Annual cycles in PKS B1322-110 and J1726+063 with implications for scattering plasma

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Scintillometry 2019, Bonn, 2019/11/07

Extragalactic (non-FRB) scintillators

- most AGNi too big to scintillate
- but some twinkle occasionally
- two flavours (screen distance?):
 - ESEs, Extreme Scattering Events: slow (far), one-off, high amplitude
 - IDVs, Intra-Day (Hour) Variables: fast (nearby), intermittent
- modelling suggests plasma is highly overpressured and anisotropic
- IDV screens lie close to, co-move and align (radially) with nearby hot stars
 we want to test the association!





Scintillometry 2017 slide

PKS1322-110: New data



Slow-down, as predicted

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Same plot, full year of light curves

Model plasma • anisotropic ('1D') • points at Spica • moves with Spica • at distance of Spica + T_b=10¹³ K for source

- no free parameters!





(But there are issues)

Point 1: Rates better than time scales



Rate = 1/Timescale

Rate models: • simple |sine| curve • phase = anisotropy PA • baseline = ⊥ velocity • flips at 'standstills'

Rate estimates:

• better behaved error bars (particularly near standstills)

•less biased

Point 1: Rates better than time scales





Point 2: Standstills can be quantified

Rates when little varies

- scaled $ACF_i(\Delta t) = ACF(r_i \Delta t)$
- fast epochs estimate ACF
- ACF estimates slow epochs
 in practice: global fit for ACF, r_i
 there is MCMC code for this





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350















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Successful models:

• crosses hodograph at standstills





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All squeeze together at low β

PKS B1322-110: Conclusions



eycle strongly suggests anisotropy
consistent with Spica hypothesis
but no definite kinematic proof
continued for another year so far
cycle essentially unchanged
other tests needed



J1726+063: New (and better) IDV



- from better targeted survey
- further from ecliptic
- faster IDV (IHV)
- potential association α Oph, Rasalhague (A5III, 15 pc)
- alternatively γ Oph (AOV, 30 pc)



J1726+063: Annual cycle

- distinct cycle with two standstills
- stable over two years
- tight kinematic constraints
- tight orientation constraints
- screen needs to be local (<20-30 pc)





• PA hardly consistent with α Oph $\bullet v_{eff} \perp inconsistent \ with \ \gamma \ Oph$

Summary

- IDVs show clear annual cycles, as expected
- Cycles imply strong anisotropy
- Best analysed as rates, not time scales
- Slow epoch rates measurable with global optimisation
- Targeted search yields efficient IDV detection
- Ecliptic best to be avoided
- For PKS1322, orientation poorly constrained, association with Spica still plausible
- For J1726, constraints much tighter, suggest non-radial orientation of plasma if associated with Rasalhague