

Unit 2: Smiley Basics

Student Guide: Teacher Version

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KENAN FELLOWS PROJECT

2010

Smiley Basics

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Smiley Basics

2.1 Introduction to Smiley



Podcast: 2.1 : Smiley Basics

The Podcast is **4:58** min in length.

P

Presentation Slide 2.1



Student Guide: P.2

Q

Quiz 2.1

SMILEY

1. "Smiley" is a **4.6m** radio telescope located at the **Pisgah Astronomical Research Institute**, or PARI.
2. Smiley is remotely accessed via the internet to be used by teachers and students to introduce them to **Radio** Astronomy.
3. Smiley is a real working radio telescope and not a simulation.
4. After training students will be able access and utilize a real working radio telescope to conduct real world scientific investigations.

RADIO TELESCOPE OPERATIONAL BASICS

5. A **telescope** is any device that makes an object look **bigger** than it is.
6. Most are familiar with **optical** telescopes, which view the **visible** spectrum.
7. Radio telescopes do the same as optical except they “look” at the radio spectrum.
8. Radio telescopes are **Astronomers** “ears to the sky”.
9. Smiley scoops up **radio** waves in a dish looking telescope.
10. Radio telescopes catch radio waves in a dish looking antenna called a **reflector**.
11. The reflector sends the signals up into the center of the dish called the **focal** point.
12. The feed is comprised of a horn.
13. The horn feeds the incoming signals to a sensitive radio **receiver** and amplifier.

14. Lastly, the signals are sent to a computer for conversion from analog to digital data.

RADIO TELESCOPE SPECS.

15. Hydrogen is the first element on the periodic table. It contains one positively charged proton and one negatively charged electron.

16. Normally the electron spins in the opposite direction in relation to the proton.

17. When a hydrogen atom is hit by another atom, or an electron, the hydrogen's electron is forced to flip into the same direction as the proton.

18. Since the proton is positively charged and the electron is negative, they repel each other causing the electron to flip back into spinning into the opposite direction.

19. When the electrons flip back energy is released in the form of a photon.

20. The photon has a wavelength of 21cm or a frequency of 1.42 GHz.

21. This Flip –Spin action identifies the presence of hydrogen.

22. Smiley collects the emissions from neutral hydrogen to locate and study hydrogen.

23. Since Hydrogen is the most abundant element, studying it gives us better insight into the Universe.

DATA ANALYSIS

24. Data from Smiley is processed by a computer to be analyzed by three types of scanning.

25. Spectrum Scanning measures the intensity of a radio emission's frequency.

26. Continuum Scanning measures the intensity of radio emissions over time.

27. Mapping Scanning Collects the intensity of an emission over an area to generate a Map image of the source

Proceed to 2.2

2.2 Accessing Smiley



Podcast: 2.2 Gaining Access

The Podcast is **5:37** min in length.

P

Presentation Slide 2.2



Student Guide: P.5

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Quiz 2.2

START POINT

1. **STEP #1:** Open web browser
2. **STEP 2:** Enable/allow Pop-ups (disable pop-up blockers) to the Smiley website.
 - a. Also, Make sure JAVA is enabled on your browser.
3. **STEP 3:** From your web browser, go to <http://www.pari.edu>.
4. **STEP 4:** Click on the Teachers and Students tab at the top.
5. **STEP 5:** Select Log in to Smiley link located mid page.
6. You are now in the **Smiley Control Room.**
7. If you are only observing a Smiley session, click the **Observe Current Session** tab. You do not have to login to Smiley to observe a control session.
8. If you are planning on controlling Smiley continue with the next procedure.

LOGIN PROCEDURE

9. After a minute in the Control Room a **Log-In** Box pops up.
10. **STEP 6:** Type in your username (case sensitive).
11. Type in your password (case sensitive).
12. Click on the Log in to Smiley link in the middle of the page.
13. The Smiley Control Room **Manager** pops up.

SCHEDULING A SESSION

14. New tabs now appear in blue.
15. **STEP 7:** Schedule your **control session** time by clicking on the schedule control sessions button.
16. **STEP 8:** Select the day you want to observe and select the Date on the calendar.
17. A new window will pop up asking for time of day. Enter the beginning and end times for when you want to observe. Use 24-hour time, or military time. Enter a short description of your session. Submit your request.
18. **STEP 9:** After receiving a successful reservation message and confirming it, Click on **Return** to Control Room
19. You can now **log off** and return later, or wait for your scheduled time to arrive.
20. **STEP 10:** Start session or return on the scheduled observing time.
21. Once logged in you now have control of Smiley.

Proceed to 2.3

2.3 Controlling Smiley

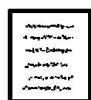


Podcast: 2.3 Controlling Smiley

The Podcast is **8:05** min in length.

P

Presentation Slide 2.3



Student Guide: P.6

Q

Quiz 2.3

USING SMILEY

1. Access Smiley by logging into the Smiley Control Room Manager.
2. From the Control Room Manager, select and click on Start Control Session and the Smiley Internet Telescope Control window pops up. You now are in control of Smiley. (Review 2.2)

SMILEY INTERFACE

3. It is important to understand Smiley's interface before use.
4. The interface is divided into several control panels.
5. In the upper right is Current Session Status, which gives information on the session.
6. In the middle is the live video feed of Smiley.
7. Upper right box is for administrators only to post important information.
8. The Coordinates Box: Refer to the blue box located in the center right of the page. Every object in the sky has a series of coordinates. The coordinate box is the true control panel center for Smiley.
9. To the right of the coordinates box is Local Sidereal Time. Astronomers use sidereal time as a way to keep track of the direction in which their telescopes need to be pointed to view any given star in the night sky.
10. Below is the Hand Paddle box which allows manual control of Smiley. It is only to be used under close teacher supervision.
11. You can move smiley UP, DOWN, CW (Clockwise), and CCW (Counterclockwise).
12. The status box to the left indicates Smiley's present Movements.
13. Since Smiley has certain Physical limitations, only use the hand paddle mode under teacher supervision.
14. You must Click and Hold the cursor down on the hand paddle buttons down to manually control Smiley.

15. The Coordinate box is divided into two headers, **Current** and **Target**.
16. On the right side is the Target, which uses two coordinate systems.
17. The two systems used are the **Azimuth** and **Altitude** Coordinate System and the Right **Ascension** and **Declination** System.
18. Both systems use the same units: **Degrees**, **Minutes**, and **Seconds**.
19. The left side of the coordinate box displays Smiley's current position in both formats.
20. Smiley's current coordinates will change as it moves toward the target until they match up.
21. In the bottom middle of the coordinate box is the **limit brakes**. It notifies you if Smiley is nearing its physical limits. If any of these boxes turn yellow or red, stop and notify your teacher immediately. (NOTE: Teacher, if this occurs- immediately move smiley to a safe position. Use the hand paddles if necessary. Smiley's parameters are between 350-10 AZ and 20-80 Alt.)
22. Below are the GO and STOP buttons. Go: starts Smiley's movements and Stop: Stops it's movement.
23. To the right you can choose track or drift. Track will continue to follow the target through the sky. Drift will allow the object to move away. End Session, ends the session and exits you out of the control room.
24. To the left is the **Source** Box. It is a drop down menu of several common and interesting radio emissions sources.
25. Below is the status box mentioned earlier.
26. The bottom half of the control Center is comprised of a large five-tab window.
27. The First tab is the **Sky Map** tab, which displays an overview of the sky. It lists many interesting target sources.
28. Smiley's **current position** is indicated on the map by a white crosshair or plus mark (+).
29. Many target sources are indicated on the map. A small yellow circle marks the Sun and the Moon is a small **white** circle.
30. Most target sources are distant sky objects.
31. Targets include the **Galactic** Poles.
32. There are three ways to select your target. First, all the objects indicated on the sky map are also available on the source drop down menu.
33. Secondly, clicking on a position/target on the Sky Map will automatically load its coordinates into Smiley's target coordinates.

34. Another way to choose the target is to manually enter its coordinates.
35. The next three tabs are the scanning methods you will learn about and use in PARI Pod 2.4.
36. These scans are *Spectrum*, *Continuum*, and *Mapping*
37. The last tab you see on the screen is weather, which gives the current weather conditions at *PARI*.
38. When done observing, click on End Session, then Exit Control Room

Proceed to 2.4

2.4 Scanning Basics



PARIPod: 2.4 Scanning Basics

The Podcast is **5:13** min in length.



Student Guide: P.8



Quiz 2.4

SCANNING BASICS:

1. There are three methods of collecting data from Smiley: Spectrum, Continuum, and Mapping. Each scan will have different individual parameters, but there are similar controls and features on all three.

THE CONTROLS

2. Controls are located to the left and are the same in all three scan interfaces.
3. Begin Scan. Once the scan starts the green button will change to a red stop scan.
4. Save Scan: allows you to save your current data.
5. Clear: clears the present data.
6. Open Data file: allows users to open previously saved data files to be re-analyzed. Files are saved to a location on the PARI server.
7. IF Gain, the IF stands for Intermediate Frequency which magnifies the amplitude of the incoming radio waves. It is the “volume” for radio scans.
8. Plot Rate: determines the rate at which Smiley collects data and is then plotted. It can be increased or decreased. Increasing the rate plots data more quickly but less data is collected.
9. Base Frequency: 1.42 GHz is the default base frequency because is the target frequency for neutral hydrogen. There are others frequencies.

THREE TYPES OF SCANS

10. Spectrum Scan graphs the intensity over frequency.
11. The intensity scales ranges from 0-10.
12. Continuum Scanning measures Intensity over time.
13. Mapping Scans take samples of several scans to form an overall map.

GRAPHING FEATURES

14. Graphs can be accessed and modified by right clicking, including:
Show unconnected points, Zoom in and Out, Translate: up, down, left, and right. Show Grid, and Data point color.

Proceed to 2.5

2.5 Spectrum Scan



PARIPod: 2.5 Spectrum Scan

The Podcast is **5:08** min in length.



Presentation Slide 2.5



Student Guide: P.9



Quiz 2.5

1. Spectrum scanning is a technique that collects radio emissions to analyze electromagnetic characteristics.
2. In spectrum mode Smiley separates the incoming radio waves into a spectrum (like a prism) and takes data on a single part of the spectrum. This is like finding a specific radio station on the stereo.
3. Signal intensity is based on 0-10 scale. 0 being the lowest intensity and 10 being the highest.
4. Steps for Scanning:
 - 1) Step One: Select a Target/Source by using one of the three methods learned in the previous PARIPod, manual, dropdown menu, or skymap.
 - 2) Step Two: Enter the spectrum control room by choosing the spectrum tab on the screen.
 - 3) Step Three: Select IF Gain.
 - 4) Step Four: Adjust Plot Rate if needed, Plot Rate determines the rate at which Smiley collects and is then collected.
 - 5) Step Five: Spectrum Parameters should be set to the base frequency of 1.42 for Neutral Hydrogen. Finally, Frequency range must be entered in KHz.
5. Frequency range determines the range for the scan.
6. Frequency offset and Intensity displays the current data during a scan. Nothing needs to be entered here.
7. Once you click Begin Scan, Smiley will begin taking data.
8. After a several seconds you should see data points being plotted on the graph.
9. Run the scan to the time required by the lab or by the teacher.
10. As you are observing, notice the changes in slopes, especially as the line approaches and passes the base frequency.
11. Hit Stop Scan to stop the data collection.
12. Useful Scan data file should be saved.
13. Once Scanned, refer to Analyzing Smiley Data (2.8)

Proceed to 2.6

2.6 Continuum Scan



PARIPod: 2.6 Continuum Scan

The PARIPod is 4:06 min in length.

P

Presentation Slide 2.6



Student Guide: P.10

Q

Quiz 2.6

Starting point

1. A continuum scan is an extension/continuum of a spectrum scan.
2. Note that on the graph the y-axis is Intensity, which was the same in the spectrum scan, but the x-axis is now Time.
3. Continuum scanning plots the Intensity of a frequency over time.
4. The only controls that can be modified in this scan are the base frequency and IF gain.
5. The time is recorded/plotted in seconds based on UT Universal Time (UT)
6. Both current UT time and intensity are displayed in the two lower boxes.
7. To begin the scan, go to the Continuum tab at the bottom.
8. Use default parameters unless the lab or your teacher tells you otherwise.
9. Once controls and parameters are set, click Begin Scan, Smiley will begin taking data.
10. After a several seconds you should see data points being plotted on the graph, note how time and intensity changes over your graph. If you do not see major changes in your scan. You may want to run another frequency with a higher IF gain.
11. Run the scan to the time required by the lab or by the instructor.
12. Hit Stop Scan to stop the data collection. If you do not stop the scan it will continue to re-graph the scan starting over from the beginning.
13. Useful Scan data should be saved.
14. Once scanned, refer to Analyzing Smiley Data (segment 2.8)

Proceed to 2.7

2.7 Mapping Scan



PARIPod: 2.7 Mapping Scan

The PARIPod is 4:44 min in length.

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Presentation Slide 2.7



Student Guide: P.11

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Quiz 2.7

Starting Point

1. A mapping scan is basically several spectrum snapshots put together over a source to form a larger map. This is like taking many small photos of an object put together to make a larger one.
2. Set Smiley to target an object.
3. Go to the Mapping Scan tab at the bottom.
4. Use default parameters unless the lab or your instructor tells you otherwise.
5. The scan controls and parameters of a mapping scan are the same as the other scans except there are now two new controls, AZ (Azimuth) and Altitude (ALT). These two controls help guide the speed thus the sampling rate while Smiley zigzags around its target area.
6. A lower rate increases the accuracy of the scan and a higher rate decreases.
7. The scanning range controls the size of the target range. The larger the range, the larger the grid, or map. The X-axis is the Azimuth while the Y axis is the Altitude.
8. Delta shows the current scan positioning.
9. To start your mapping scan, click Begin Scan, Smiley will begin taking data. There will be a 20 second delay before data begins being plotted on the graph, which allows smiley to position itself towards the target. Plots on your graph appear as square grayscale patches. This creates a mosaic map, which is a composite image of the target. Analyze or rescan data according to variations in your map. Depending on the variation in your graph, you may want to rescan with a higher IF gain.
10. The Scan will automatically stop once it has scanned the set map area or you can hit Stop Scan to stop the data collection.
11. Useful Scan data file should be saved.
12. Once scanned, refer to Analyzing Smiley Data (PARIPod 2.8)

Proceed to 2.8

2.8 Analyzing Smiley Data



PARIPod: 2.8

The PARIPod is 6:04 min in length.

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Presentation Slide 2.8



Student Guide: 12 *Quiz 2.8*

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PREPARATION

1. There are two ways to access your data for analysis.
2. After scans save files before conducting analysis.
3. Name files in an organized format to make it easier to identify and locate for future use. 082909scansun is an example.
4. 08 stands for August, 29 stands for the day, and 09 for the year. Scansun identifies the source. The naming system needs to be consistent.
5. All files are saved to the PARI main server and stored under username and type of file.
6. Data analysis can be during a control session or outside of a session

ANALYSIS DURING A CONTROL SESSION:

7. Open saved data all your saved data files for the particular scan will be displayed. By using either plot or list.
8. Plot replots the graph using the data while list displays the data in raw number format. This data can be copied and pasted into a document or other applications such as Excel.

ANALYSIS OUTSIDE OF A SESSION:

9. Login to the Smiley Control Room Manager and locate the Inspect/Analyze Data button and click.
10. The Smiley Data Analysis Center will open.
11. The user selection drop down menu allows you to select the USER (The user is based on your Smiley username). All smiley users will be displayed. Your file(s) are not only accessible by you, but also by all other Smiley users. You can access others files as well.

12. Use file type to select the scan you wish to use and then use file selection to chose the desire file(s)
13. Select desired file(s) and move it to the right column using the arrows and then hit display data. Click on the new window to move it to the front.
14. Data from Spectrum and Continuum scans be displayed in three ways: **plot, table, and text.**
15. Plot format displays the graph with **data points.**
16. Table format presents data in raw numbers format .
17. Text displays data in **raw data format** which can be copied and pasted into another applications such as **Excel** to create graphs.
18. The **graph** features can be accessed through right clicking .
19. Mapping scan data can be viewed as a map or **text**. The map displays the original data map, while text provides the raw data.
20. Below the map view is specific information about the scan. Use the options below to zoom in & out, up or down, and change between greyscale and **colorscale.**

Unit 2 Completed:

Start Unit 3 Labs