Inspiral Rates for NS-WD binaries

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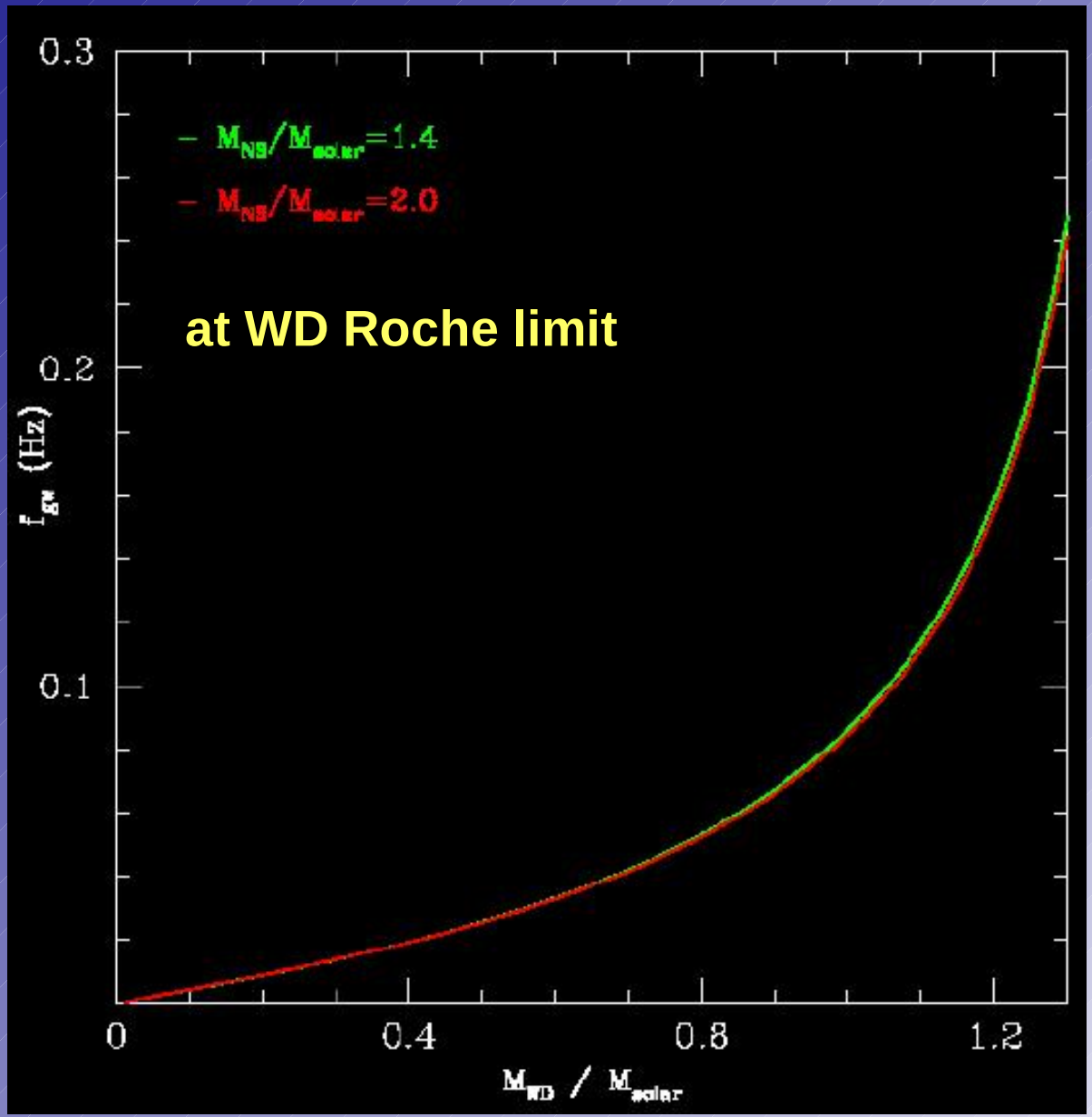
Maximum Inspiral Frequency



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_o
PSR J1757-5322	5 Gyr	9.5 Gyr	> 0.55 M_o
PSR J1141-6545	1.4 Myr	11 Myr	> 0.97 M_o

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/Vmax arguments

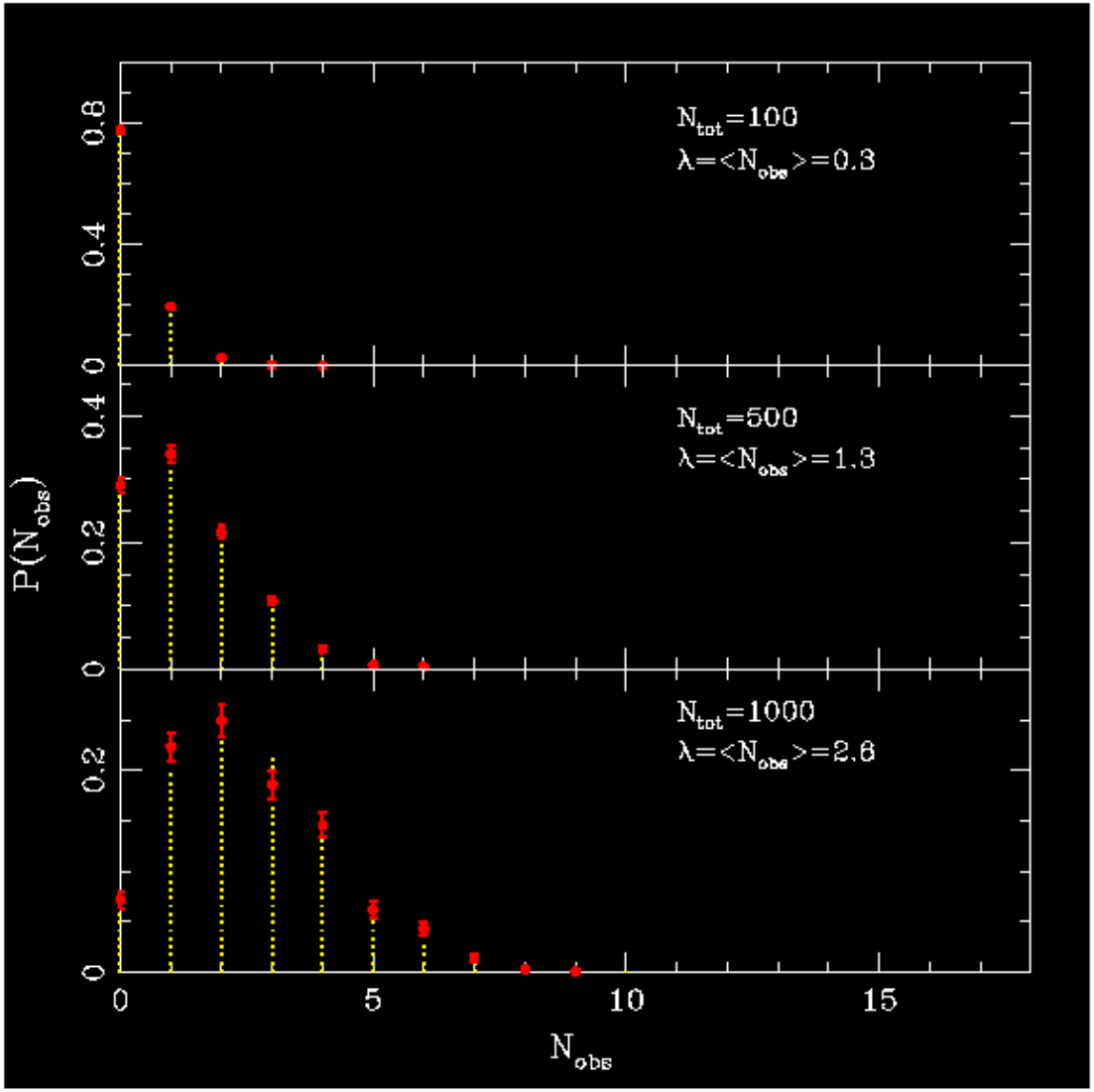
Statistical "Forward" Approach → **Calculation of Rate *Probability Distribution***

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

Kim, VK, Lorimer '03

For <u>each</u> 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 $P(1; N_{tot})$ for best-fitting Poisson distribution
- Derive $P(N_{tot})$ (Bayesian analysis) and $P(R_{1141})$
- Repeat for other two observed systems and derive $P(R_{tot})$



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

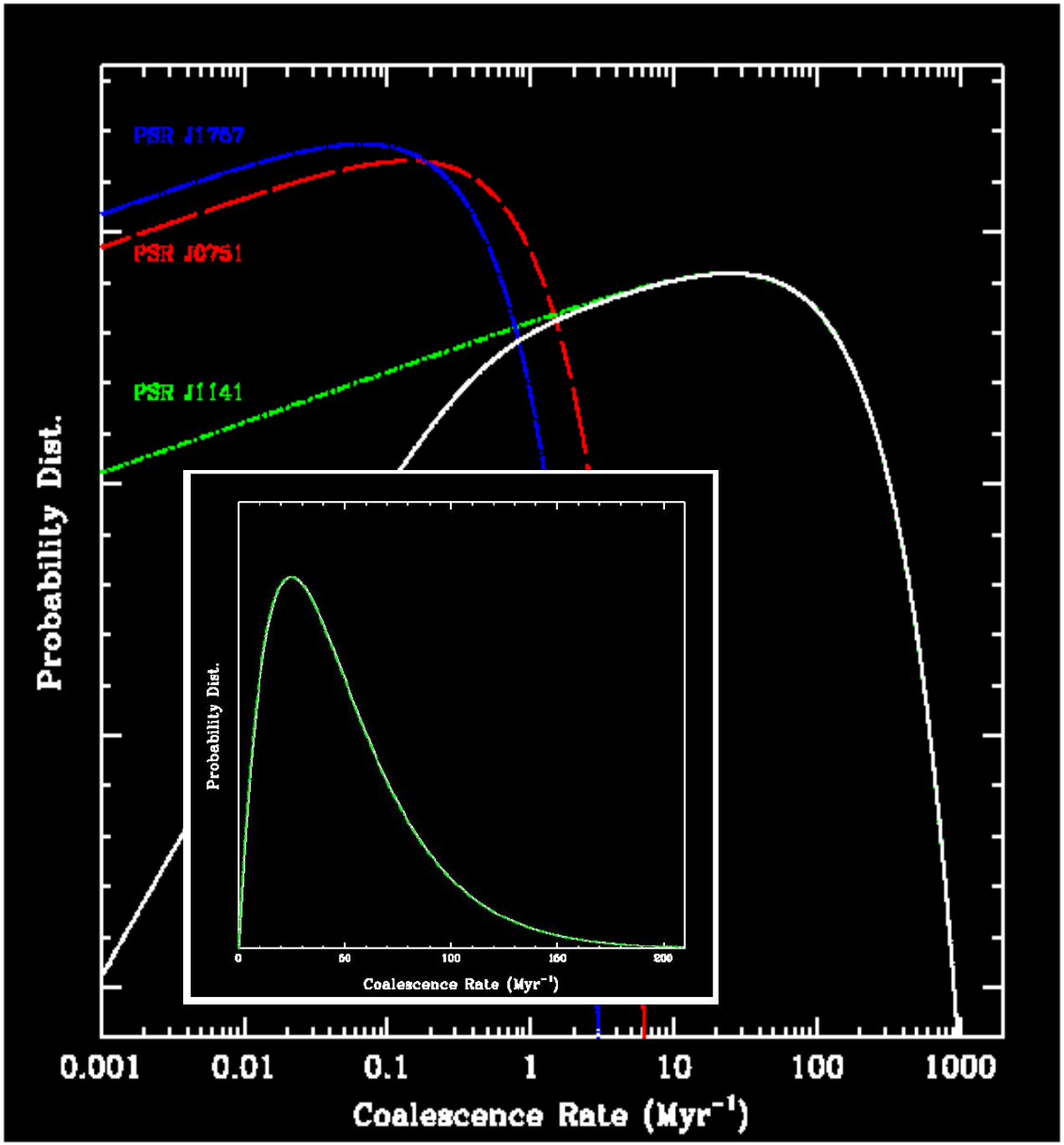
Poisson

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

Likelihood of current sample:

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

Galactic NS-WD Coalescence Rate:

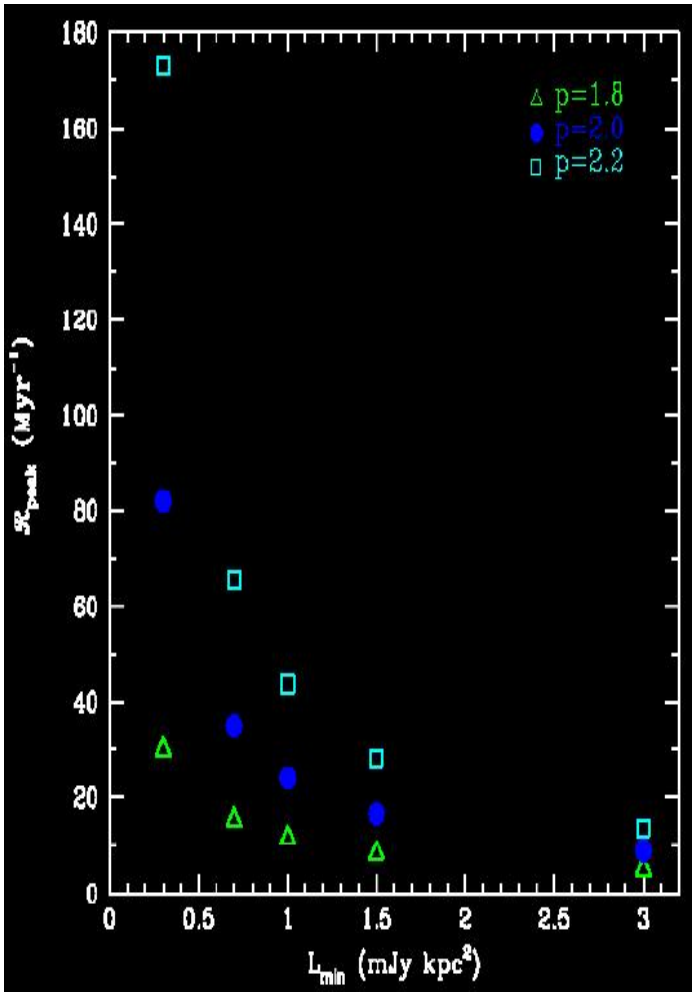


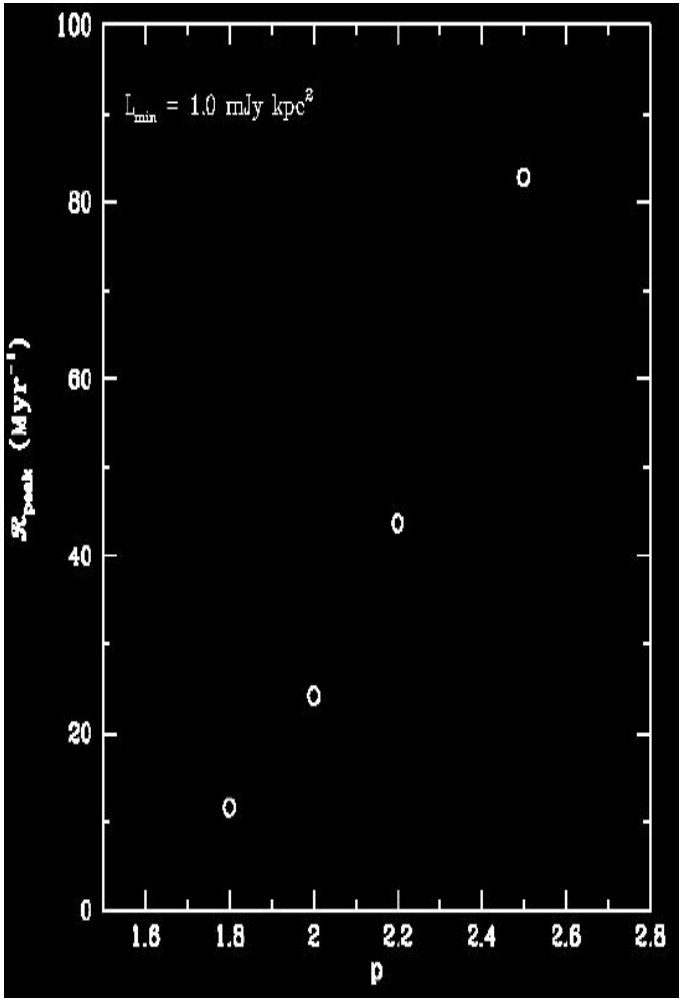
$R = (N_{tot} / \tau_{life}) f_b$

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

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:

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

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

most probable value for NS-WD rate: $\sim 25 f_b$ 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