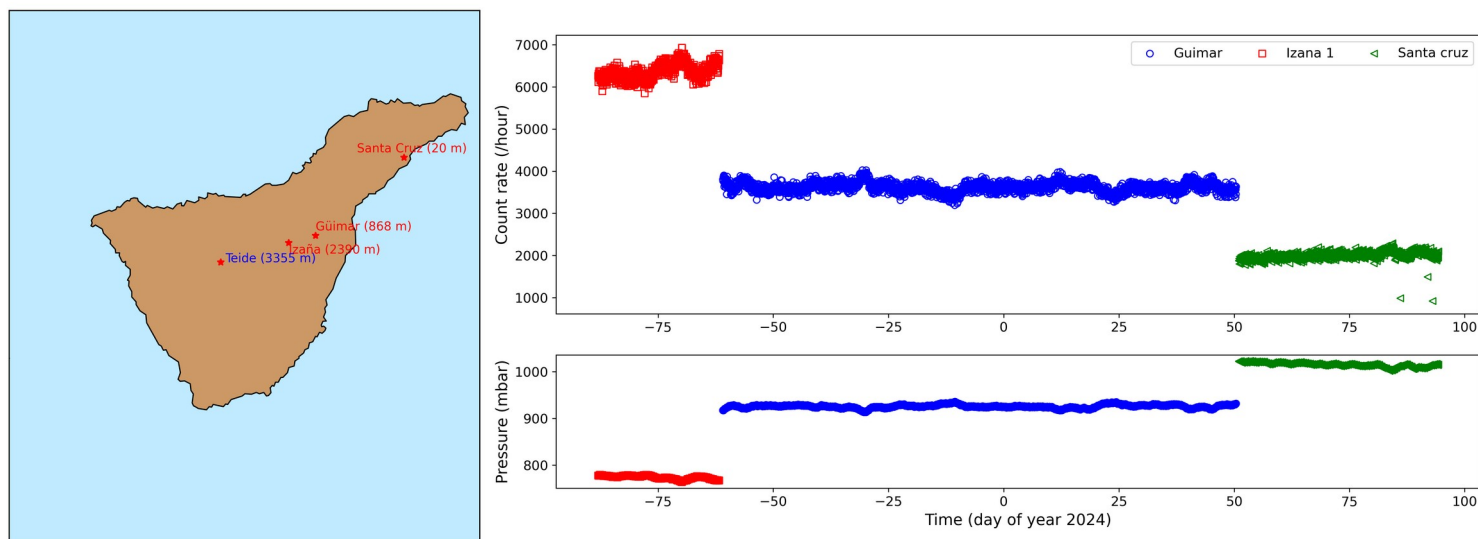


# Multiplicity in neutron monitors

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*Fig: Neutron monitor data from a recent observing campaign on the Spanish island of Tenerife.*

## Project statement:

Neutron monitors register the count rate of secondary cosmic rays, produced in the Earth's atmosphere, on ground level. They are most sensitive to super-thermal neutrons, produced in the atmosphere and also in the lead producer inside the monitor, which are captured by a proportional counting tube. Recently, using faster electronics, it has become feasible to register the arrival time of individual neutrons in the tube; something that has never before been possible. This has allowed us to calculate waiting time distributions (the distribution of elapsed time between subsequent pulses are registered) down to  $\sim$ ns accuracy. This, in turn, allows us to calculate the multiplicity of the detector which is an indication of the spectral index of the incoming radiation. Data from a world-wide neutron monitor network will be analyzed as part of an ongoing international collaboration.

In this project the student will:

1. Study how multiple neutrons are produced inside a neutron monitor
2. Calculate the waiting time distributions for a number of different neutron monitor stations
3. Calculate the multiplicity from such distributions
4. Compare the results with previous measurements and possibly space-based measurements

## Student development and recommended skills:

During this project, the student will become familiar with analyzing neutron monitor data, including pressure and temperature corrections. Much of this work will require an aptitude for data analysis and (Python) programming skills.