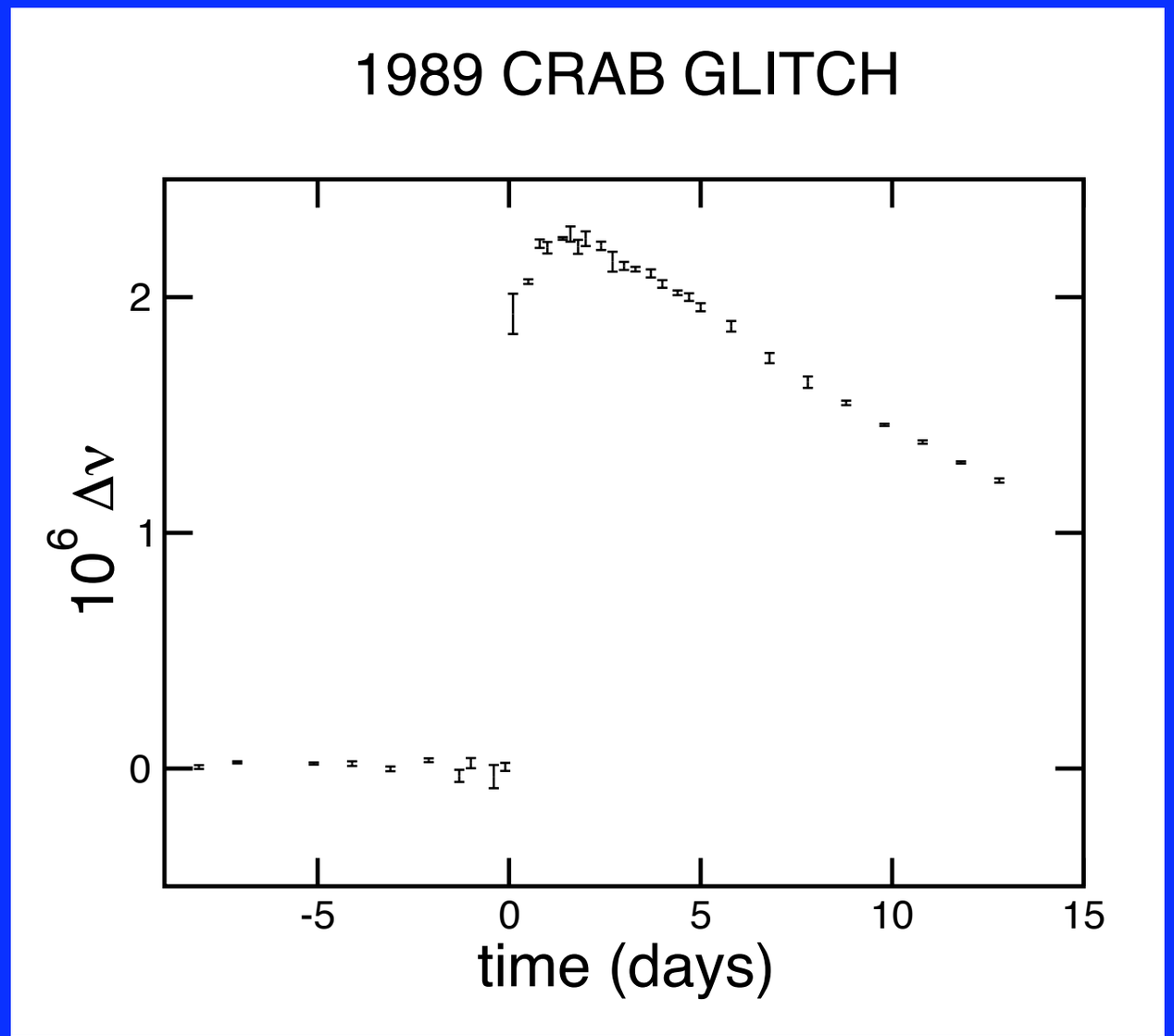
Messages from Spin Glitches in Neutron Stars

Observations



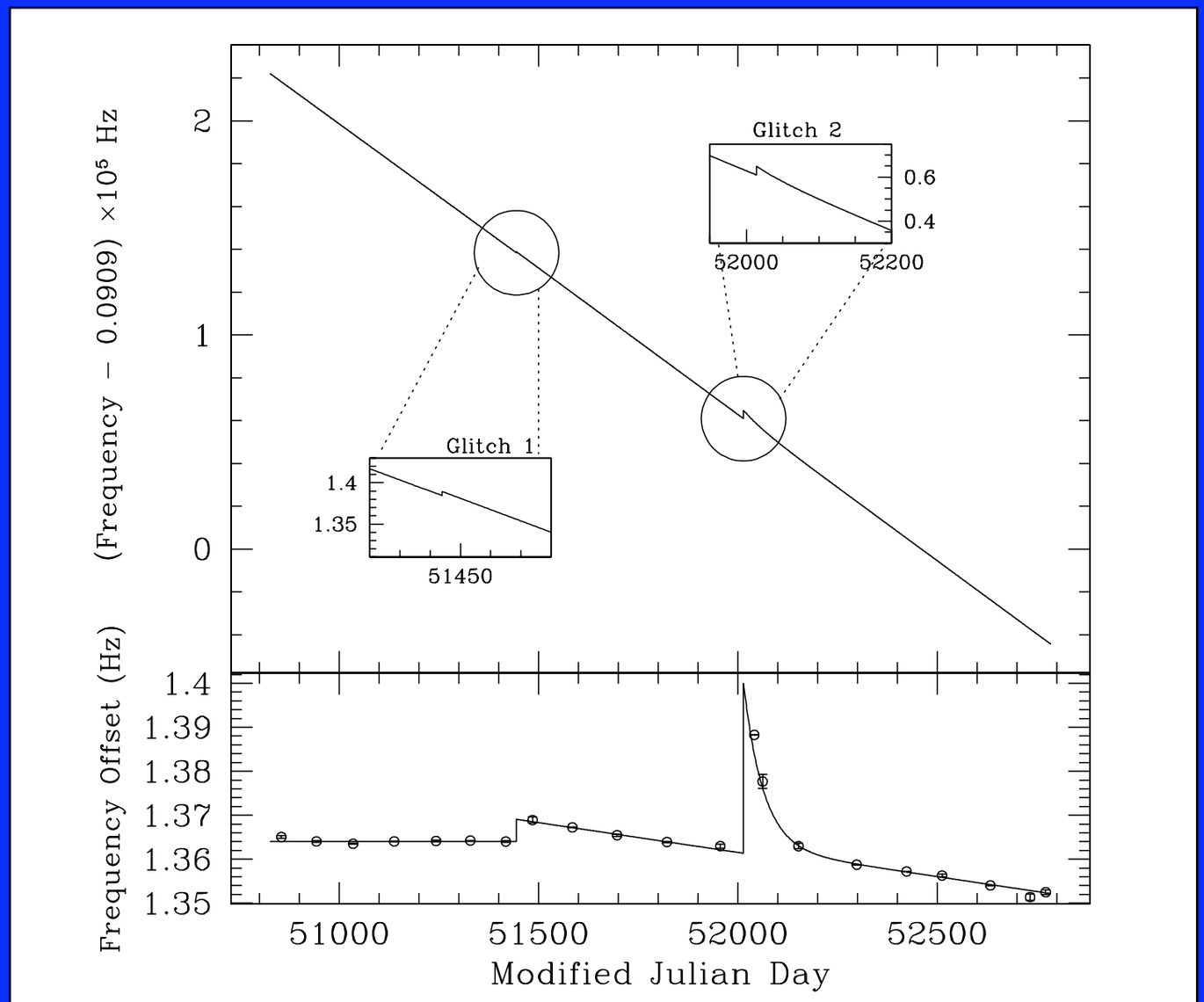
(Lyne, Smith, Pritchard 92)

$$\frac{\Delta\nu}{\nu} \sim 10^{-6}$$

$$\Delta E_{\rm rot} \sim 10^{43}\ {\rm erg!}$$

Glitches occur in magnetars too

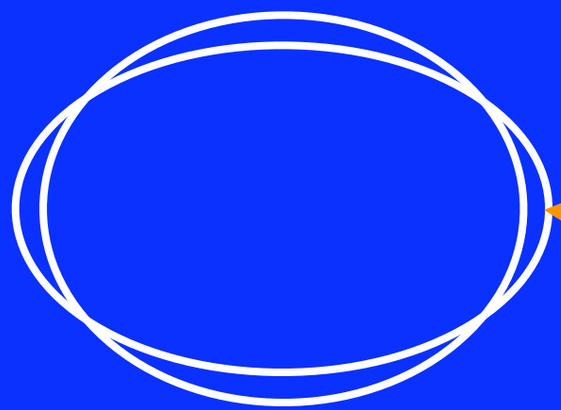
Two glitches in a magnetar



(Kaspi & Gavriil 03)

Glitches cannot be starquakes

A starquake would produce a spin jump



$$-\Delta\epsilon_{\rm rig} = \frac{-\Delta I}{I} = \frac{\Delta\nu}{\nu}$$

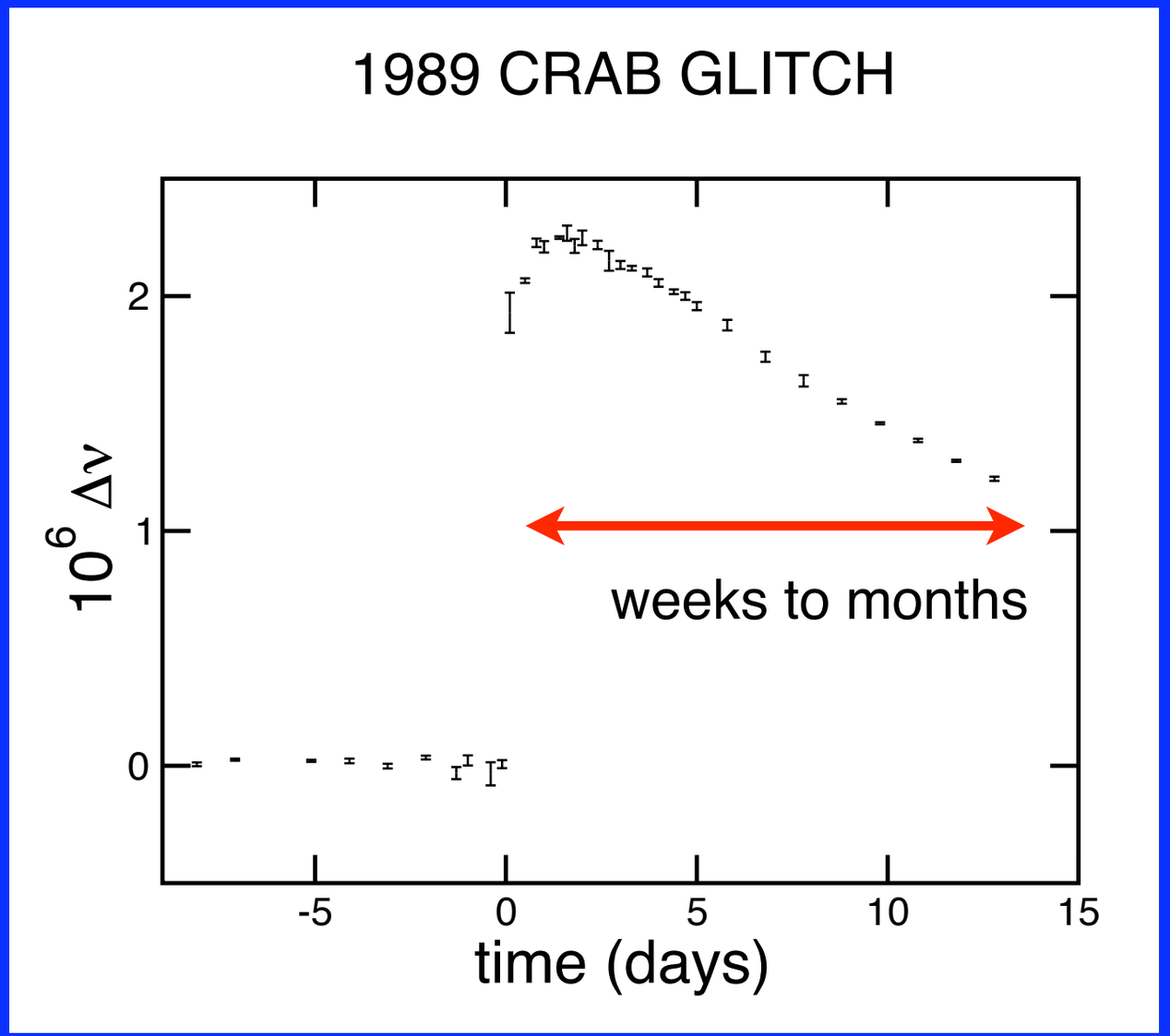
Require

$$\Delta\epsilon_{\rm rig} \sim 10^{-6}$$

Time required for spin down to produce required deformation is

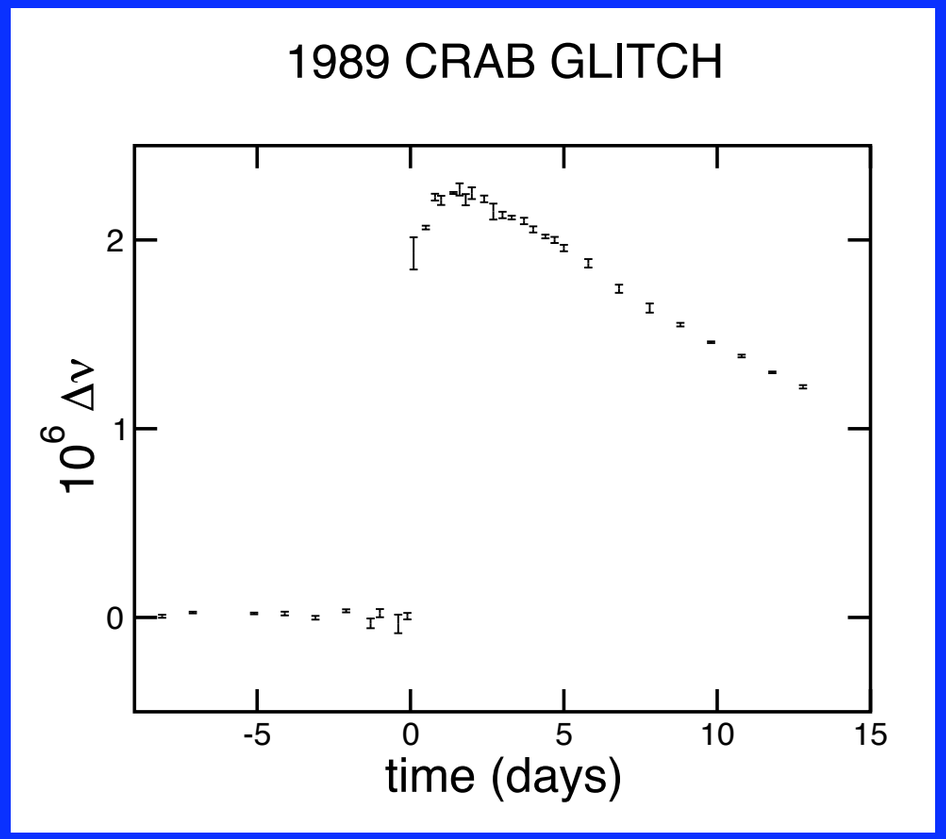
$$t_{\rm glitch} \sim 0.1\, t_{\rm age} \sim 10^3 \ {\rm yr}$$

Superfluidity is required

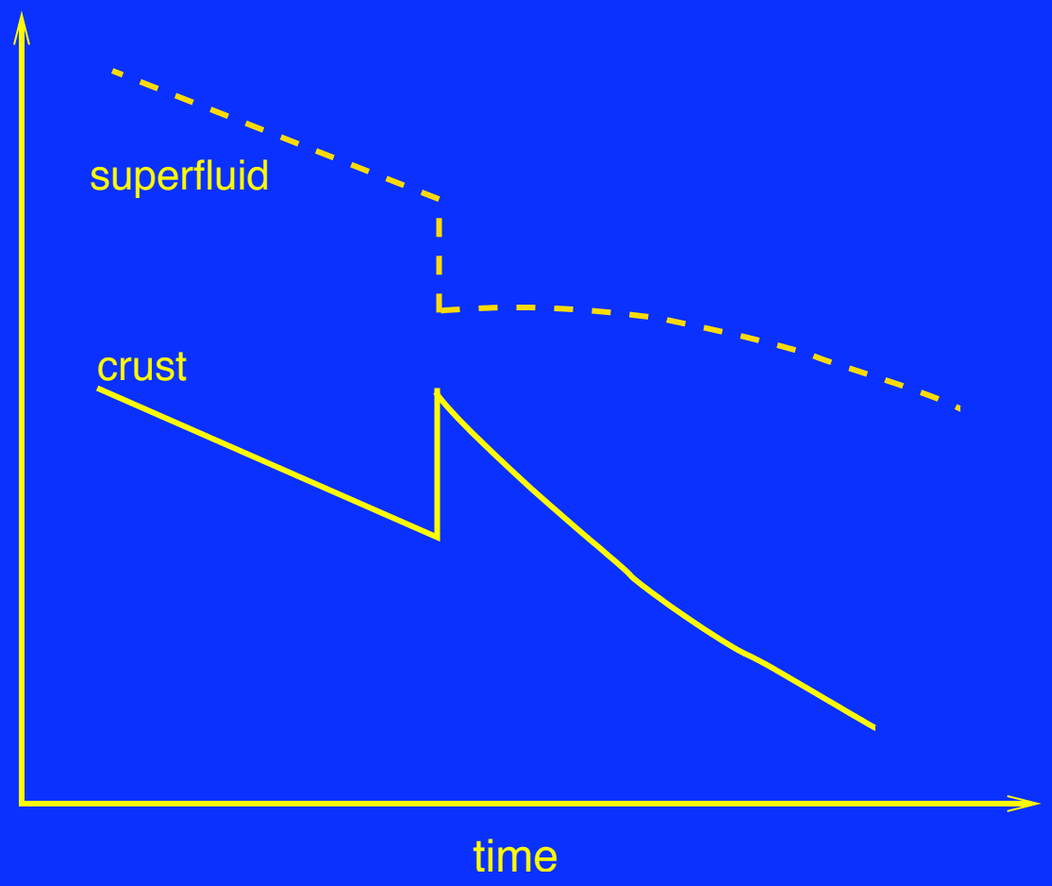


Coupling times in normal n,p,e matter are << 1 sec.

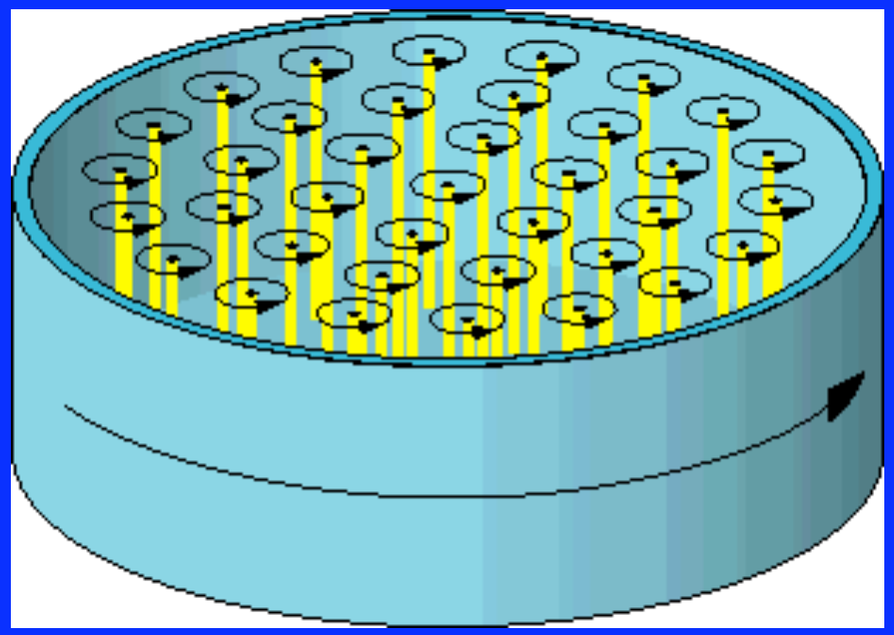
Idea for the origin of glitches: variable coupling to liquid



(Lyne, Smith, Pritchard 92)

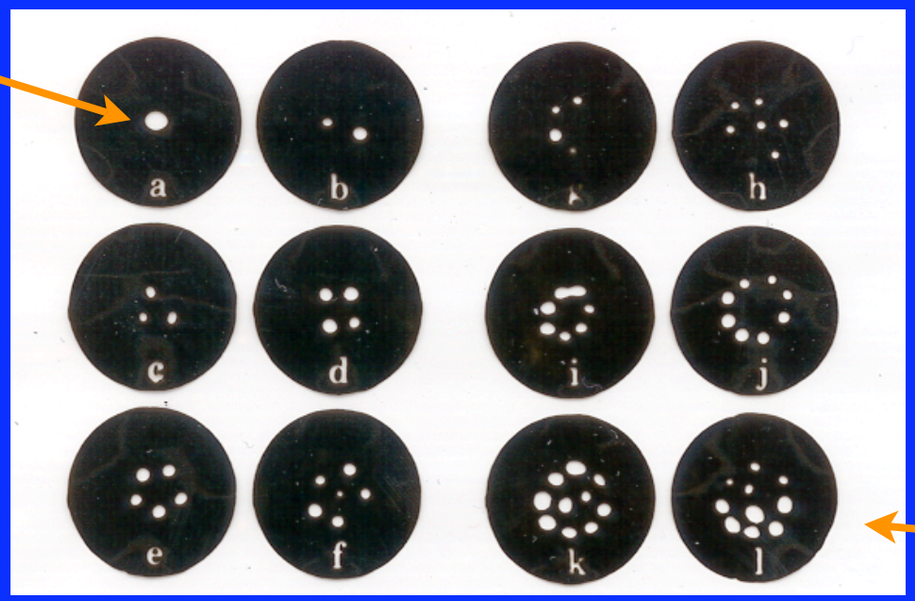


The neutron superfluid's rotation



Rotating superfluid He

low angular momentum



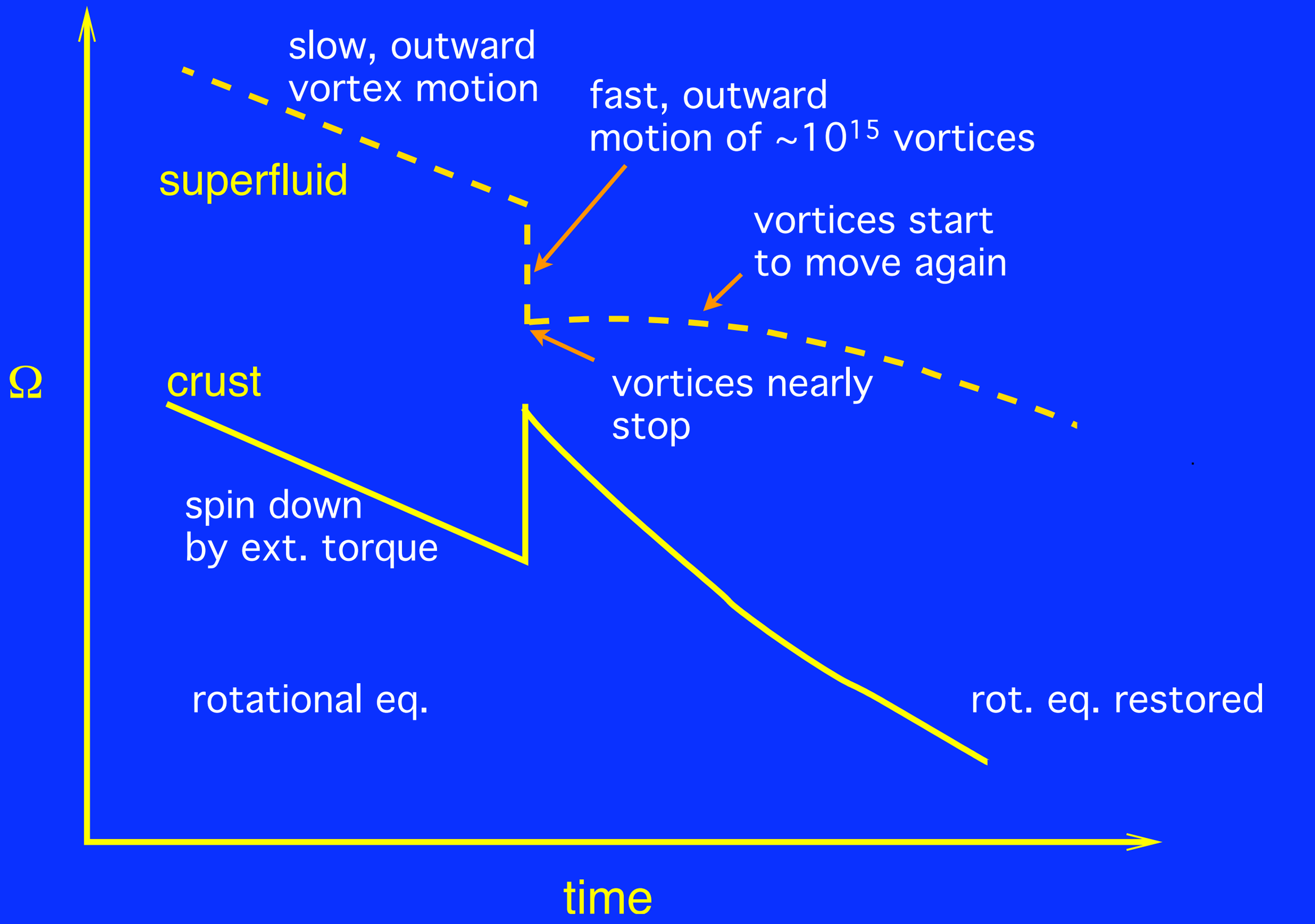
high angular momentum

Vortices “pin”

- to nuclei in the crust
- to flux tubes in the core

Better calculations are needed!

Stages of a glitch



Glitches in liquid helium

Tsakadze & Tsakadze (1980)