

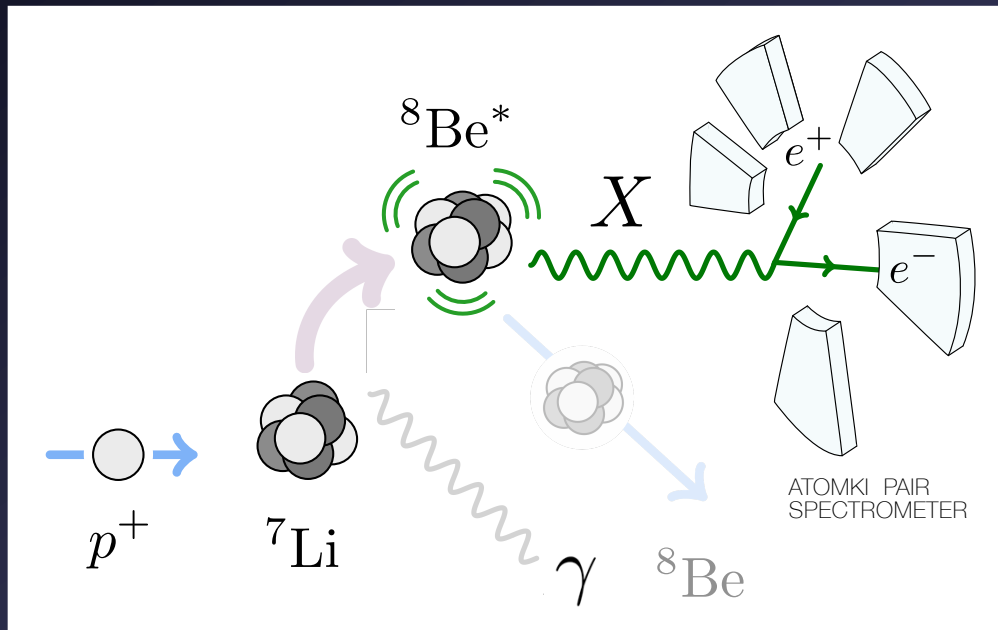


# Evidence for a Protophobic Fifth Force from $^8\text{Be}$ Nuclear Transitions

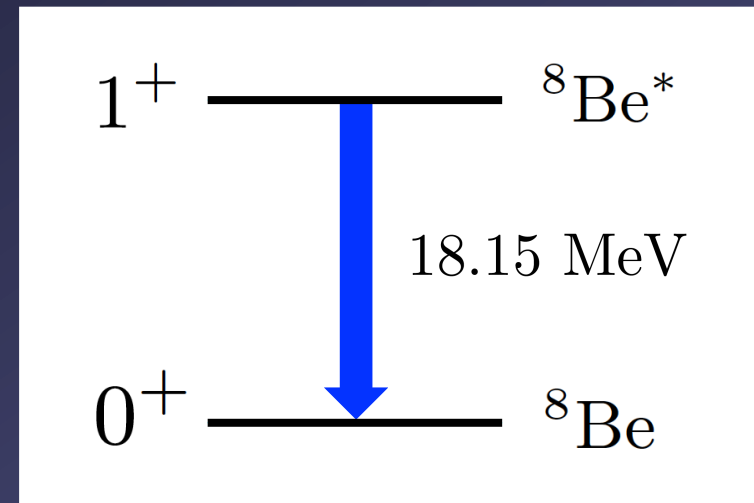
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## Experimental design

(Krasznahorkay et al., PRL 116 (2016) 042501)



## $^8\text{Be}$ electromagnetic transition

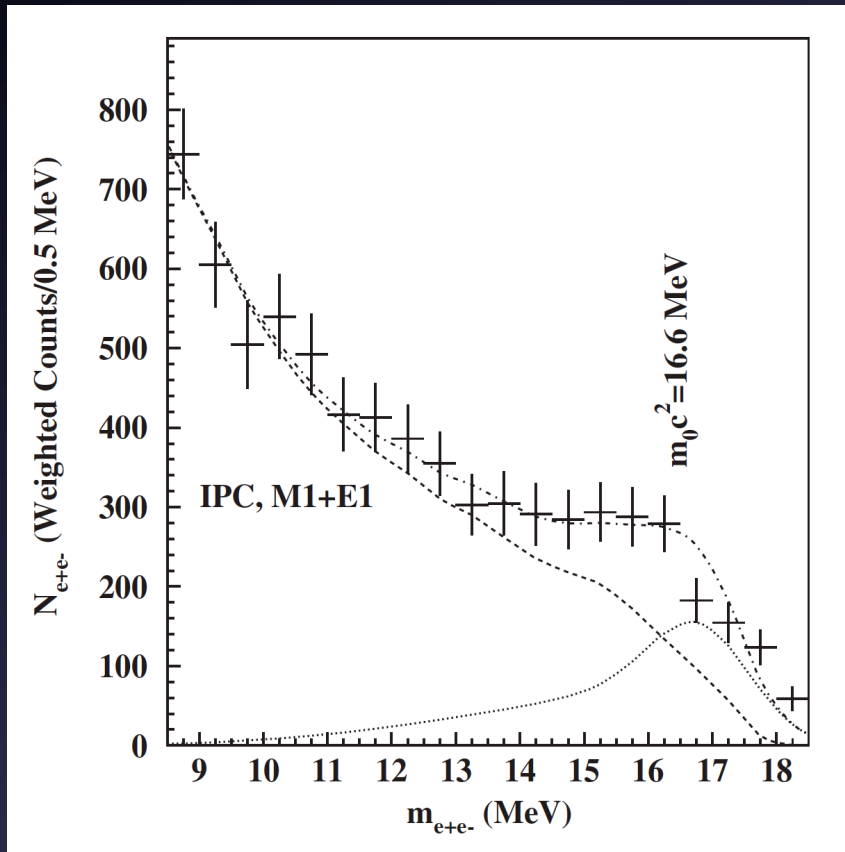


$$Br(^8\text{Be}^* \rightarrow ^8\text{Be} \gamma) \approx 1.4 \times 10^{-5}$$

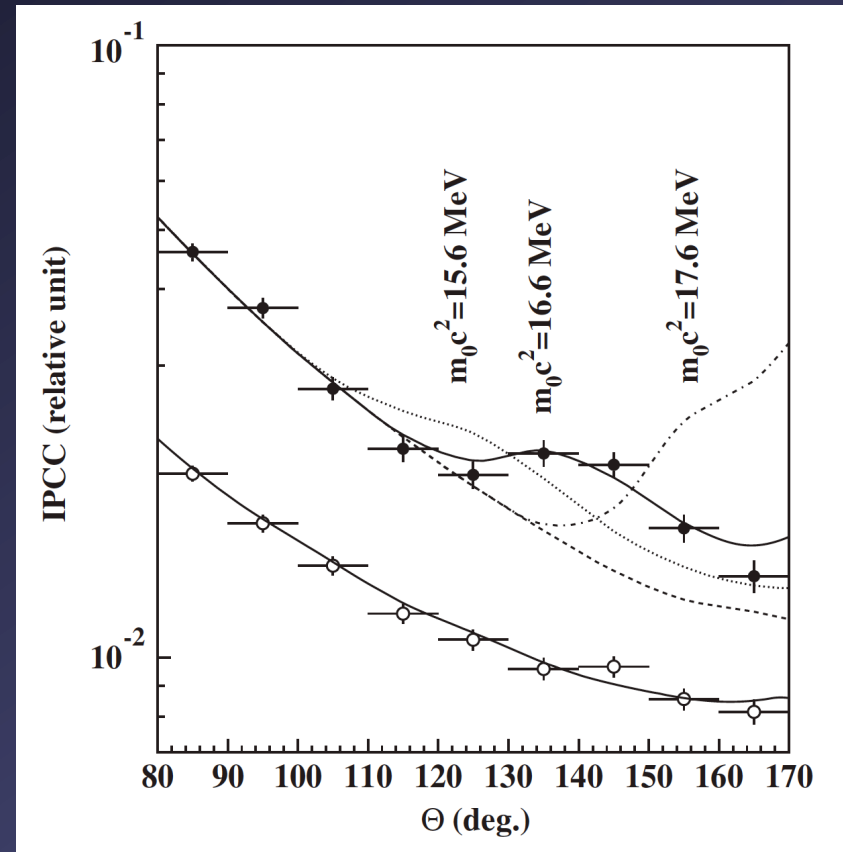
$$Br(^8\text{Be}^* \rightarrow ^8\text{Be} e^+e^-) \approx 5.5 \times 10^{-8}$$

# Evidence for a Protophobic Fifth Force from $^8\text{Be}$ Nuclear Transitions

Invariant mass distribution of  $e^+e^-$



Angular correlation of  $e^+e^-$  pairs



Krasznahorkay et al., PRL 116 (2016) 042501

**→  $m_x \approx 17$  MeV**

# Evidence for a Protophobic Fifth Force from $^8\text{Be}$ Nuclear Transitions

Feng et al., arXiv:1604.07411 [hep-ph]

- ➔ dark photon ❌
- ➔ scalar ❌
- ➔ axion ❌
- ➔ protophobic gauge boson ✓

$$\mathcal{L} \supset -X^\mu \sum_f e \varepsilon_f \bar{f} \gamma_\mu f$$

$$\begin{aligned} \varepsilon_u &= -\frac{1}{3} \varepsilon_n \approx \pm 3.7 \times 10^{-3} \\ \varepsilon_d &= \frac{2}{3} \varepsilon_n \approx \mp 7.4 \times 10^{-3} \\ 2 \times 10^{-4} &\lesssim |\varepsilon_e| \lesssim 1.4 \times 10^{-3} \\ |\varepsilon_\nu \varepsilon_e|^{1/2} &\lesssim 7 \times 10^{-5} \end{aligned}$$

Future discovery prospects

