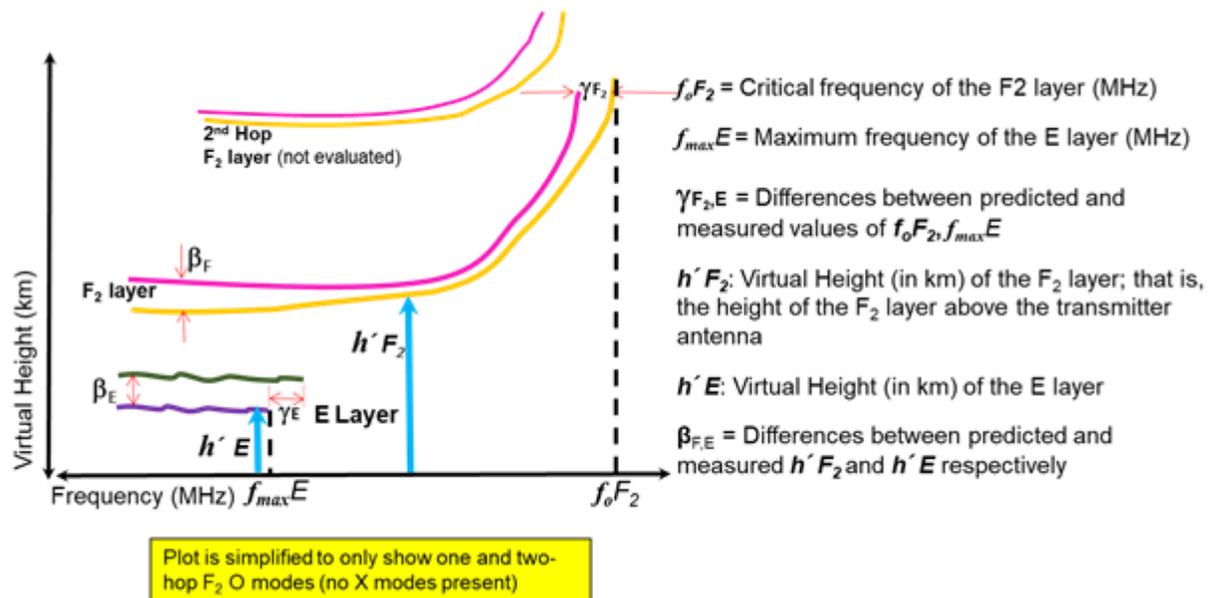# PINS Challenge Details

During the Explorer Challenge, Solvers will be asked to calculate ionospheric parameters from samples of I/Q data. The parameters of interest are presented below.

This process will require Solvers to extract a VI sounder's waveform from the given I/Q data. Successful Solvers will be able to determine the sounder's sweep rate and start time. For pulsed soundings, derived parameters may also include number of pulse repeats per frequency and inter-pulse period.

For this challenge, Solvers will be given descriptions of soundings (e.g. continuous linear sweep, coded pulse sounding, chirps) found in raw HF I/Q data. The PINS Challenge Team will then present Solvers with a series of I/Q data sets containing these soundings. The initial data sets will be synthetic with little or no noise or interferers. Subsequent synthetic data sets will include increasing levels of noise and more interferers. The final data sets will be from live collections with realistic noise and interferer environments.

The synthetic and first few live data sets will be provided as training data. Evaluation data sets will consist of live data in a realistic noise and interferer environment.

For each of these datasets, Solvers will develop algorithms to extract sounder waveform details and calculate these basic ionospheric parameters:

- $h'F_2$ & f_oF_2 (See McNamara)
- Determine presence of E layer and $f_{max}E$ (See McNamara)

The goal of the Master Challenge is to derive specification of the HF sky-wave environment (the bottom-side ionosphere) across a longer circuit. This will be accomplished through passive reception of active sounders from an oblique incidence. This process will require modification of the solver algorithms developed in the Explorer Challenge to determine ionospheric characteristics derived from OI ionograms.

The parameters of interest are presented below.
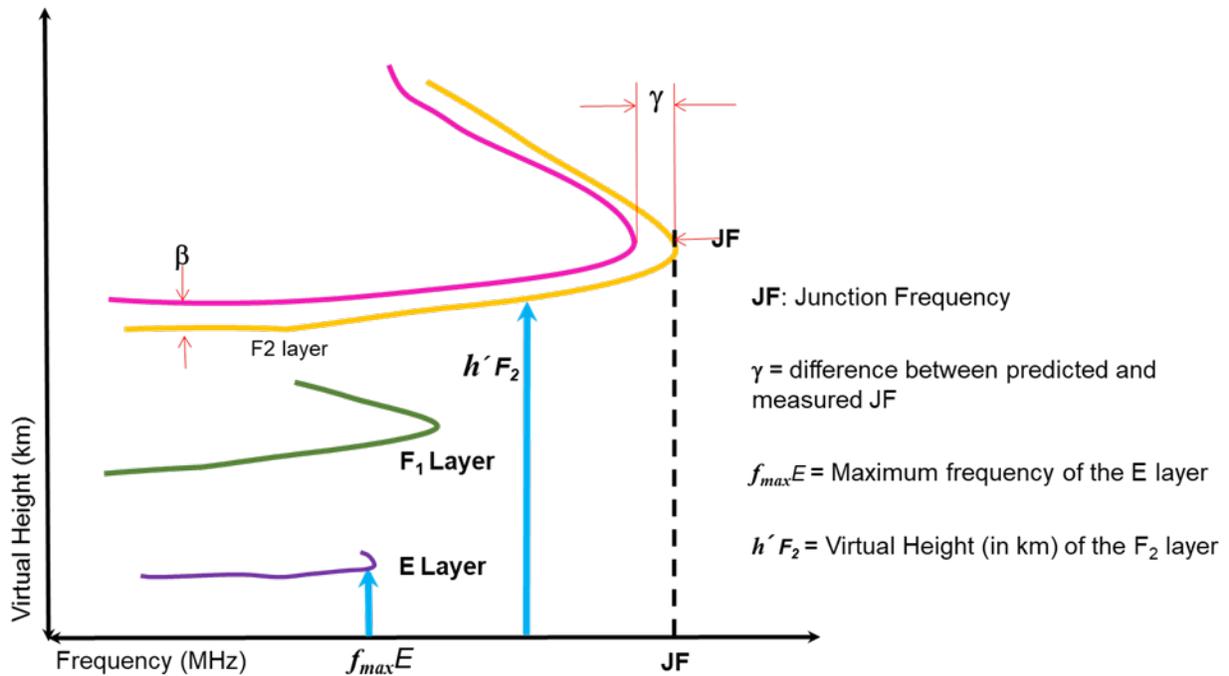
In the Master Challenge, Solvers will:
- Produce expected OI ionogram traces
- Identify & segregate the E/F1/F2 layers in these traces as shown in Figure 3
- Determine **Junction Frequency, $f_{max}E$** and **F_2 layer virtual height** (see Goodman 1991). In doing so, it is anticipated that Solvers will also determine the sounder timing (start time and sweep rate). These parameters will be expected from Solvers as well.