

Southern Site RF Background Survey & Implications for Radio Detectors

M. A. DuVernois
School of Physics and Astronomy
University of Minnesota
116 Church St. SE
Minneapolis, MN 55455

In the interest of radio detector of extensive air showers in coincidence with the southern Pierre Auger site, RF background measurements were taken from a number of locations in and near the array site. These measurements were made at:

1. The central Auger campus
2. The Los Leones fluorescence site
3. At the center of the Engineering Array (at the Carmen and Miranda tanks)
4. South of the site near Pto. Gentile
5. East of the site near Co. Nevado
6. In the remote eastern sand dunes of the site
7. On the northern edge of the site near Nihuil along Rte. 144
8. And in El Sosneado at the northwest corner of the site

Frequencies from 150kHz – 2 GHz were measured with three different techniques. At low frequencies, a scanning shortwave receiver was used in conjunction with a long-wire antenna. Above 25MHz, a scanning communications spectrum analyzer and a scope FFT were both used.

Sources of radio noise

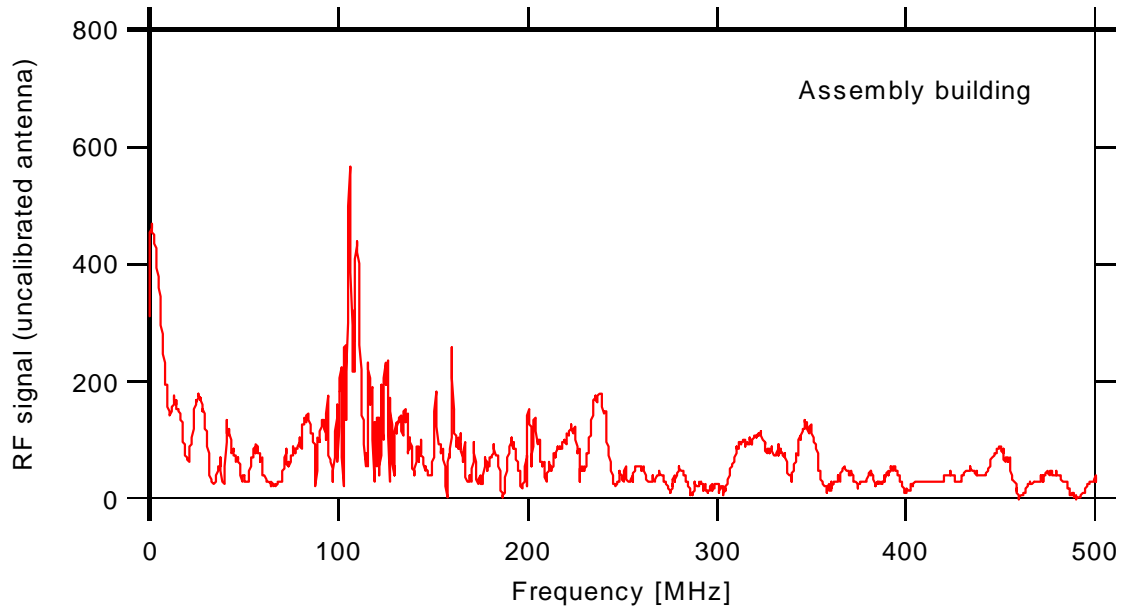
FM radio stations were prominent across virtually the whole site. The strongest local stations are at 88.1, 93.1, 94.1, 100.1, 103.1, 104.1, and 107.1 MHz. Some broadcast TV signals were seen above the FM band. Strong AM broadcasts in town include a Baptist church across the street from the Galpon with a signal that increases dramatically at 10AM on Sunday. 49MHz signals were seen a few locations—in the States these would likely be licensed handhelds. I'm not sure about in Argentina. Aircraft band signals at 144-155MHz were also noted. At higher frequencies, the cellular band at 833MHz was quite pronounced. Signal strengths were measurable on the scope long after the cell phone had lost signal lock. Unknown signals were seen at 1690, 1590, 1290, 758, 682, and 530 MHz. Near towns, 900MHz signals were quite strong.

Sample spectra & RF measurement site info

Although most of the measurements were not absolutely calibrated, the setup in each case was the same, so relative calibration between locations and sample spectra remain the same. The sample spectra shown here are from the scope FFT. Receiver spectra and detailed notes on scanner reception are available on request.

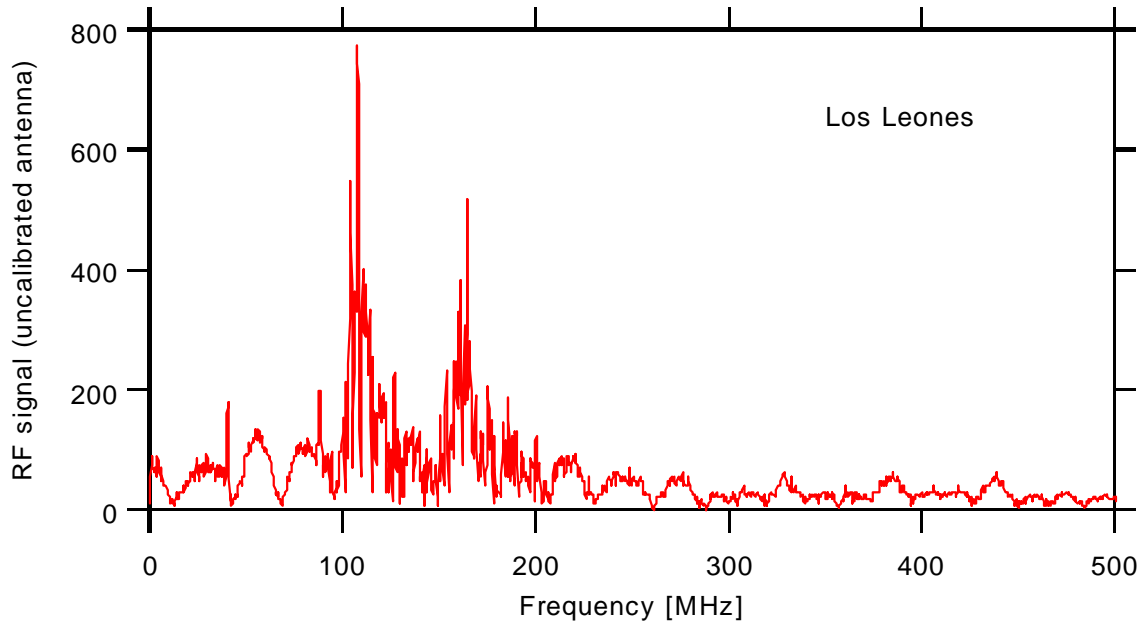
1. *The central Auger campus*

In addition to broadcast transmissions, 8, 33, 40, and 50MHz signals were seen—likely from computer equipment. Near the satellite dish the receiver front ends on all of my equipment went into saturation. Even inside the assembly building spurious IF signals due to the strong RF signals could be found.



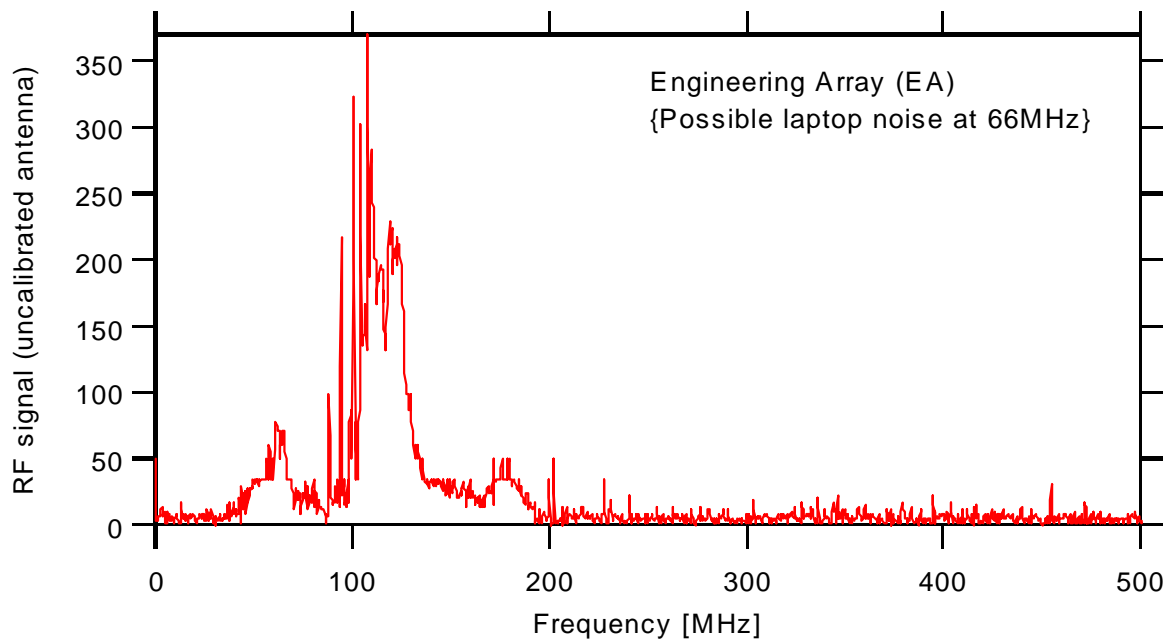
2. *The Los Leones fluorescence site*

Within line of sight of town and at the highest point for many miles, additional FM radio stations were observed at 105 and 90 MHz. (We also observed the LS to LSX traffic over the air as well.)



3. *At the center of the Engineering Array (at the Carmen and Miranda tanks)*

Not far from town, the RF environment was quite similar to campus or Los Leones (minus the satellite link). We were unable to observe LS RFI without the background of a bunch of laptop computers.



4. *South of the site near Pto. Gentile*

S 35 deg 48' 17.8"
W 69 deg 10' 38.4"

The usual FM radio stations (88.1 and 107.1 MHz strongest) plus an unknown signal at 84.05 MHz and carriers only at 95.2 and 88.2 MHz are observed.

5. *East of the site near Co. Nevado*

S 35 deg 24' 54.9"

W 68 deg 55' 54.1"

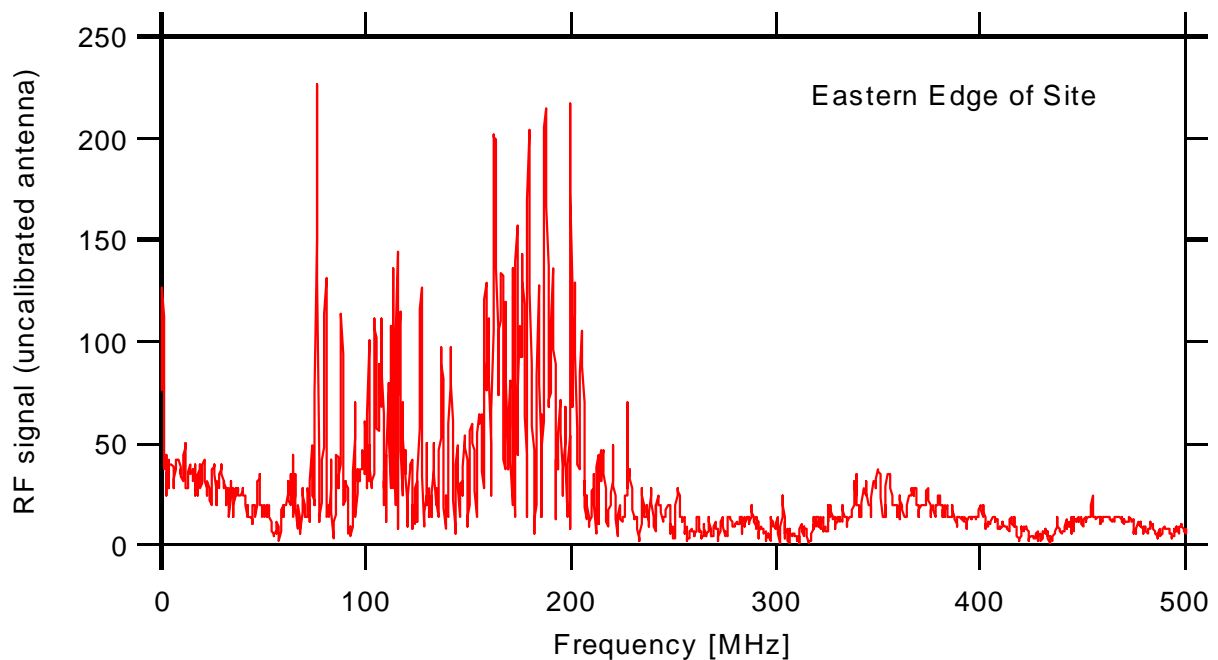
Radio background drops significantly as one heads south from Nihuil. Along here would probably be the best site for a RF detector if one wanted easy road access. Although it's about three hours from the central station, it's all low-ground-clearance-car-doable with little effort. Near here I briefly caught some 49MHz traffic.

6. *In the remote eastern sand dunes of the site*

S 35 deg 19' 11.3"

W 69 deg 5' 58.2"

Getting farther into the remotest part of the site, signal strengths on the FM stations are still dropping but likely to be strong enough to listen to with a suitable radio. (I was able to get good shortwave reception of Radio Havana from here.)



7. *On the northern edge of the site near Nihuil along Rte. 144*

S 34 deg 54' 39.4"

W 68 deg 49' 37.0'

Although the radio stations and most of the radio noise fades out as one drives East past Canada Amarilla, signals from the East (San Rafael) begin to pick up

again. A carrier is once again seen at 95.2 MHz. Along here are among the quietest Auger regions which are close to a tarred highway.

8. *And in El Sosneado at the northwest corner of the site*

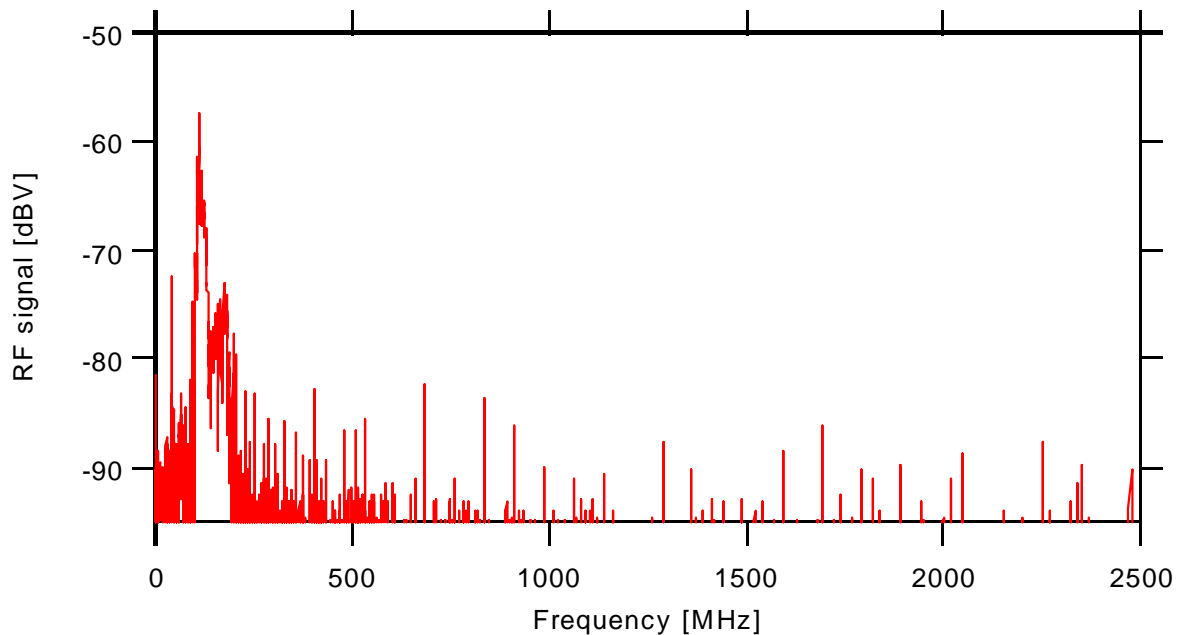
S35 deg 03' 41.9"

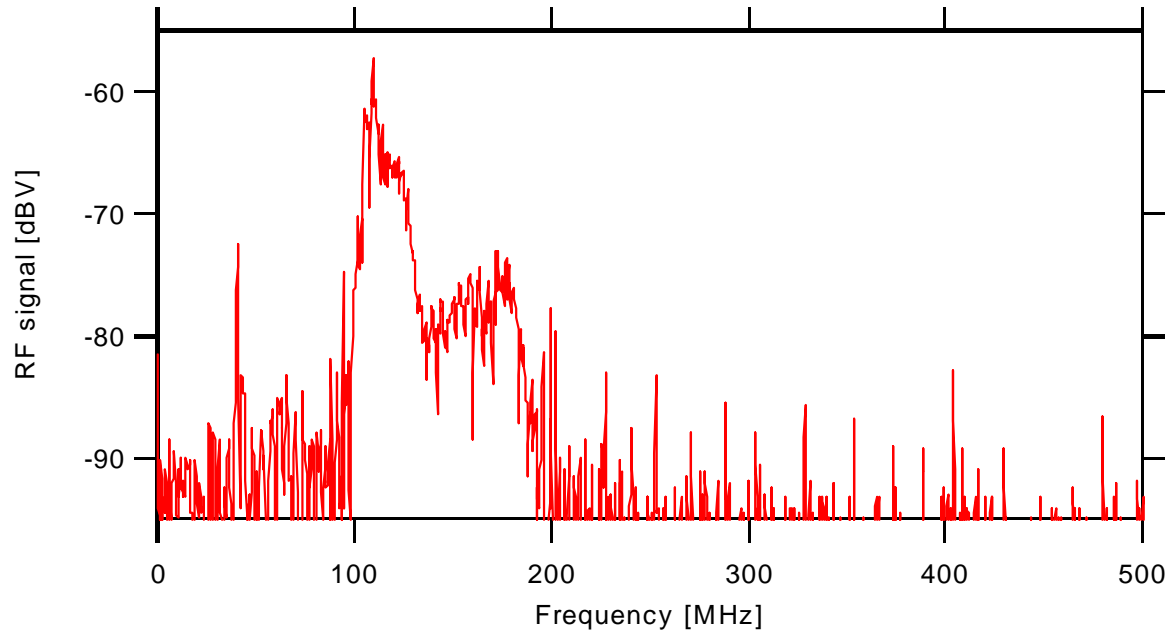
W69 deg 31' 30.2"

Lots of FM multipath can be seen here for the strong FM signals. Only by going into the Atuel Canyon headed and into the mountains can the FM radio signals be completely eliminated.

Absolute RF signals

These measurements were taken in El Chacay. A dipole antenna was used with a horizontal ground plane. Full bandwidth and 500 MHz bandwidth are shown. There is a 6 dB per octave rolloff in sensitivity above 1.25 GHz that isn't taken into account in the plots shown. Also note that I have set a noise floor at about -95 dBV—this is an estimate of the intrinsic noise of the preamp and spectrum analyzer.





Relevance to RF detection

The best sites for any RF detection of cosmic rays in coincidence with the Auger surface array would definitely be in the Southeast of the site, with the mid-North as a possibility if good nearby roads were required. (This might change if the planned improvements to Rte. 184 (the cross-Augur expressway) move ahead.)

Conclusions

Well, these data give us a little bit of a handle on the RF noise at the site. Beyond the RF detector issue, it is clear that the primary source of radio noise on the site are broadcast FM stations—these should have little effect on SDE operation, especially since signal strengths are no higher than those in the States or Europe. Lower frequency noise could be more of a problem (as was seen at the Galpon) for example at the central station. Computer EMI/RFI also shows up quite clearly when laptops (and a working LS) are in the field.