Modeling Radio Pulsar Selection Effects

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By accounting for selection effects, we find the true pulsar population.

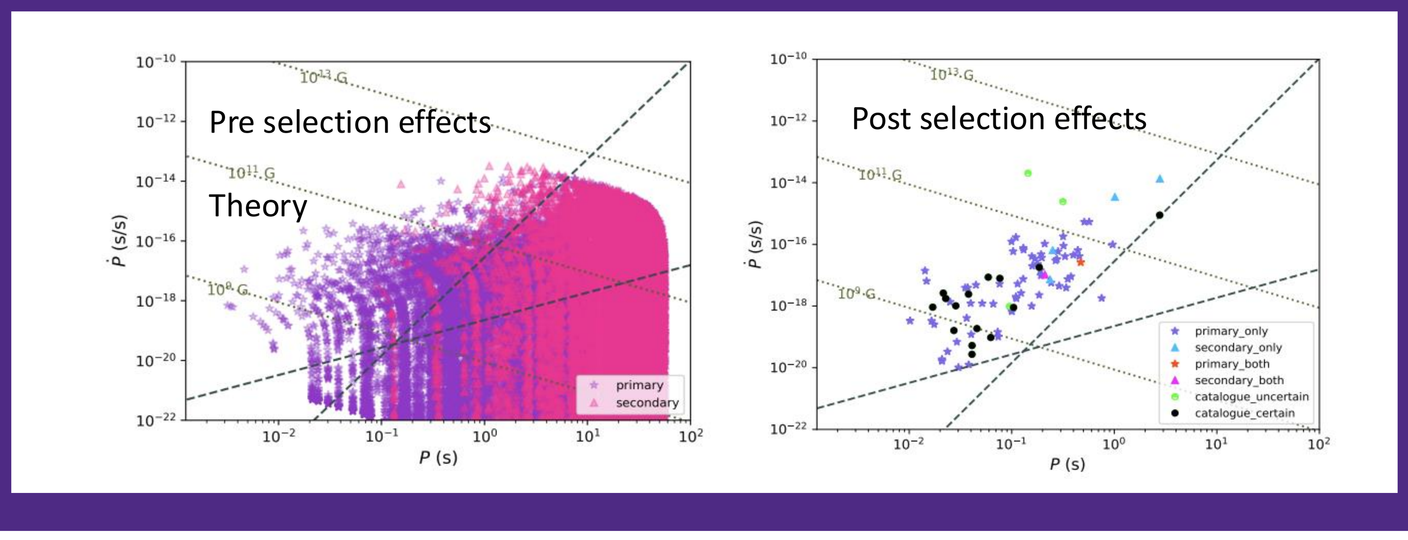
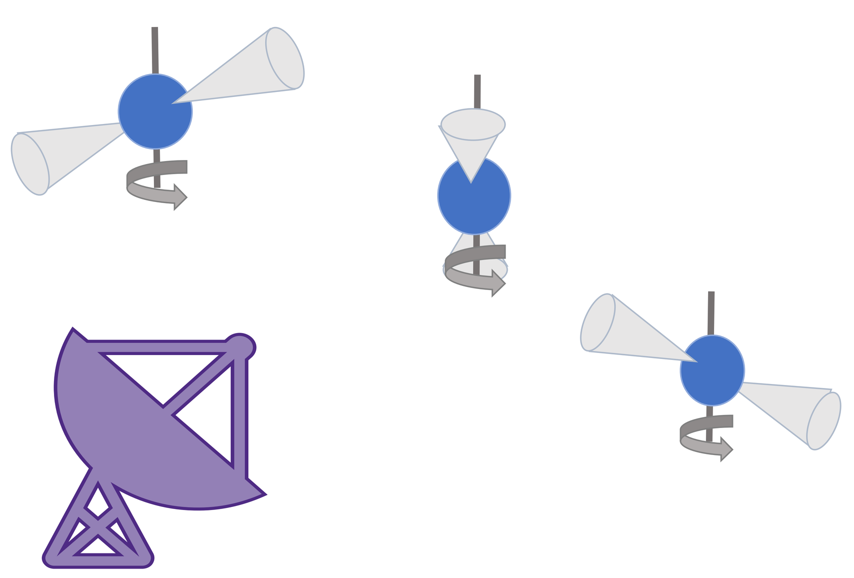
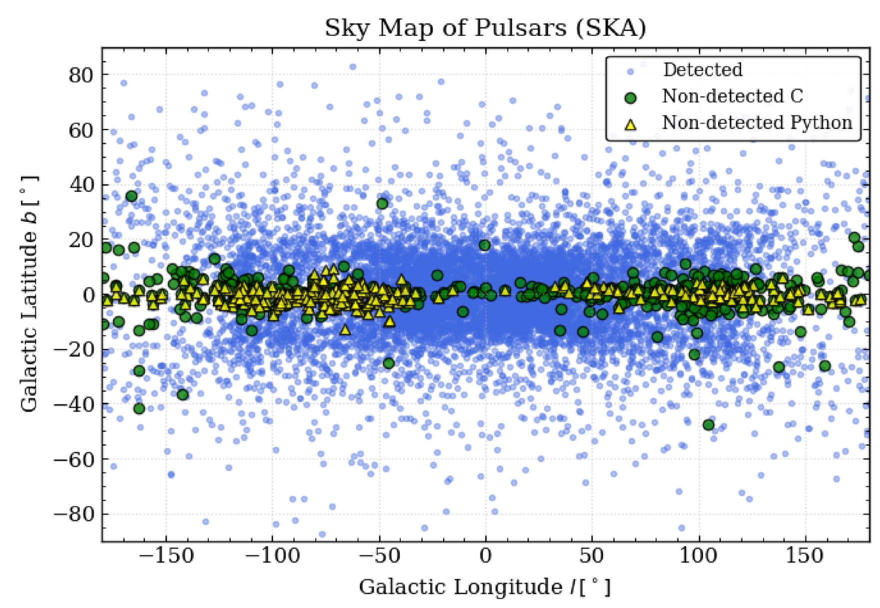


Image credit: [1]

Pulsar Detection

- Pulsars in single or binary systems are difficult to detect
- **Improve ability to detect pulsars with selection effects**:
  - Intervening matter at sky location, twinkling of interstellar radio source, changes in pulse profile depending on the radio frequency, beaming fraction [1]
- Pulsars are extremely useful for astronomy and astrophysics:
  - Modeling interstellar medium matter distribution, measuring gravitational waves, testing general relativity

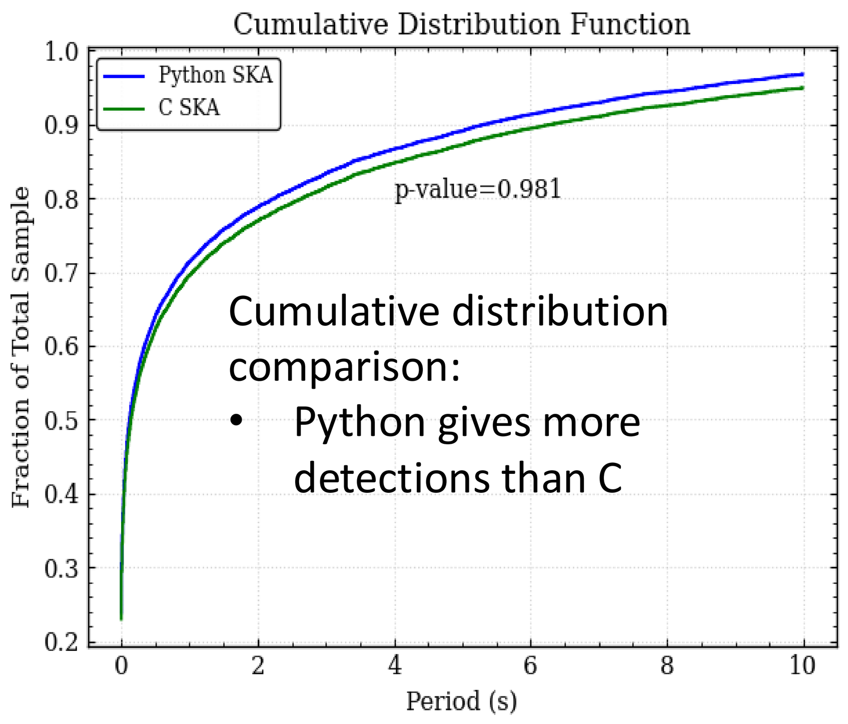




Calculating Selection Effects

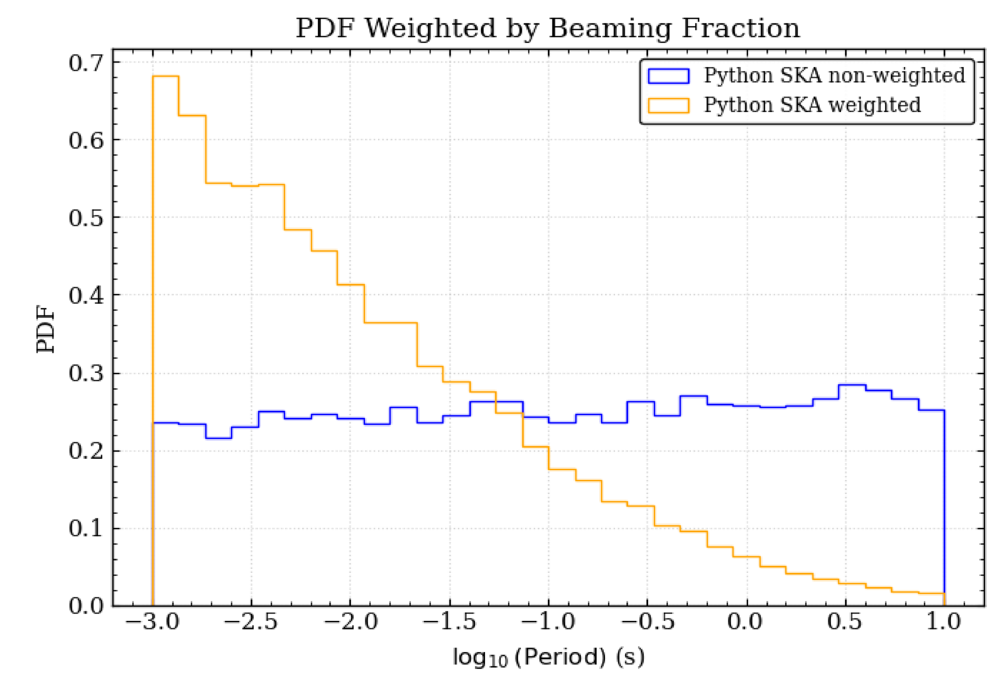
- Create a new Python pipeline and calculate selection effects on binary pulsars (code is based on the psrEvolve code [2])
- Determine if a pulsar could be detected by SKA survey
- **If minimum observable luminosity of the survey < luminosity of the pulsar, it could be detected** [1]
- Using an emulated population of pulsars (applicable for full binary evolution simulaitons)
- Tested the Python pipeline by comparing results to those from psrEvolve code
  - K-S test, CDF, weighted PDF, visual comparison of sky map and p-pdot plots

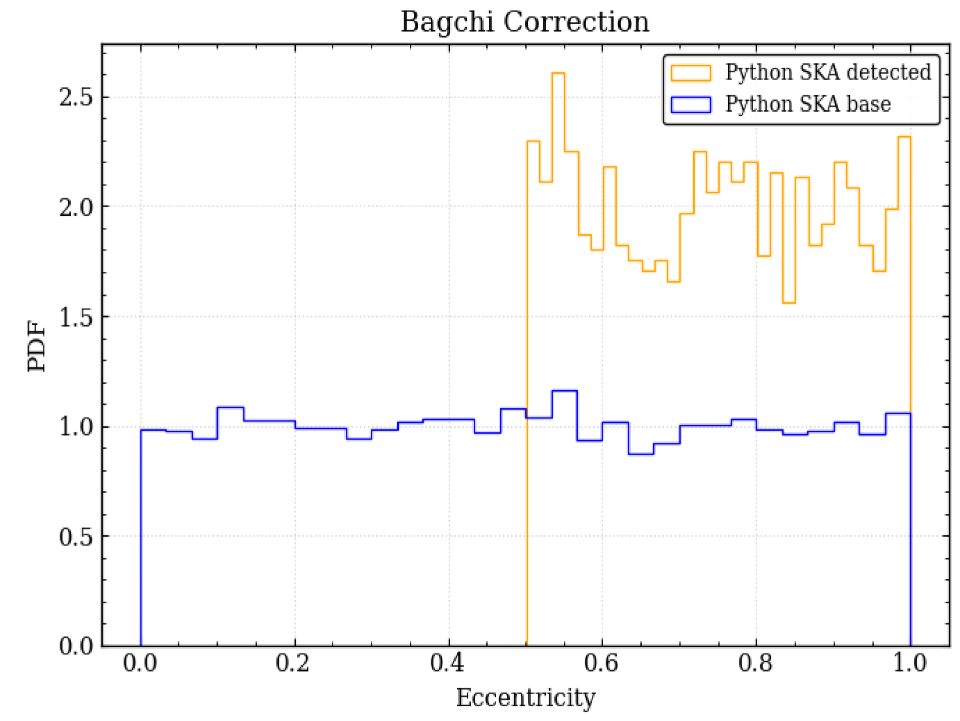
Results



Posterior distribution weighted by beaming fraction:

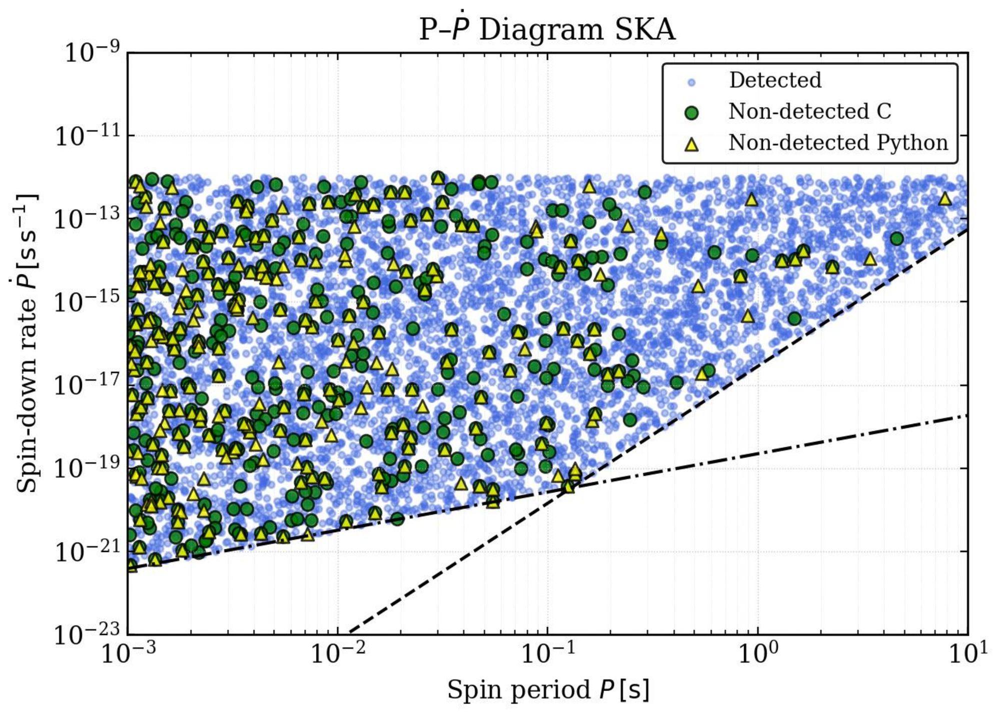
- **Including weights, more pulsars detected at lower spin periods**





Bagchi correction:

- Binary eccentricity varies, all else held constant



P-Pdot plot (spin vs spin down rate):

- Using hard cutoffs for death lines
- **Python and C show similar distributions of detections**

$$\dot{\Omega} = -\frac{8\pi B^2 R^6 \sin^2\alpha\,\Omega^3}{3\mu_0 c^3 I}$$

$$P = \frac{2\pi}{\Omega} \qquad \dot{P} = -\frac{\dot{\Omega}P}{\Omega}$$

Discussion and Future Work

- New pipeline gives very similar results to psrEvolve
- **Python returns more detections, fixes a bug in the psrEvolve code**
- Possibly incorporate binary eccentricity [3], and test with "real" data from simulations

REFRENCES

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