

A new detection set-up to search the X17 boson

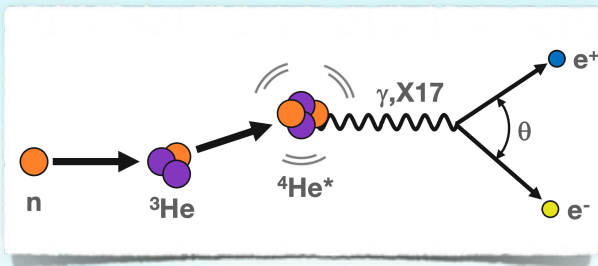
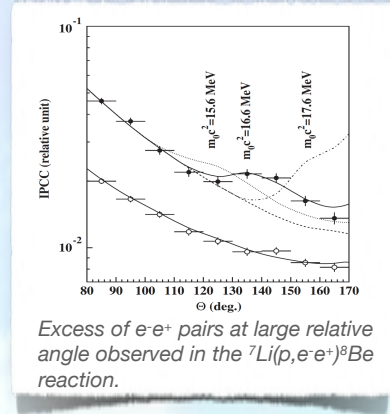
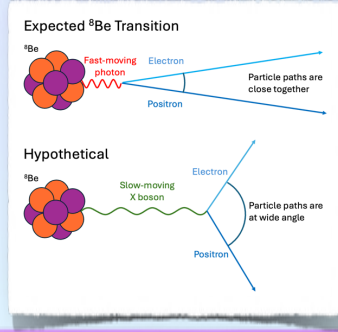
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The X17 anomaly

Three significant anomalies have been observed in the in the ${}^3\text{H}(p, e^- e^+) {}^4\text{He}$, ${}^7\text{Li}(p, e^- e^+) {}^8\text{Be}$, ${}^{11}\text{B}(p, e^- e^+) {}^{12}\text{C}$ nuclear reactions. These anomalies consist in an excess of electron-positron pairs emitted at large relative angle. This excess have been interpreted as the signature of a new particle with mass of about 17 MeV, called **X17 boson**.

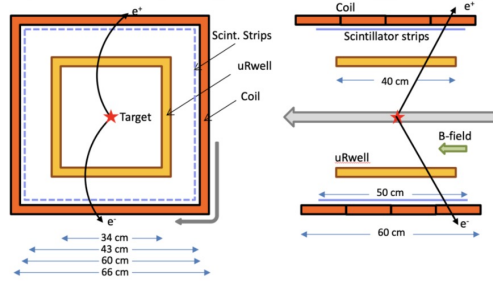


Hunting the X17 boson at the n_TOF neutron facility

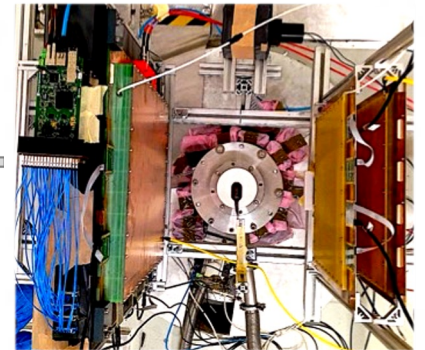
- Study of the ${}^7\text{Li}(p, e^- e^+) {}^8\text{Be}$ reaction \rightarrow X17 search.
- Study of the ${}^3\text{He}(n, e^- e^+) {}^4\text{He}$ reaction in a wide energy at the n_TOF facility, using a custom target of ${}^3\text{He}$ at 380 bar \rightarrow determination of X17 quantic numbers J^π .
- Study of the ${}^2\text{H}(p, e^- e^+) {}^3\text{He}$ and ${}^2\text{H}(n, e^- e^+) {}^3\text{H}$ "specular" reactions \rightarrow probing the protophobic coupling.

Detector requirements

- Large angular acceptance
 - Reconstruction of $e^- e^+$ kinematics
 - Low sensitivity to photons and neutrons
- ↓
- 4 large μTPC with $380 \times 460 \times 30 \text{ mm}^3$ active volume \rightarrow 3D tracking
 - 4 planes composed by 32 scintillator bars $3 \times 12 \times 500 \text{ mm}^3 \rightarrow$ trigger
 - 1 coil (B = 500 Gauss) \rightarrow momentum reconstruction

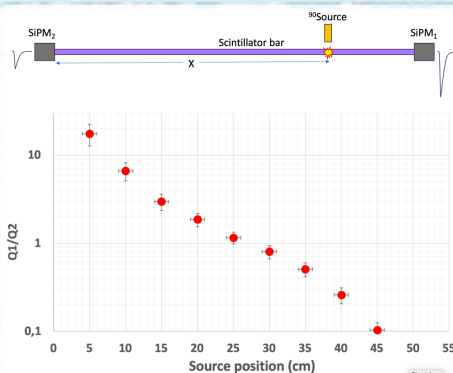


Sketch of the X17 detector setup.

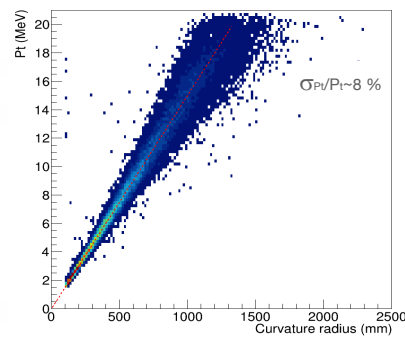


The X17 demonstrator at n_TOF.

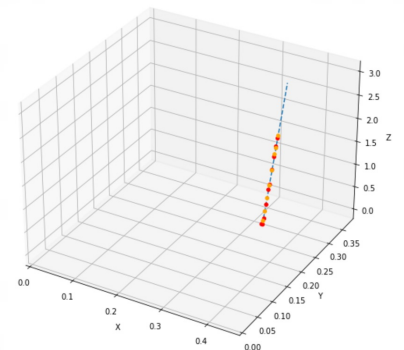
Analysis & Results



Amplitude ratio between the pulses at the ends of a scintillator bar coupled with the S13363-3050NE-16 SiPM array.



Simulation of the transverse momentum reconstruction from the curvature radius of electron/positron tracks produced in the ${}^3\text{He}(n, e^- e^+) {}^4\text{He}$ reaction at $E_p = 0.380 \text{ MeV}$.



Example of an electron track reconstructed with the large μRwell operated in μTPC mode. The electron is produced by the ${}^7\text{Li}(p, e^- e^+) {}^8\text{Be}$ reaction at $E_p = 0.450 \text{ MeV}$.