Fast Gaia transients

T. Wevers, in coll. with P.G. Jonker, S.T. Hodgkin, and many others!

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TDEs in a nutshell

\[ r_{t, \odot} = 100 R_{\odot} \left( \frac{M_{\text{bh}}}{10^6 M_{\odot}} \right)^{1/3} \]
TDEs as tracers of IMBHs?

- Star enters tidal radius of BH: differential gravity leads to disruption
- A fraction of the material remains bound and accretes onto the BH

Typical fallback timescale (Lodato & Rossi, 2011):

$$t_{peak} \sim 41 \times m_{\text{star, } \odot}^{-1} \times r_{\text{star, } \odot}^{1.5} \times M_{BH, 6}^{1/2} \text{ days}$$  \hspace{1cm} (1)
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For a 0.6 \( M_\odot \) WD:

- tens - 1800 sec for \( M_{\text{BH}} \sim 100 - 10^5 M_\odot \)
  
  [see e.g. Jonker+13, Glennie+15, Bauer+17 for X-ray events]
Fast TDEs can only occur around IMBH!

Tidal disruption events & IMBHs

Y-axis ($r_{\text{tidal}}$ in km)

X-axis ($M_{\text{BH}}$ in $M_\odot$)

- 0.1 $M_\odot$ MS star
- 1 $M_\odot$ MS star
- 10 $M_\odot$ MS star
- 1 $M_\odot$ WD
- Schwarzschild radius

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Fast transients with Gaia

![Graph showing the relationship between luminosity and decay time for various types of transients.]

- GRB afterglows
- LGRB Orphan Afterglows
- CCSNe
- SNe Ia
- Tidal Disruption Flares
- Luminous Supernovae
- Luminous Red Novae
- LBVs
- Classical Novae
- Macro Novae
- Fallback Supernovae

Decay Time (days)

M_r (mag)
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Skewness ($\gamma$) vs. von Neumann ($\eta$)

TW+2017d (arXiv:1710.08924)
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Skewness ($\gamma$) vs. von Neumann (\(\eta\))
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Skewness ($\gamma$) vs von Neumann ($\eta$) plot.

TW+2017d (arXiv:1710.08924)

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Gaia per-CCD data is great!
Through aggressive filtering, we can find real transients
Gaia is the only mission with this capability, now and the foreseeable future
Use spectra, colours, etc for ”classification” (?)
Real-time alerts of fast transients?