"Anomalous" pulsars

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Many astrophysicists believe that Anomalous X-Ray Pulsars (AXPs), Soft Gamma-Ray Repeaters (SGRs), Rotational Radio Transients (RRATs), Compact Central Objects (CCOs) and X-Ray Dim Isolated Neutron Stars (XDINSs) belong to different classes of anomalous objects with neutron stars as the central bodies inducing all their observable peculiarities. We have shown earlier (I.F. Malov and G.Z. Machabeli, Astron. Astrophys. Trans. 25, 7, 2006) that AXPs and SGRs could be described by the drift model assuming usual properties of central neutron stars (rotation periods $P \sim 0.1 - 1$ s and surface magnetic fields $B \sim 10^{11} - 10^{13}$ G). Here we shall try to show that some differences of considered sources will be explained by their geometry (particularly, by the angle β between their rotation and magnetic axes). If $\beta \lesssim 10$ deg (the aligned rotator), the drift waves at the outer layers of the neutron star magnetosphere should play a key role in the observable periodicity. For large values of β (the case of the nearly orthogonal rotator), an accretion from the surrounding medium (for example, from the relic disk) can cause some modulation and transient events in emitted radiation. Recently Kramer et al. and Camilo et al. (Astro-ph/0702365 and Astro-ph/0802.0494v1) have shown that AXPs J1810–197 and 1E 1547.0–5408 have both small angles β, that is these sources are nearly aligned rotators, and the drift model should be used for their description. On the other hand, Wang et al. (Nature, 440, 772, 2006) detected IR radiation from a cold disk around the isolated young X-ray pulsar 4U 0142+61. This was the first evidence of a disk-like object around the neutron star. Probably there is the bimodality of anomalous pulsars. AXPs, SGRs and some radio transients belong to the population of aligned rotators with $\beta < 20$ deg. These objects are described by the drift model, and their observed periods are connected with the periodicity of drift waves. Other sources have $\beta \sim 90$ deg. Switching on or off their radiation is caused by accretion phenomena connected with a relic (debris) disc surrounding them. XDINSs and CCOs are probably neutron stars with rather low magnetic fields on their surfaces. Other known models of "anomalous" pulsars are briefly discussed.