Detailed models of recurring superbursts

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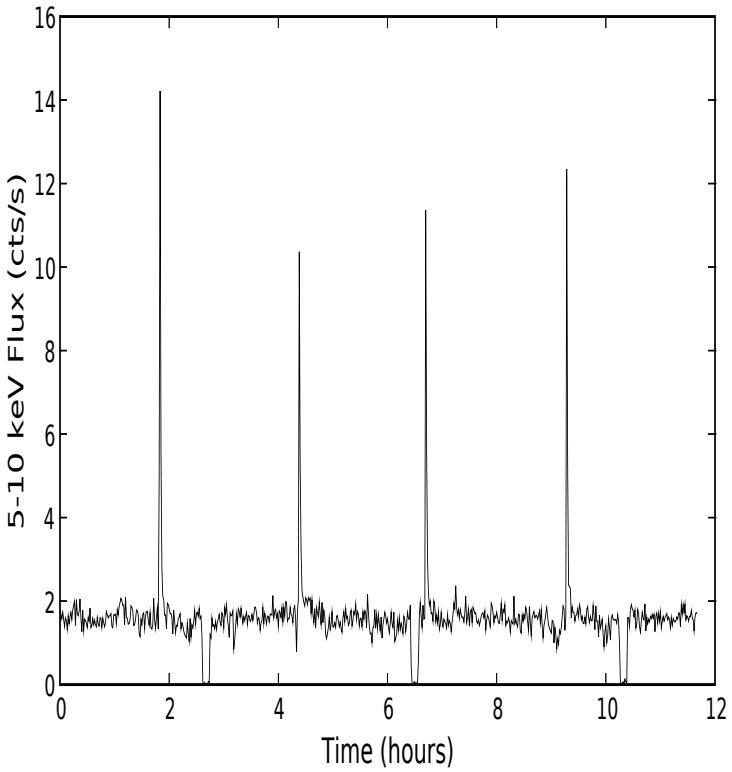
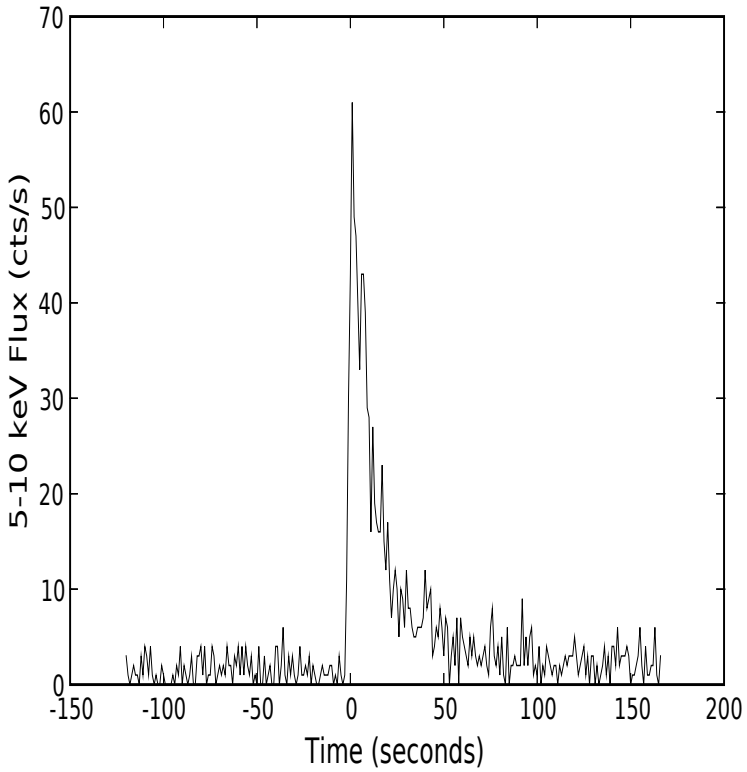
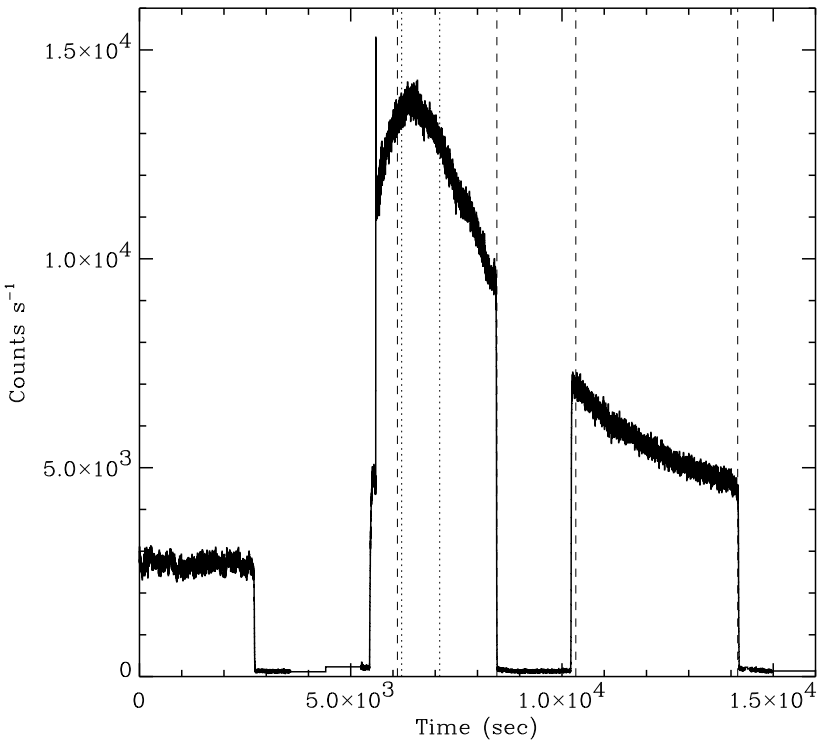
Type I X-ray burst





- Unstable thermonuclear burning of a layer of hydrogen/helium
- Fast rise (1–10 s), exponential-like decay (10–1000 s)
- Build up carbon-rich layer

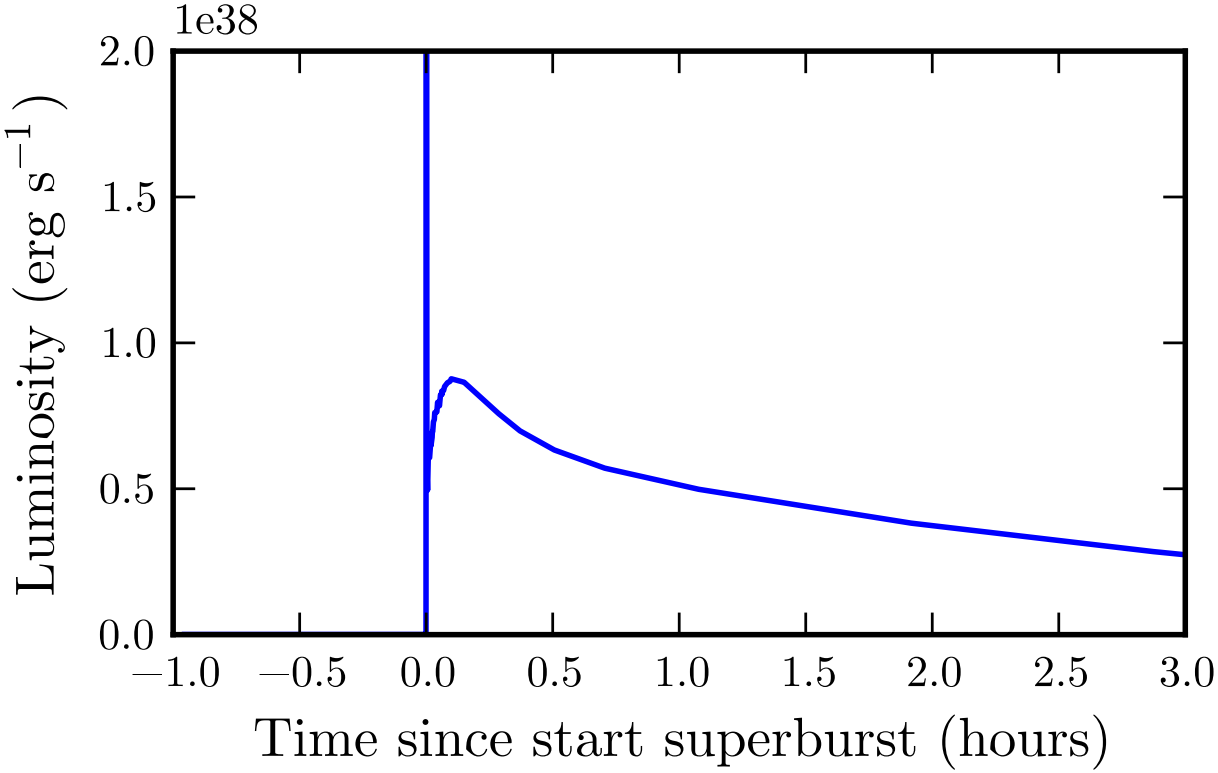
Superbursts



From Strohmayer and Markwardt (2002)

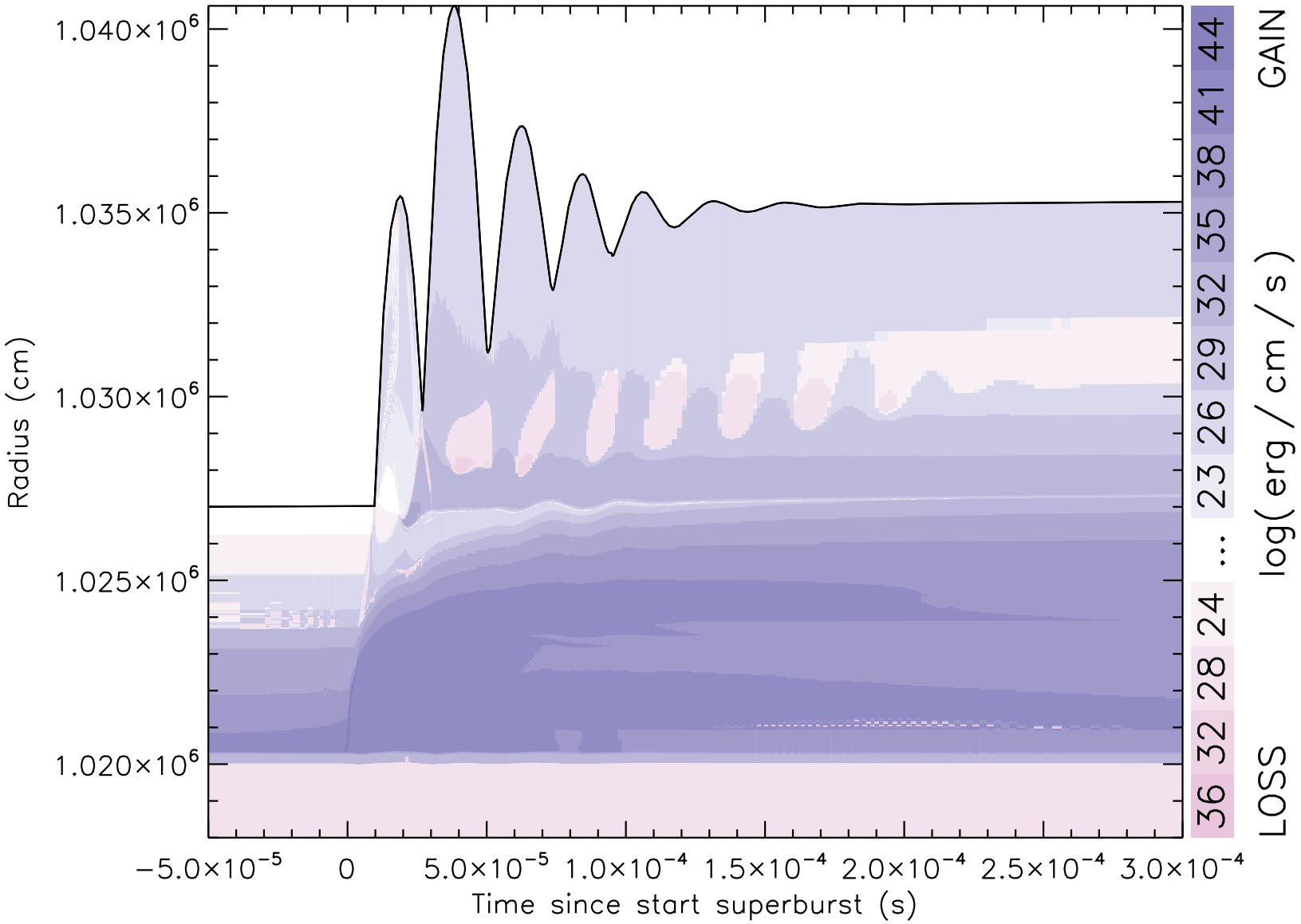
- 1000x longer decay time (hours), 1000x more energetic
- Thermonuclear burning of a carbon-rich layer
- Ignition depth depends on temperature of the crust

Superburst models

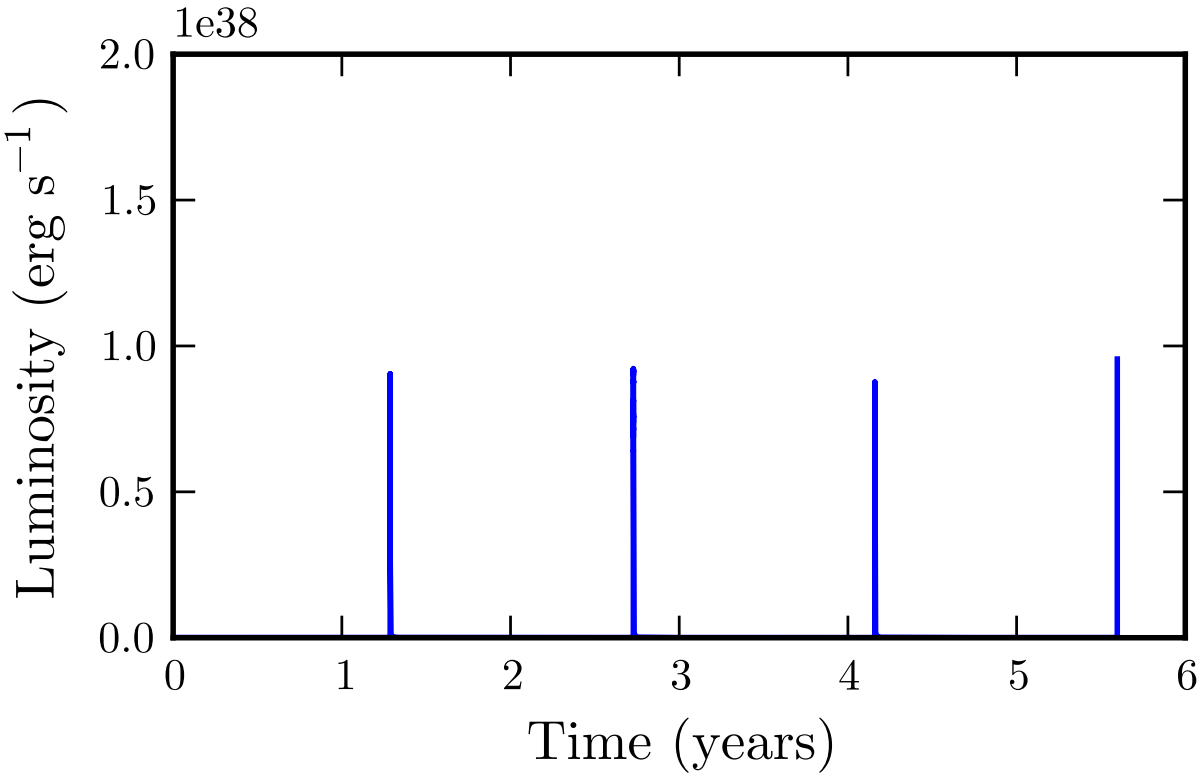


- Implicit 1d hydrodynamics code with extensive nuclear network
- Accrete 20% carbon, 80% iron
- Reproduce precursor, decay

A shocking start

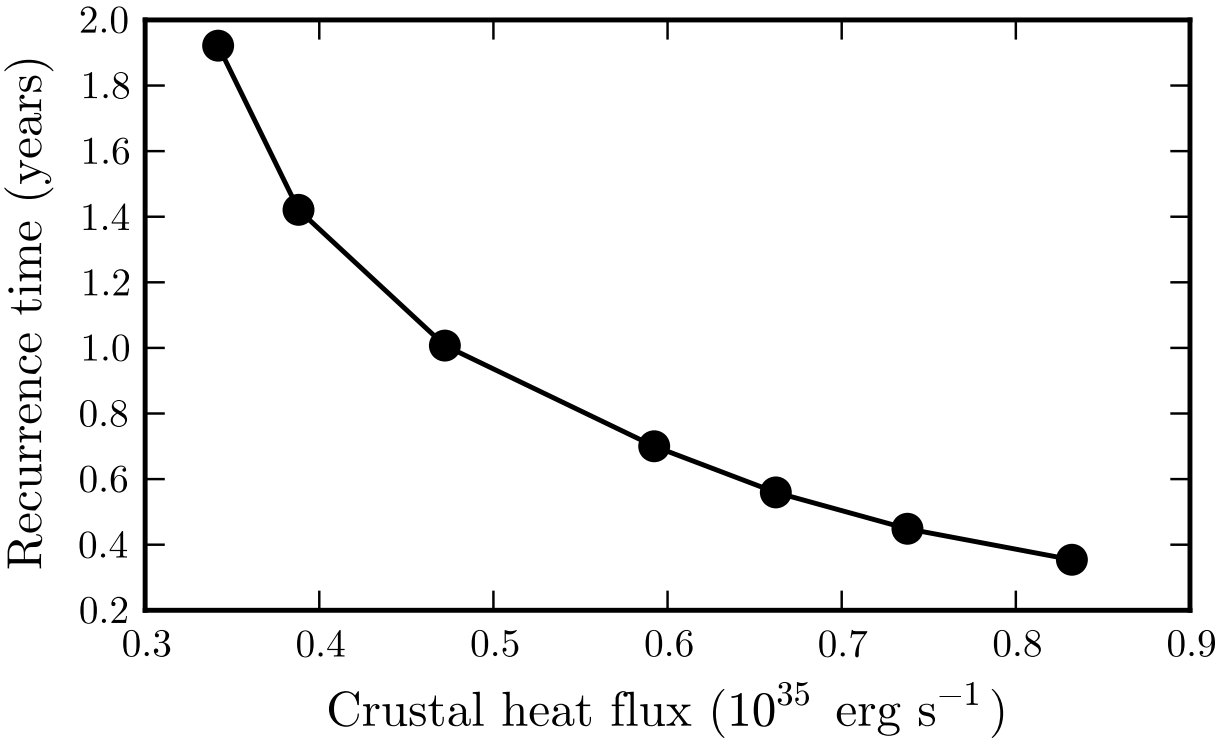


Recurring superbursts



- Recurrence time of about 1 year
- Close to observed recurrence times (for two sources)

Crustal heating



- Hotter crust leads to earlier superburst ignition
- Lower recurrence times

Conclusion

Superbursts:

- day-long X-ray bursts from accreting neutron stars
- rare: only 18 observed
- ignite close to neutron star crust

Model of carbon accretion:

- Precursor burst: shock-heated carbon burning
- Reproduce shape of light curve, recurrence time

To do:

- Study recurrence time as a function of crustal heating
- More observations of recurring superbursts