Build Your own FM Radio Astronomy Lab

by **foxmcf** on February 17, 2008

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Intro: Build Your own FM Radio Astronomy Lab

Because I'm a simple man, and the thought of trying to understand all of the unknown is more than I can handle, I prefer the simpler side of astronomy. My personal astronomy tools include a 4.5" reflector telescope, a pair of binoculars, and a FM Radio! So your asking, "FM Radio?". Well... I love to tune into the oldies and listen to some Hendrix or Three Dog Night while viewing the heavens! Ha ha! No - not really. I actually love listening to static, and the occasional ping produced from 'stray' amplified radio waves. Okay... Okay... don't click on your browsers Home button or Back button just yet. Give me a chance to explain! This is something that thousands of amateurs and professional astronomers alike have started doing recently.

Hobby based observation of the heavens is harder or more difficult than most people think. A lot of things need to be just perfect to make the most of a night of visual observation.

- a clear clean sky subject to the least amount of *light pollution possible
- the weather must be cooperating - forget about visual observation when it's raining
- a full moon can increase light pollution too - unless you are observing the moon!
- generally speaking, you need "a night sky" (it's hard to visually observe during the daylight hours)

Most of all, you need patience and time. Many of the things above are beyond our control. We can't control when it's day or night and we can't control the weather. That doesn't leave us much time. Then we are at the mercy of our daily schedules to determine when we have time to relax and observe. But this isn't necessarily true of FM Radio Astronomy.

Being an astronomer isn't just about observing the heavens by using a telescope. Amateurs and professionals alike enjoy many different methods of observing the skies. As I stated earlier, FM Radio astronomy has been gaining popularity lately due to its ease and uniqueness. It's unique, due to the fact that it's not a visual observation technique, but an audible observation. For the techno-geek, it's called listening to Forward Scatter. The technique that I explain isn't for listening to the heavens, the moon, or the pulse of 'nearby' binary star. It's a technique for listening to falling meteors. That's right! You can 'listen' to falling meteors! "Why would I want to listen to meteors?", you ask? Well, mainly because it's geeky and it can be done day or night, rain or shine. Well, actually let me correct my self. You could probably listen for falling meteors during a small steady rain-shower, but it would be hard during a thunder-shower. Lightning would cause interference that would make it difficult to distinguish meteors from lightning. Andy passing-by airplanes can cause interference as well, but these are just a few of things that make this hobby so exciting. Lighting, airplanes and meteors all have their own specific audible signature mark. So for a seasoned FM Radio Astronomer, it's fairly easy to distinguish between 'interference' and an actual falling meteor.

And you don't have to necessarily listen to falling meteors. NASA recently called upon amateur and professional FM Radio Astronomers alike to volunteer. They wanted signature data from different FM Radio Astronomers to record the re-entry of a de-orbiting satellite. They used this data from different observers to triangulate and document the re-entry process. Other amateur observers have web-sites that you can join, and submit your findings of fallen meteors in order to give more accurate predictions in the future for meteor per/hour peaks. They make available free software that you can use with your computer to ease the process; and make it more interesting as I like!

The following pages will explain the basics and what you need to setup your lab. If this is something that interests you, visit my website at http://phoxes.com http://phoxes.com to learn more. You will also find free software and tools to find the necessary stations to tune into throughout the USA.

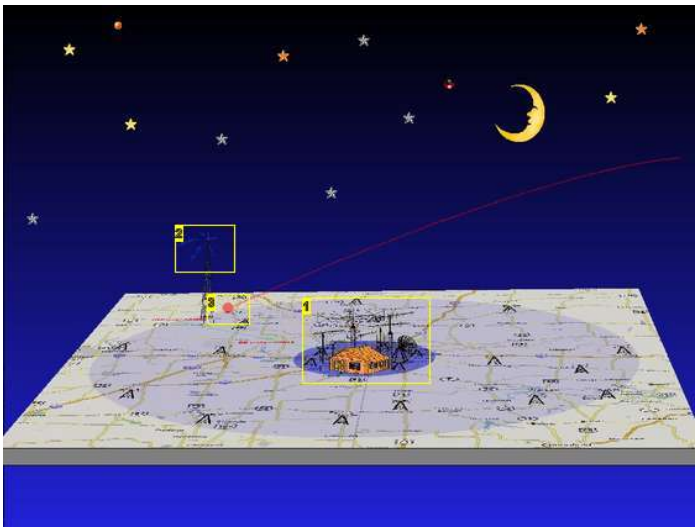


Image Notes
1. This is your house.
2. This is a distant FM Transmitter.
3. Falling Meteor

Step 1: Safety Time - Warning

Installation of antennas near power lines is dangerous. For your safety, follow the installation instructions that comes with your antenna. Each year, hundreds of people are either killed, mutilated, or they receive severe, permanent injuries while attempting to install or remove an antenna. In many of these cases, the victim was aware of the danger of electrocution but did not take adequate steps to avoid the hazard. For your safety, and for proper installation, please read and follow the safety precautions that accompany your specific model of antenna.

If you are installing an antenna for the first time, please, for your safety, as well as others, obtain the assistance of a professional installer or electrician. He can explain which mounting method is best suited for the size and type of antenna you are about to install and help you obtain on-site assistance.

Remember, the antenna, the mast, the cable and any metal guy wires are excellent conductors of electrical current. If you are touching the antenna, the mast, or any of their components and they come in contact with an electrical wire -- even the slightest touch -- an electrical path will be completed through the antenna and the installer -- THAT'S YOU! If you are unsure about how to install your antenna, or you have any doubts about your abilities to successfully perform the job, stop and obtain the help of a professional installer.

If any part of the antenna system should ever come into contact with a power line, DON'T TOUCH IT! NEVER TRY TO REMOVE IT YOURSELF! CALL YOUR LOCAL

POWER COMPANY. They will remove it safely.

Step 2: Break into your life savings... Step 1. Bill of Materials

Today is a good day. YES! You have finally set aside some time, and your high-interest bearing savings account has built itself enough funds to support your long awaited dream of a life-time! You are going to build your own FM Radio Astronomy Lab! Congratulations and welcome to the beginning of a new you. You have just joined a group of elite individuals. Those that call themselves, FM Radio Astronomers. It makes a great title on a business card too.

Okay, now that we're over ourselves and have that our of our system, it's time to get down to business. First, put the money you took out of your savings account back. You're not going to need it. Most of the items you need, you probably already have. Although not required, a computer is almost a must. If you don't have a computer, this will be the most costly item on your bill of materials. I'm assuming that if you don't have a computer, you may not be that technically savvy. If this is the case, I recommend that you have a computer geek friend help you with your lab. At least with the setting up of the computer and training you how to use the Operating System and software discussed in this article. If you don't already have the items in this article, don't fret. They can be purchased cheap from garage or estate sales, or you can also find the items on-line from e-Bay very cheap as well.

Here is the list of materials you will need. Each item and the specific requirements for each will be described in more detail below.

Bill-of-materials:

- Digital FM Receiver
- Outdoor Yagi Directional Antenna and required mounting accessories

- Optional: Electric antenna position rotor.

- Windows Compatible PC Computer with Sound Card input
- Various audio connectors and cables

Step 3: FM Tuner

The FM Tuner will be the core component of your lab. Sounds expensive, doesn't it? Well, it doesn't have to be. The picture above is a used Digital FM Tuner that I bought off eBay for $8.00 total (including shipping). The thing I like about this tuner, is that it's not complicated and doesn't have too many controls. The memory presets come in real handy as well. When I find stations that work well, I program them into the memory presets for easy access later.

On the back of the tuner, make certain that you are able to plug in an external antenna, and that you have some sort of audio outputs to plug into your computer. All FM tuners have audio outputs of some sort. Become familiar with the type of output jacks that you have because if you are going to hook a computer up to your tuner, you will need the appropriate cable to make the hookup.

Step 4: The antenna

First and foremost, safety should be your most prominent concern. Mounting antennas should be done by someone with experience. Please re-read the safety warning at the beginning of this document. For safety reasons, this document nor any part of the accompanying web-site, phoxes.com will explain how to mount antennas. If you must personally install the antenna yourself, please read the accompanying installation manual of your antenna, and or seek professional assistance. Please be safe!

This is another core component. I suggest that you get a directional Yagi style antenna. A directional antenna will allow you to 'aim' the antenna towards the direction of the station that you are tuned into. This will allow minimal interference from other FM Transmission towers that may be in your area. Your antenna may be in the medium price range of items to purchase, but it all depends on where you get it. I purchased mine at Radio Shack a while back for around $140, but I have seen them on e-bay for around $50.00 or less. Just watch the shipping charges. I started with a standard 18 element FM Antenna from Radio Shack to see how it worked in my area. I made certain from the Sales Representative that I would be able to return the antenna if it didn't work for my application. I'm glad that I did, as I did need to return it because there are way to many high powered local stations in my area. I found it hard to lock onto a distant transmitter. They were happy to sell me the more expensive antenna anyway. :)

Along with your antenna, you will need a cable kit which can be purchased at Radio Shack. Most antennas don't come with the cables that connect your antenna to your FM Receiver. If you are in doubt what cables you need, again, ask your local Radio Shack expert. They seem to be very knowledgeable in this area and are very helpful.

Last but not least in the antenna department, you may find it very useful to get an electric rotor for your antenna. This is a small motor that is mounted on the mast of your antenna. A control box is wired inside your lab that allows you to easily rotate the antenna in any direction from the comfort of your own home.

Step 5: The Computer

This is the 'fun' component. It will also make your life easier and more enjoyable. Listening for meteors through a speaker is fun at first, but you will find that sometimes waiting for a 'ping' will put you to sleep fast. And the constant listening of static has been known to drive some people insane! Let the computer record your sessions for you automatically. By using software, you can have it automatically record, and mark points of interest. Those interests being the familiar sound of a meteor Ping!

I use an old IBM Server PC that I purchased for $35.00. Don't let the 'Server' part scare you. In this PC's hay-day, it was a beast of a machine that ran Windows NT Server operating system. I reformatted the hard drive and put Windows 2000 on it. Even thought Windows Vista just made it's release yesterday, you don't need a powerful or new operating system to make due of this hobby.

This article won't go into detail on how to use your computer or setup the software needed to listen to meteors. (Although I have links on the Red Phoxes web-site that take you to Freeware available just for this purpose). If you aren't computer savvy, enlist the help of a friend that can help you with the computer part.

The only main requirement that I list is that your computer has a sound card with a Line In input.

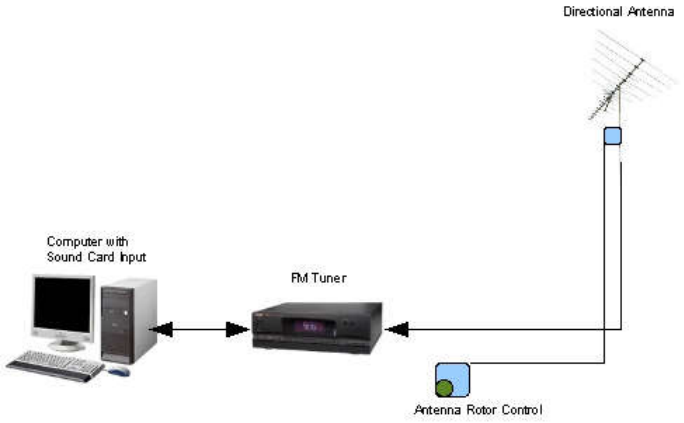
The middle jack of this picture is the important jack for our implementation. It's a Line In input that allows me to take the output of my FM Tuner directly to the Line In of the sound card.

And because my output from my FM Receiver uses RCA Male jacks, I needed a RCA Female to Mini cable to make the connection.

Step 6: Here you have it...

The diagram below depicts a simple hookup configuration. Computer inputs, tuner inputs, antenna connections, as well as Antenna and audio cables are all different, so be certain that when you purchase your cables, that you are familiar with the input and output connectors of your equipment.

Well, there you have it. That's all their is to building your own FM Radio Astronomy Lab. Please feel free to view the Red Phoxes web-site Red Phoxes web-site for more information on how you can become a pro at listening to Meteors.



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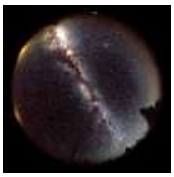

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Comments

5 comments **Add Comment**

static says: Mar 20, 2008. 9:26 PM **REPLY**

I think it would be interesting to have a FM receiver that could sweep the FM band an use an omni- directional antenna. That should let one observe multiple meteors over a given time period during a shower. Sure that will take some training of your ear ignore the stronger normaly received stations.

kouker says: Feb 27, 2008. 1:12 PM **REPLY**

Great Instructable!

GorillazMiko says: Feb 18, 2008. 12:13 PM **REPLY**

Great Instructable. Very interesting as well (as thearchitect said). Awesome job.

thearchitect says: Feb 17, 2008. 3:27 PM **REPLY**

This is very interesting. Do you have any sample sound files? I checked out your website, very rich and lots of fun. Thanks for posting!.. Cheers, K.

foxmcf says: Feb 17, 2008. 4:53 PM **REPLY**

No - I don't have any sound clips, but you can visit the JAS site for some samples. Thanks for the comments.