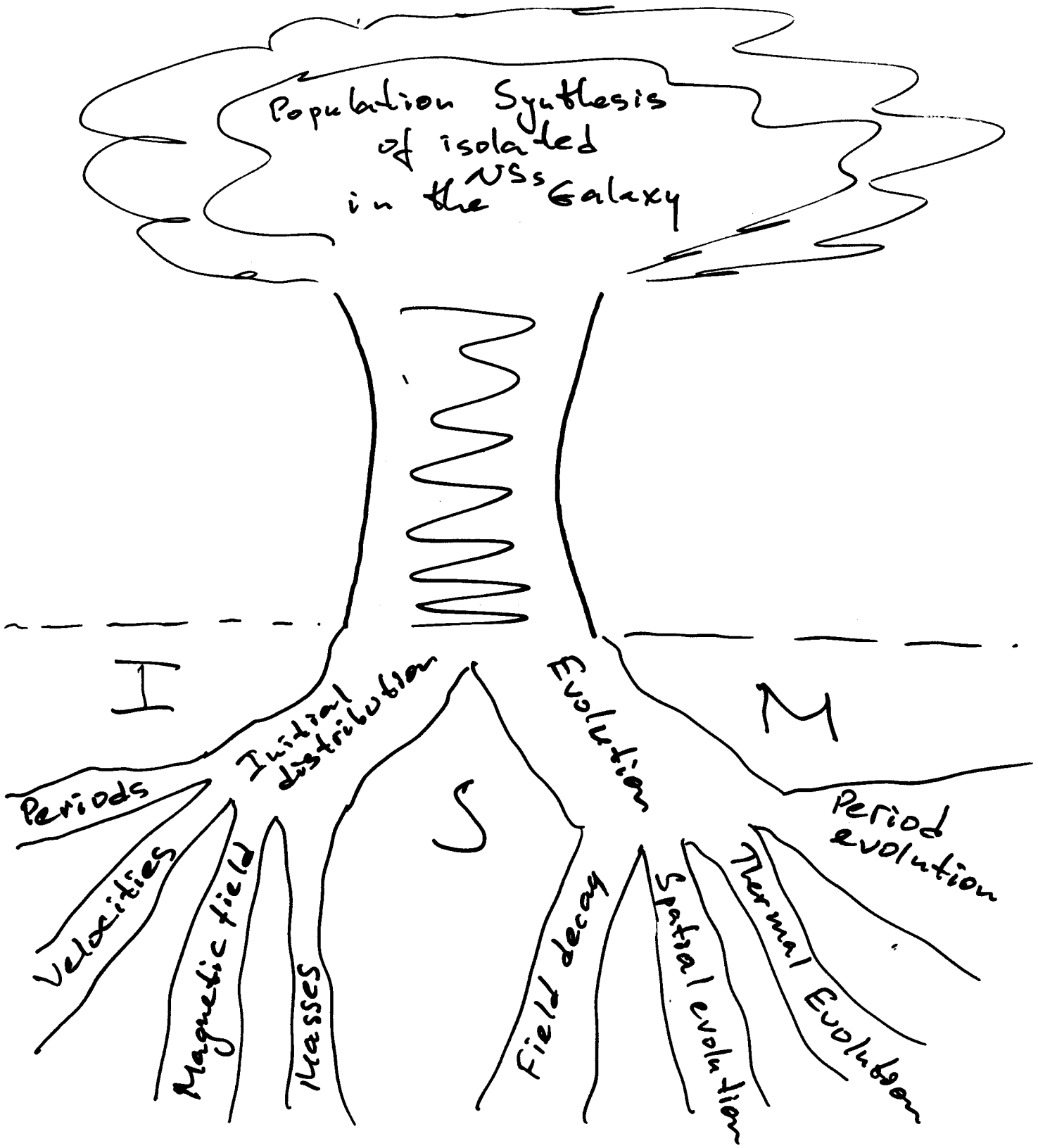
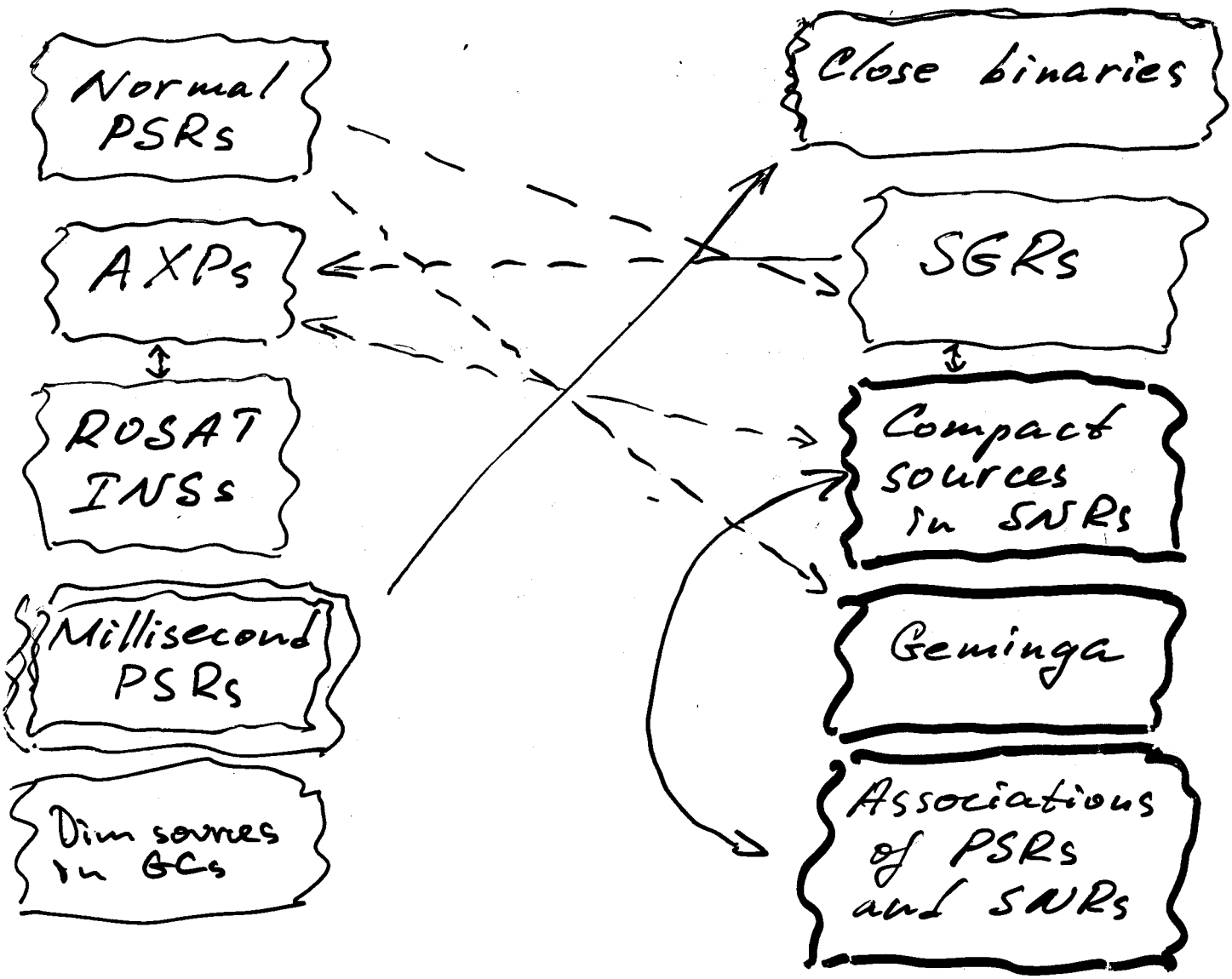
Roots to Branches



NS Mosaic for theorists.



"Population" consequencies!

Magneto-rotational evolution.

Four stages: **Ejector, Propeller, Accretor, Georotator**

E: $R_{stop} > R_c$, $R_{stop} > R_G$; $P \simeq 3\cdot 10^{-4} \mu_{30} t^{1/2}$ sec, $\mu = \frac{B}{2} R^3$

$t_E \simeq 10^9 \mu_{30}^{-1} n^{-1/2} v_{10}$ yrs (for $\mu = const$).

P: $R_{stop} < R_G$, $R_{co} < R_{stop}$; $\frac{dP}{dt} = \frac{\dot{M} R_A^2 P}{I}$ (Shakura, 1975)

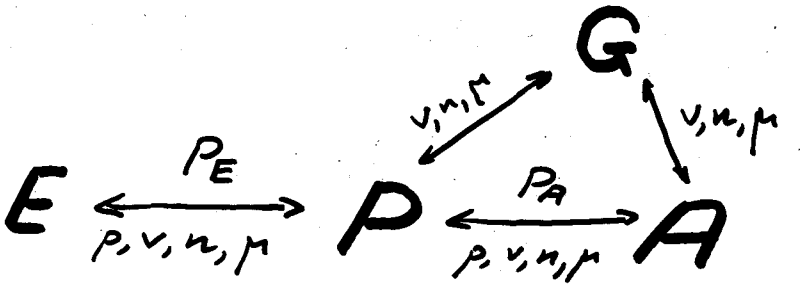
$t_P \simeq 1.3\cdot 10^6 \mu_{30}^{-8/7} n^{-3/7} v_{10}^{9/7}$ yrs (($\mu = const$).

A: $R_{stop} < R_G$; $R_{stop} < R_{co}$;

$P = P_{eq} = 2.6\cdot 10^3 v_{t10}^{-2/3} \mu_{30}^{2/3} n^{-2/3} v_{10}^{13/3}$ sec

(Konenkov & Popov 1997; Lipunov & Popov 1995)

G: $R_{stop} > R_G$; $V > 410\, n^{1/10} \mu_{30}^{-1/5}$ km/s



$P_E\,(E \to P) \simeq 11{,}5\, \mu_{30}^{1/2} n^{-1/4} v_{10}^{1/2}$ sec

$P_E\,(P \to E) \simeq 3\, \mu_{30}^{4/5} n^{-2/7} v_{10}^{6/7}$ sec (Shvartsman, 1970s)

$P_A = 420\, \mu_{30}^{6/7} n^{-3/7} v_{10}^{9/7}$ sec

Magneto-rotational evolution.

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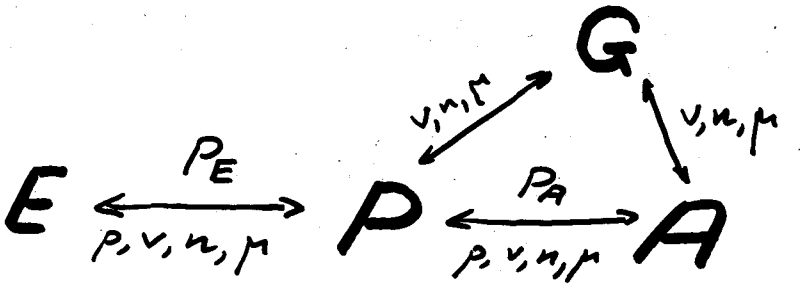

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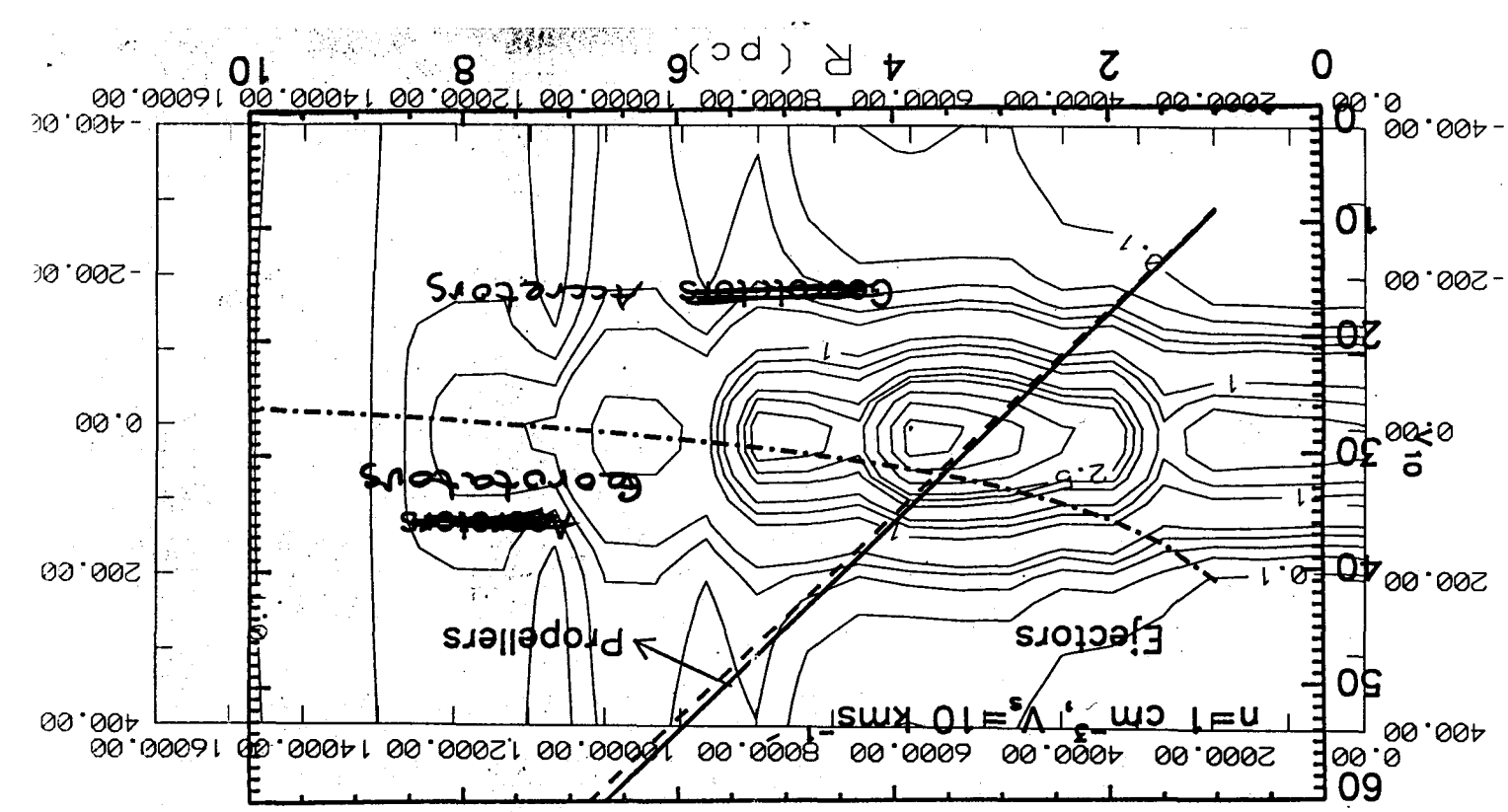
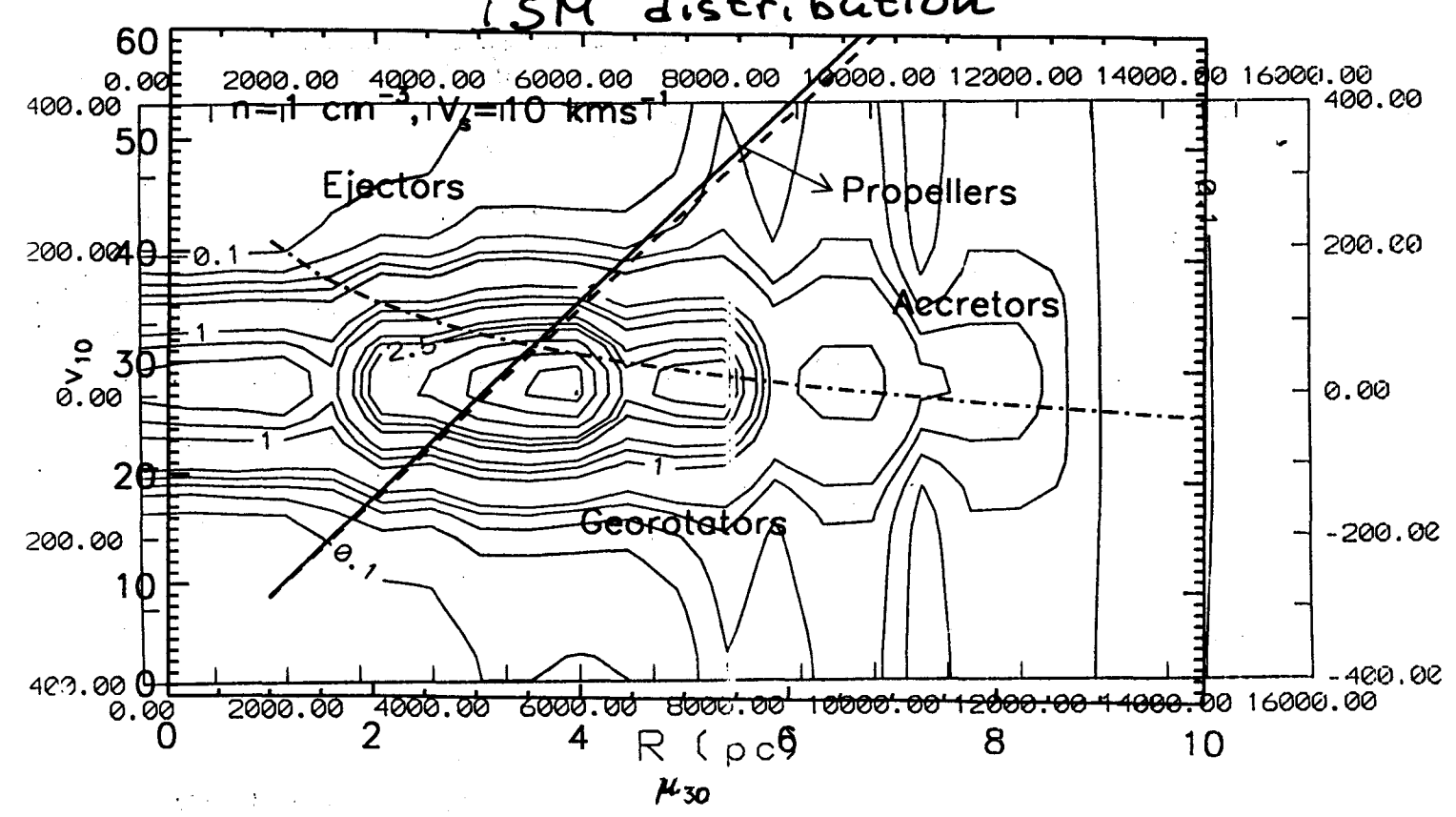
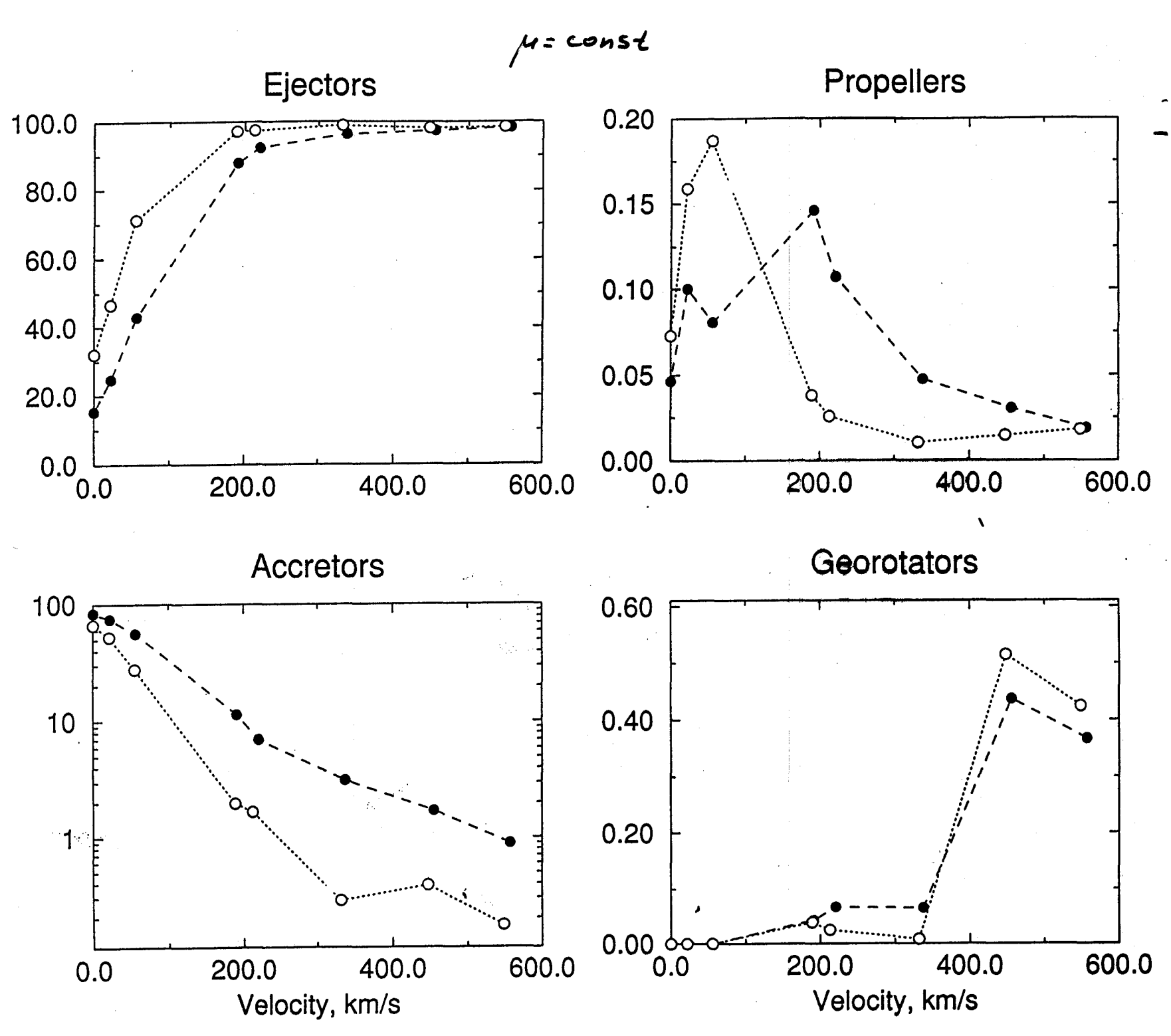


ISM distribution



μ = const



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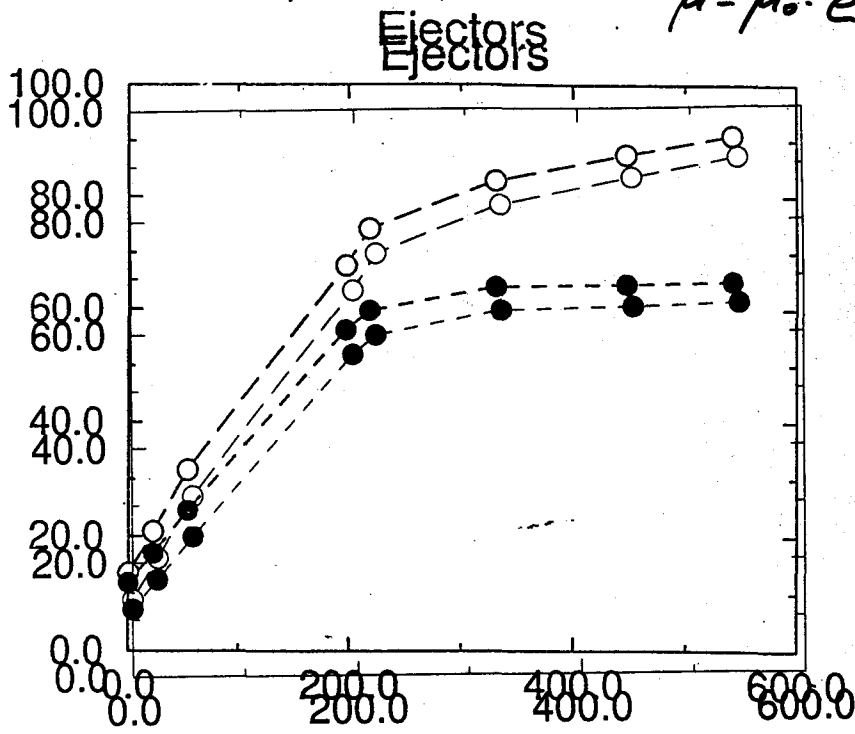
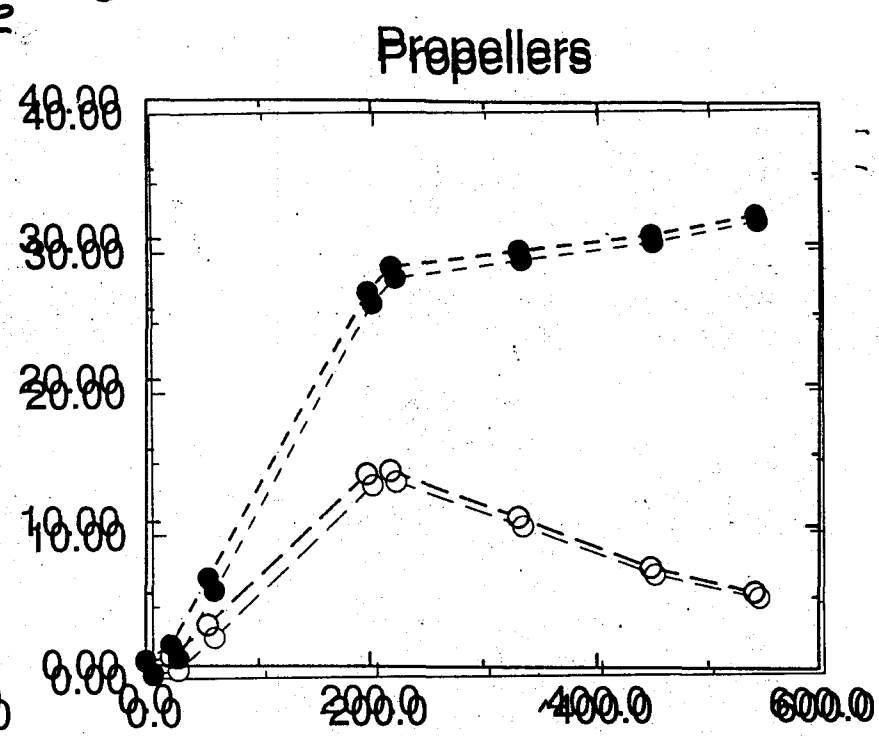
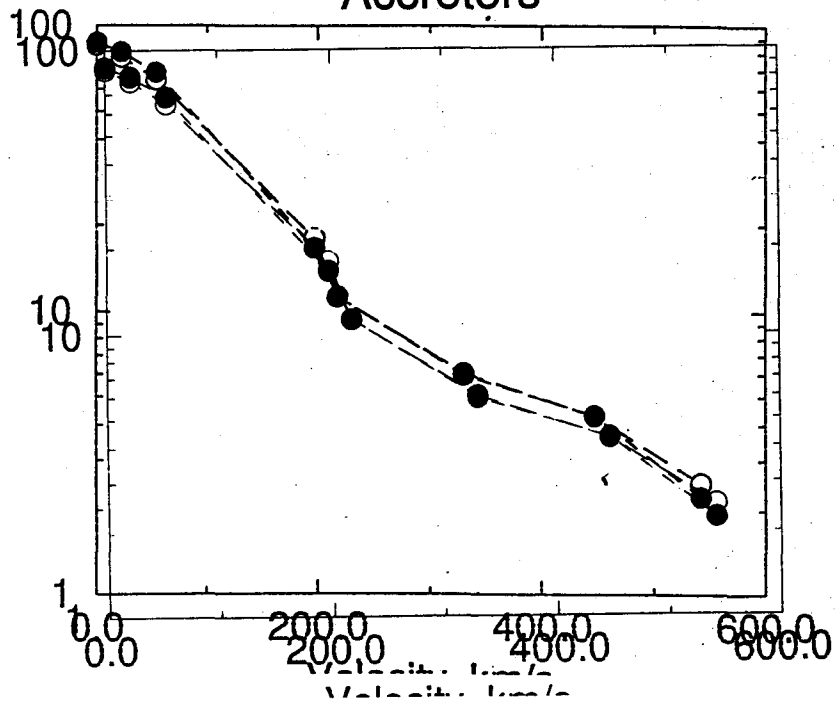
$\mu = \mu_0 \cdot e^{-t/t_d}$

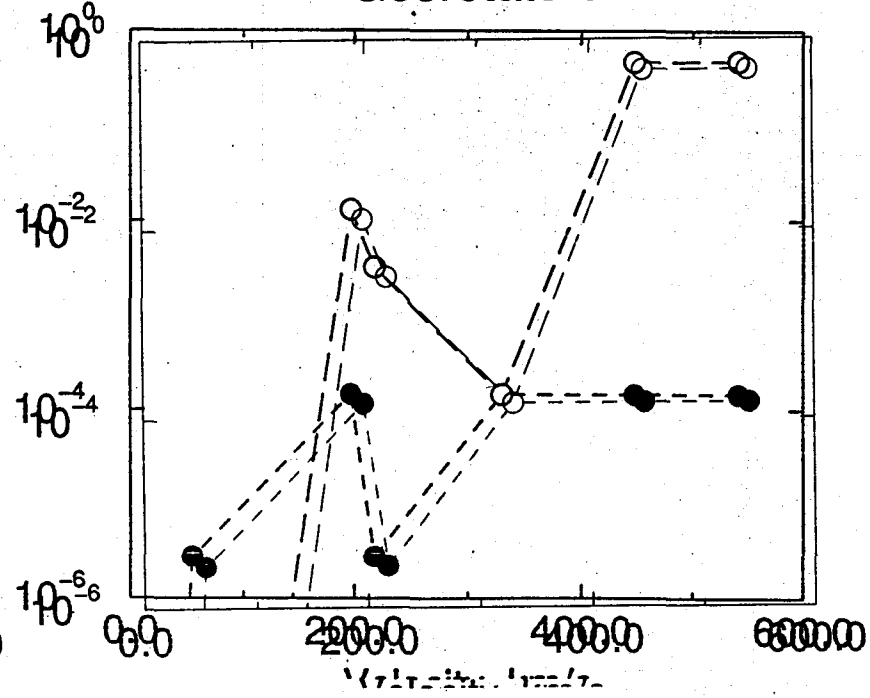




$-\circ-$ $t_d = 2.2 \cdot 10^9$ yr

$-\bullet-$ $t_d = 1.1 \cdot 10^9$ yr





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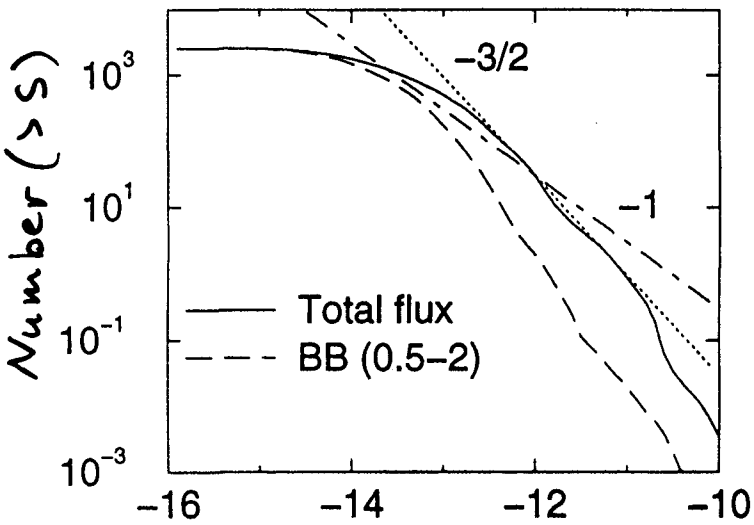
ApJ 530, p 896 2000

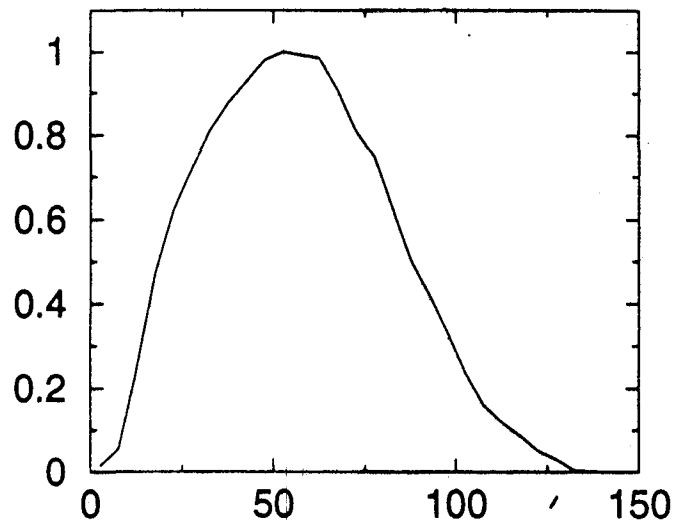
Log N – Log S

for unabsorbed flux (r<500 pc)



Velocity distribution

for accretors



14820 tracks

$f(\mu) = \frac{1}{\sqrt{2\pi}\sigma} \cdot e^{-\frac{(\lg\mu - \lg\mu_0)^2}{2\sigma^2}}$

(pulsar distribution)

Maxwellian velocity distribution $\langle V \rangle \sim 300$

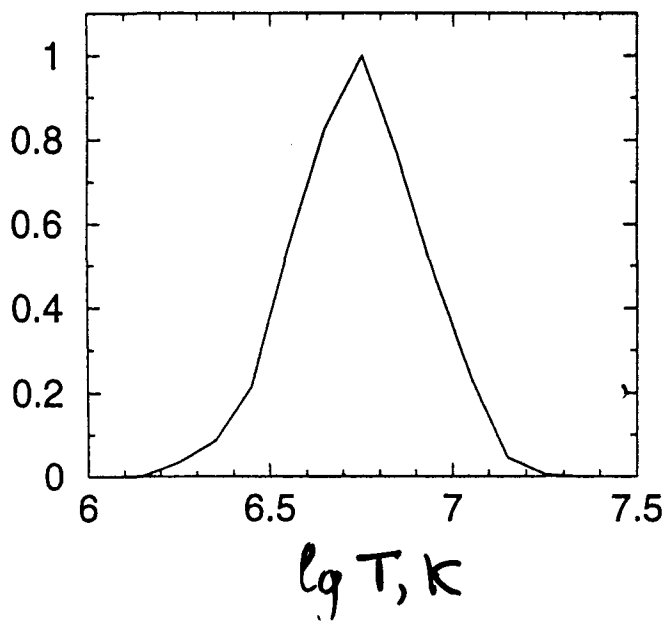
$P_0 = 0.02$ s

E ⟷ P ⟷ A

V, km·s^{-1}

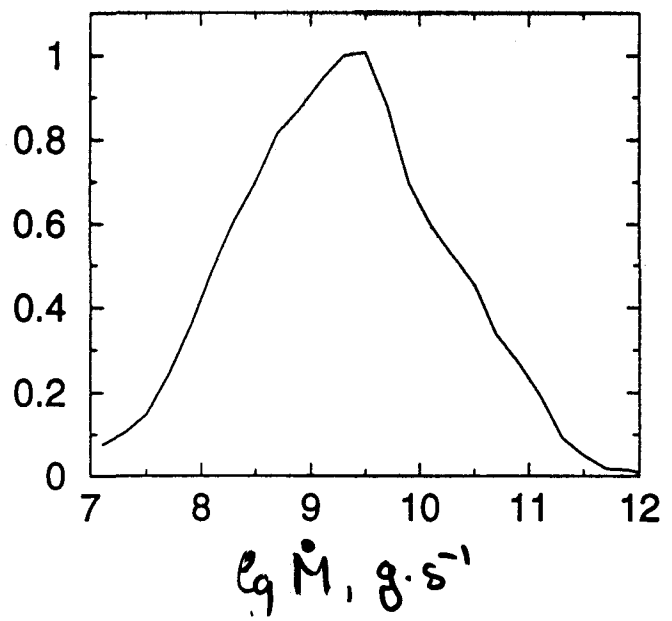
Temperature distribution

for accretors



Mdot distribution

for accretors



Temperature!

Polar caps

$L = 2\pi R_{cap}^2 \sigma T^4$

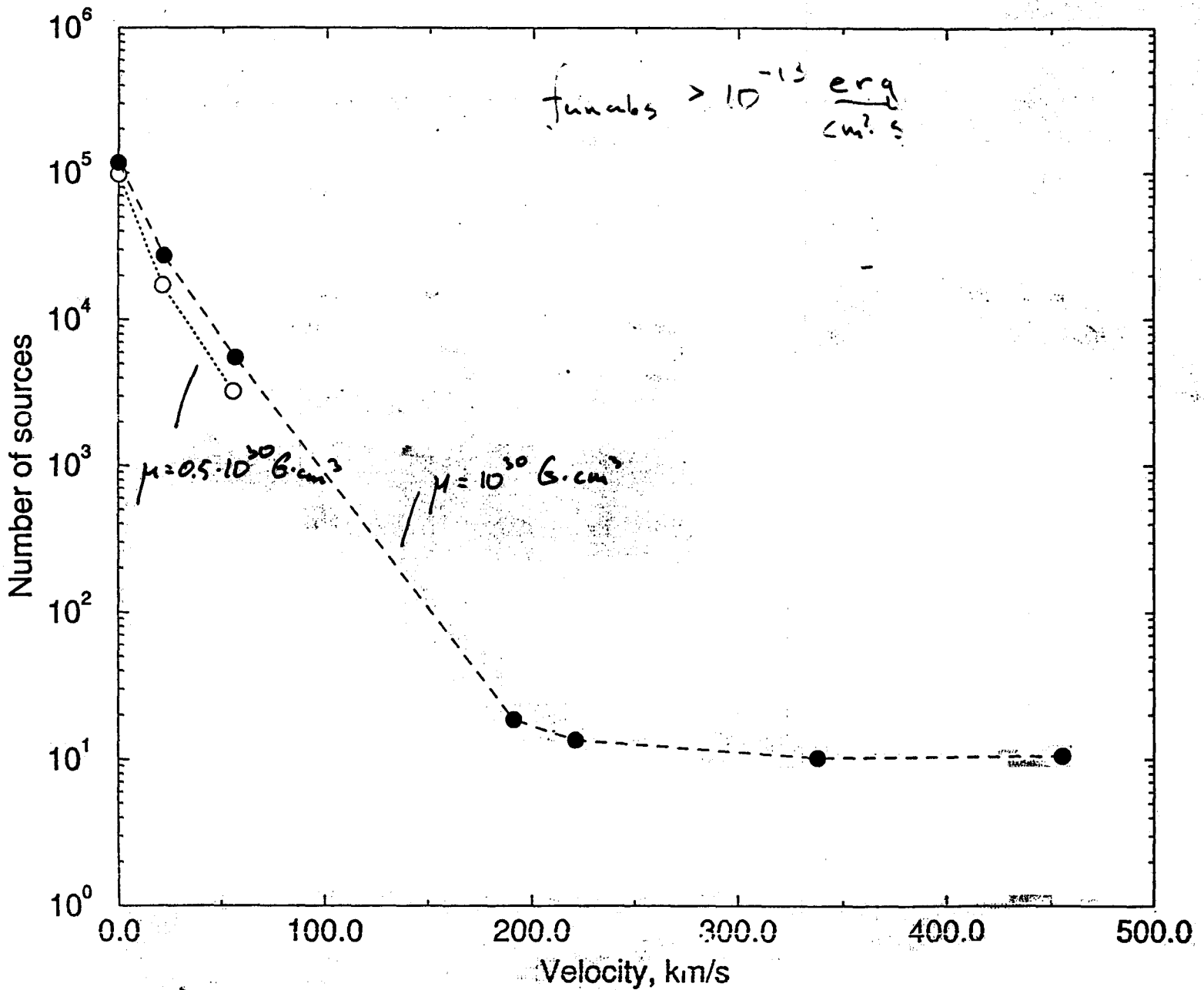
$R_{cap} = R \cdot \sqrt{R/R_A}$

For $\langle V \rangle \sim 200$ km/s

↑ 3.12

A.J 544 <c3

Bright (ROSAT) Accreting NS
in the Solar vicinity (≲140pc).



Popov et al.
astro-ph
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WHAT'S NEW? (2002-2003: Observations I.)

astro-ph/0312369

1. Magnetic field determination

- AXP 1E 1048-5937. $B \sim 1.2 \cdot 10^{12}$ G or $B \sim 2.4 \cdot 10^{15}$ G (Gavriil et al. 2002, 2003). Not very clear.... Not consistent with spin-down.
- 1E 1207.4-5209. CCO in SNR. $B \sim 8 \cdot 10^{10}$ G or $\sim 1.6 \cdot 10^{14}$ G (Bignami et al. 2003). From spin-down $B \sim (2-3) \cdot 10^{13}$ G.
- SGR 1806-20. $B \sim 10^{15}$ G (Ibrahim et al. 2002).
- AXP 1RXS J170849-400910. $B \sim 9 \cdot 10^{11}$ G or $1.6 \cdot 10^{15}$ G (Rea et al. 2003).
- RBS 1223. "Magnificent seven". $B \sim (2-6) \cdot 10^{13}$ G (Haberl et al. 2003).
- RX J0720.4-3125: "Magnificent seven". $B \sim 5 \cdot 10^{13}$ G (Haberl et al., private comm.).

2. Relations between AXPs and SGRs

X-ray burst very similar to the ones from SGRs.

- AXP 1E1048-5937 (Gavriil et al. 2002, 2003).
- AXP 1E 2259+586 (Kaspi, Gavriil 2002).

3. More radiopulsars.

- ATNF catalogue (Hobbs et al. 2003).
- Parkes survey (Morris et al. 2002).

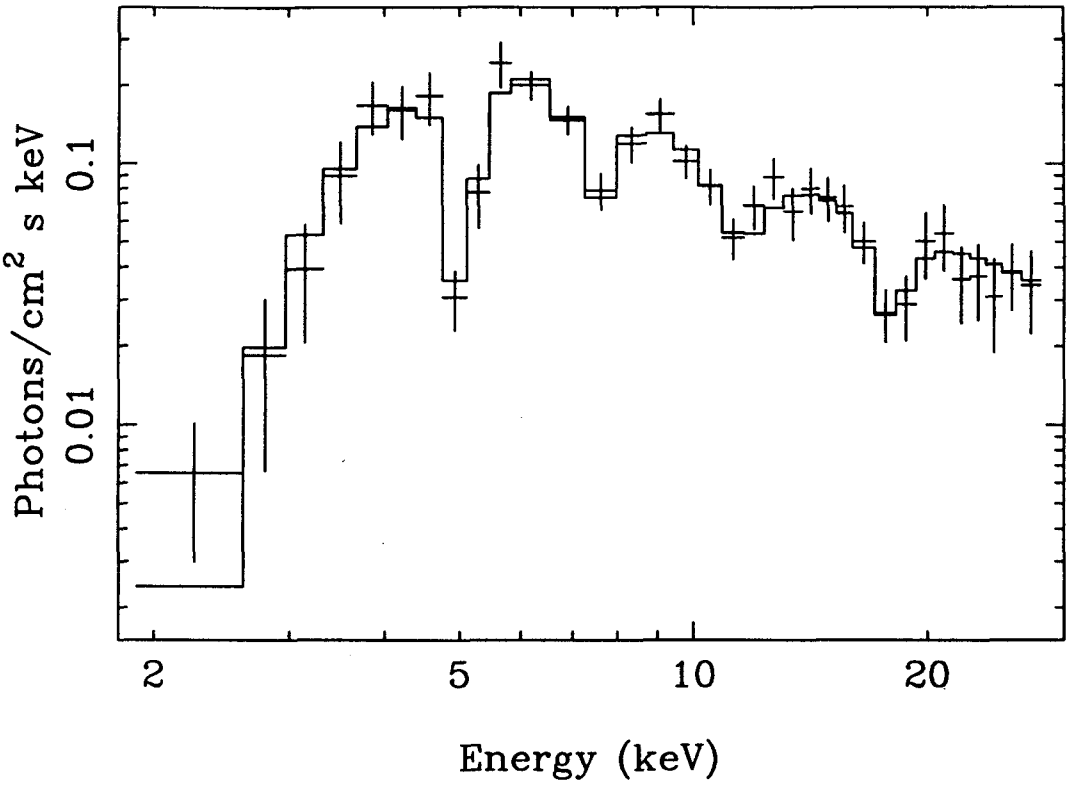
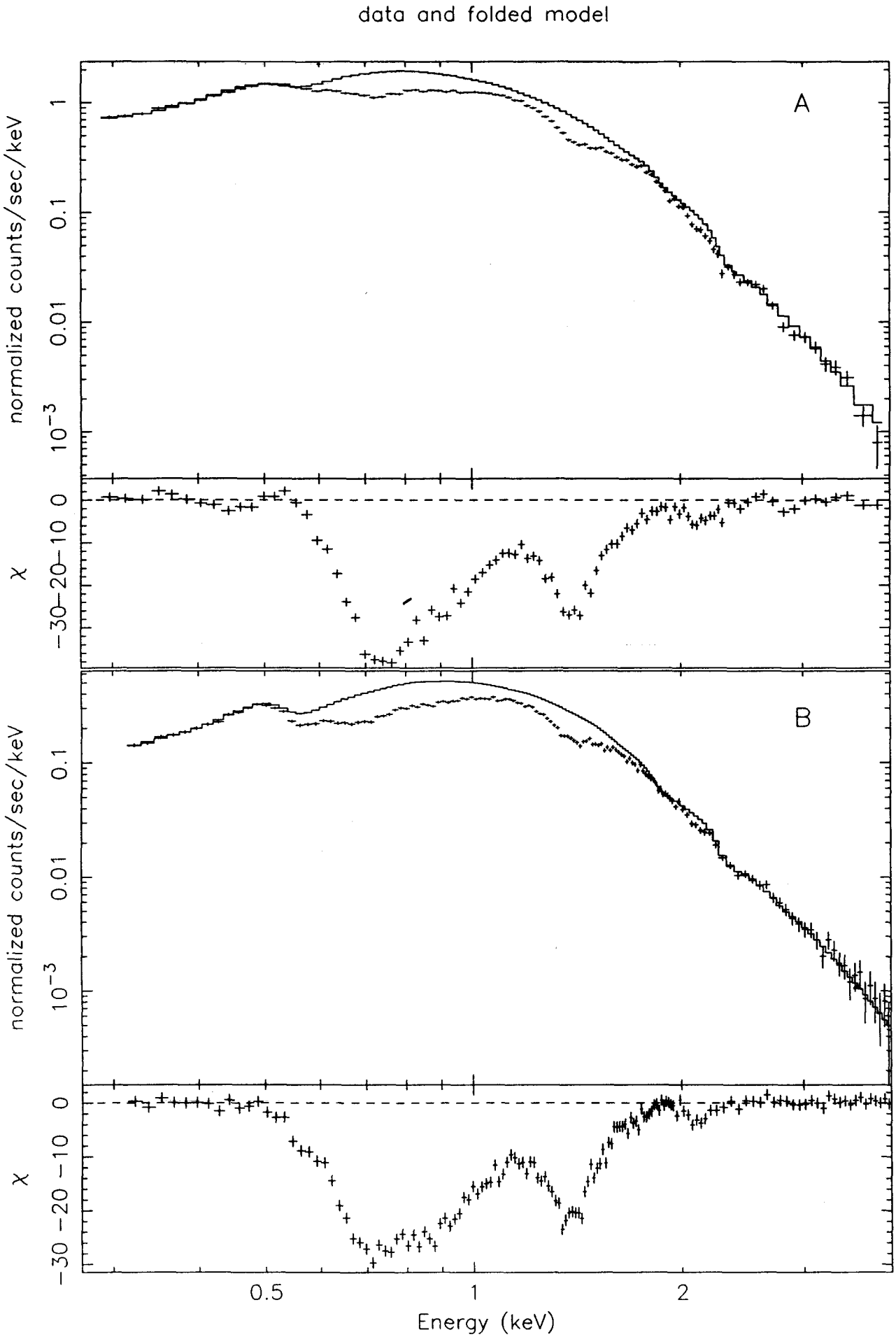


Figure 2: Spectrum of SGR 1806-20. From Ibrahim et al. 2002 (astro-ph/0210523).



Bignami et al. (2003)

1E 1207.4−5209

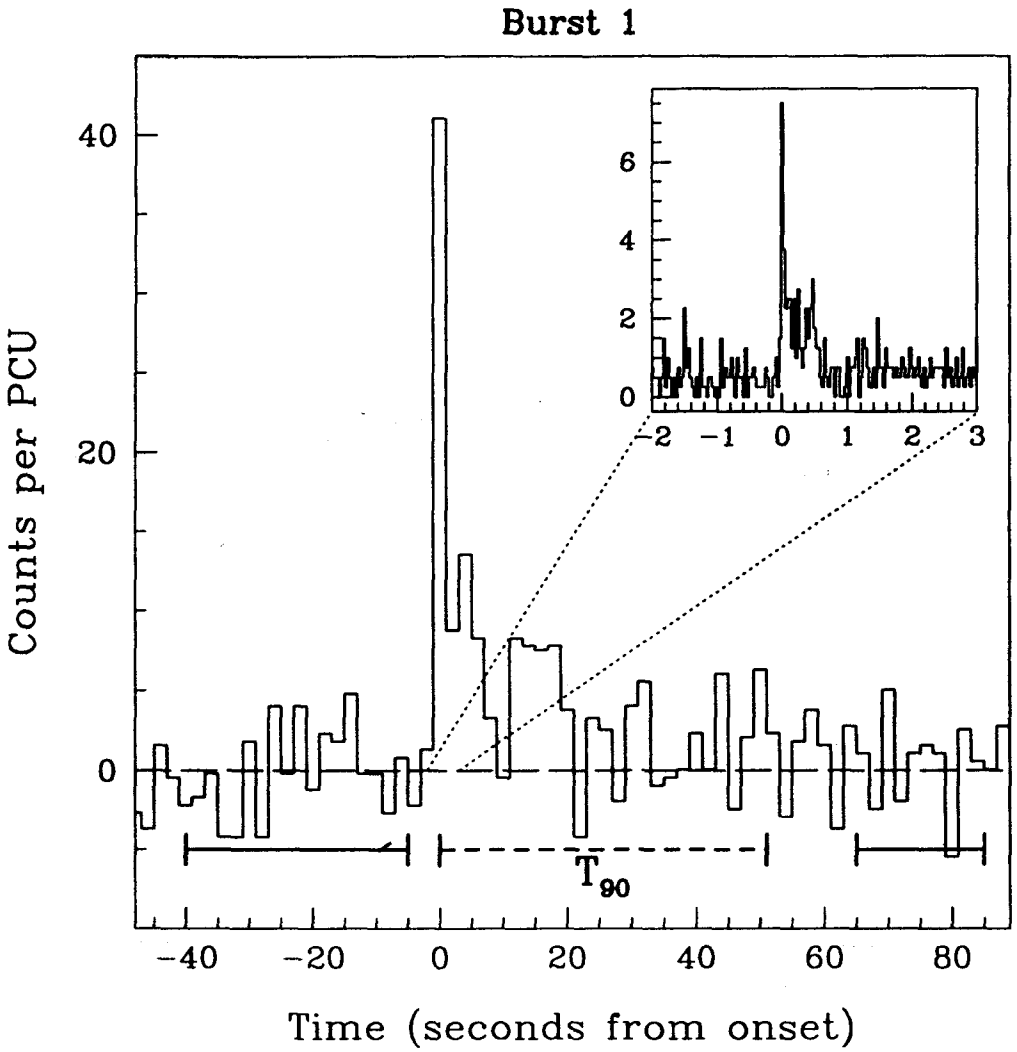


Figure 1: AXP 1E 1048-5937 burst. From Gavriil et al. 2002 (astro-ph/0209202).

WHAT'S NEW? (2002-2003: Observations II.)

4. NS velocity distribution

- Two components: 90 km/s and 500 km/s (Arzoumanian et al. 2002).
- New pulsar proper motions (Brisken et al. 2003).
- New Model for the Galactic Distribution of Free Electrons (Cordes, Lazio 2002).

5. Proper motions of RINSs

- RX 1856.5-3754. $d = 117$ pc, $v_T = 185$ km/s (Walter, Lattimer 2002; Kaplan et al. 2002).
- RX 0720.4-3125. $v_T = 50(d/100\text{pc})$ km/s (Motch et al. 2003).

6. Geminga-like object

- 3EG 1835+5918. EGRET source (Halpern et al. 2002).

7. $\dot{p}$ for RINS.

- RX 0720.4-3125. $\dot{p} \sim (3-6) \cdot 10^{-14}$ (Zane et al. Haberl et al 2002).
- RX 1308.6+2127. $\dot{p} < 10^{-11}$ (Hambaryan et al. 2002).

8. IR from AXPs

- 1E 2259+586 (Halleman et al. 2001).
- 1E 1048.1-5937 (Wang, Chakrabarty 2002).
  Variability (Israel et al. 2002).
- 1RXS J1708.9-400910 (Israel et al. 2003).

9. Pulsars jets and toruses

- Variable Jet of the Vela Pulsar (Pavlov et al. 2003)

10. NS masses

- Vela X-1 $M \approx 2\,M_{\odot}$ (Quaintrell et al. 2003).

11. Precession of isolated NSs

- Review (Link 2002).
- Crab (Vidri et al. 2003).

12. Pulsars with magnetar parameters

- $p = 6.7$ s, $B \approx 9.4 \cdot 10^{13}$ G (McLaughlin et al. 2003).

13. 3C 58

- X-ray (Murray et al. (2002).
- Radio (Camilo et al. 2002).
- Cooling (Yakovlev et al. 2002).

14. Gravitationaly redshifted line from an accreting NS

- EXO 0748-676. z=0.35 (Cottam et al. 2002).

WHAT'S NEW? (2002-2003: Observations IV.)

15. $\dot{p}$ for CCO in SNRs

- Kes 75. $p = 0.325$ s, $\dot{p} = 7.1 \cdot 10^{-12}$ (Mereghetti et al. 2002).
- G296.5+10. $p = 0.424$ s, $\dot{p} = (0.7 - 3) \cdot 10^{-14}$ (Pavlov et al. 2002).

16. Pulsar wind nebulae: new data

- X-rays. Correlation between the X-ray spectra of pulsars and their PWN (Gotthelf 2003).

17. BHs in microlensing

- Agol et al. 2002; Bennet et al. 2002.

WHAT'S NEW? (2002-2003: Theory I.)

1. SN explosions

- 3-Dimensional core-collapse (Fryer, Warren 2003).
- Nucleosynthesis, dynamics (Heger, Woosley et al. 2002).
- Jets, GRB, X-ray flashes [HETE-2 data] (Lamb et al. 2003).

2. Gould Belt in population synthesis

- EGRET sources (Grenier, Perrot 2003).
- RINS (Popov et al. 2003).

3. Spectra of strongly magnetized NSs

- Lines for high magnetic field (Turolla, Zane; Ho, Lai; Özel).
- Naked neutron star emission (Turolla et al. 2002).
- Atmospheres + Spectrum for high magnetic field (Potekhin, Chabrier et al.).

4. Accretion

- CDAF (Igumenschev 2002)
- Low angular momentum accretion (Proga, Begelman 2003).
- INS (Toropina et al., Romanova et al. 2003).

5. Cooling curves

- Superfluidity (Kaminker, Yakovlev, Gnedin et al. 2002).

WHAT'S NEW? (2002-2003: Theory II.)

6. Fossil discs

- It can be! (Alpar 2003).
- It can't be! (Francischelli, Wijers 2002).

7. Electrodynamics of magnetars

- SGR (Thompson et al. 2002).

8. Magnetic field decay

- Nonlinear decay (Geppert, Rheinhardt 2002).

9. Gravitational waves

- GW from newborn NSs (Ferrari et al. 2002).

10. Propeller regime

- Subsonic propeller (Ikhsanov 2003).