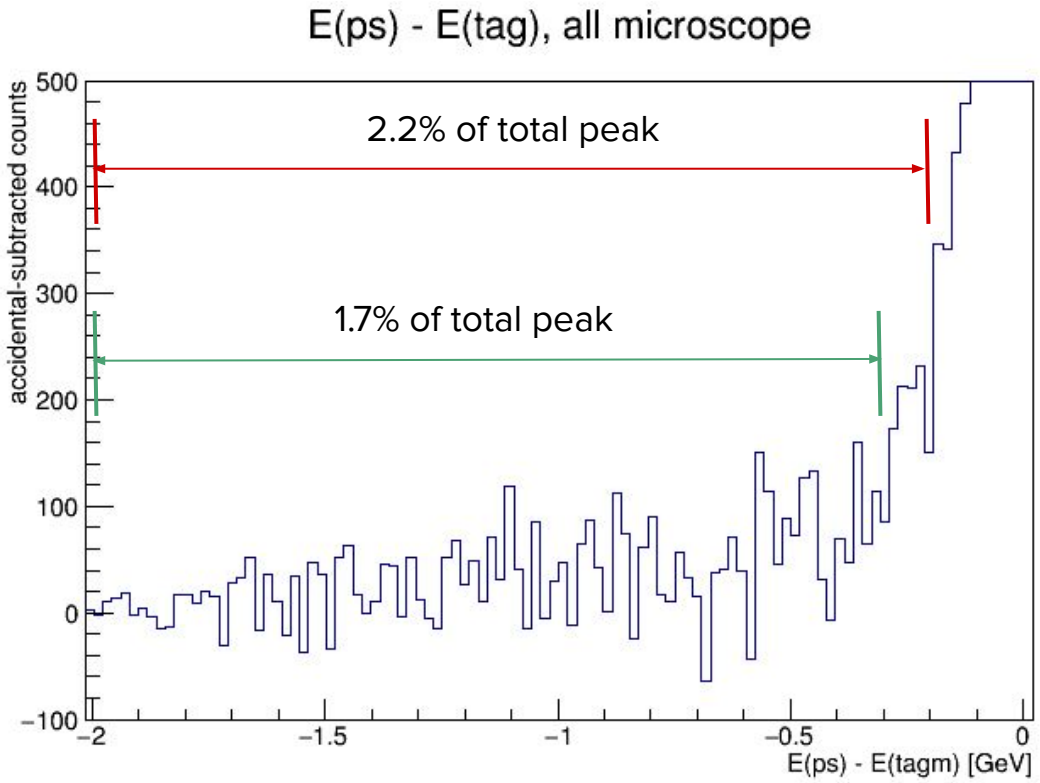
Tagger resolution

- same plot as shown before, but on a linear scale
- resolution on ΔE ~ 30 MeV is in good agreement with MC
- shift between the PS and TAGM energy scale ~25 MeV is well known, will be fixed.
- radiative tail is visible on LHS past ~100 MeV contains 2% of PS-TAGM coincidences.



Tagger resolution: *radiative tail*

- radiative tail is clearly visible past tails of the central peak ~6-7σ
- visible tail contains 2% of peak counts
- … but the tail actually goes all the way to 0 !
- radiative corrections to polarization A needed to match other sources of systematic error.



Photon beam systematics: *summary*

- PS, TAGM and TAGH energy scales need to be unified
  - plan is to use the PS simulation (uses measured map) to set the energy scale to correct the existing “scaled_energy_range” tables for TAGM/H in ccdb.
  - *RTJ will do this within next 2 weeks*

- Systematics of the dependence of the TPOL asymmetry on the E_{PS}- E_{tag} cut needs to be understood and quantified.
  - significant radiative tail is seen in the data
  - radiative correction are not presently included in MC
  - *RTJ plans to work on correcting this defect over the summer (2019).*

p.s. Diamond radiators

- **X-ray rocking curve run scheduled for June 12-14 at CLS !**
- time will be sufficient to take detailed maps of these samples:
  a. ***JD70-104*** : 17 um diamond, highest radiation damage so far
  b. ***JD70-105*** : 50 um diamond, used from spring 2017 - spring 2018
  c. ***JD70-121...125*** : 50 um diamonds, 5 new virgin samples
- these 5 new radiators are needed for our program through fall, 2020
- conservative estimate: 3-5 radiators per calendar year for 2021+
- to be understood: *character of radiation damage, possibility of annealing to recycle used radiators.*