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Four-fold coincidence logic for photon counting with universal control DAVID BRANNING, SARTHAK KHANAL, YOUNG HO SHIN, Trinity College, MARK BECK, Whitman College — Photon coincidence counting is a central technique in the field of quantum optics. We have built and tested a new coincidence-counting circuit that is faster, cheaper to assemble, and more portable than the commonly-used time-to-amplitude-conversion method. The circuit takes up to four TTL inputs (typically from avalanche photodiode photon-counting modules) and counts either 2-, 3-, or 4-fold coincidences between them within a user-selected coincidence time window as short as 10 ns. Up to eight user-defined coincidence combinations can be assigned to different TTL outputs, which may be monitored externally. Each of these outputs also increments a corresponding onboard 16-bit counter, whose value may be delivered to a computer over a USB interface at up to 400 Hz. Data acquisition is controlled via custom LabVIEW software. The circuit can accurately perform coincidence counting on Poisson-distributed inputs with mean rates of up to 24 MHz, with no dead-time effects. Because of its small size, low cost, and high bandwidth, this new circuit will find applications in quantum optics research at all levels, but it will be particularly beneficial to undergraduate teaching laboratories.

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