### TPC status and first results

#### 13th CAST Collaboration Meeting
CERN 23.11.2002

#### Data taking calendar

<table>
<thead>
<tr>
<th>L</th>
<th>M</th>
<th>X</th>
<th>J</th>
<th>V</th>
<th>S</th>
<th>D</th>
<th>L</th>
<th>M</th>
<th>X</th>
<th>J</th>
<th>V</th>
<th>S</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>Sep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nov</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Nov</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
</tr>
</tbody>
</table>

- **Background runs with magnet current OFF**
- **Background runs with magnet current ON**
- **Solar data runs (magnet ON & tracking)**
  - 23 hours effective exposure (~30% potential tracking time since Oct 8th)

---

Igor G. Irastorza

13th CAST Meeting - CERN 23.11.2002
Background data

Total background statistics accumulated so far: 28.5 effective days.
- About 8 of them with the magnet OFF
- Magnet mostly in “parking position”, i.e., horizontal and close to TPC measurement position
- Fe$^{55}$ Calibrations taken regularly, but not enough to precisely monitor gain fluctuations.

Averaged background level (conservative cuts) $\sim 1 \times 10^{-4}$ c/cm$^2$/s/keV but there are strong variations...
Background data

Evolution of background with time.

• Events after cuts
• Rate in fixed ADC range (roughly 3-7 keV) far from threshold and saturation limits

→ Physical background (no noise)

15 OCT | 22 OCT | 25 OCT

Igor G. Irastorza

13th CAST Meeting - CERN 23.11.2002
Background data

![Graphs showing data evolution over time]

Days indicated:
- 5 NOV
- 14 NOV
- 18 NOV
- 23 NOV
Background data

Data set 10 (last week) → Background very unstable

Peak while µM data taking

Sudden changes...
P/T changes?

In general...
• No clear correlation with magnet on/off
• Variations probably dominated by gain changes due to P and T changes. (though not clear correlation with periodic gain calibrations neither)
  • Need monitoring P & T of chamber gas!
• No clear correlation with magnet position but work still in progress, and more data needed with monitoring of magnet coordinates.

• Probably a mixed dependence of all of the above.
  • Need full record of SC parameters to disentangle every dependence (and correct for it if possible...)
Sun tracking data

• 23 hours of solar tracking data gathered so far
• Acquisitions not homogeneously distributed in time. Most of the data have been taken the last two weeks (data sets 9 and 10).

• Total spectrum:
Subtracted spectrum

Straightforward analysis with ALL data (excluding only set #10) gives positive excess...

Effect not meaningful until background instabilities better understood (and eventually corrected).
Using only data set #9:
- 4.7 hours of Sun tracking data
- 58 hours of background with reasonable stability

Already goes beyond Tokyo result

\( g \approx 1.5 \times 10^{-10} \text{ GeV}^{-1} \)
(1\~2\sigma limit)

Preliminary!
- Integral rate used only (more statistical refinements using spectral information could give better result)
- Conservative cuts
- No efficiency correction (small change)
Conclusions and what to be done next…

- The TPC has reached an almost continuous operational status with robust performance.
- 23 hours of Sun-tracking data taken so far.
- 28.5 effective days of background data in different conditions.
- Analysis software in advanced stage.
- First preliminary axion limit presented, obtained with a stable subset of data.
- Physical background presents complex variations that are not yet well understood. The possible dependencies are being studied, but for this (and for their eventual correction) we need to take...

**Very important steps for the next weeks…**

- **Precise monitoring** of P and T of the chamber gas:
  - It will allow to correct gain variations event by event.
  - Install pressure transducer (and thermocouples) and include in slow control system.
  - Determine if P & T precision is enough(?)

- **Final version** of tracking program (with full record of SC parameters and magnet position) working **all the time!!** Even during background runs.
  - It will allow us to systematically study background dependences with every kind of parameters.

- **SHIELDING.** It will reduce many possible causes of background variation (apart from the background itself):
  - Noise: the shielding will act as a very good Faraday cage
  - Visible light.
  - Temperature & Pressure.
  - Of course, radioactivity, specially radon fluctuations in the air.