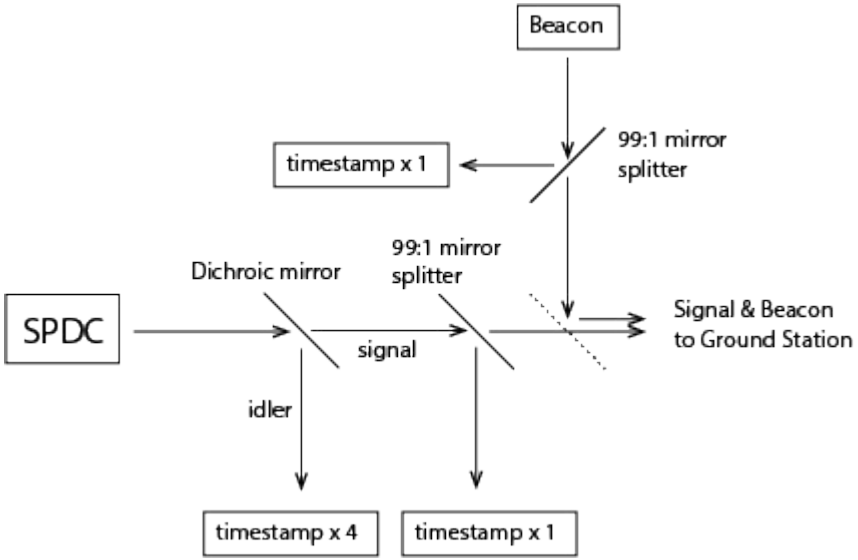
Satellite-to-ground coincidence matching using timing beacon under Doppler effects

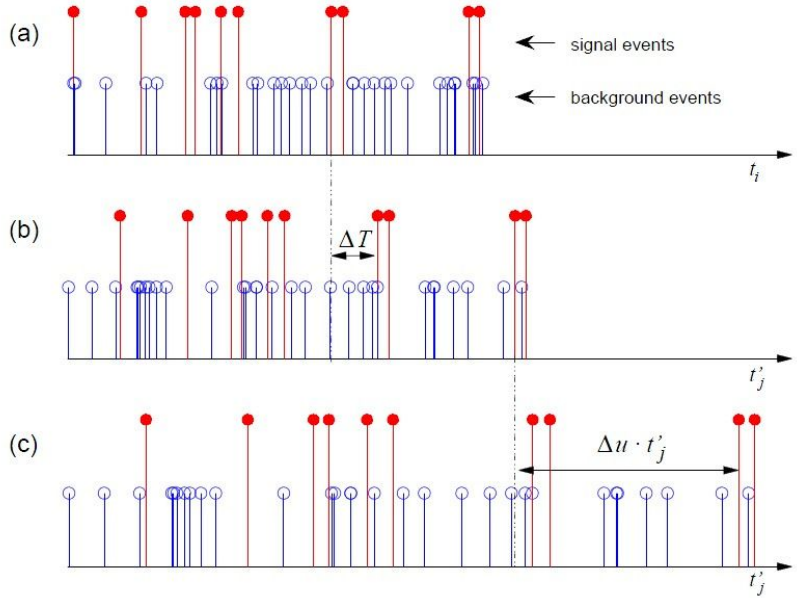
A preliminary simulation study

SPDC source on satellite



Idlers and 1% of signal photons are time-stamped on the satellite. Rest of the signal photons are transmitted to ground

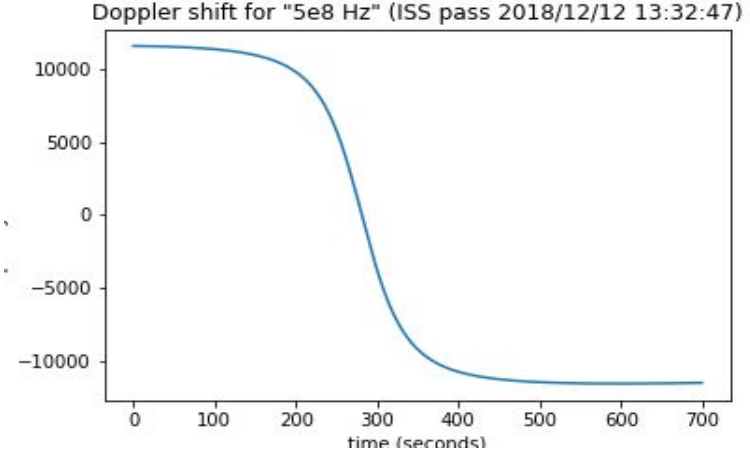
The coincidence matching problem

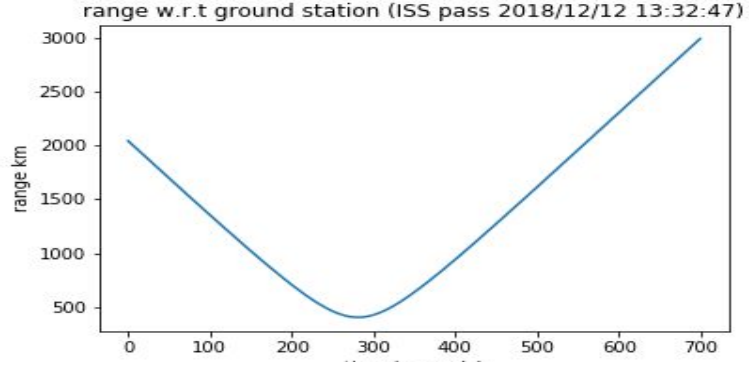


Detection events under clock drift and offset

Image credit: HO Tianyu Basil Caleb

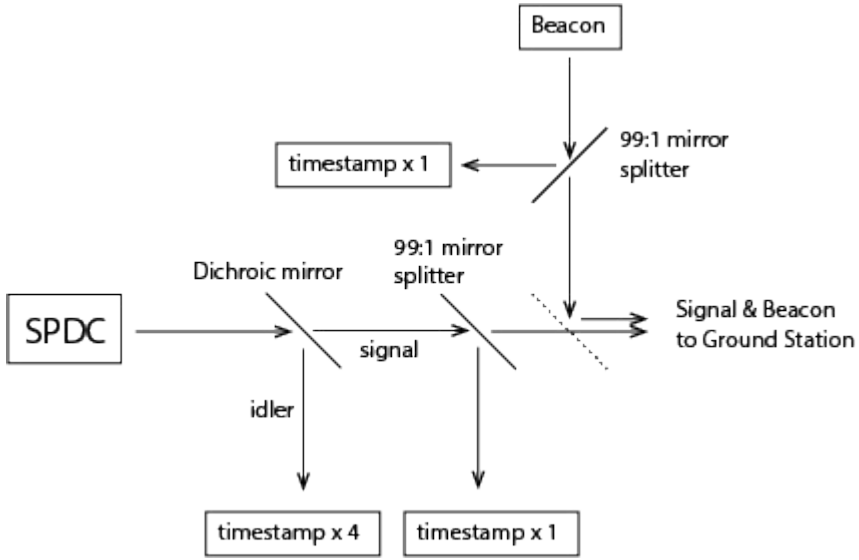
Complications due to Doppler effects





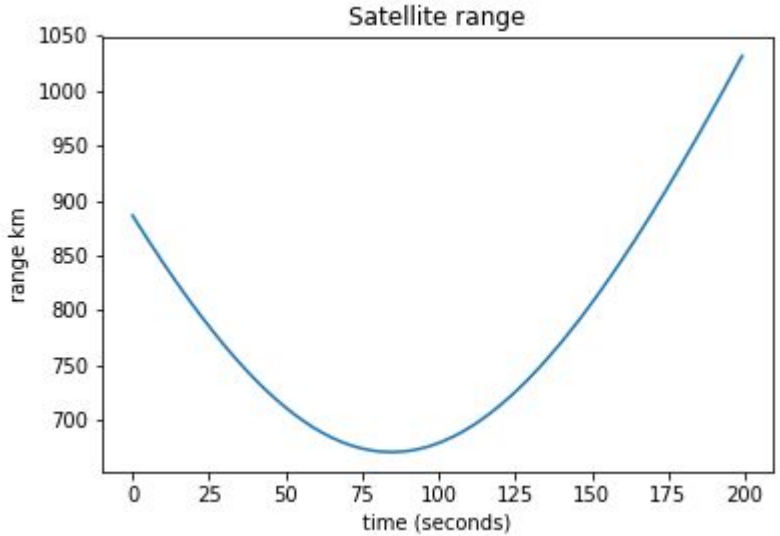
A 500 MHz clock observes in between ±10 kHz shift during a typical LEO pass

SPDC source and beacon on satellite



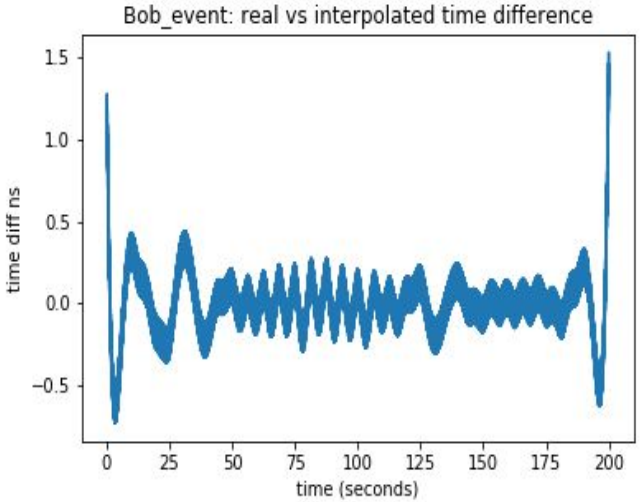
The time-stamping units and Beacon generator uses the same clock reference

Range vs. time for Gallasia pass over NUS ground station on 2018/10/19 04:53:01 computed using ephem

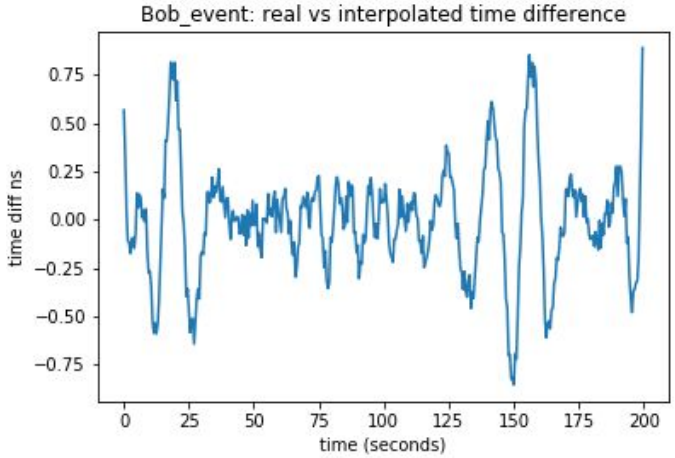


Beacon rate vs. error in timing reconstruction

Beacon rate 5Hz

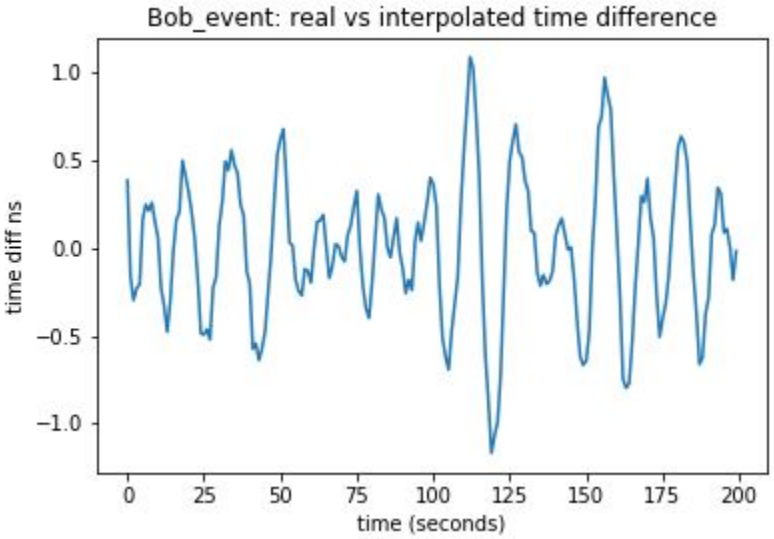


Beacon rate 2Hz



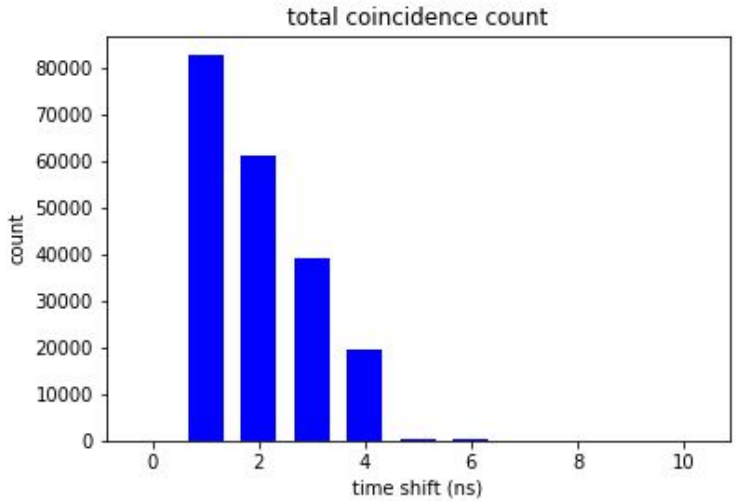
Beacon rate vs. error in timing reconstruction

Beacon rate 1Hz

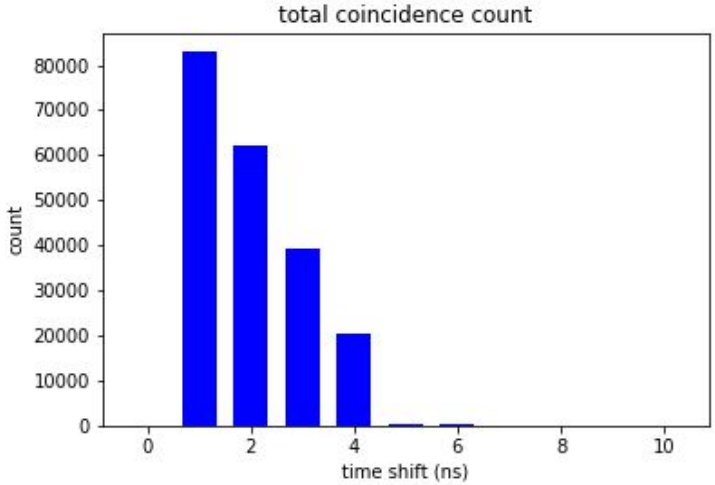


Effects on coincidence matching

Beacon rate 5Hz

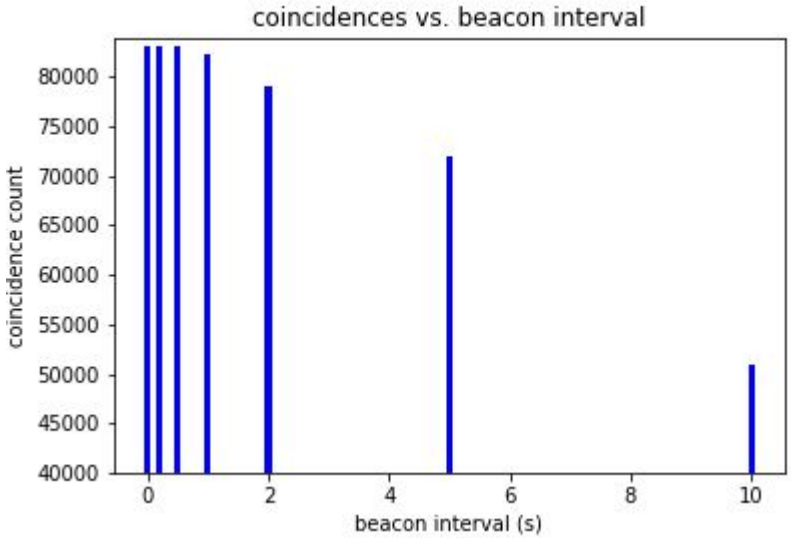


Beacon rate 2Hz



Coincidences for various beacon rates

Beacon rate (Hz)	Coincidence Count
5	83018
2	83046
1	82388
0.5	79080
0.2	72011
0.1	50860



Coincidence without doppler: 83100