Once upon a time in quarantine - the ending of AmBe saga

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First draft of paper on nuclear recoils identification ready
• exhaustive on CYGNO reconstruction algorithms
• complements the iDBSCAN paper by Igor Abritta

mentions vaguely the saturation issue, and its calibration procedure

reports on a initial efficiency vs rejection factor for NR vs ER
Results 1: ER rejection

- Preselection:
  - cluster properties selection
  - after studies by D. Piccolo, PMT selection used to reject additional 20% of cosmics in the Fe sample (i.e., split tracks which are “spot-like”, but still have a “long” PMT signal)

- Selection: 1D cut on cluster density
- Identified 2 example Working Points: 50% and 40% eff on signal. Correspond to 3.5% and 0.8% efficiency on ER with E=5.9 keV

Table 1. Signal (nuclear recoils) and background (electron recoils) efficiency for different selections on $\delta$.

<table>
<thead>
<tr>
<th>Working point</th>
<th>Signal efficiency $\varepsilon_S^{\text{presel}}$</th>
<th>Signal efficiency $\varepsilon_S^{\delta}$</th>
<th>Signal efficiency $\varepsilon_S^{\text{total}}$</th>
<th>Background efficiency $\varepsilon_B^{\text{presel}}$</th>
<th>Background efficiency $\varepsilon_B^{\delta}$</th>
<th>Background efficiency $\varepsilon_B^{\text{total}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP$_{50}$</td>
<td>0.98</td>
<td>0.51</td>
<td>0.50</td>
<td>0.70</td>
<td>0.050</td>
<td>0.035</td>
</tr>
<tr>
<td>WP$_{40}$</td>
<td>0.98</td>
<td>0.41</td>
<td>0.40</td>
<td>0.70</td>
<td>0.012</td>
<td>0.008</td>
</tr>
</tbody>
</table>
Results 2: NR spectrum

- analysis provides the background-subtracted spectrum of NR, with, e.g. the WP50 selection
Result 3: NR efficiency vs $E$

- For the two WPs, show the efficiency of NR signal versus (calibrated) energy

The signal efficiency for the WP with 4% bkg efficiency has:

$$\varepsilon_S^{\text{total}} \approx 18\% \text{ at } E=6 \text{ keV}$$
Examples of 2 low-E NRs

- Two selected NR candidates with E<6 keV

E=5.2 keV

E=6.0 keV
Paper status

- First version written, currently under editors review
- E.T.A. for PubCom review: end of this week
- Current version of the paper available:
  - in git at this link
  - PDF at this link
- Target journal:
  - 1st choice: Nature
  - backup solution: Measurement Science and Technology

- Side notes for PubCom from this experience:
  - propose to PubCom to store every paper source (including figures) in github
  - can make “tags” (e.g. “preliminary”, “referee”, “published”) and can be used to access the figures for talks, etc
  - Overleaf can push to github easily
  - Now github allows free private repositories (the ambe paper one is such)
The End