

<https://www.observatoiredeparis.psl.eu/where-do-fast-radio-bursts.html>



Where do fast radio bursts come from ?

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Observatoire de Paris - PSL Centre de recherche en astronomie et
astrophysique

(A team from Paris Observatory - PSL proposes an original model able to explain the mysterious "Fast Radio Bursts" (FRB). The study was published in December 2020, in the journal *Astronomy & Astrophysics*.)

These bursts are short, a few milliseconds, and very intense radio wave flashes, the first of which, FRB010724, was detected by chance in 2007. Some of them repeat themselves, others have been seen only once so far, and their distribution on the celestial vault seems homogeneous.

By analyzing their spectral properties, radio astronomers can deduce that their sources are in galaxies far away from ours.

The question of which object can produce such bursts of radio waves remains a mystery. Indeed, if the source emits in all directions of space, it should emit cataclysmic energy comparable to that released by a collision between two stars, but such events are not repeated.

One solution is to assume that the emission is concentrated in a very narrow cone, a bit like a very directional flashlight.

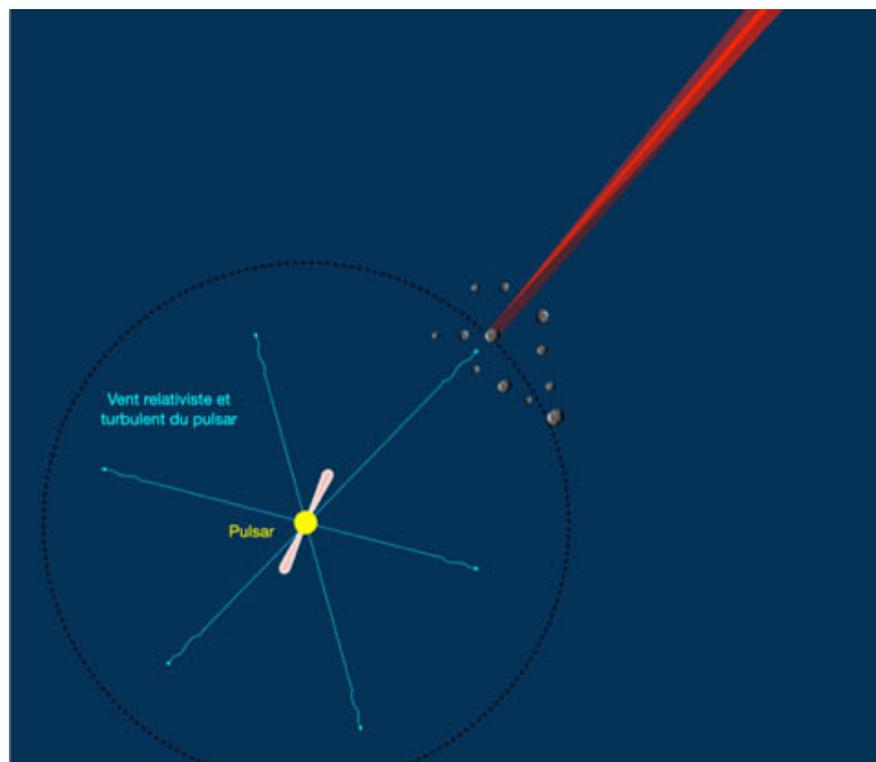


Schéma représentant un essaim d'astéroïdes dans le vent du pulsar. Pour plus de clarté, une seule aile d'Alfvén pour un seul astéroïde est représentée en rouge vif. Lorsque celle-ci pointe momentanément dans la direction de l'observateur, celui-ci voit un FRB. Le cône rouge transparent représente la zone où l'aile d'Alfvén se déplace à cause de la turbulence du vent. La zone rouge foncée représente l'« ombre » de l'astéroïde par rapport au vent du pulsar. © Observatoire de Paris - PSL

Finding an appropriate physical mechanism

(It is there that the researchers of Paris Observatory propose an original idea : the fast radio bursts would result from the perturbation of the very energetic plasma wind blown by pulsars or magnetars by asteroids in orbit around these objects.

Pulsars and their cousins magnetars are highly magnetized neutron stars that are well known to emit such winds blowing almost at the speed of light, nearly 1,000 times faster than the solar wind !

We can then generalize a well-known phenomenon in the solar system : when an asteroid (or a planet) is plunged into the wind, it creates a kind of plasma bow wave called "Alfven's wing". This perturbation is the right place to develop instabilities capable of generating very efficient radio radiation.

When the plasma wind moves at a speed close to the speed of light, a strong phenomenon of relativistic collimation occurs, which concentrates the beam in the direction of the movement of the wind. The motion of the asteroid as well as the turbulence of the wind cause the beam to point randomly in space and cross the direction of the observer for only a fraction of a second. It's all there. (If we refer to the Solar System, asteroids are rarely isolated, but most often members of a belt or a swarm with similar trajectories and not strictly periodic.

Thus according to the astrophysicists of Paris Observatory, the repeater FRB 121102 could be a young pulsar surrounded by an asteroid belt with a radius of less than 10 km between 0.03 and 1 astronomical units, far enough away from the pulsar not to be evaporated by its intense radiation.

The authors of the study also conclude that this mechanism could explain a certain number, if not all, of the other RBFs observed to date, although much theoretical and observational work remains to be done to demonstrate this. (((

Bibliography

Mottez F., Zarka P., Voisin G., Repeating fast radio bursts caused by small bodies orbiting a pulsar or a magnetar, *Astronomy and Astrophysics*, Volume 644, Décembre 2020