

Simulation of Gaia DR4 epoch astrometry for binary systems



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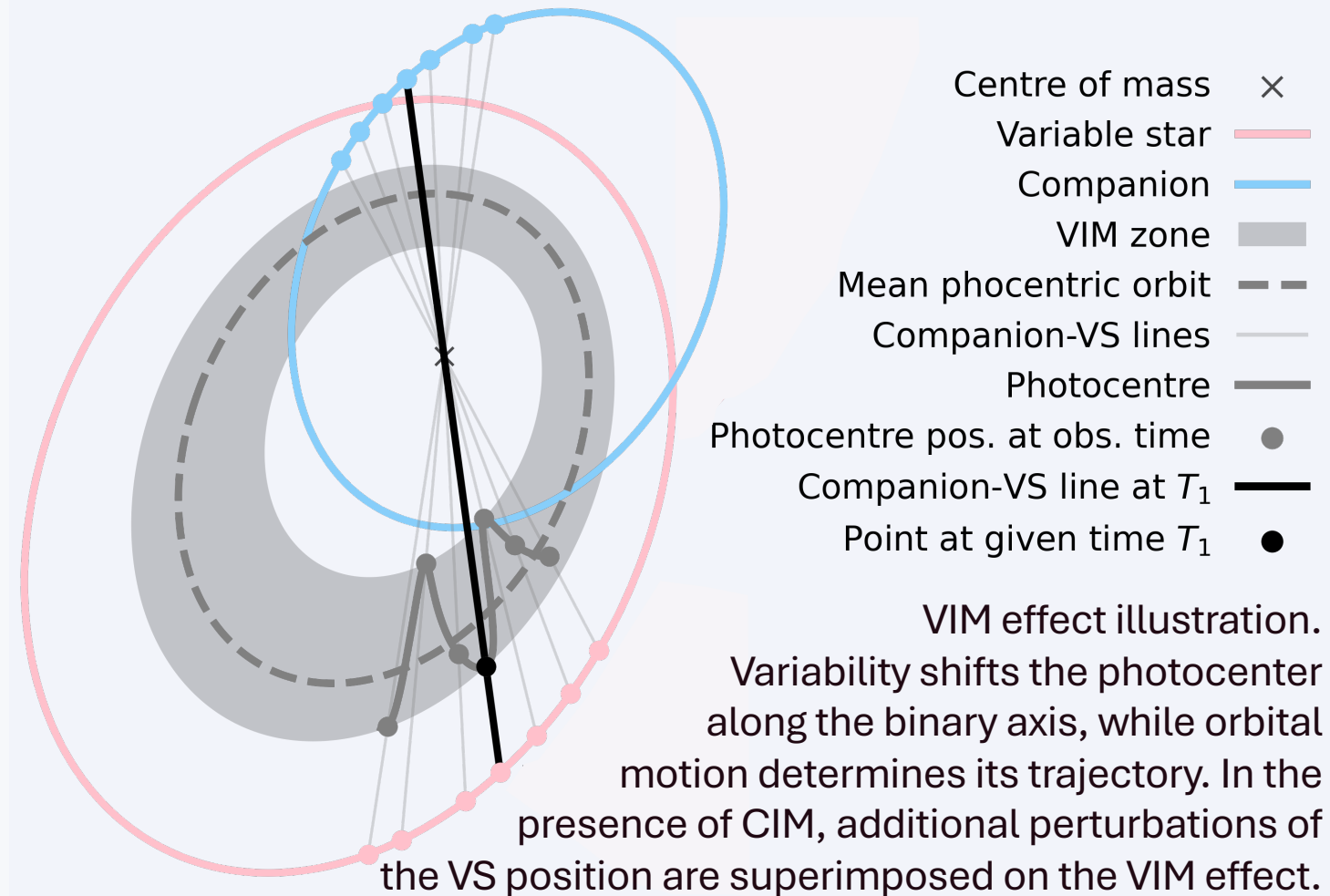


Gaia epoch astrometry

Gaia epoch astrometry (GEA) consists of time-series along-scan measurements used to derive parallax and proper motion. In **unresolved binaries**, orbital motion modifies these positions and can **bias** the fitted **astrometric parameters**. The upcoming **Gaia DR4** will publicly provide GEA for the first time.

VIM and CIM

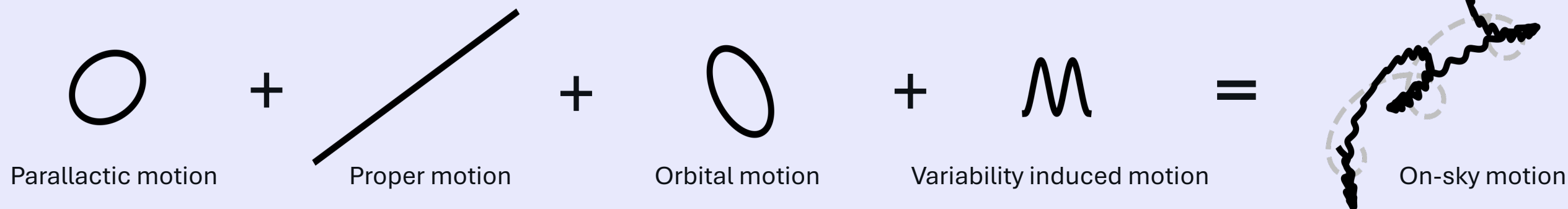
Stellar variability also affects the astrometric position of unresolved binaries. Such systems are known as **variability-induced movers** (VIMs) and consist of one variable star (VS) and one photometrically stable companion¹. In AGB containing systems, **convection-induced motion** (CIM) further perturbs the photocentre position².



Impact on distance measurement

In our first study¹, we analysed five binary Cepheids with negligible VIM effect, Their **distance precision** was impacted **up to 30% by the binary** when fitted with a standard single-star (SS) model. Cepheid **AW Per** exhibited a VIM amplitude of 2.23 mas, leading to a **24% distance bias**.

In our second study², we investigated two AGB binaries: π 1 Gru and V Hya. While π 1 Gru showed no significant VIM signal, **V Hya** displayed a VIM amplitude of 5.7 mas. Combined orbital, VIM, and CIM effects produced a **distance bias up to 56%** compared to SS fit.



Conclusion

Our results show that photometric effects such as VIM and CIM can **significantly bias** Gaia **distance measurements** of Cepheids and AGB stars. Accurate parallaxes for these standard candles therefore require **dedicated binary** and **variability-aware astrometric models**.

References ¹Sivkova+ submitted, ²Decin+ submitted