LAT perspectives in detection of high energy cosmic ray electrons
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Abstract. The LAT science objectives and capabilities in the detection of high energy electrons in the energy range from 20 GeV to ~1.5 TeV are presented. LAT simulations are used to establish the event selections. It is found that maintaining the efficiency of electron detection at the level of 50%, the residual hadron contamination does not exceed 2.5% of the electron flux.

Exploring LAT Capability to detect HE electrons

• Being a gamma-ray telescope, LAT is already an excellent detector of electrons

• The main problem is to separate electrons from all other species: Proton-electron separation power above 10 GeV is needed to be $10^9$ to have not more than 10$%$ proton contamination in measured electron flux. Gamma's can be removed by the ACD.

• We explored LAT’s capability to detect electrons in the energy range from 10 GeV to ~150 GeV. We developed the cuts with which we observe reasonable flux reconstruction for electrons up to ~700 GeV; above this energy the resolution quickly degrades.

• residual proton contamination is ~ 3% of the electron flux after applying our cuts (see Table below)

Our high energy electrons selections:
Approach: Utilization of the difference between electron-innuarance and neutron-initiated event patterns in LAT:
• LAT includes configurable trigger mode that sends all events with energy > 10-20 GeV in calorimeter to the ground for further analysis. Our data will be in the set with this trigger.
• no problem with albedo, geomagnetic variation or with SAA

Selection Group 1 (panel 1). Remove events which passed the LAT without interaction or interacted too deep in the calorimeter (CTBBestEnergy > 10 GeV). Removes ~75% of all hadrons
Selection Group 2 (panels 2 and 3). Electron-initiated shower in calorimeter is much more compact (dense) than most of hadron-initiated events. Remove events which have scattered hit crystals at some distance from shower axis (CalTransRms, CalLongRms, CalNCalRatio)
Selection Group 3 (panel 6). Hadron-initiated events have larger number of backward moving charged particles which create excessive hits in the ACD — remove events with large energy deposition in ACD tiles (AcdTotalEnergy)
Selection Group 4 (panel 5). Use asymmetry of the shower shape in calorimeter — most hadron-initiated events have larger asymmetry (CalRmsAsym)
Selection Group 5 (panels 4 and 7). Select events which interact in the tracker — very powerful cut to separate electrons from hadrons, but of course it also removes many electrons (Tk1ToTrAve, Tk1CoreRd)
Selection Group 6. Select events with the path in the calorimeter to be longer than 8 $\lambda$ to improve energy resolution

Efficiency of electron cuts

$\frac{E_{\text{recon}}}{E_{\text{inc}}} \times 100$ %

<table>
<thead>
<tr>
<th>Selection</th>
<th>e passed selection</th>
<th>All other species passed selection</th>
<th>Residual proton contamination line in $E_{\text{recon}}$ and $E_{\text{inc}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 GeV &gt; McEnergy &gt; 500 GeV</td>
<td>0.90</td>
<td>0.85</td>
<td>0.72</td>
</tr>
<tr>
<td>10 GeV &gt; CTBBestEnergy &gt; 500 GeV</td>
<td>0.74</td>
<td>0.65</td>
<td>0.51</td>
</tr>
<tr>
<td>CalTransRms/CalLongRms &gt; 1.30</td>
<td>0.60</td>
<td>0.51</td>
<td>0.41</td>
</tr>
<tr>
<td>AcdTotalEnergy &gt; 30</td>
<td>0.65</td>
<td>0.59</td>
<td>0.49</td>
</tr>
<tr>
<td>CalRmsAsym &gt; 0.25</td>
<td>0.63</td>
<td>0.59</td>
<td>0.35</td>
</tr>
<tr>
<td>CalRmsAsym &lt; 0.45</td>
<td>0.52</td>
<td>0.67</td>
<td>0.32</td>
</tr>
<tr>
<td>Tk1ToTrAve &gt; 2</td>
<td>0.36</td>
<td>0.60</td>
<td>0.29</td>
</tr>
<tr>
<td>Tk1CoreRd &lt; 10</td>
<td>0.30</td>
<td>0.60</td>
<td>0.28</td>
</tr>
</tbody>
</table>

Who survived the cuts:

Expected number of detected electrons for 1 year of observation (with our current cuts):

- $> 20$ GeV $\approx 10^7$
- $> 100$ GeV $\approx 4 \times 10^6$
- $> 500$ GeV $\approx 2,500$

Summary

- Electron spectrum can be well reconstructed up to 1 TeV with 1 year data
- Nearest future work:
  - Start using Classification tree technique to improve electron cuts and G(E)
  - Develop the energy reconstruction technique for high energy events ($> 700$ GeV)

Simulated results for collecting power: it is tuned well for 100-200 GeV: need work on electron cuts to improve for high energy

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