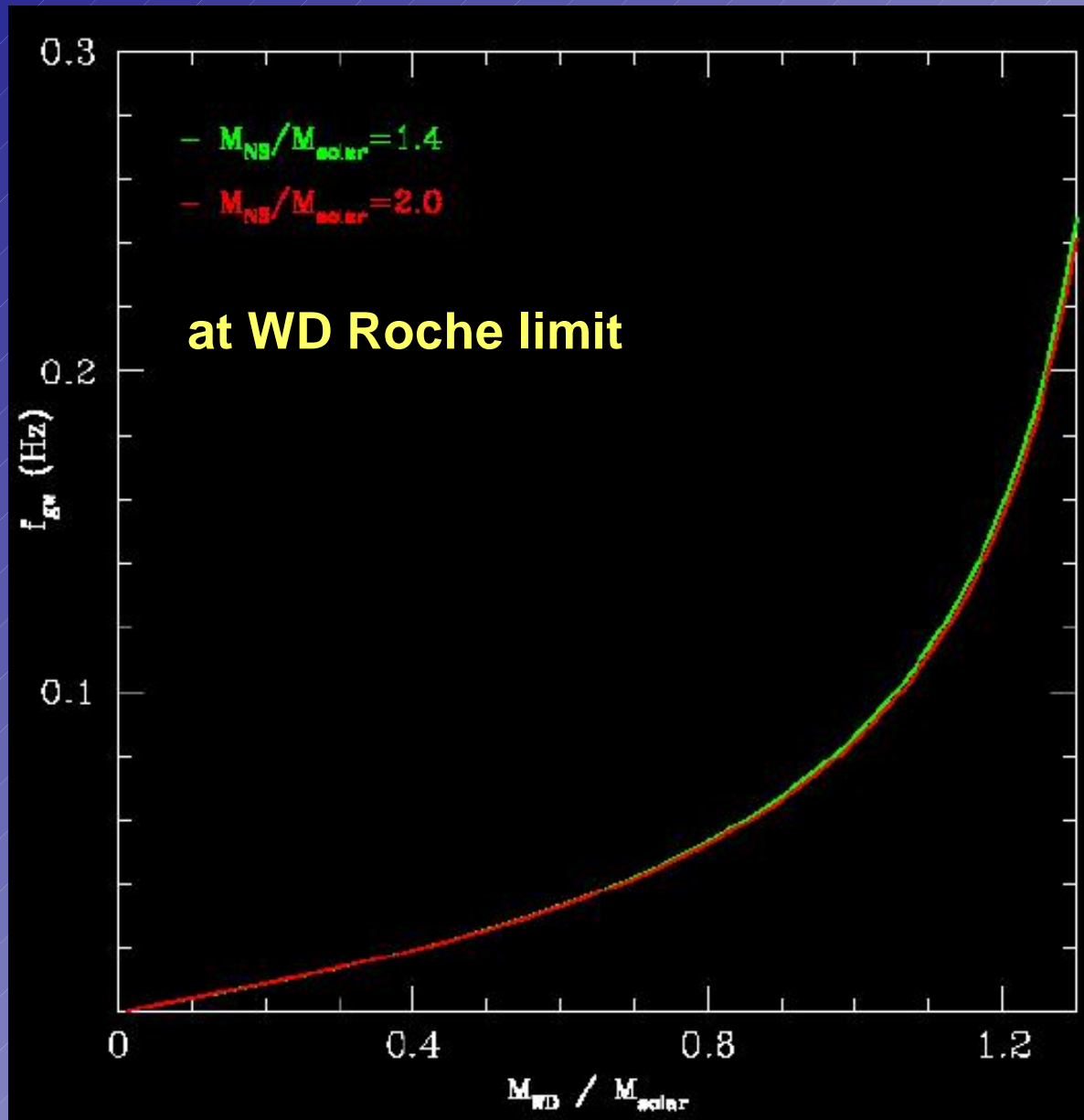


Maximum Inspiral Frequency



PULSAR RATES

HOW?

First obtain estimate of total number:

- Properties of observed sample
- Modeling of PSR-survey selection effects
- Correction factors due to emission processes

Then obtain estimate of rate:

- Lifetime estimates

NS-WD binaries observed as binary radio pulsars

3 binary pulsars with lifetimes comparable to or shorter than a Hubble time are known in the Galaxy:

	age	+ remaining lifetime	WD mass
PSR J0751+1807	8.2 Gyr	7 Gyr	$> 0.1 M_{\odot}$
PSR J1757-5322	5 Gyr	9.5 Gyr	$> 0.55 M_{\odot}$
PSR J1141-6545	1.4 Myr	11 Myr	$> 0.97 M_{\odot}$

PULSAR RATES

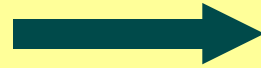
HOW?

Earlier estimates:

→ 'Scale factor' calculation: inverse problem

Density-weighted estimate of the number of PSRs in the Galaxy for every observed one based on V/V_{\max} arguments

Statistical
"Forward"
Approach



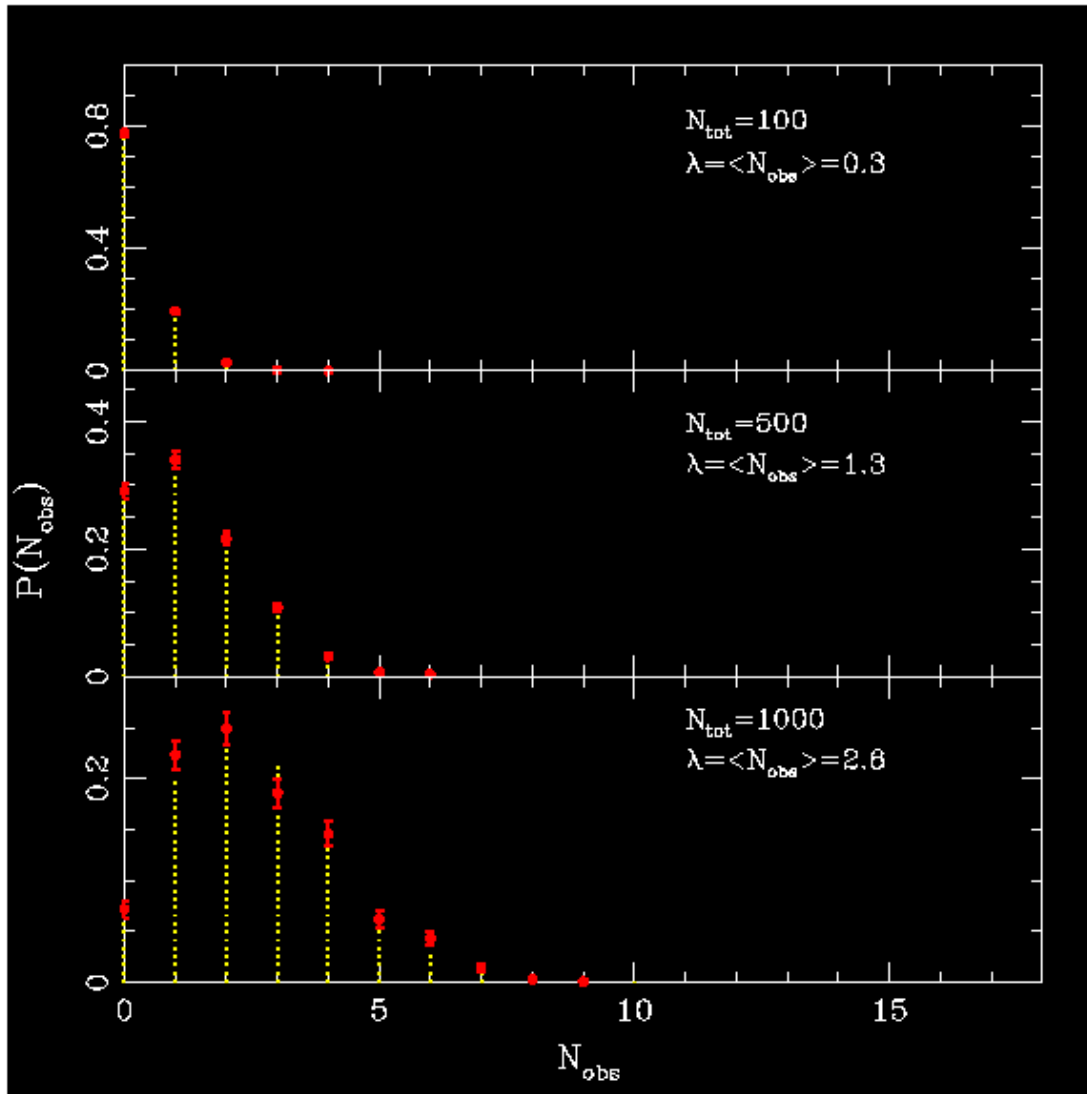
Calculation
of Rate
*Probability
Distribution*

It is possible to assign *statistical significance* to
pulsar *rate estimates* with Monte Carlo simulations

Kim, VK, Lorimer '03

For each observed binary pulsar :

- Choose PSR space & luminosity distribution
- Populate Galaxy with N_{tot} "1141-like" pulsars
- Simulate PSR survey detection and produce observed samples
- Distribution of N_{obs} for a given N_{tot} : Poisson
- Calculate $P(1; N_{\text{tot}})$ for best-fitting Poisson distribution
- Derive $P(N_{\text{tot}})$ (Bayesian analysis) and $P(R_{1141})$
- Repeat for other two observed systems and derive $P(R_{\text{tot}})$



Distribution of number of objects N_{obs} in observed samples:
Poisson

$$P(N_{obs}; \lambda) = \frac{\lambda^{N_{obs}} \exp(-\lambda)}{N_{obs} !}$$

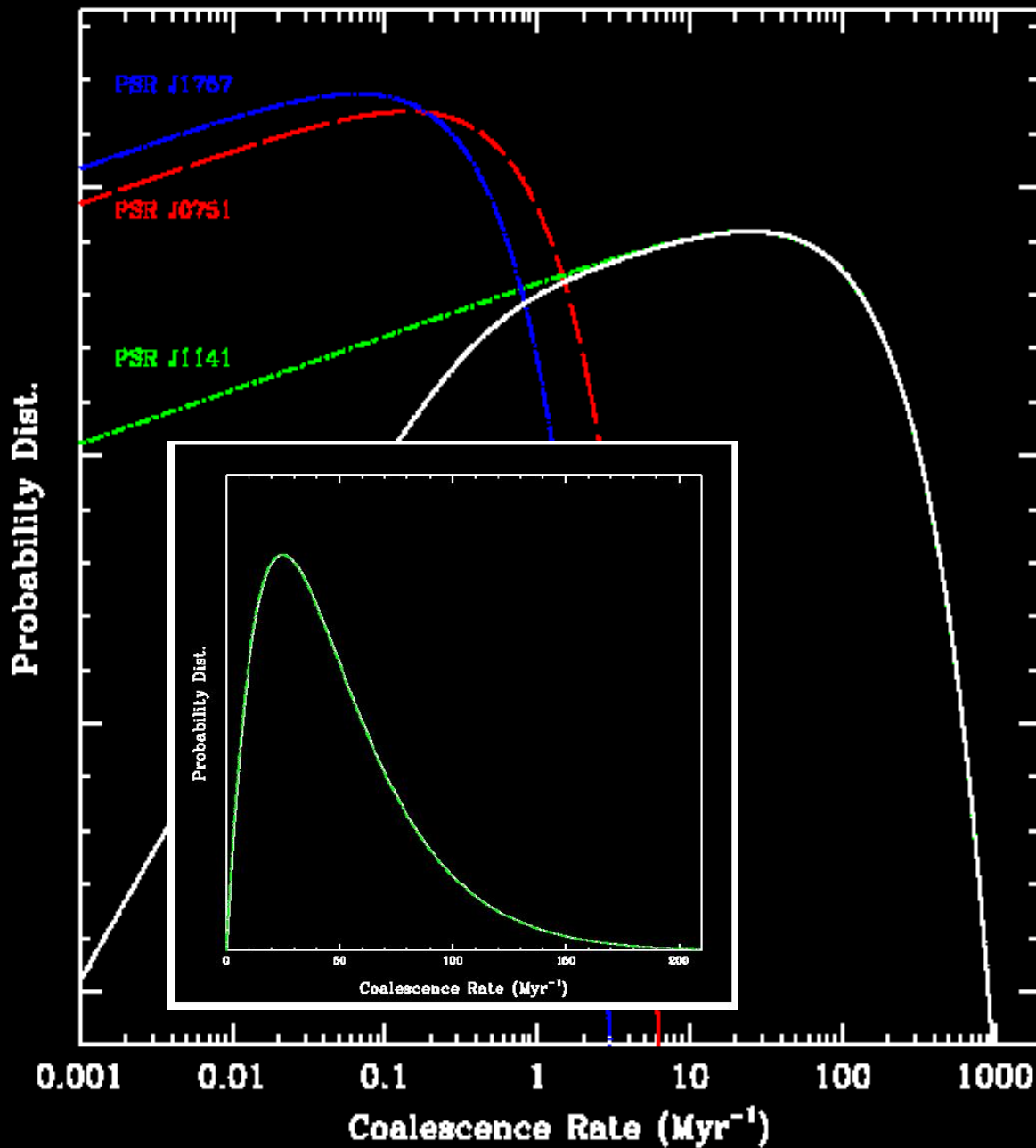
Likelihood of current sample:

$$P(1 ; \lambda) = \lambda \exp(-\lambda)$$

Galactic NS-WD Coalescence Rate:

$$R = (N_{\text{tot}} / \tau_{\text{life}}) f_b$$

$$P(R_1, R_2, R_3) \rightarrow P(R_{\text{tot}})$$



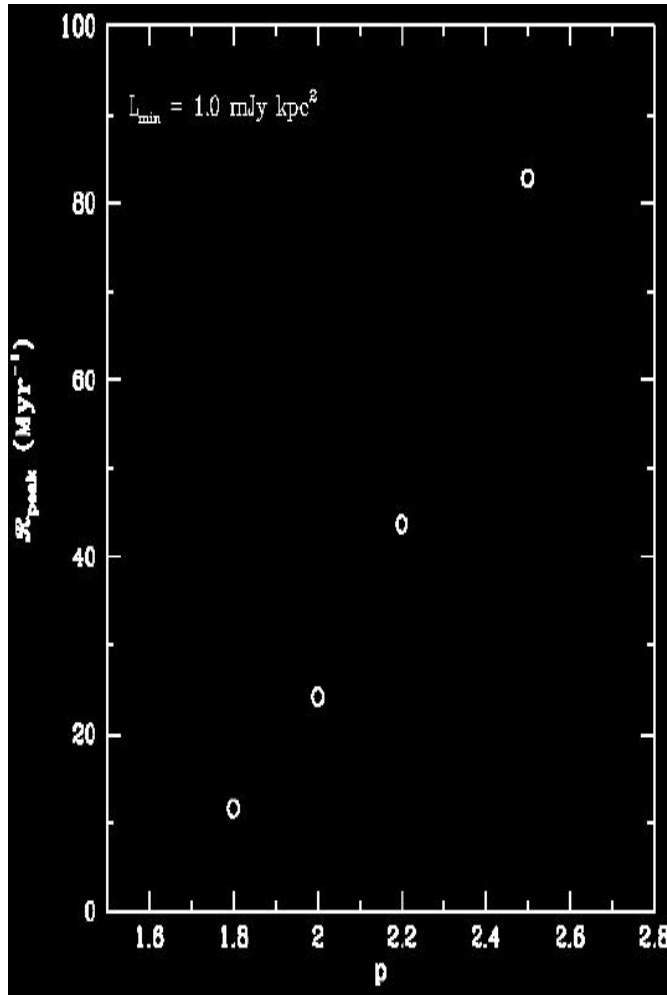
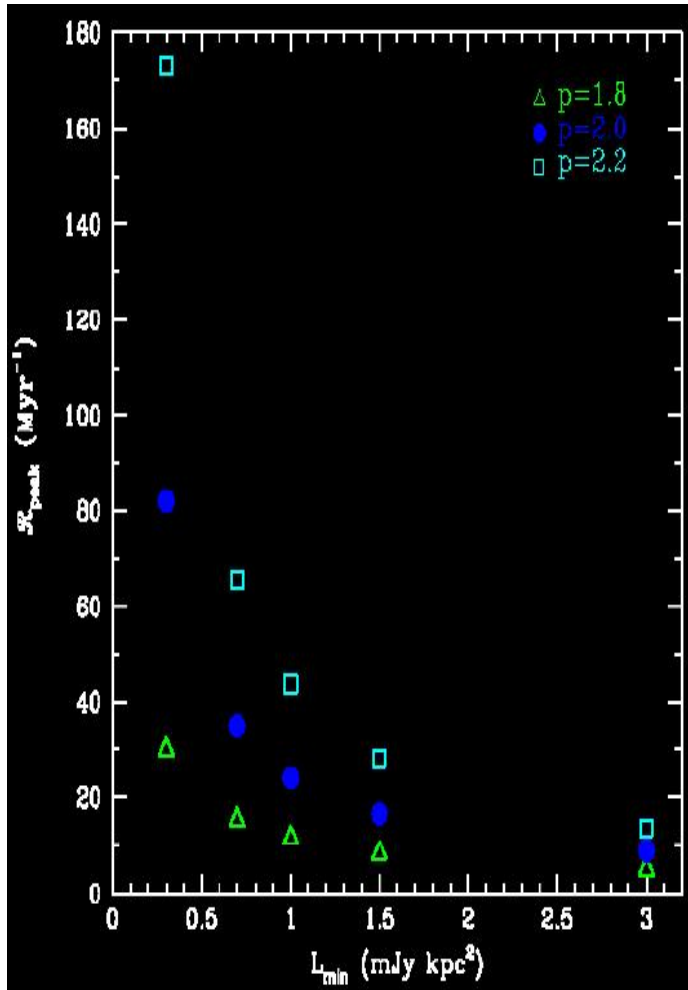
Using the probability distribution we can calculate the

most likely rate R_{peak}

as well as the ranges of rates at various

confidence levels

Systematics...



Dependence of most likely coalescence rate on the PSR LF parameters:

$$L \sim L^{-p}, L > L_{\text{min}}$$

R_{peak} is mostly insensitive to the spatial distribution parameters

**most probable value for NS-WD rate:
~25f_b per Myr**

(compare with most probable value for NS-NS rate: 8 per Myr)

Typical uncertainties:

68% C.L.	~ 9	systematics ~ 20
95% C.L.	~ 80	(PSR-pop parameters)

For the future ...

- Extrapolate to other galaxies
- Apply pulsar rate constraints on population synthesis models
- Obtain number estimates for pulsars in globular clusters