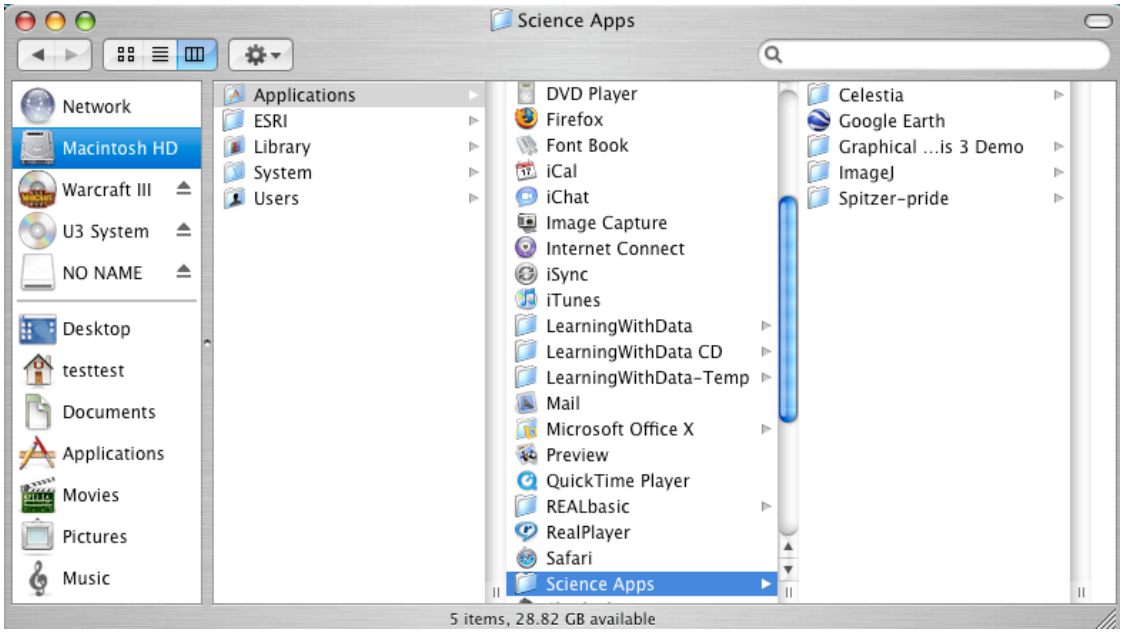
Astronomical Research with the Spitzer Space Telescope

Students enrolled in TESS-Astronomy at Chippewa Hills High School have a unique opportunity. You will have access to data from the Spitzer Space Telescope that can be used to both study the structure and evolution of our galaxy AND do original research on questions that you develop as you learn more about how infrared light can reveal hidden details of the universe around us. This includes how stars and planetary systems like our own solar system form.

We have this access – one of the only schools in Michigan (Grosse Pointe North High School is the only other!) – because I was chosen as one of the last cadre of teachers in the Spitzer Teacher Program (STP). The STP is part of the Education and Public Outreach (E/PO) program for the Spitzer Space Telescope mission – a requirement of getting NASA funding. Several students have been able to participate in actual astronomical research as well. They explored star formation in dark nebulae along with students from 4 other schools across the country. This included a trip to the Spitzer Science Center in Pasadena to work on the data analysis from the Spitzer Space Telescope and a trip to Long Beach to present their findings at a meeting of the American Astronomical Society.

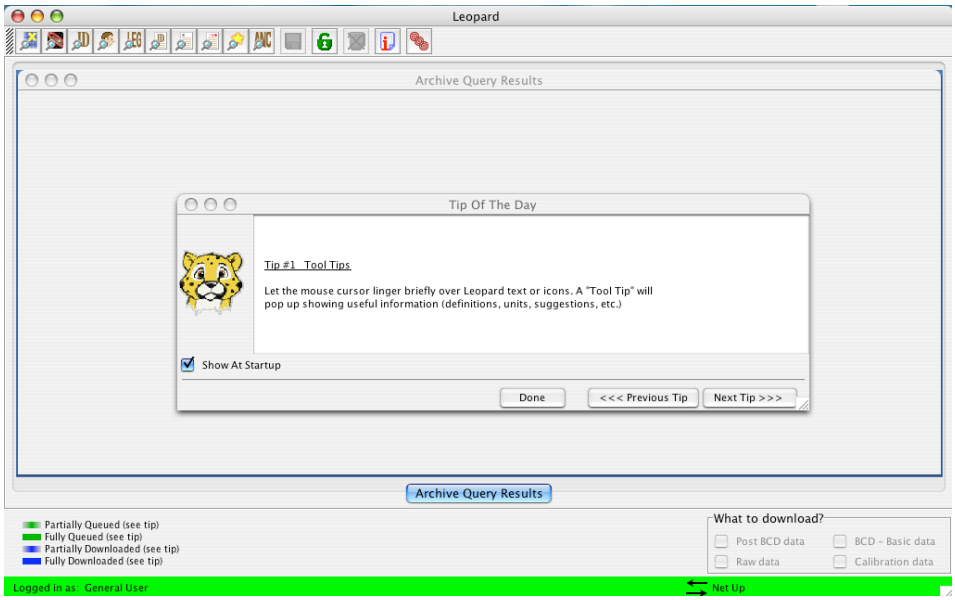
eMac Lab Lesson One – Accessing Spitzer Data

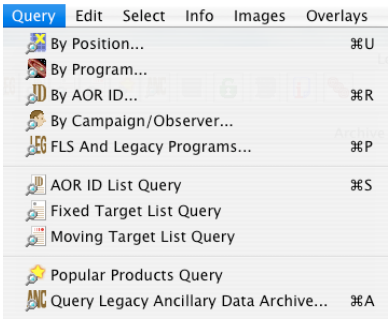
The Spitzer Space Telescope Institute has developed two pieces of software to both get data and set-up targets for additional data acquisition. The software suite is called Spitzer Pride. The Data access component is Leopard. The target evaluation piece is called Spot. This software can be found on your hard drive in a subfolder called **Science Apps** in the folder **Applications**.



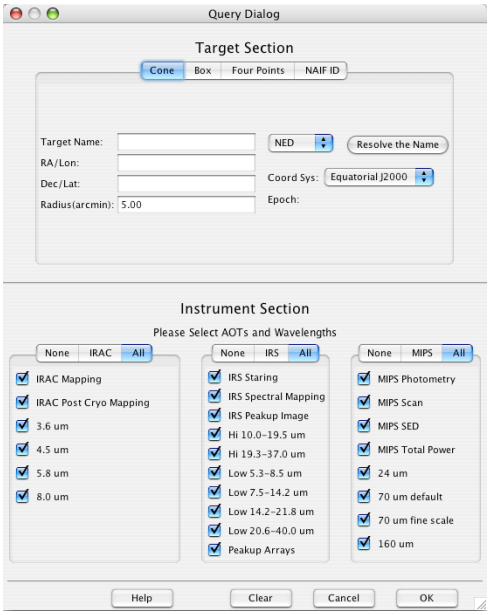
- "Tic-tic" on the Spitzer-pride folder. This sub-folder contains the 2 programs and a PDF version of the user manual for each. These would be handy to read through if you get stuck and I'm busy!
- Open Leopard by double clicking on the file icon.

The opening window looks like what you see below. It provides a "Tip of the Day" every time you open the software. Just click the Done button and go on.





- Choose **Query** from the menu bar. This window is where you set up your request for data from the Spitzer archives.
- For this project – choose **By Position….**

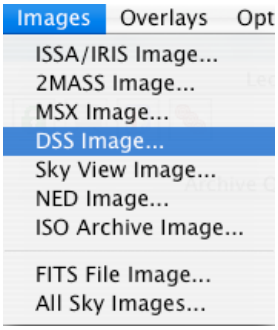


- In the Target Name field enter the name **LDN 951**. Change the searchable database from **NED** to **SIMBAD**.
- Click Resolve the Name.
- The program will search for this object and automatically fill in the RA and Dec when it finds the target.
- Click the OK button (lower right) once Leopard has resolved the name LDN 951.

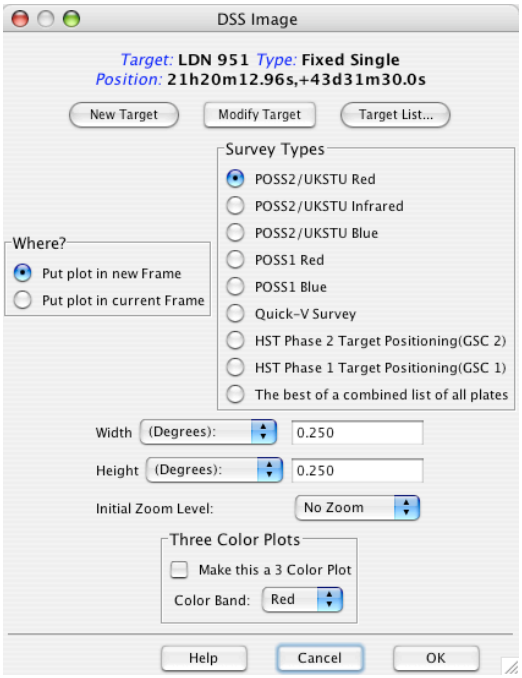
LDN 951 is one of close to 2000 small dark nebulae cataloged by Beverly Lynds in the early 1960's. LDN stands for Lynds Dark Nebulae. These objects are rich in dust and gas – the raw materials for the formation of new stars and planetary systems.

- What are the RA and Dec of LDN 951? Write your answer in your lab notebook. Be sure that you label what object these coordinates refer to!
  ***You will need to go back to the Query window from the menu bar to find this information.**

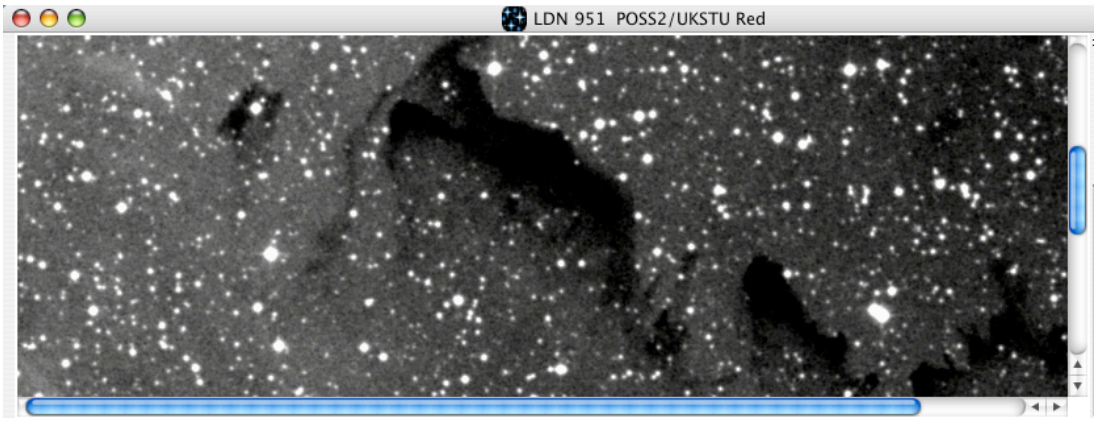
- You will see a server error window pop up after the search completes. This is not necessarily a bad thing. All it means is that this object has not yet been imaged by the Spitzer Space Telescope.
- Go to the Images option on the menu bar. Choose DSS Image from the pop-up window options. DSS stands for Digitized Sky Survey and is a collection of images from many different sources.



- The target information is automatically entered in the DSS Image window. Just click the OK button (lower right corner) and the software will retrieve this image for you.



- This is what you should see:



ANSWER THESE QUESTIONS IN YOUR LAB NOTEBOOK.

- What does LDN stand for?
- Why can't we see inside this cloud?
- What is the DSS?

The Spitzer Space Telescope detects infrared light from objects in space. Infrared is not blocked by the dust and gas in dark nebulae. This allows us to see what is inside them. Often Young Stellar Objects (YSOs) can be found. These objects are infant stars – just beginning their hydrogen fusing existence as main sequence stars.

Often, accretionary disks can be seen around these objects as well – sometimes with gaps between the disk and the central star. These gaps indicate the possible presence of planets – planets that formed by accretion and swept the inner zone of their system free of dust and gas.

NASA's Exoplanetary Exploration project searches for these objects. As technology evolves, it will soon be possible to find earth-like worlds around these stars. Also we can soon use spectroscopy to look for water and oxygen in the atmospheres of planets that are found – the signs of life.

Use the list of LDNs provided and investigate which ones Spitzer has imaged and which ones Spitzer hasn't. Set up a chart or table in your lab notebook to record what you discover.