

# Mainz and Olympus Simulations



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# Corroborating TDR Rates:

- Mainz Generator: signal, irreducible QED, (we hope!) single positrons
- Olympus Generator: single electrons
- After a bunch of fine-tuning and learning (on my part!) how the Mainz generator selects for particles, we **mostly** have been able to confirm TDR rates
  - Except positrons!
- Our code is mostly working!

Setup	Signal	Irreducible QED (SIM)	Irreducible QED (TDR)	Singles e+ (SIM)	Singles e+ (TDR)	Singles e- (SIM)	Singles e- (TDR)
13@30, e39p20	3.703 mHz	6.57 Hz		24.96 kHz		1.975 MHz	
13@31, e34p20	4.852 mHz	8.97 Hz	9.1 Hz	30.85 kHz	30.2 kHz	3.231 MHz	3.6 MHz
13@32, e30p22	8.487 mHz	13.13 Hz		7.97 kHz		4.656 MHz	
17@31, e48p27	0.391 mHz	2.37 Hz	0.83 Hz	1.29 kHz	18.2 kHz	0.862 MHz	.751 MHz
17@45, e30p19	4.18 mHz	6.72 Hz	11.2 Hz	8.22 kHz	32.3 kHz	2.695 MHz	2 MHz
17@50, e26p17	8.694 mHz	13.44 Hz		10.24 kHz		3.866 MHz	

# Positron “NOE” rate discrepancies:

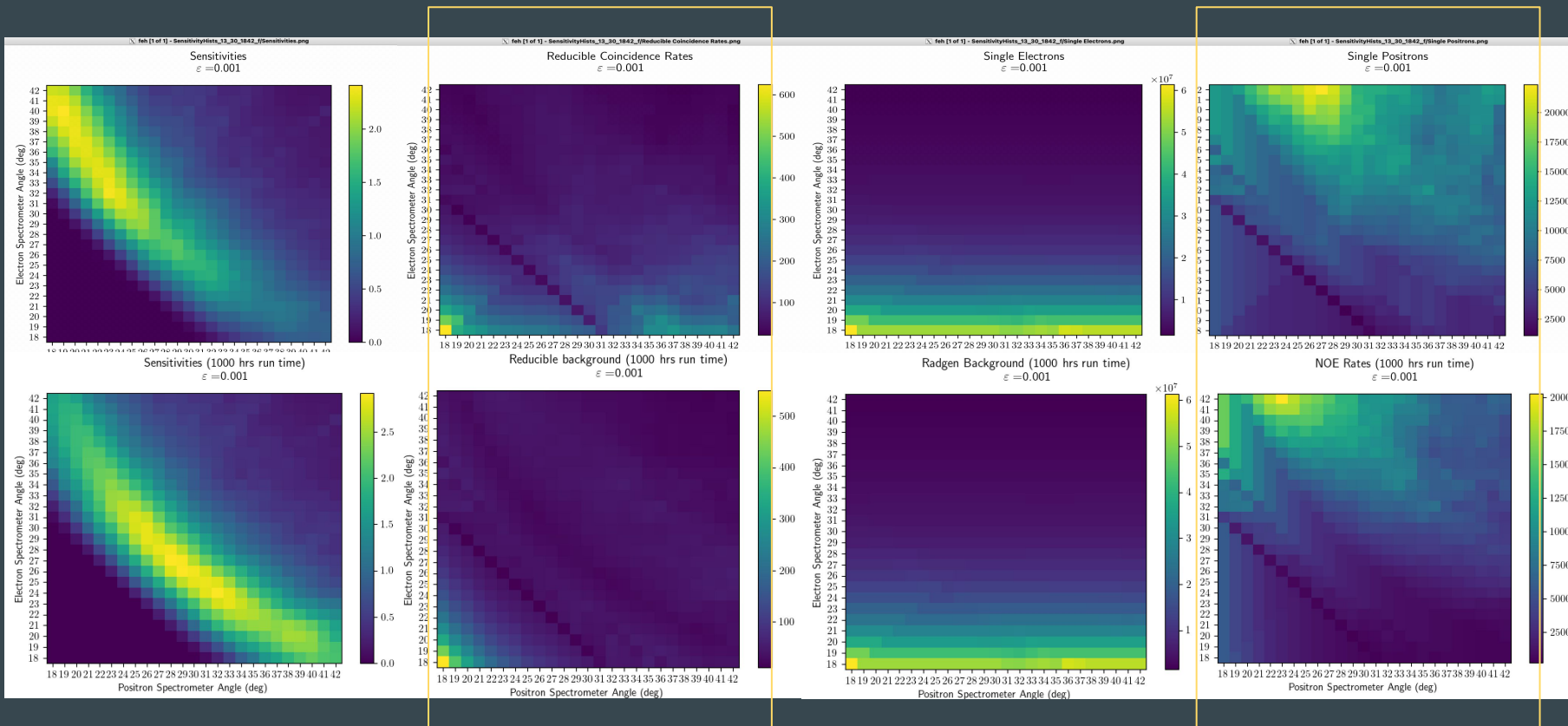
- suboptimal phase space / single-particle acceptance not maximized
- misapplication of Mainz QED source code
  - unclear which generated particle defines an intermediate reference frame

```
double thetaD = e2out.Lorentz(-q_out).rotate(q_out).theta();
double phiD   = e2out.Lorentz(-q_out).rotate(q_out).phi();
// 0 for muon - not currently being changed
double weight = QEDBackground(e_in,e_out,q_out,m,thetaD,phiD, 0, ((struct args*)input)->trident, ((struct args*)input)->asymm)*Solidangle;
```

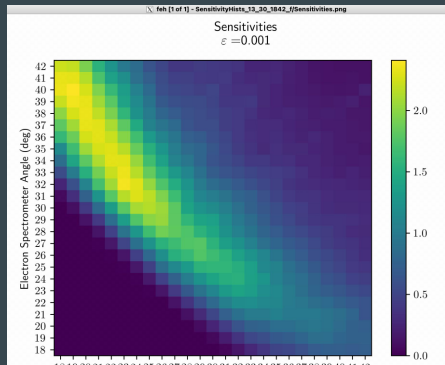
```
double thetaD = e1out.Lorentz(-q_out).rotate(q_out).theta();
double phiD   = e1out.Lorentz(-q_out).rotate(q_out).phi();
// 0 for muon - not currently being changed
double weight = QEDBackground(e_in,e_out,q_out,m,thetaD,phiD, 0, ((struct args*)input)->trident, ((struct args*)input)->asymm)*Solidangle;
```

- we “swapped”  $e_2 \rightarrow e_1$  (but maybe we shouldn’t have?)

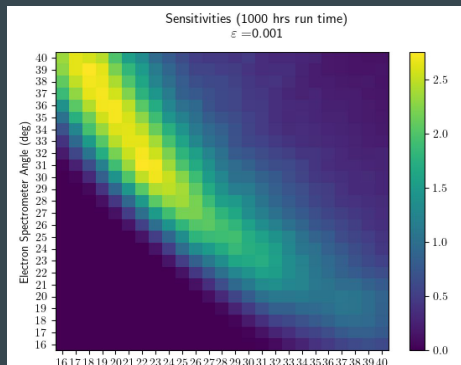
# Pre-swap (top) v. post-swap (bottom) event rates: (13@30)



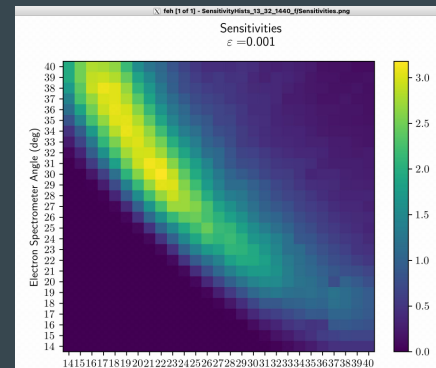
# Sensitivities using original Mainz source code:



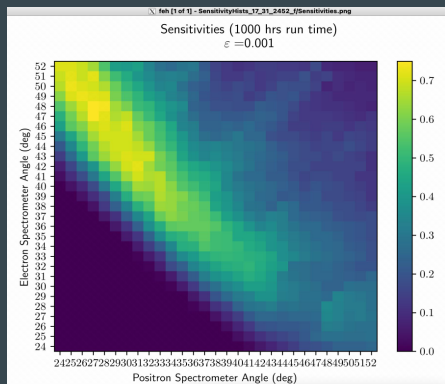
13@30



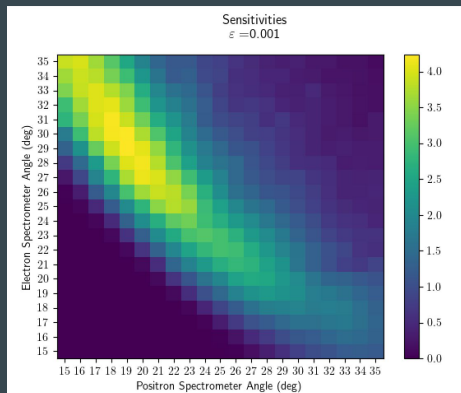
13@31



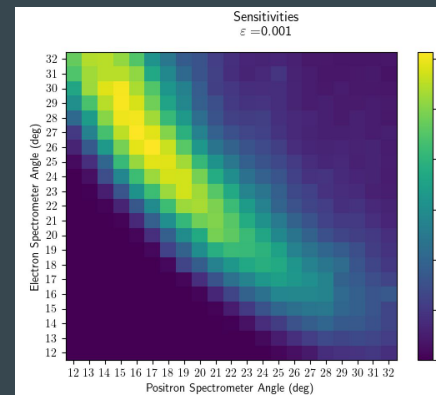
13@32



17@31

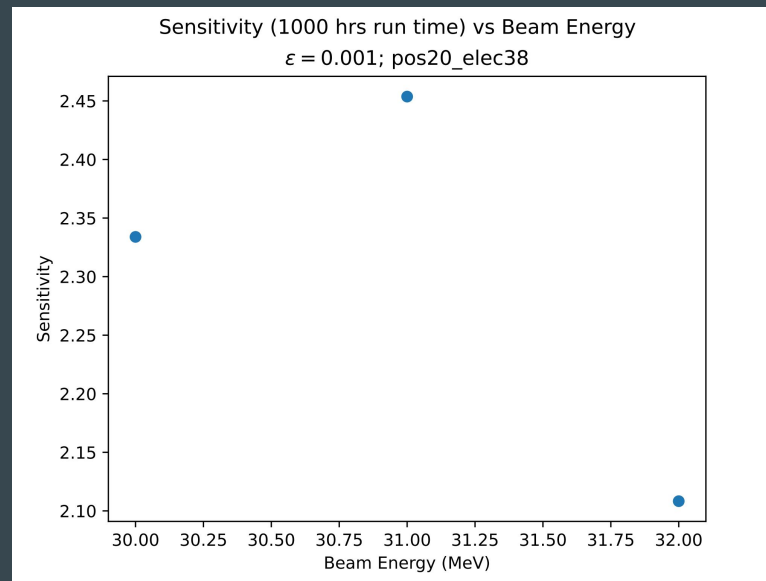
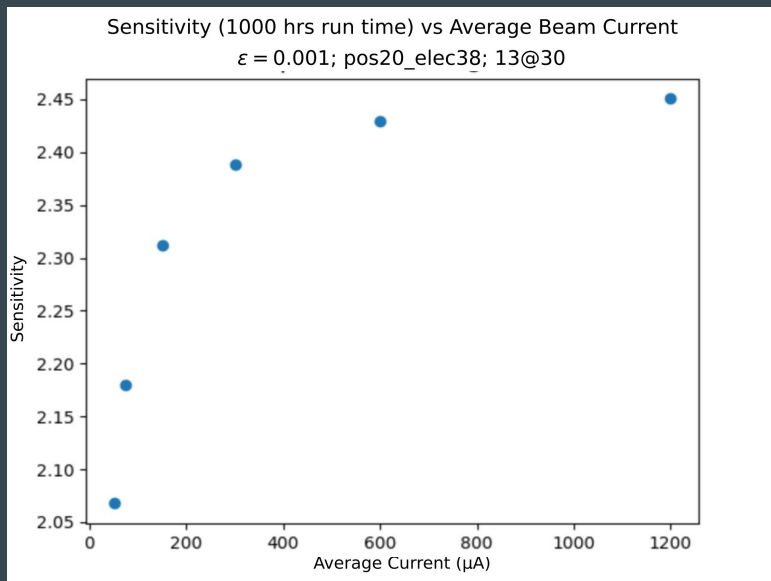


17@45



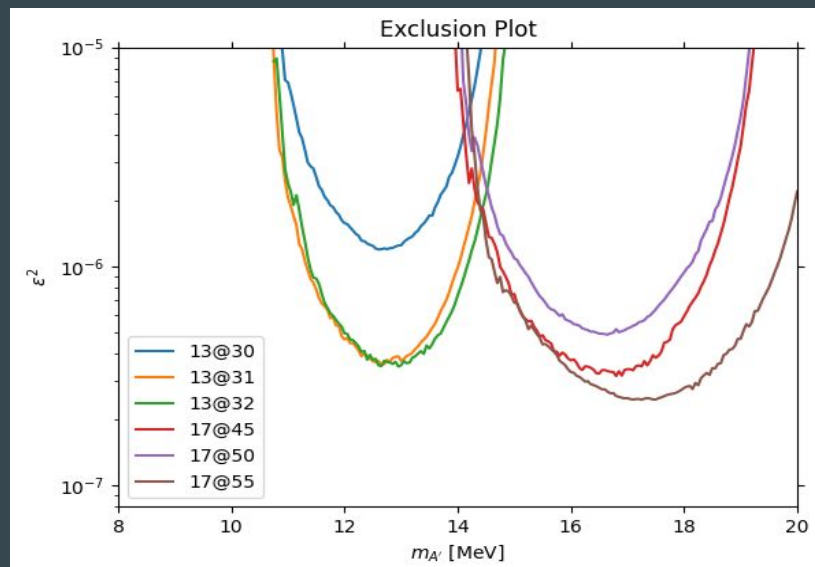
17@50

# Current and beam strength dependences:



# Exclusions:

- Existing code fine-tuned
- Confirmation pending accurate positron rates
- In process of analyzing as a function of spectrometer acceptances



# Checklist:

- Confirm Mainz cross section routine & determine correct particle
- Validate positron rates
- Incorporate functionality to finetune spectrometer acceptances according to the proposed magnet design → finalize Sensitivities & Exclusions