Determination of positron magic energies

Sami Habet

IJCLab.

Jefferson Laboratory.

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Plan

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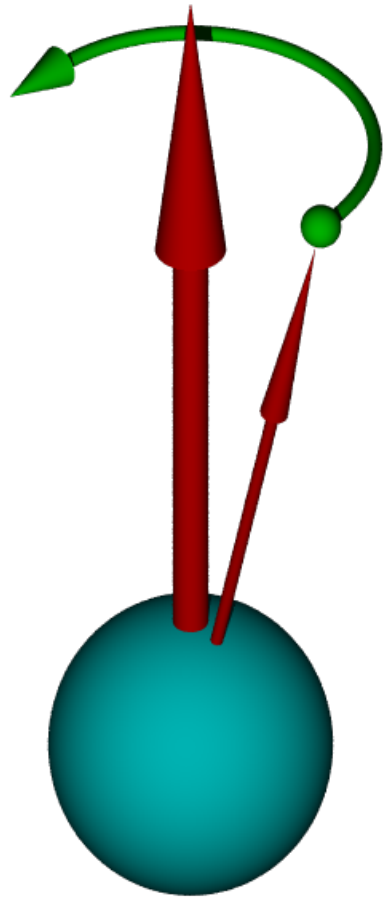
Spin precession

- **precessional angular velocity**: $\omega = \frac{eg}{2m}$
- **Positron case** : For
  $E_{e^+} = 6\,GeV$
  $B = 0.45$ T $\Downarrow$

$$\omega_{e^+} = 1.76 \times 10^{11} \frac{rad}{s}$$



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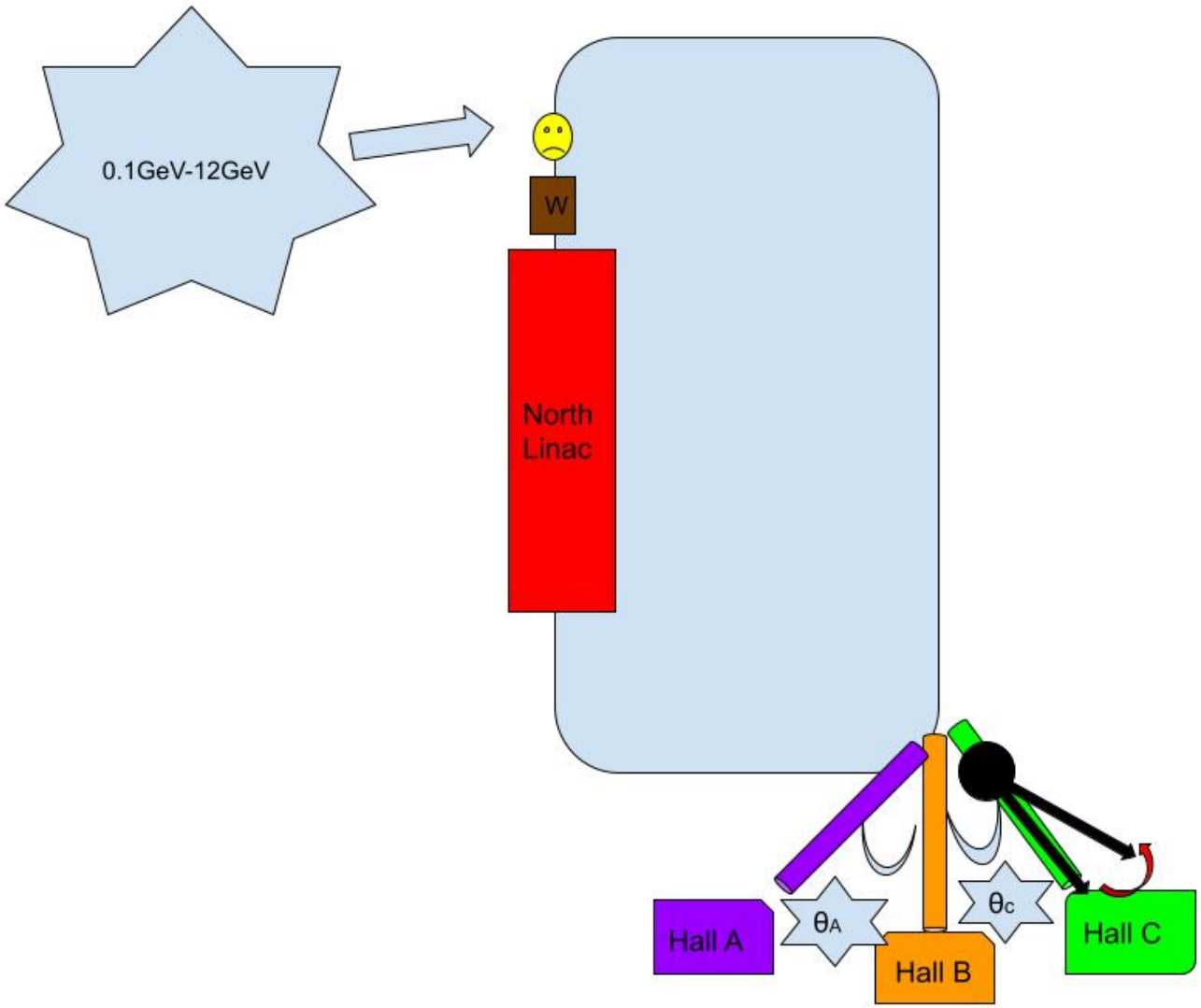
Case 1 : Positron production after the north linac



Case 1 : Positron production after the north linac

- **Positron energy formula at Hall A, B, C.**
  - **Hall A**

$$precession_{Hall_A} = \frac{g-2}{2m} \times [E_{e^+} \times \pi + E_{e^+} \times \theta_A]$$

  - **Hall B**

$$precession_{Hall_B} = \frac{g-2}{2m} \times [E_{e^+} \times \pi + E_{e^+} \times \theta_B]$$

  - **Hall C**

$$precession_{Hall_C} = \frac{g-2}{2m} \times [E_{e^+} \times \pi + E_{e^+} \times \theta_C]$$

- $\theta_A = -\theta_b = \frac{\pi}{4.8}$
- $\theta_B = 0$

Case 1 : Positron production after the north linac

- **Positron energy formula at Hall A, B, C.**
  - **Hall A**

$$precession_{Hall_A} = \frac{g-2}{2m} \times [E_{e^+} \times \pi + E_{e^+} \times \theta_A] = N \times \pi$$

  - **Hall B**

$$precession_{Hall_B} = \frac{g-2}{2m} \times [E_{e^+} \times \pi + E_{e^+} \times \theta_B] = N \times \pi$$

  - **Hall C**

$$precession_{Hall_C} = \frac{g-2}{2m} \times [E_{e^+} \times \pi + E_{e^+} \times \theta_C] = N \times \pi$$

- $\theta_A = -\theta_b = \frac{\pi}{4.8}$
- $\theta_B = 0$

Case 1 : Positron production after the north linac

- **Positron Magic energies at Hall A, B, C.**
  - **Hall A**

$$E_{e^+} = \frac{N \times \pi}{\frac{g-2}{2m}} \times \frac{1}{\pi + \theta_A}$$

  - **Hall B**

$$E_{e^+} = \frac{N \times \pi}{\frac{g-2}{2m}} \times \frac{1}{\pi + \theta_B} = \frac{N}{\frac{g-2}{2m}}$$

  - **Hall C**

$$E_{e^+} = \frac{N \times \pi}{\frac{g-2}{2m}} \times \frac{1}{\pi + \theta_C}$$

- $\theta_A = -\theta_b = \frac{\pi}{4.8}$
- $\theta_B = 0$

Case 1 : Longitudinally polarized positrons at Hall A, C in the same time

- **Hall A and C**

$$E^{A}_{e^+} - E^{C}_{e^+}$$

$$\left[\frac{N_A \times \pi}{\frac{g-2}{2m}} \times \frac{1}{\pi + \theta_A}\right] - \left[\frac{N_C \times \pi}{\frac{g-2}{2m}} \times \frac{1}{\pi + \theta_C}\right]$$

$$E_{e^+} = \frac{N_A - N_c}{2\theta_A} \times \frac{2m\pi}{g-2}$$

- $\theta_A = -\theta_b = \frac{\pi}{4.8}$
- $\theta_B = 0$

Case 1 : Positron Magic energies

Hall A [MeV]	Hall B [MeV]	Hall C [MeV]	hall A and c [MeV]	Hall A and B [MeV]	Hall C and B [MeV]
556.61	862.33	364.68	2069.59	862.33	862.33
1113.22	1724.66	729.35	4139.18	1724.66	1724.66
1669.83	2586.99	1094.03	6208.77	2586.99	2586.99
2226.44	3449.32	1458.7	8278.36	3449.32	3449.32
2783.05	4311.65	1823.38		4311.65	4311.65
3339.66	5173.97	2188.06		5173.97	5173.97
3896.28	6036.3	2552.73		6036.3	6036.3
4452.89	6898.63	2917.41		6898.63	6898.63
5009.5	7760.96	3282.08		7760.96	7760.96
5566.11	8623.29	3646.76		8623.29	8623.29
6122.72	9485.62	4011.44		9485.62	9485.62
6679.33		4376.11			
7235.94		4740.79			
7792.55		5105.46			
8349.16		5470.14			
8905.77		5834.82			
9462.38		6199.49			
		6564.17			
		6928.84			
		7293.52			
		7658.2			
		8022.87			
		8387.55			
		8752.22			
		9116.9			
		9481.58			
		9846.25			

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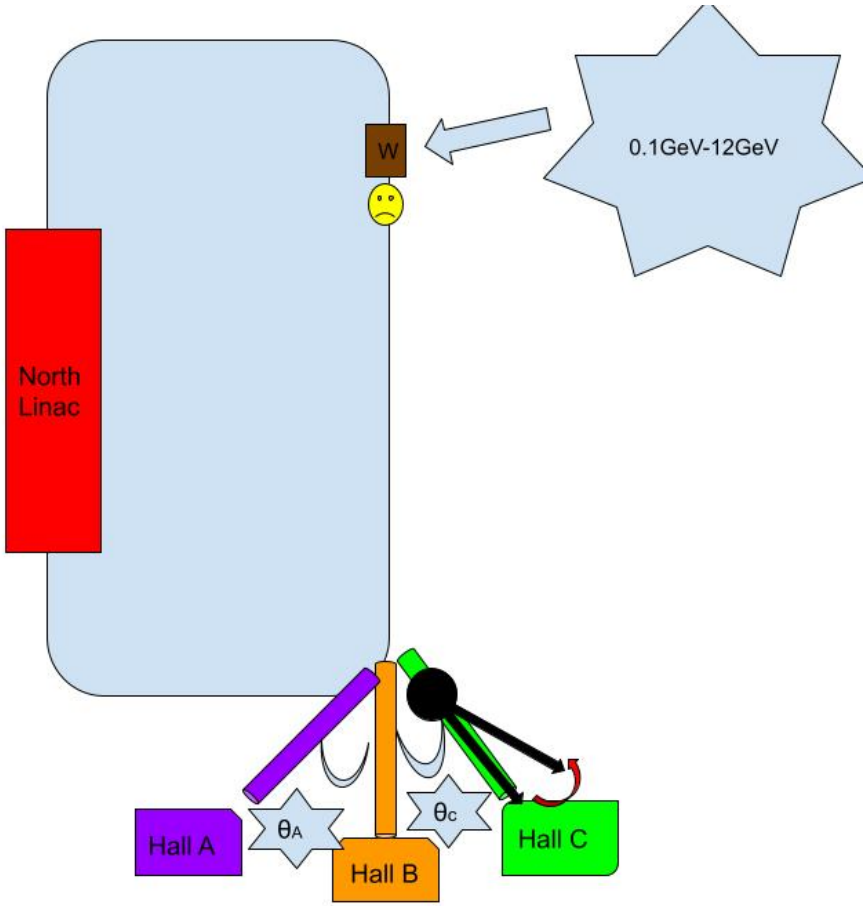
Case 2 : Positron production before the entrance of the south linac



- **Hall A**

$$E_{e^+} = \frac{N\pi}{\theta_A} \times \frac{2m}{g-2}$$

- **Hall B**
  E_{e^+}=All energies are magic
- **Hall C**

$$E_{e^+} = \frac{N\pi}{\theta_C} \times \frac{2m}{g-2}$$

Case 2 : Halls combinations

- **Hall A & C**

$$E^A_{e^+} - E^B_{e^+} = \frac{M\pi}{2\theta_A} \times \frac{2m}{g-2}$$

- **Hall A & B** $=$

$$E^A_{e^+} - E^B_{e^+} = \frac{N\pi}{2\theta_A} \times \frac{2m}{g-2}$$

- $M = N_A - N_C$

Case 2 : Results

Hall A [MeV]	Hall C [MeV]	hall A and c [MeV]	Hall A and B [MeV]	Hall C and B [MeV]
8460.48	2115.12	2069.59	4139.18	8278.36
6345.36	4230.24	4139.18	8278.36	4139.18
4230.24	6345.36	6208.77		
2115.12	8460.48	8278.36		

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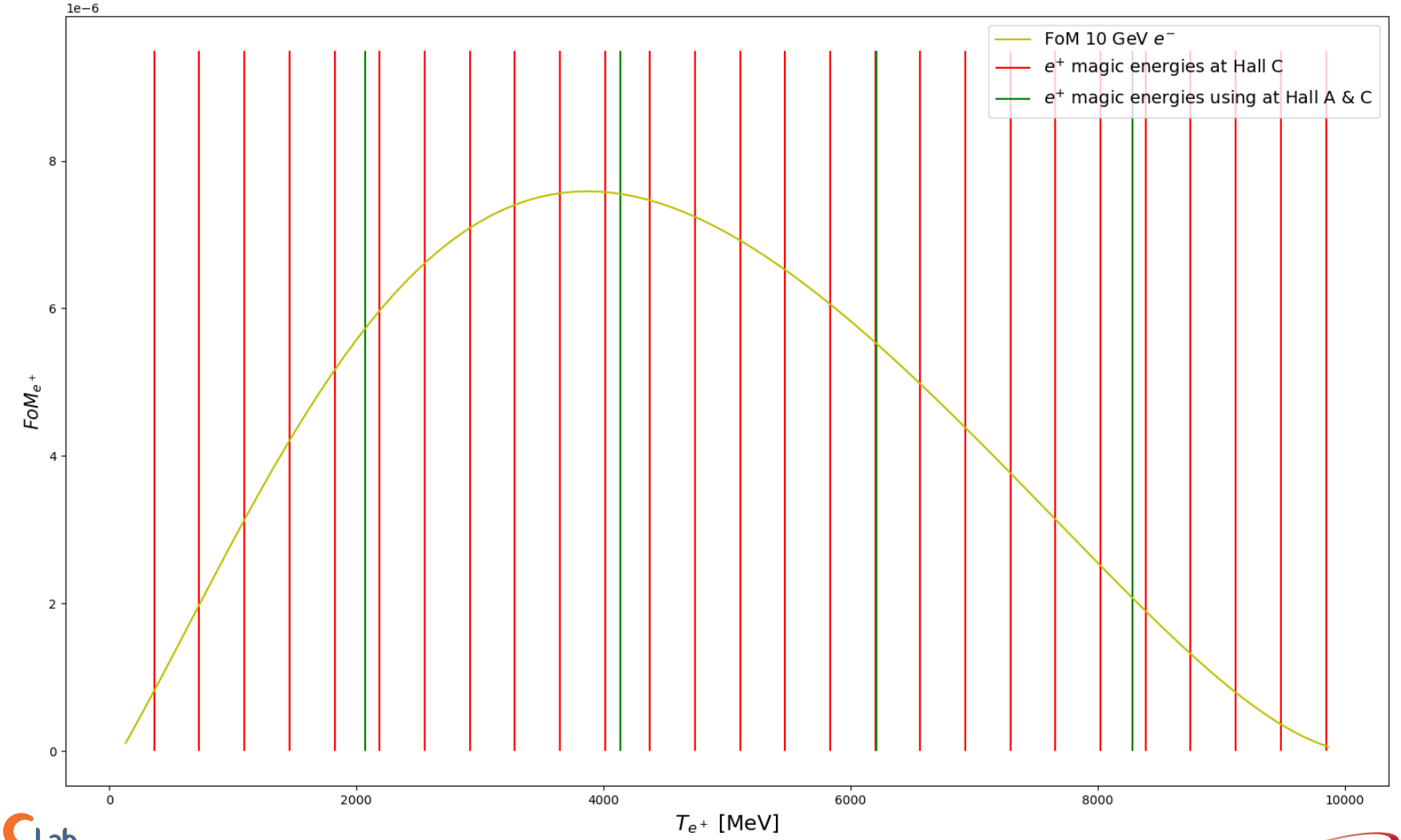
Example : case 1



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Conclusion

- Only specific positrons energies for a longitudinal polarisation.
- More constraint for multiple halls.
- Positron energies depends on the production location exept for Hall A and C.