THE CRAB PULSAR

Crab Pulsar is a young, rapidly rotating pulsating neutron star formed from the supernova explosion witnessed in 1054 AD.It is one of the few pulsars to be identified optically.

Formation: Like all Neutron stars ,Crab nebula too was formed after the death of a supermassive star with mass between 1.4 to 3 times the solar mass at the time of death.After the life cycle of such a supermassive star ends its gravity wins over the the net outward force and the atoms get squashed thereby drastically reducing the empty space between the subatomic particles to almost zero thus leading to an incredibly dense mass~around 3 times our suns mass in a measly radius of 20 km (around size of a mere city).By conservation of angular momentum,it is expected to have very very high angular velocities.

Properties:

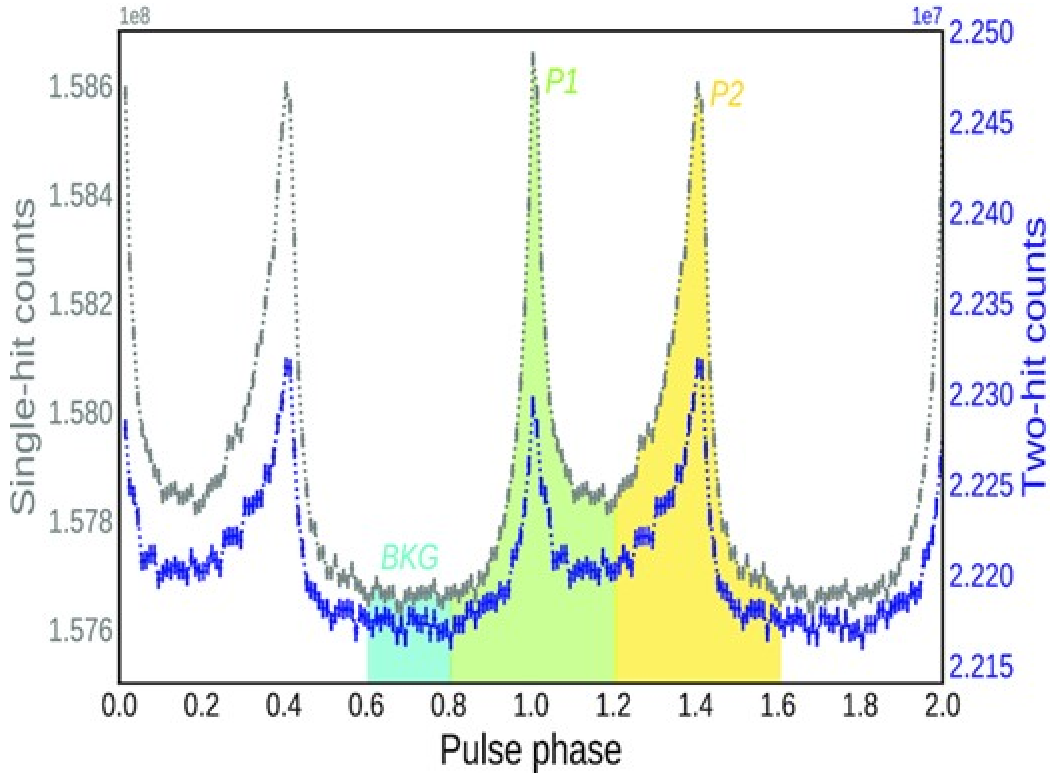
Rotation Rate: It has a rotational period of about 33 ms that is, the pulsar "beams" perform about 30 revolutions per second.

- **Magnetic Field Strength:**The Magnetic field intensity at the pulsar’s magnetic poles is about 7.6* 10^12 Gs.

- **Emission Characteristics:**It emits radiation across the radiation spectrum ranging from Radio to gamma waves .It signifies the loss of its rotational energy.This radiation energy is responsible in igniting the nearby gas and dust particles thereby powering the Crab Nebula.It is the only known entity to give off high energy gamma rays of over 100 TeV magnitude and thus an incredible asset in study of high energy astrophysics.

Observational Studies on Crab Pulsar:

i.Radio wavelengths: Its study reveals the mechanics of the magnetosphere of the pulsar.
ii.X ray and Gamma ray: **In 2019 the Crab Nebula, and presumably therefore the Crab Pulsar, was observed to emit gamma rays in excess of 100 TeV, making it the first identified source of ultra-high-energy cosmic rays.**It helps in understanding the emission mechanism and particle acceleration process.



iii.Infrared: It helps in deepening our understanding about the crab nebula and the pulsars' surrounding.

Future Evolution:

According to current models the crab pulsar like other neutron stars is expected to slow down as it radiates away its rotational energy.However the rate at which it is losing its rotational energy is very very low.So low that it even broke the spin down rate(the lower limit of slowing rate of a pulsars' rotation).Eventually it is expected to transition from a pulsating to non pulsating neutron star.

The Crab pulsar was one of the first pulsars discovered optically.It has helped us immensely to understand the mechanics of neutron stars and supernova remnants.Also it is one of the only sources of high energy gamma rays(energy over 100 Tev) thus playing a pivotal role in high energy astrophysics.It remains a fascinating and useful cornerstone in modern astrophysics research.