Equation of state constraints for the dense matter inside neutron stars:

The cooling tail method

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Thermal emission from the surface layers: X-ray bursts

- Emission from the bursts contains a lot of information about the neutron star
Photospheric Radius Expansion bursts

- Roughly 2 kinds of bursts
  - Hard state bursts (with low accretion)
  - Soft state bursts (with high accretion)
Soft state bursts

\[ L \propto T^4 \]
Hard state bursts

$L \propto T^4$?
Atmosphere models: emerging spectrum

Well described by diluted black body (in range 2.5 - 25.0 keV)

\[ F_E = \frac{1}{f_c^4} B_E(T_c = f_c T_{\text{eff}}) \]
Color-correction factor $f_c$
Color-correction factor $f_c$

- **Models:**
  \[ F_E = \frac{1}{f_c^4} B(f_c T_{\text{eff}}) \]

- **Observations:**
  \[ F_E = K_{bb} B(T_{bb}) \]

\[ f_c \propto K_{bb}^{-1/4} \]

\[ T_{bb} \propto f_c T_{\text{eff}} \]
Observations with hard state bursts

Color corrected temperature
Observations with hard state bursts
Mass and radius constraints from hard state bursts

- 4U1702-429
- 4U 1724-307
- SAX J1810.8-2609
Parameterized EoS
Parameterized EoS from the data
Parameterized astrophysical EoS: A probe for nuclear parameters
Thanks!
Soft vs. hard state bursts
Effect of distance: Uninformative priors

No information of distance

Boxcar distance prior from 5.3 to 7.7 kpc