PULSAR WIND FORMATION

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24.4.2003 }

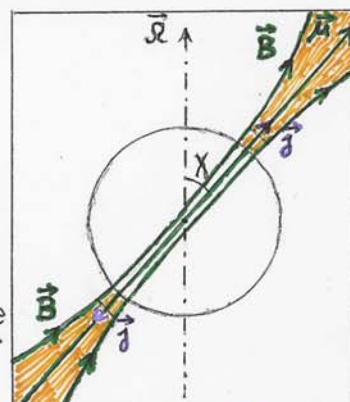
1) Observed *Bowshocks* of $\gtrsim 12$ pulsars imply large outgoing momenta $\xi \langle\gamma\rangle = 10^{7\pm1}$, where $\xi := \dot{N} / \dot{N}_{GJ}$ is the neutral-excess factor. Often: $\xi = 10^{4\pm1}$ can be inferred.

2) *Forcefree Magnetosphere* versus strong *Wind Formation*:
E.W. Hones & J.E. Bergeson, 1965: J. Geophys. Res. 70, 4951-4958: Magnet. Rotator.
P. Goldreich & W.H. Julian, 1969: Astroph. J. 157, 869-880: Aligned Rotator.
L. Mestel, 1971: Nature Phys. Science 233, 149-152: Pulsar Magnetosphere.
J. Krause-Polstorff & Michel, F.C., 1985: MNRAS 213, 43p: Aligned Electrosphere.
W. Kundt & R. Schaaf, 1993: Astrophys. Sp. Sci. 200, 251-270: Pulsar Problem.
A.K. Harding & A.G. Muslimov, 1998: Astroph. J. 508, 328-346: Particle Acceler. Zs.
F.C. Michel, 2002: COSPAR review paper, 14 pp: Pulsar Theory.
U. Geppert, 2003: talk presented at Bonn in February: Inner PSR Acceleration Region.

$$\left\{\begin{aligned} \rho_{HB} &= -(3\Omega B R^3 / 8\pi c r^3)\,\{[\cos 2\theta + 1/3]\cos\chi + \sin 2\theta \sin\chi \cos(\varphi - \omega t)\}, \\ \sigma_{HB} &= -(\Omega B R / 8\pi c)\,\{[\cos 2\theta + 1]\cos\chi + \sin 2\theta \sin\chi \cos\varphi\} \text{ (for } \vec{B} \text{ continuous)} \end{aligned}\right\}$$

$$\Rightarrow \quad E = 4\pi(\rho h + \sigma) \approx \Phi / h \overset{\sigma=0}{=} 10^{6.3}\,(\mathrm{V/cm})\,(\vec{\Omega}\cdot\vec{B})_{14}\, h_0, \quad \text{i.e. } \boxed{\gamma = 4\,(h/\mathrm{cm})}.$$

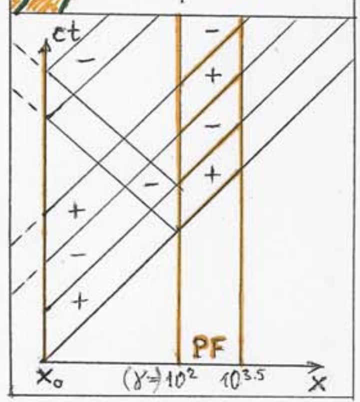
3) *Constraints*:
a) Downward currents generate a *Pair Corona* of scale height $h = kT/mg = 10^{3.6}\mathrm{cm}\,T_{6.5}$.
b) The pair corona implies a vanishing *Work Function* of the surface.
c) The pair corona causes the surface charge layer σ to be *unstable*.
d) Outward moving *Relativistic Pairs escape* to ∞.
e) Beyond the Speed-of-light Cylinder, the *Strong Outgoing Wave* acts like a suction pump on all charged particles.
f) The n*'s *Effective Surface* is at $n_{pc} = n_{HB}$, viz. at $x \approx 10^4$ cm.
g) Wind generation along magnetic flux tube through the n*'s center is *symmetric*; i.e. we deal with a 1-sided problem, (see figure).
h) $\langle\vec{j}\rangle = 0$ must hold for a non-charging n* ; also bec. of high inductive resistivity.



4) The simplified (*cold, 1-d*) *Equations* read: (generalized Child's Law)

$$\boxed{\begin{aligned} \partial_x E &= 4\pi(\rho^+ - \rho^- - \rho_{HB}) \\ \partial_{ct} E &= 4\pi(\rho^+\beta^+ - \rho^-\beta^-) \\ \dot{\rho}^\pm &:= \beta^\pm \partial_x \rho^\pm + \partial_{ct}\rho^\pm = 0 \\ \dot{\gamma}^\pm &:= \beta^\pm \partial_x \gamma^\pm + \partial_{ct}\gamma^\pm = \pm(e/mc^2)\,E\,\beta^\pm \end{aligned}} \quad \left\{\begin{aligned} \dot{} &:= d/d\,ct \\ \gamma^\pm &:= (1-\beta^{\pm 2})^{-1/2} \end{aligned}\right\}$$

plus pair formation: $\gamma(e^\pm) \in (10^2, 10^{3.5}) \Rightarrow \rho^\pm(\gamma) \rightarrow$
$\sum_{0}^{\xi}{}_k\,[\rho^\pm_k(\gamma - \gamma^2 h\nu) + \rho^+_k(\gamma^2 h\nu/2) - \rho^-_k(\gamma^2 h\nu/2)]$.



5) To be solved for $(x, ct) \geq 0$, i.e. in positive quadrant, for suitable boundary conditions at $t = 0$ (should be unimportant at large t, for reasons of stability) and at $x = x_o$: ...