Periodic variability of Stripe 82 quasar light curves and associated changes in Mg II emission line profiles

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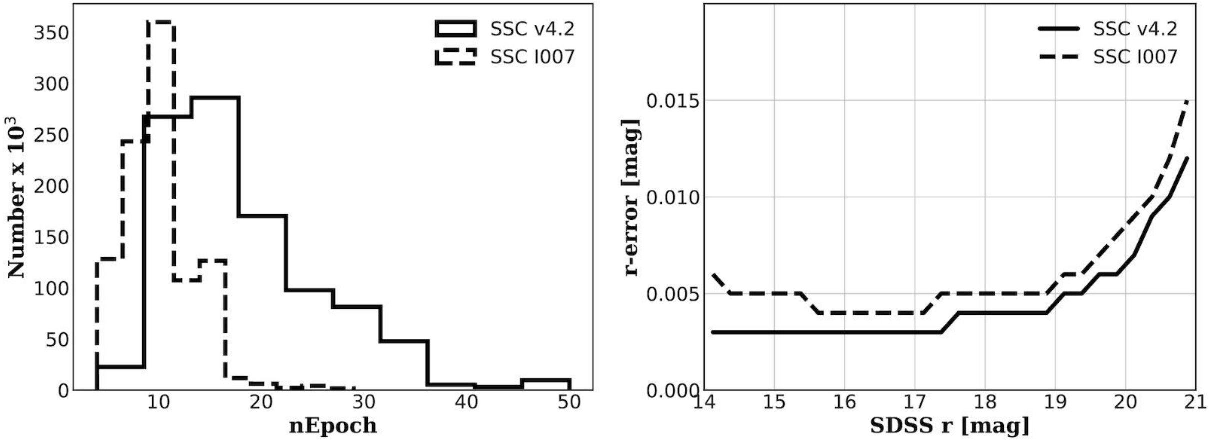
The Restless Nature of AGN: 10 years later
Napoli
27 Jun 2023

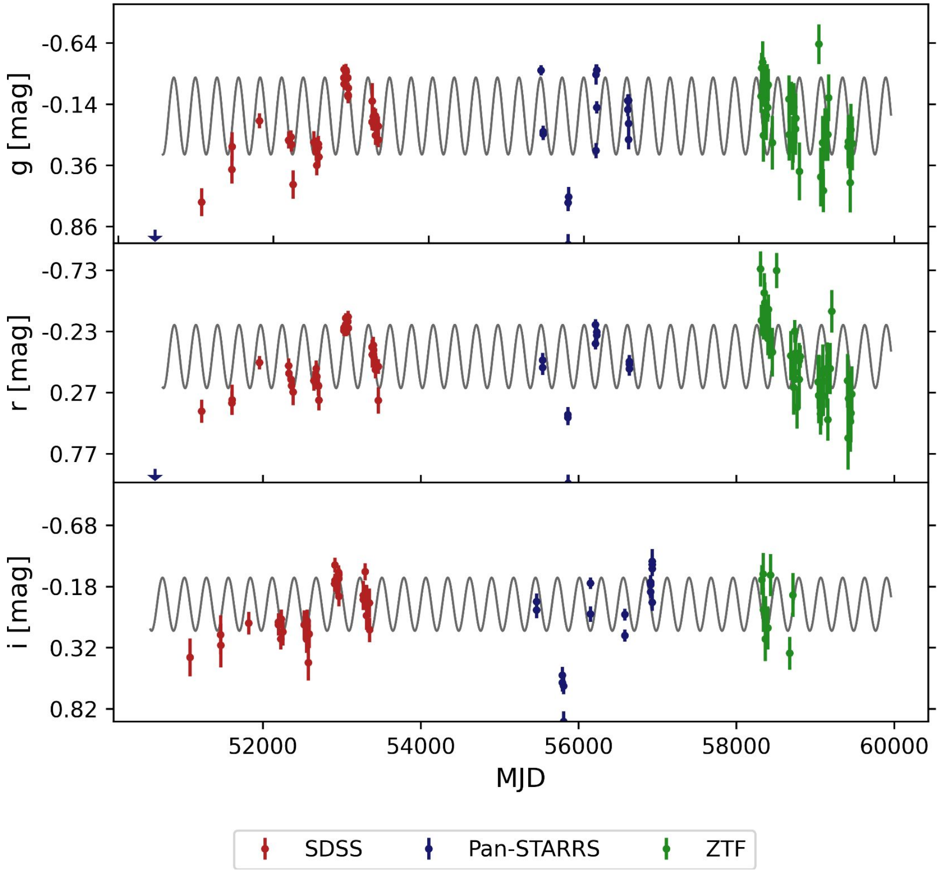
SDSS Stripe 82 long-term periodic variability

- SDSS Stripe 82 (RA≤|60°|, DEC≤|1.3°|)
- observational baseline ~6-years
- SDSS S82 standard stars (Thanjavur+21)
- ~1M sources, $r \lesssim 22$ mag, *ugriz bands*
- sources selected as non-variable, with $\chi_{dof}^2<3$
- previously detected variable sources also removed (e.g. Sesar+07...)
- max epochs per band~50, average~20
- our sample $N_{epochs}>25$, $0.1<pm_{error}$[mmag]<20



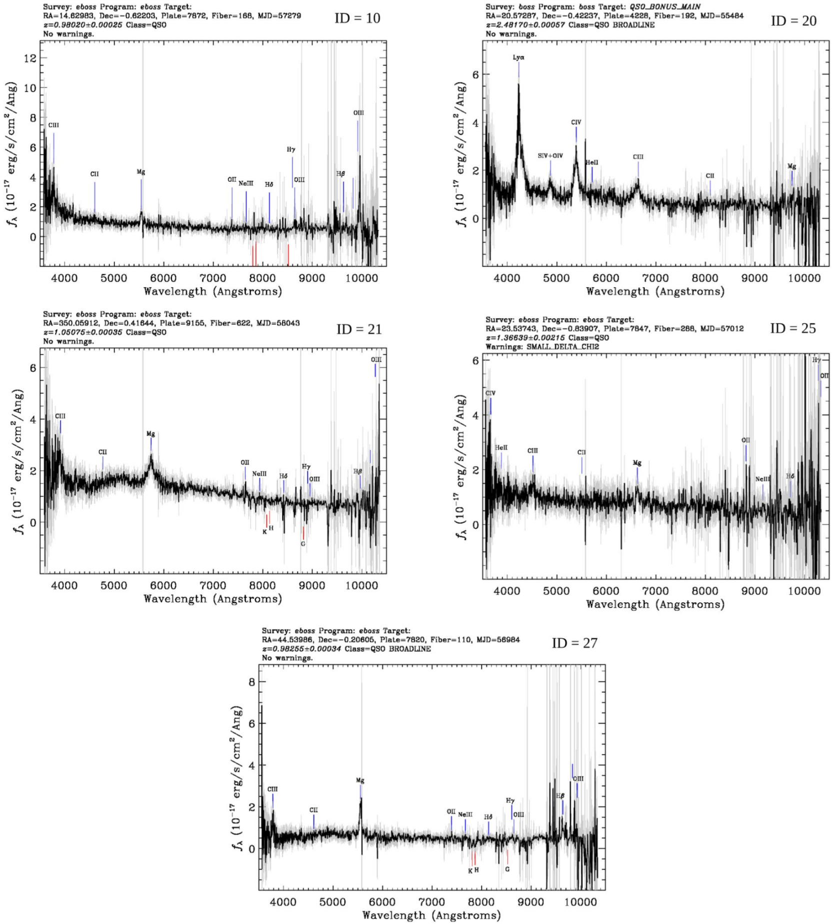
Stripe 82 long-term periodic variability

- ~150k sources in our sample
- robust variability and periodicity analysis:
  - LS periods in *gri* bands agree to 0.1%
  - no significant gaps in phase-folded LCs
  - no clumps in the overall period distribution (i.e. no obvious interloping signal)
  - purged 1-year aliases
  - period uncertainties obtained from MC sim.
  - 2D hybrid method (Kovačević+21) & Multiband LS (VanderPlas & Ivezić 2015) for validation of periods
  - verification of variability with data from recent surveys (ZTF, Pan-STARRS)
- **result: 5 candidates, all QSOs** (Fatović+23)



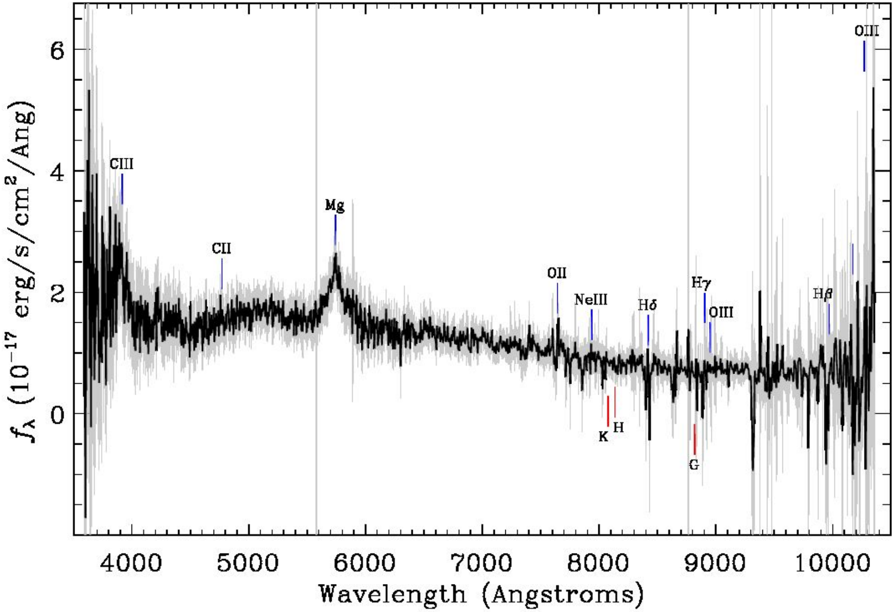
5 candidates

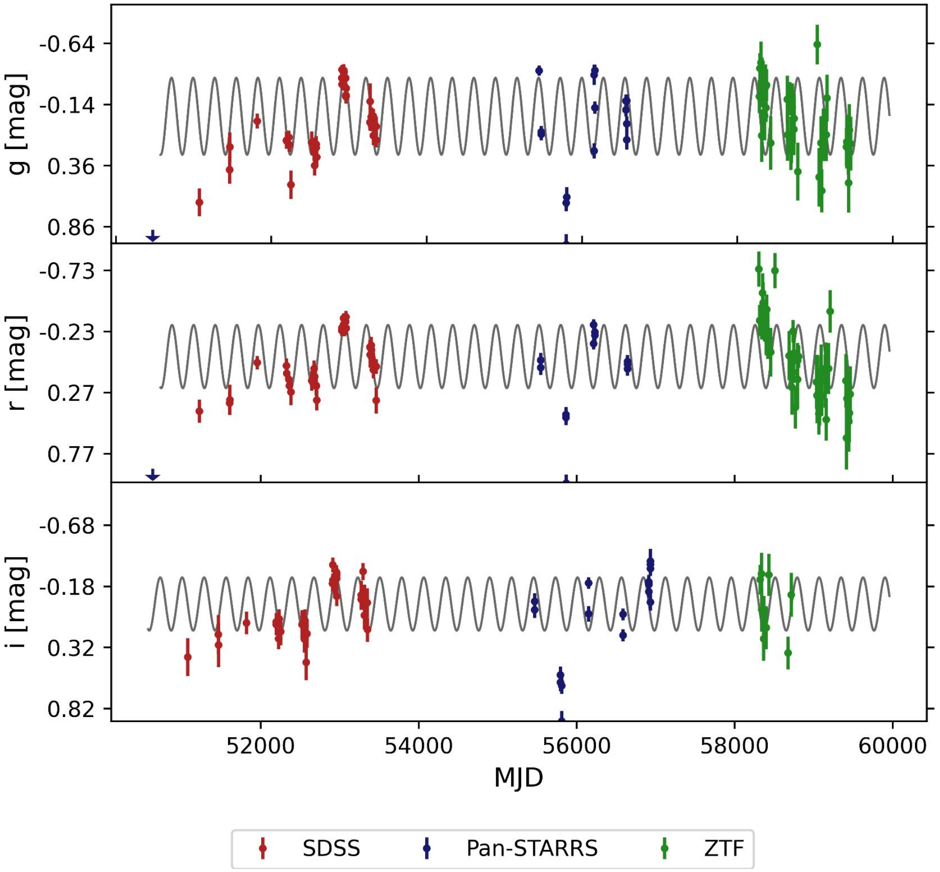
- jets (Fan+02,Kudryavtseva+11)
- warped accretion disks & hot spots (Greenhill+03, Herrnstein+05, Strateva+03)
- TDEs (Komossa & Greiner+99, Mandel & Levin+15)
- Black hole binary system (Sillanpää+96, Graham+15)
- ...
- ... or a combination



Prototype

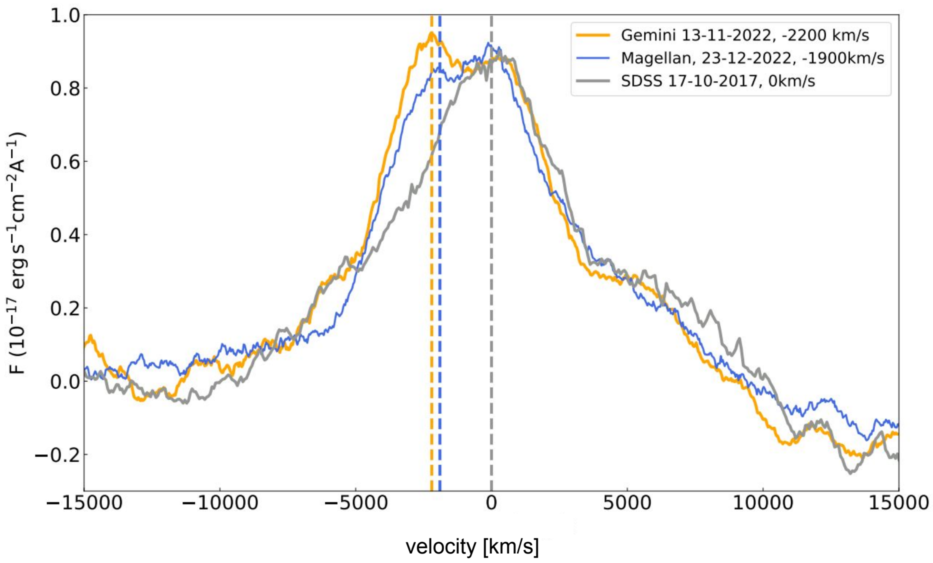
- r~21 mag, A_r~0.5 mag, P=278 ± 2 days *(shortest P cand?)*
- Chandra detected x-ray variability
- broad Mg Ⅱ line, hint of structure
- no archival radio emission
- Pan-STARRS & ZTF observations confirm variability

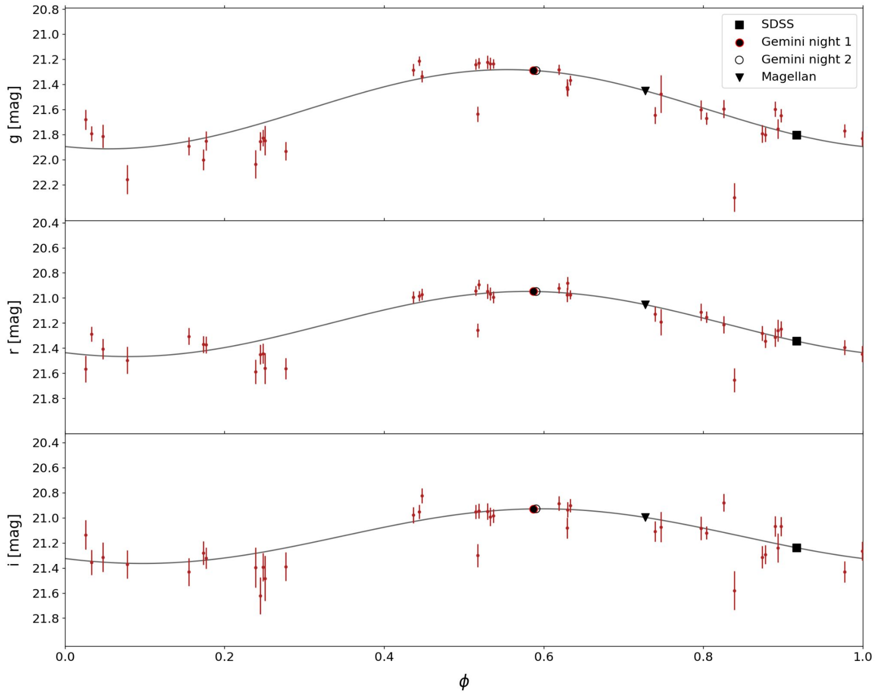




Recent observations focused on the Mg Ⅱ line profile

- double peak in Magellan & Gemini observations
- unambiguous changes in the Mg Ⅱ line profile
- velocity shift

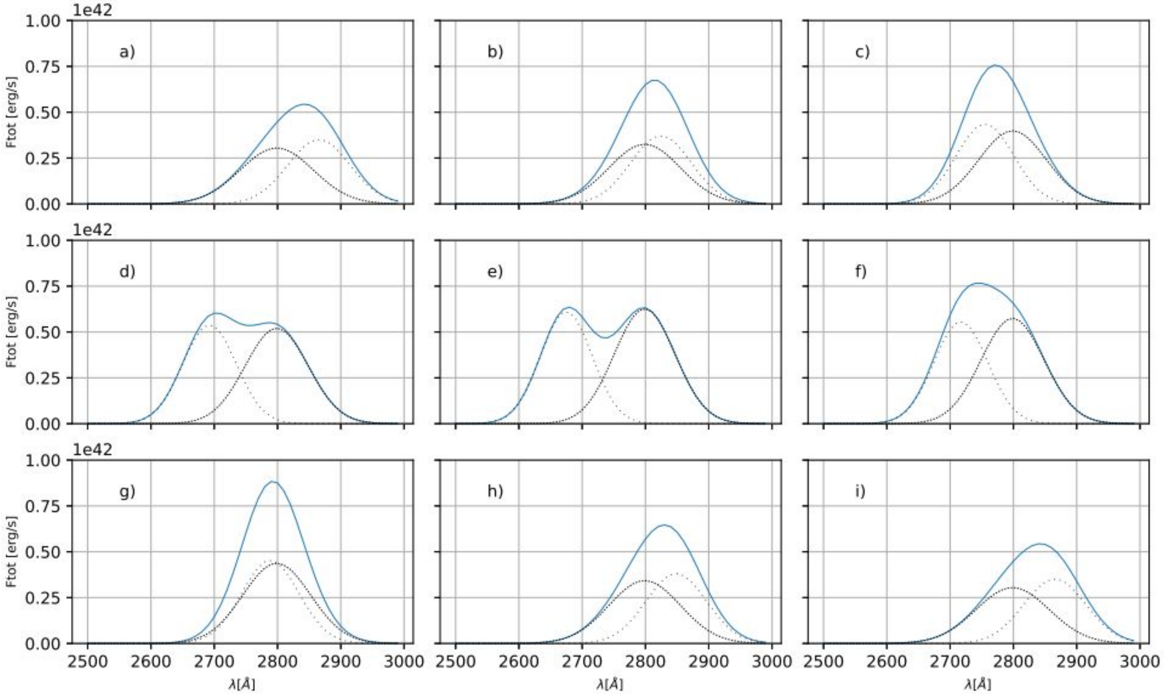




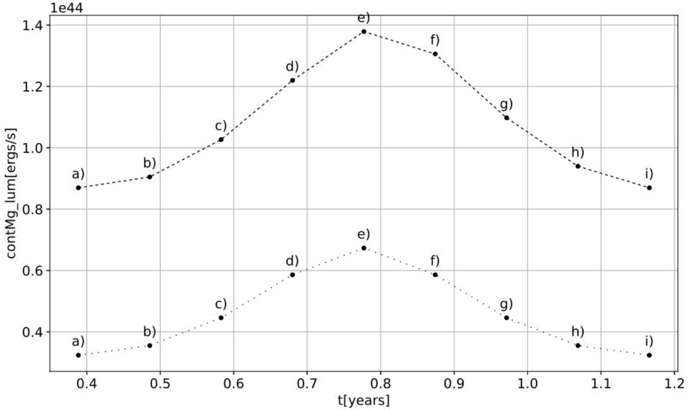
Model (PoSKI, Popović+21)

- model assumptions:
- BH_1 orbits BH_2 & strips its BLR
- system emission generated by BH_1 & cBLR
- $m_1=10^7 M_\odot$, $m_2=10^8 M_\odot$, R=0.002 pc
- i=45°, e=0.3, ω=90°

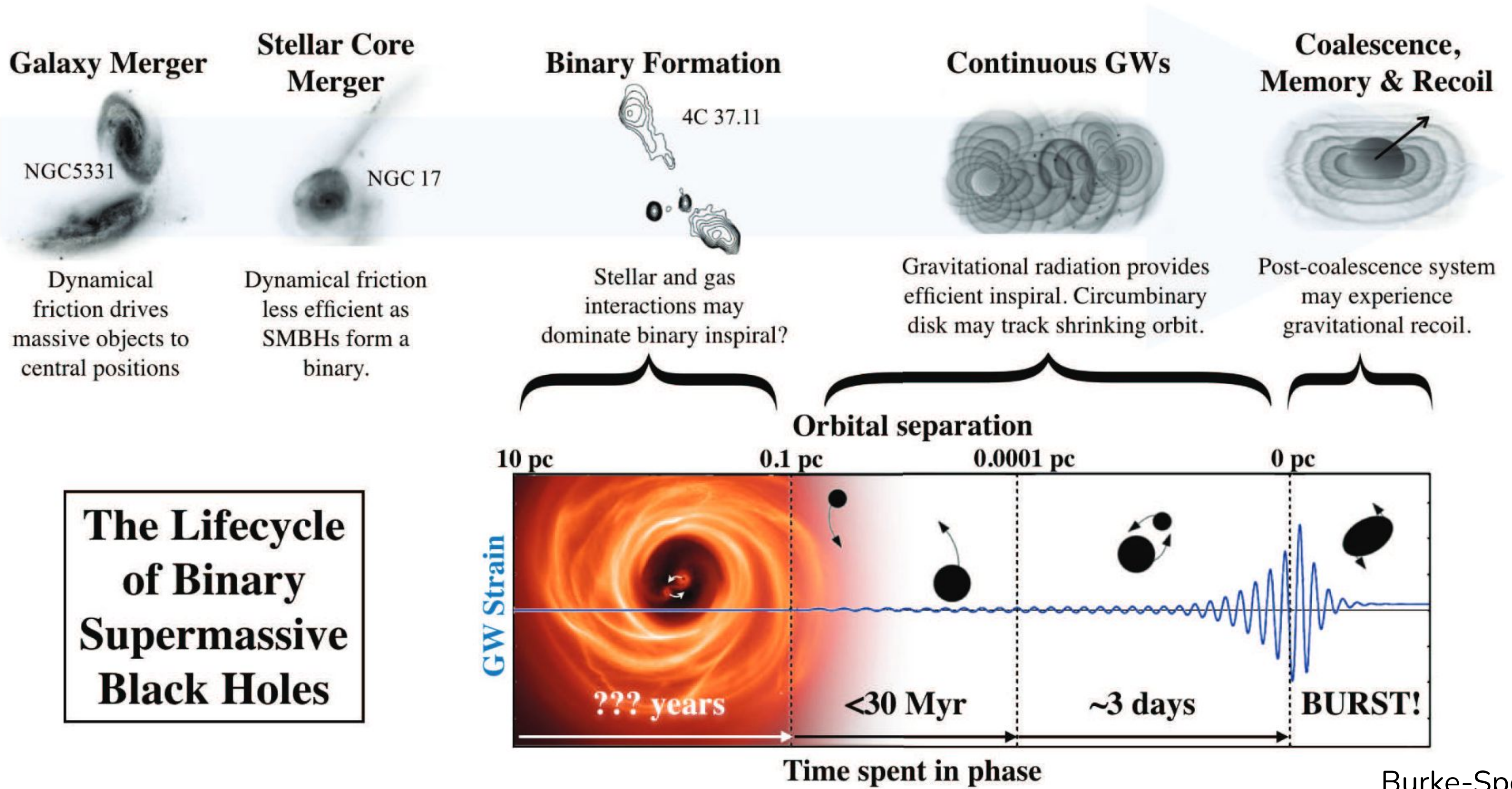
- solid line: Mg Ⅱ total line flux
- dashed line: cBLR contribution
- dotted line: BLR_1 contribution



- dotted line: continuum variability
- dashed line: Mg Ⅱ variability



SMBBHs & Gravitational Waves



Burke-Spolaor+18

LSST@Europe5

LSST@Europe5: "Towards LSST Science, Together!" conference will be held in Poreč, Croatia, September 25–29, 2023. We look forward to welcoming you in historic and picturesque Poreč, a UNESCO heritage site. Please save the date!

This conference aims to build on the successful outcomes of the first four meetings in the UK, Serbia, France, and Italy, and to further collaboratively develop LSST science opportunities. We anticipate that the Rubin Construction and Operations teams will report on the observatory construction status, data products and updated timelines. We also plan to put the emphasis on in-kind contributions, and particularly on those originating in Europe.

The meeting will be conducted in a hybrid format to enable access for remote participants and the wider Rubin/LSST community. We are planning for up to 300 in-person participants, and anticipate funds for enhancing participation by junior researchers.

The organizers wish to express their gratitude to B612 Foundation and LSST Corporation for providing financial support for the meeting.

Registration is open. Abstract submission and requests for travel support will become available soon.

Thank you for your attention!