Accidental vs. true event rates

- R_e = time average singles rate in electron detector
- R_p = time average singles rate in proton detector
- R_{ep} = time average electron-proton coincidence rate
- τ = coincidence timing
- df = duty factor = fraction of time the current is really there
  = pulse width ÷ time between pulses
- Rate of accidental events A = $(R_e/df)\bullet(R_p/df)\bullet\tau$
- Rate of true events T = (R_{ep}/df)
- A/T = $(Re \bullet Rp/R_{ep})\bullet(\tau/df)$
- A/T increases inversely as df – low df makes it harder
- A/T increases with R_e and R_p – watch backgrounds!
- A/T decreases with R_{ep} – pick kinematics to maximize and watch deadtime!
- A/T decreases with better timing resolution – watch timing!
- A/T ≈ (luminosity) so lower luminosity (i.e. beam current) helps!

OLYMPUS Rates for R_{ep}

- 3.6 fb^{-1} integrated luminosity
- 500 hours at 0.3 sccm and 100 mA

θ_e deg.	$p_{e'}$ GeV/c	θ_p deg.	p_p GeV/c	Q^2 $(GeV/c)^2$	ε	Counts
24	1.69	57.0	0.82	0.58	0.905	26.5 million
32	1.51	47.8	1.08	0.92	0.828	4.8 million
40	1.33	40.7	1.31	1.26	0.735	1.2 million
48	1.17	35.4	1.50	1.56	0.636	0.4 million
56	1.03	31.0	1.66	1.82	0.538	168 k
64	0.91	27.2	1.79	2.0	0.449	80 k
72	0.81	23.8	1.91	2.23	0.367	43 k

Maximum R_{ep}:

In 24 deg. forward bin R_{ep} = 15 Hz at design luminosity and 0% deadtime

OLYMPUS

- Duty factor = fraction of time the current is really there
  = pulse width ÷ time between pulses
  = 80 ps ÷ 100 ns
  = 8×10^{-4}

  cf. BLAST ≈100%, NE-18 2×10^{-4}, HERMES 3×10^{-4}
- Coincidence time τ should be at least 2 ns for well timed detector system
- If we look for coincidence between electrons (1.69 GeV) at 24 deg. and protons (0.82 GeV) at 57 deg. then R_{ep} =15 Hz
- In this case:

$$A/T = (Re \bullet Rp)(2 \times 10^{-9}/8 \times 10^{-4}/15)$$
$$= (Re \bullet Rp)\ 1.6 \times 10^{-7}$$

- For A/T =1, then $(Re \bullet Rp) = 6 \times 10^{6}\ (Hz)^2$
- Note that recoil proton is about 5 ns slower in time than forward electron. This should help greatly in identifying elastic coincident events.
- Note that elastic events are coplanar. This should also help greatly in identifying elastic coincident events.

Strategy to see elastic events

- TOFs must be efficient and well timed in
- Run with tight trigger aimed at detecting forward electron at 24 deg. in coincidence with 57 deg. proton
- R_e, R_p, i.e. the singles rates in TOFs, must be minimized
  => careful background minimization using scrapers and beam tuning
- Need to get Re•Rp ≈ 10^7 $(Hz)^2$ to see elastic peak in timing spectrum
- Run with approx. 0.5 sccm and 50 mA
- Run with low (of order 10%) deadtime
- Take data for 30 minutes, i.e. acquire about 25 k elastic coincident events.
- Analyse using timing and coplanarity cuts
- Lower beam current to enhance T/A
- Once tracking in wire chambers is available, the requirement of a charged particle originating from the target will enormously reduce R_e and R_p and thus enormously increase T/A