Origin of Pink Noise in MAXI X-ray Sources

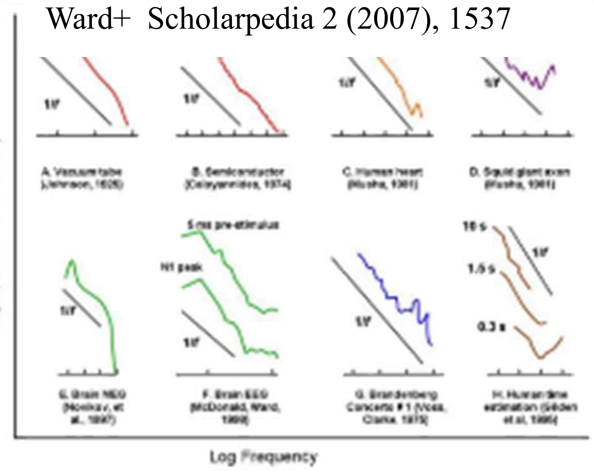
BN06

Masahiro Morikawa* (RIKEN) & Akika Nakamichi (Kyoto-Sangyo U.) *hiro@phys.ocha.ac.jp

Summary

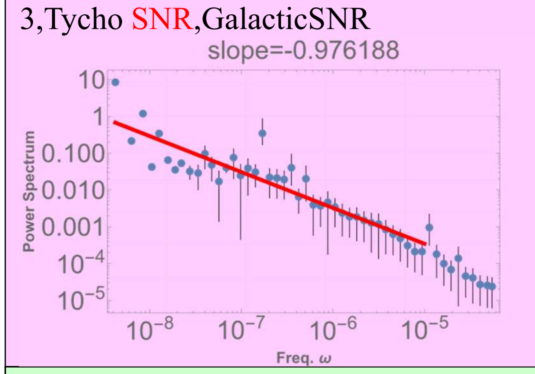
1. Some MAXI sources show **pink noise, while** others do not.
2. Origin of the noise is the **magnetic field regulated** gas accretion.
3. **Cooperative-Dynamo process** yields the magnetic field. (Macro Spin Model: MSM)
   Synchronization in MSM modulates **the beat of waves; yields pink noise.**
4. MSM predicts intermittent **polarity flips** that create **knots** in the jets.
5. Polarity flipping period yields **hard** mode, and fixed period **soft pink** mode?

Ward+ Scholarpedia 2 (2007), 1537

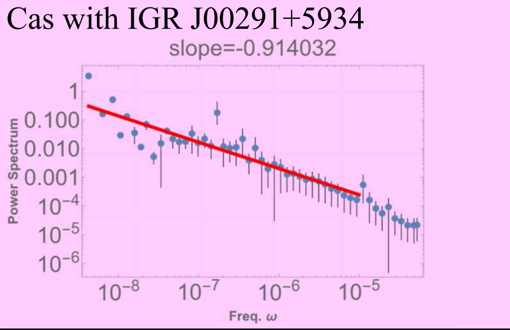


1. Some MAXI sources show pink noise, while others do not.

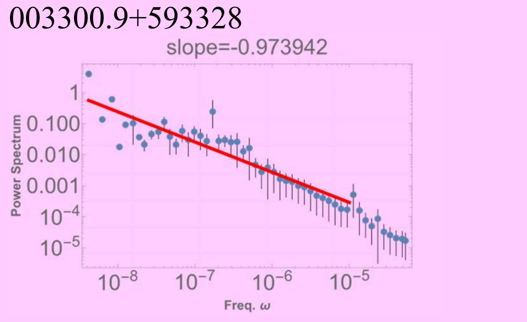
3,Tycho SNR,GalacticSNR



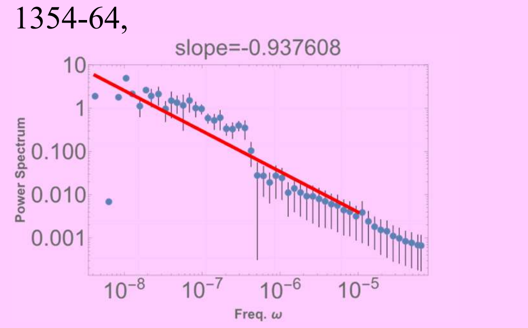
4,Galactic-Compact-Binary-WD, V709 Cas with IGR J00291+5934



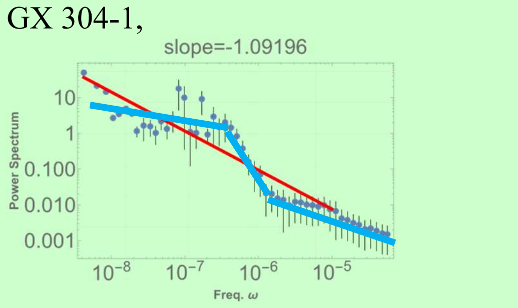
6, ExtraGalactic-AGN 87GB 003300.9+593328



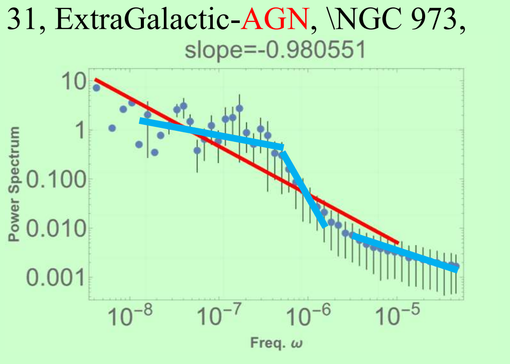
190, Galactic-Compact-Binary-BH, GS 1354-64,



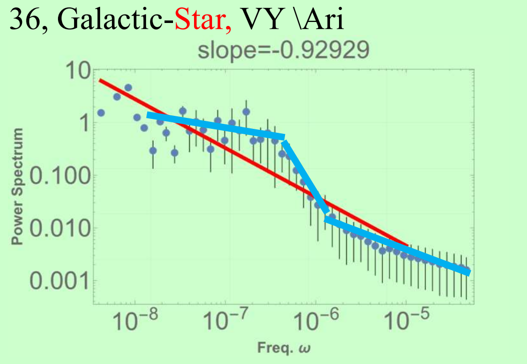
174, Galactic-Compact-Binary-Pulsar, GX 304-1,



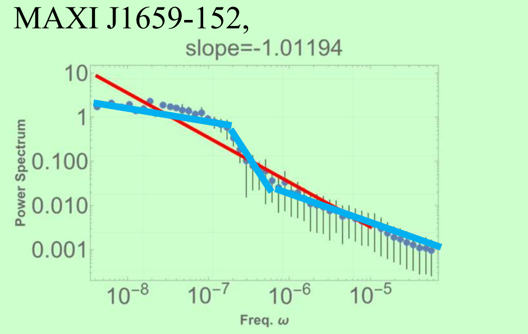
31, ExtraGalactic-AGN, \NGC 973,



36, Galactic-Star, VY \Ari



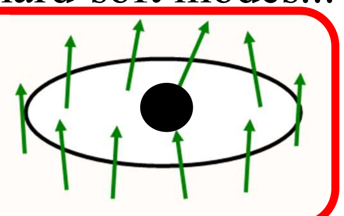
246, Galactic-Compact-Binary-BH, MAXI J1659-152,



2. origin of the pink noise: Gas accretion: △ random, Gas turbulence: △ power-5/3, long memory: △ outer edge

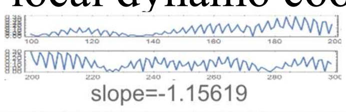
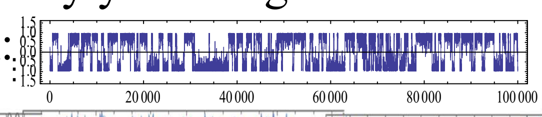
- Many related mysteries give hints: ►role of magnetic field? ►dynamo mechanism? ►jets and knots? ►X-rays from Sun also show pink noise ► BH, NS, SNR, stars, show pink noise ► distinction of hard-soft modes...

We propose: A. Origin of the pink noise is the gas accretion **regulated by the magnetic field.**
B. **Synchronized local dynamos beat with each other,**
producing signal of arbitrary small frequencies (Amplitude modulation).



3. Synchronized-Dynamo process yields the magnetic field. (Macro Spin Model: MSM)

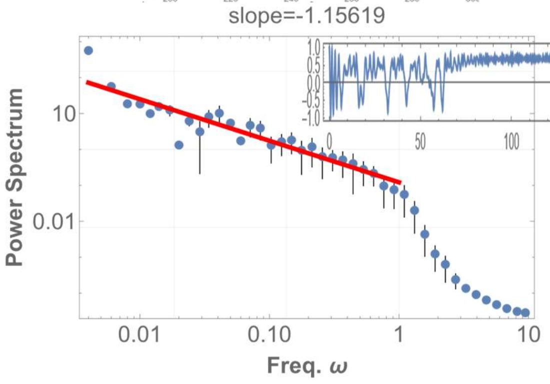
- Several local dynamo cooperatively yield magnetic field.

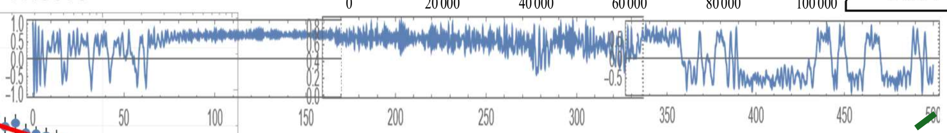
ex. Sun:  Earth: 

$$K=\frac{1}{2}\sum_{i=1}^{N}\dot{\vec{s}}_i^{\,2},\quad V=\mu\sum_{i=1}^{N}\left(\Omega\cdot\vec{s}_i\right)^2+\frac{\lambda}{2N}\sum_{j=1}^{N}\sum_{i}^{\text{nerst to } j}\vec{s}_i\cdot\vec{s}_j$$

$$L=K-V,\quad \frac{d\left(\partial L/\partial\dot{\theta}_i\right)}{dt}=\frac{\partial L}{\partial\theta_i},\quad \frac{d\left(\partial L/\partial\dot{\phi}_i\right)}{dt}=\frac{\partial L}{\partial\phi_i}$$

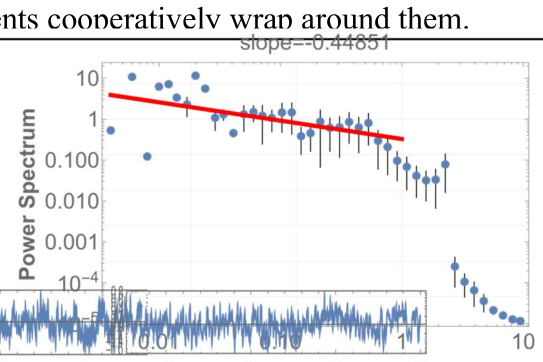
- Taylor columns = spins. Currents cooperatively wrap around them.

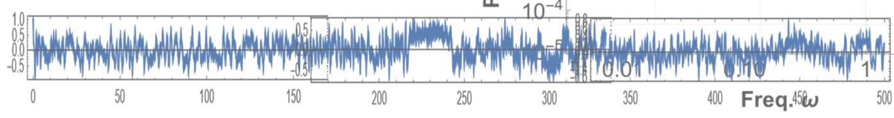




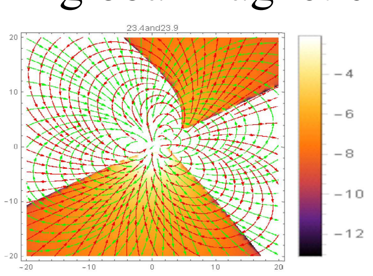
synchronized→ pink,
(finite order para.)

0 order para.
→ more white





4. Polarity flip in MSM from stochastic resonance → global magnetic recombination→ jet/knot emission

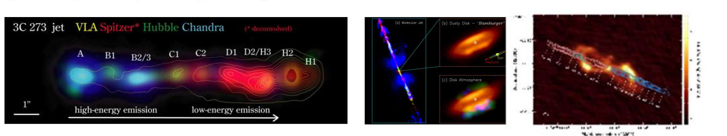


$B_{BH}=10^8 M_{sun}$, $R=100R_S$, $B=300$Gauss

$B\approx \mathbf{m}\mu_0 r^{-3}$ $E_{mag}\approx \mu_0\mathbf{m}^2(3R)^{-3}\approx 8\times10^{53}$erg

Plasma blob of mass M_{sun} is accelerated to $\beta\approx 0.7$

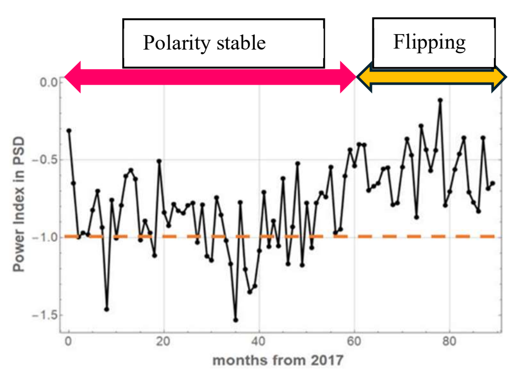
→ may create and accelerate knots universally:



L. AGN Spitzer
C. Proto star Alma
R. Old star W43A

5. Polarity flipping period ↔ hard mode

Fixed stable polarity period ↔ soft mode?



← a case of solar flare monthly PSD index

a transition is observed: from pink toward white
(polarity fixed) (flipping polarity)