

雷活動に起因する 高エネルギー放射線の発生と 宇宙線の関係

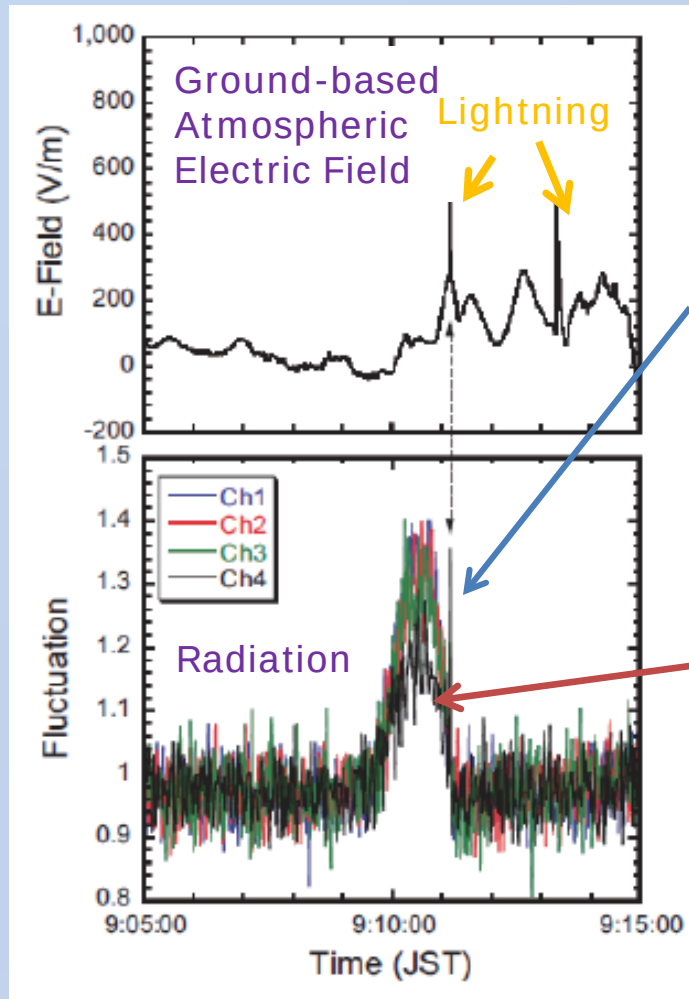
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Energetic Radiation associated with Thunderstorm Activity



Two types of radiation

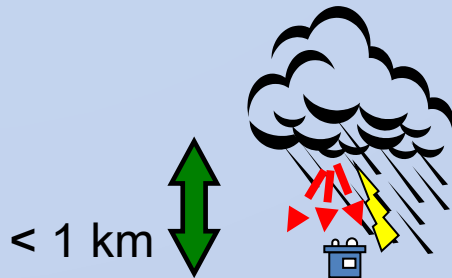
Short-burst
about 1 second **before** return-stroke
~millisecond order
~up to 250 keV in US
more than 30 MeV in Japan (?)

Long-burst
~Several minutes
~up to 20 MeV

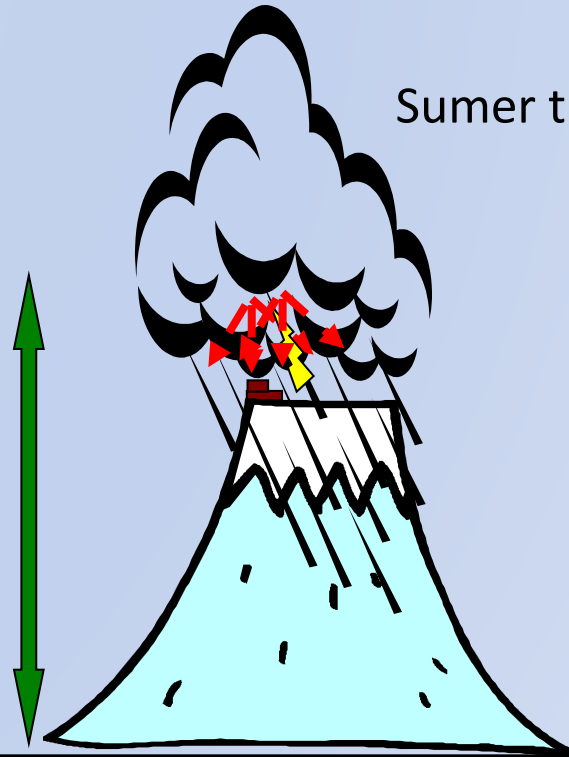
Torii et al. (2006)

Long-burst energetic radiation is observed during

Winter thunderstorm
In Japan

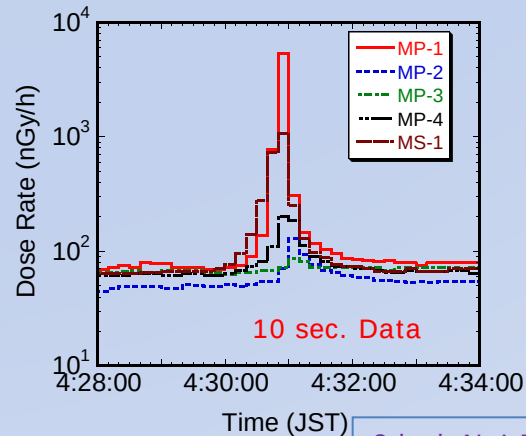


A few
kilometer



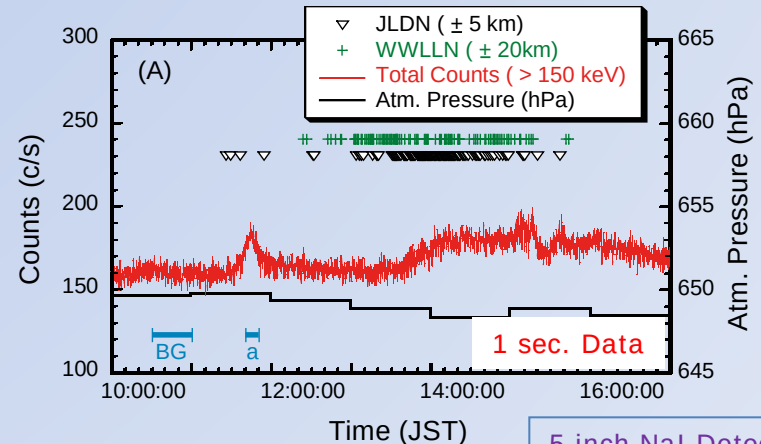
Sumer thunderstorm

Torii et al. (JGR, 2002)



2 inch NaI Detector

Torii et al. (GRL, 2009)

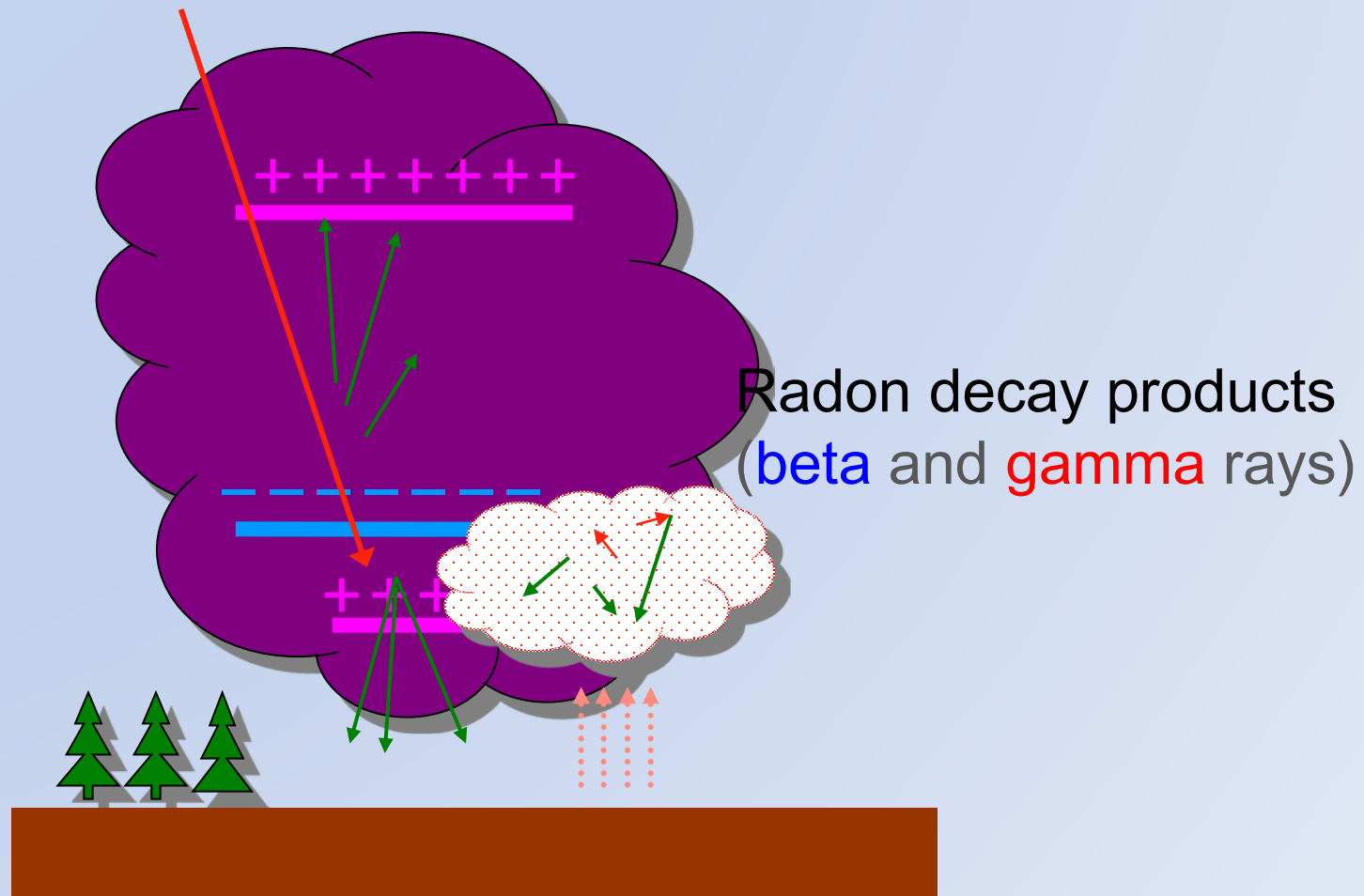


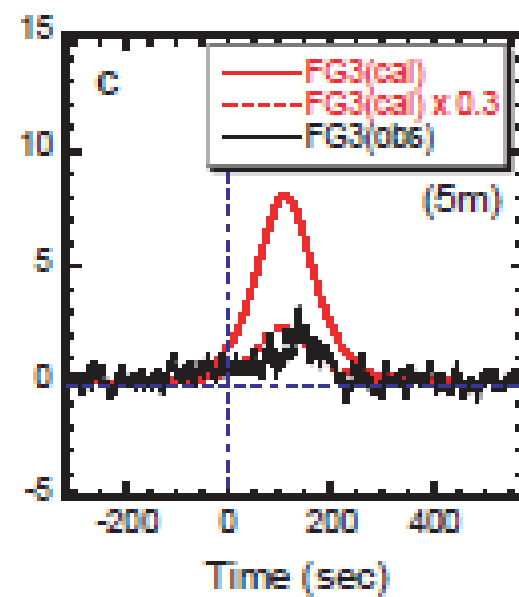
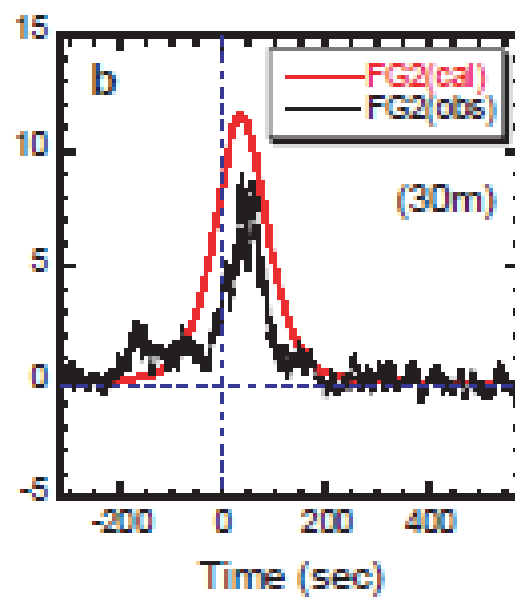
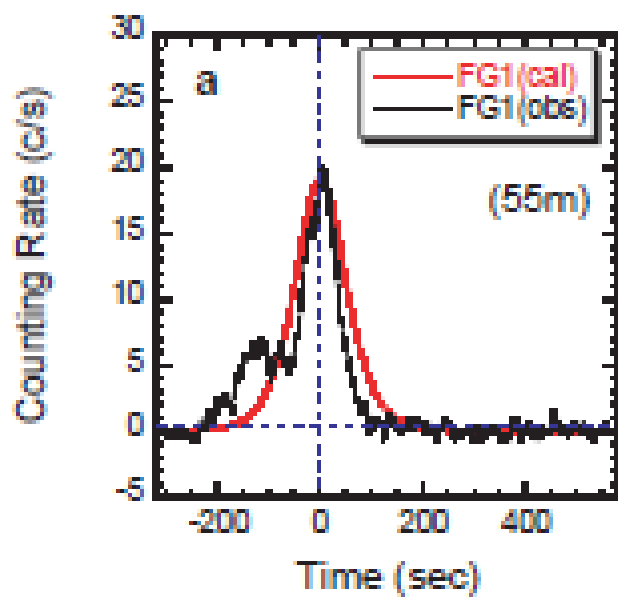
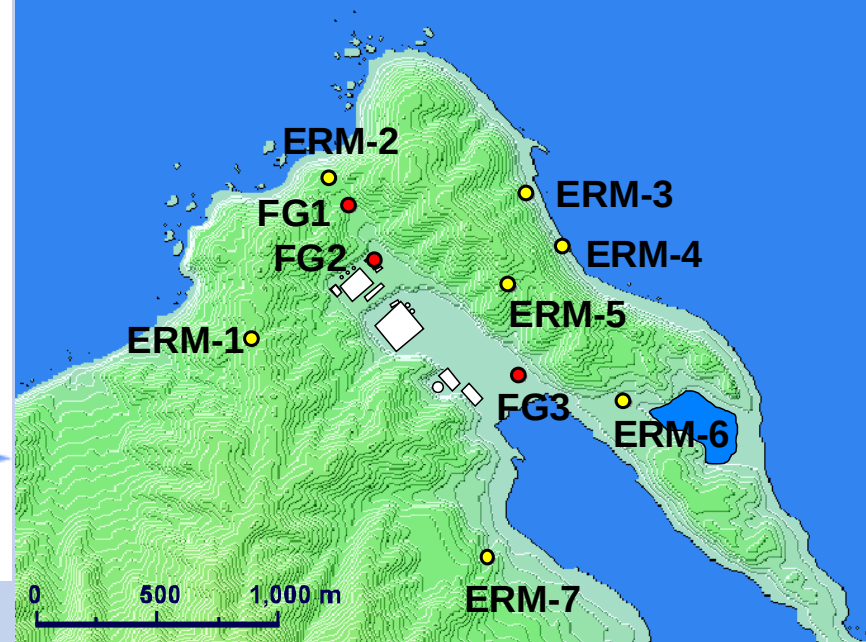
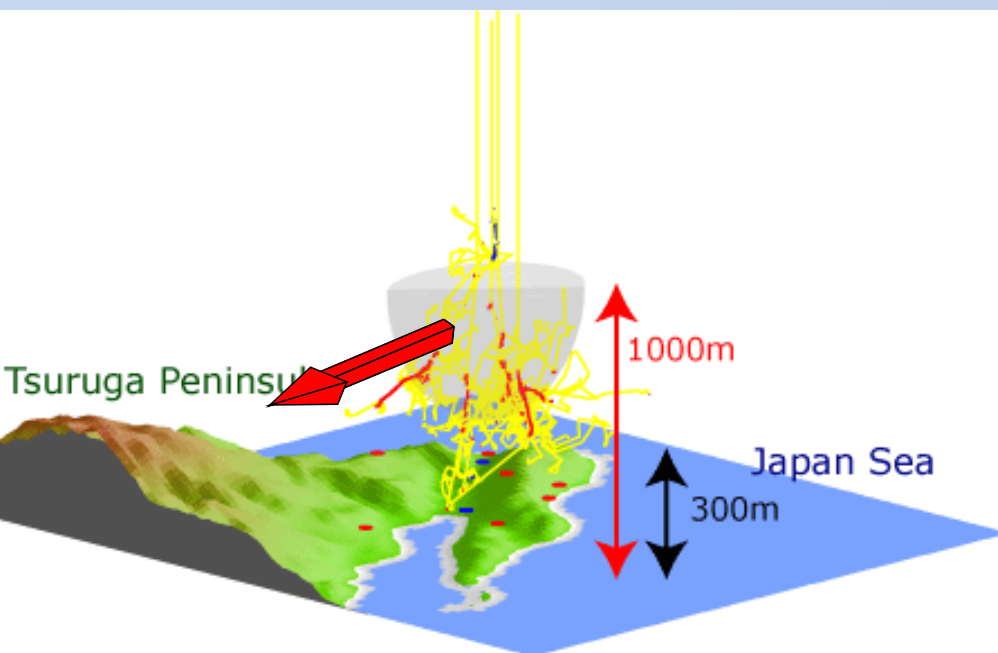
5 inch NaI Detector

Speculation of long-burst mechanism

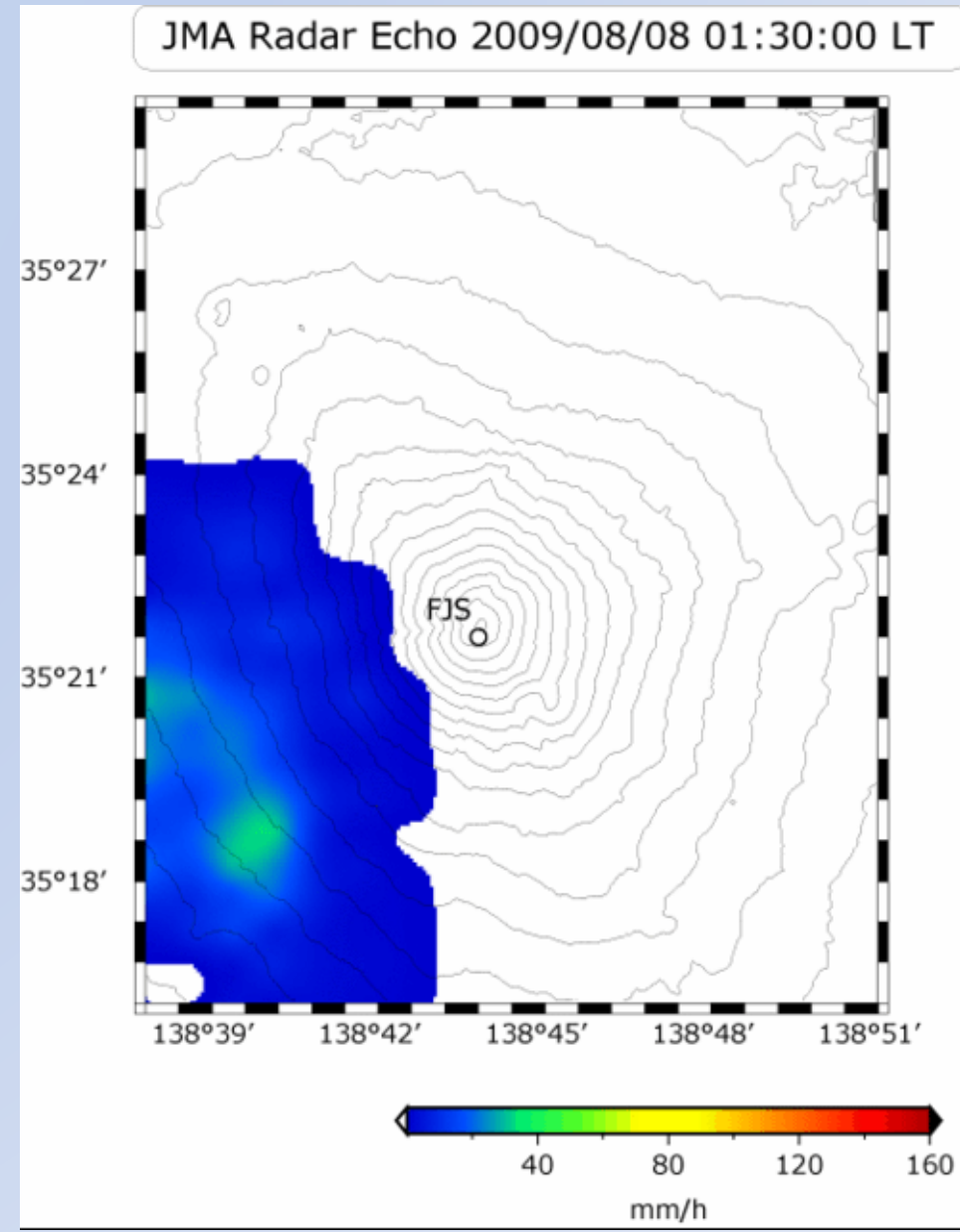
Acceleration of charged particles caused by thunderstorm electric field
-> electron and photon shower

Secondary cosmic ray (electron and photon)

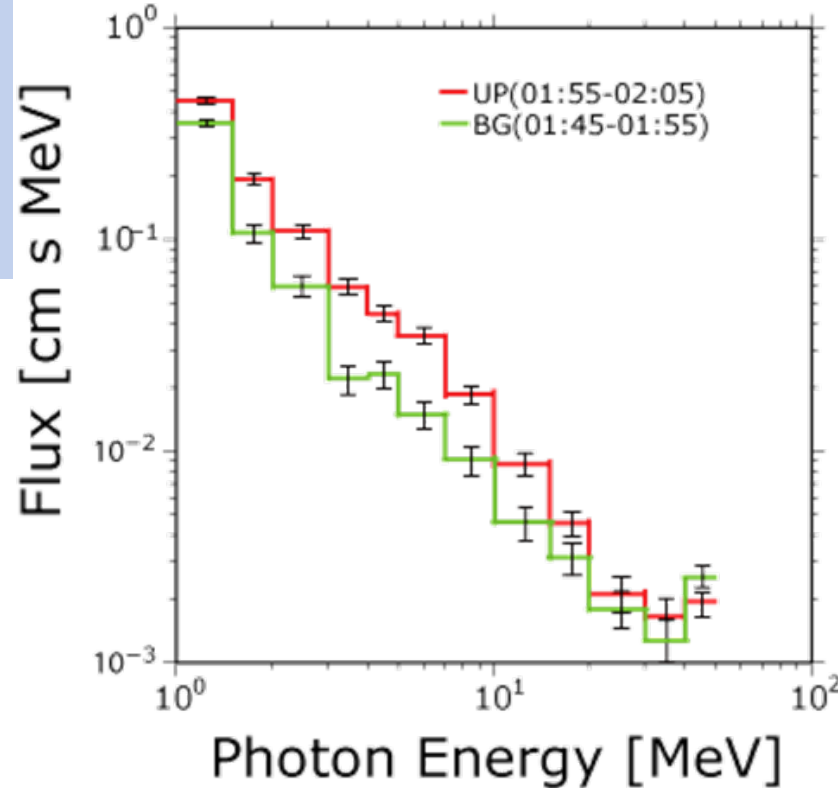
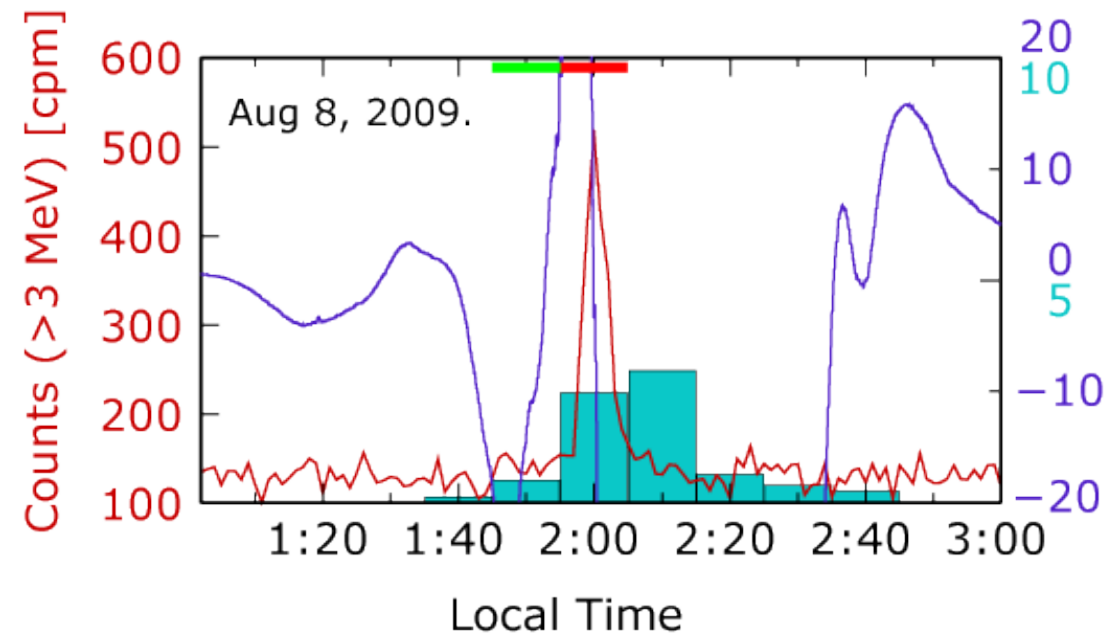
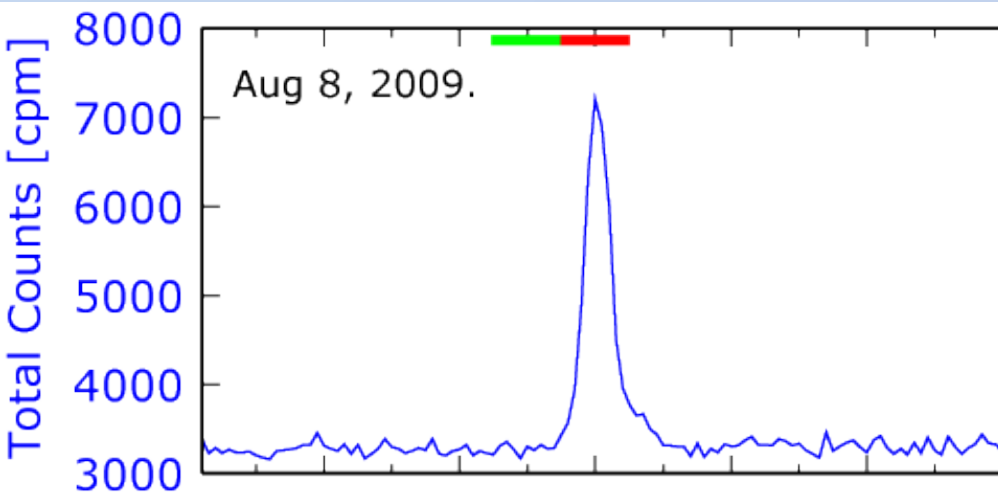




Mt. Fuji Observation



Mt. Fuji Observation (2009)



2012 Norikura Observation

NaI scintillation
counter



Field mill
All sky camera

2012 Norikura Observation

