# Pulsars and Supernova Remnants

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# Content

# Objectives

- Locate a Pulsar
  - Observe it's pulsation period and a starquake
- Examine the Cassiopeia A SNR
  - Measure it's radial velocity and distance from Earth
- Hypothesize possible relations between pulsars and SNRs

# Introduction

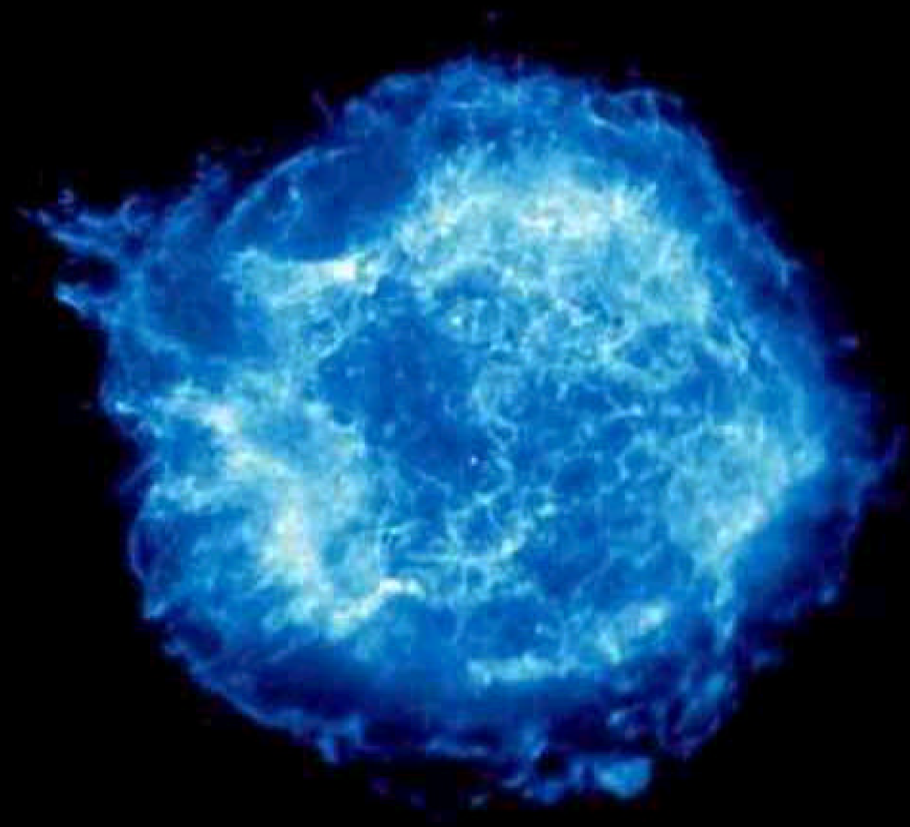
- Pulsars are rotating neutron stars that emit strong electromagnetic radiation

- A starquake is a shift in the surface of a neutron star, causing a sudden increase in the spin and decrease in the length of the period.

-Crab pulsar

# Introduction Continued

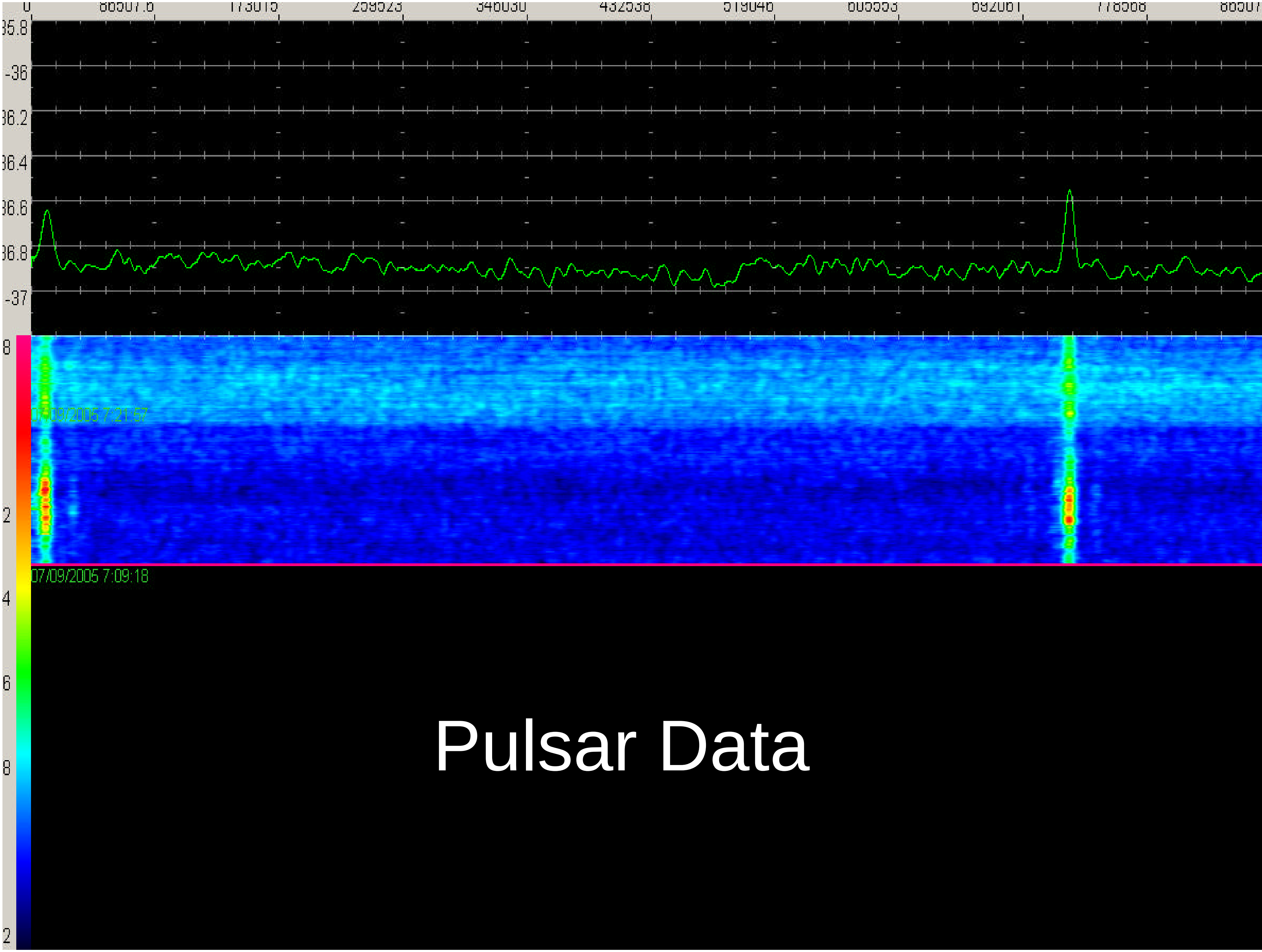
- A supernova remnant consists of the ejected material after a massive star explodes
- It consists of various gases and particles from within the star
- Most supernova remnants have a neutron star, pulsar, or black hole at their center



-Cas A

# Methods - Pulsars

- We identified the pulsars B0329+54 and B0531+21 as good candidates for observation and starquakes
- Due to machine malfunctions, we were unable to due any observing
- Thanks to data previously recorded by Dr. Moffett, we were able to examine a recording made of pulsar B0329

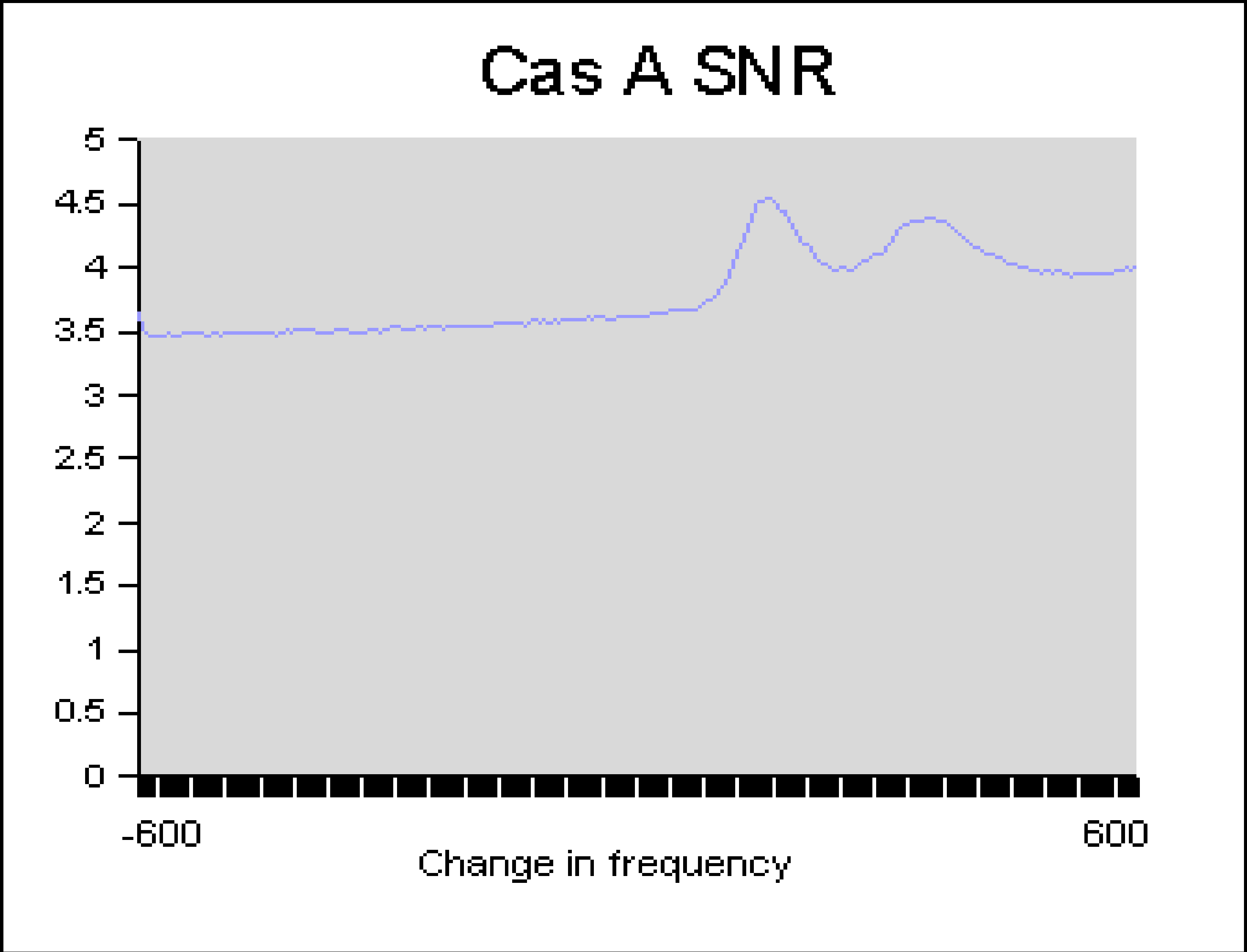

0
86507.6
173015
259523
346030
432538
519046
605553
692061
778568
-36
-37
07/09/2005 7:21:57
07/09/2005 7:09:18

# Pulsar Data

# Methods - SNR

- We collected data with the West 26 meter radio telescope which was later found to be inaccurate
- After examining that data to account for the possibility of absorption from an ionized hydrogen cloud, we recollected data from SMILEY

# Results



# Distance to SNR

- $V = -C( ?f / f_o)$
- $V = Adsin(2l)$
  - A = 1st Oort Constant in km/spc
  - l = Galactic longitude in degrees
  - C = speed of light in Km/s
  - d = distance in Kpc
  - V = velocity in Km/s
  - ?f / f = change in f / original f (MHz)

# Distance to SNR

- $V = -3x10^5\ (.115/1420) = -32.746$ km/s
  **Velocity=-32.746 km/s**

- -32.746 = 14.8dsin(2(111.7))

**Distance = 3.22 Kpc or 10497.2 Lyrs**

# Uncertainty

?f = .115 ± .005 Mhz due to machine uncertainty

A = 14.8 ± .8 due to uncertainty in Oort's 1st constant

**d = 3.22 ± .29 Kpc**

# Discussion

- Although the pulsar B0329 and Cas A are unrelated, pulsars often interact with SNR
  - A SNR with a pulsar at it's center is called a plerion
- Pulsars can loose much of their rotational energy during their lifetime, and in plerions the SNR surrounding the pulsars captures this energy, increasing it's expansion velocity.
- The Crab nebula and pulsar is an example of a plerion.

# Discussion

? Further work can be derived from our data
  - The expansion velocity can be estimated using our graph
  - From this, further characteristics of the SNR can be derived such as mass, diameter, and kinetic energy
  - If the pulsar B0329+54 were to be analyzed, it could be compared to the previous data to determine the difference in rotation and energy

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# Thanks to...

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