RELTRANS: a public X-ray reflection and reverberation mapping model

Adam Ingram[1], Guglielmo Mastroserio[2], Thomas Dauser[3], Pieter Hovenkamp[2], Michiel van der Klis[2] & Javier Garcia[4,3]

[1]University of Oxford; [2]University of Amsterdam; [3]Remeis Observatory; [4]CalTech

adam.ingram@physics.ox.ac.uk

RELTRANS[1] calculates the X-ray spectrum and energy-dependent cross-spectrum of accreting black holes. It is fast, and can be used to measure black hole mass and spin for AGN and X-ray binaries.

The Model

- Publicly available to use in XSPEC.
- Assumes lamppost geometry (Fig 1).
- Rest frame reflection spectrum calculated with XILLVER[2] and continuum is either cut off power-law or NTHCOMP.
- Calculates time-averaged spectrum, and Fourier time lags and variability amplitude (Fig 2).
- Includes a realistic disc ionization profile.
- Properly accounts for absorption and instrument response.
- Fast and on the fly, so easy to parallelize.

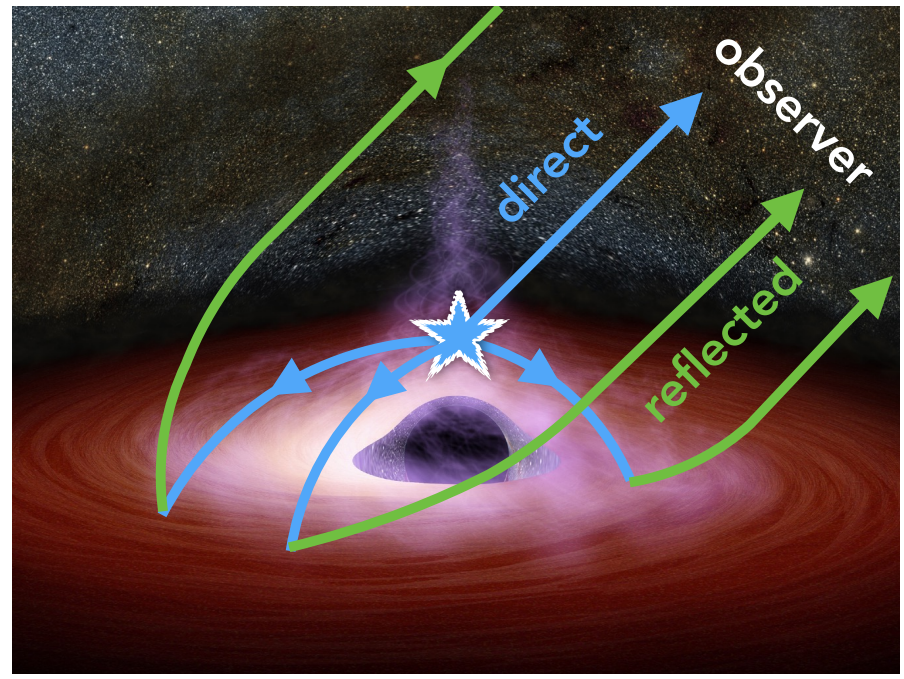

Fig 1: Schematic of the lamppost geometry.

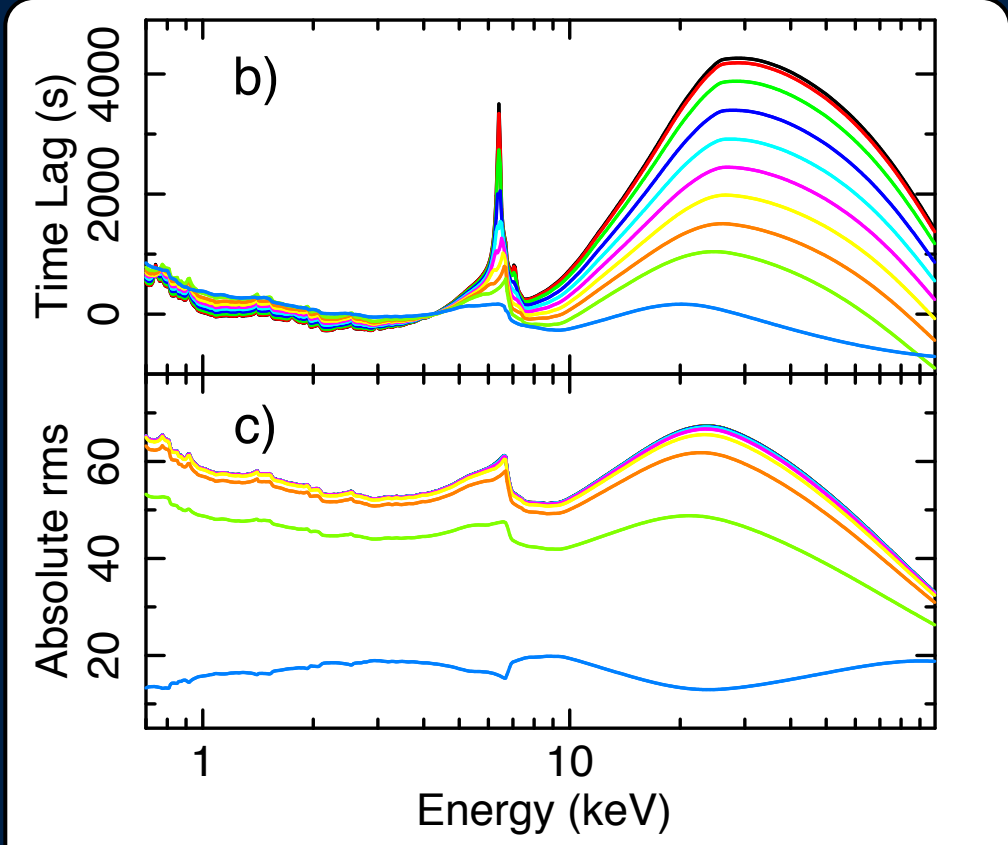

Fig 2: RELTRANS time lag (top) and variability amplitude (bottom) for a 46 million $M_\odot$ black hole. Fourier frequency increases logarithmically from black (10^{-8} Hz) to light blue (10^{-4} Hz).

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https://adingram.bitbucket.io/reltrans.html

Results

- Mass measurement of the Cygnus X-1 black hole[3].
- Find mass for the Mrk 335 black hole (~1 million $M_\odot$) lower than the optical reverberation measurements (14-26 million $M_\odot$)[4].
- Spin measurement of GRS 1915+105 black hole depends on assumed ionization profile[5] (Fig 3).

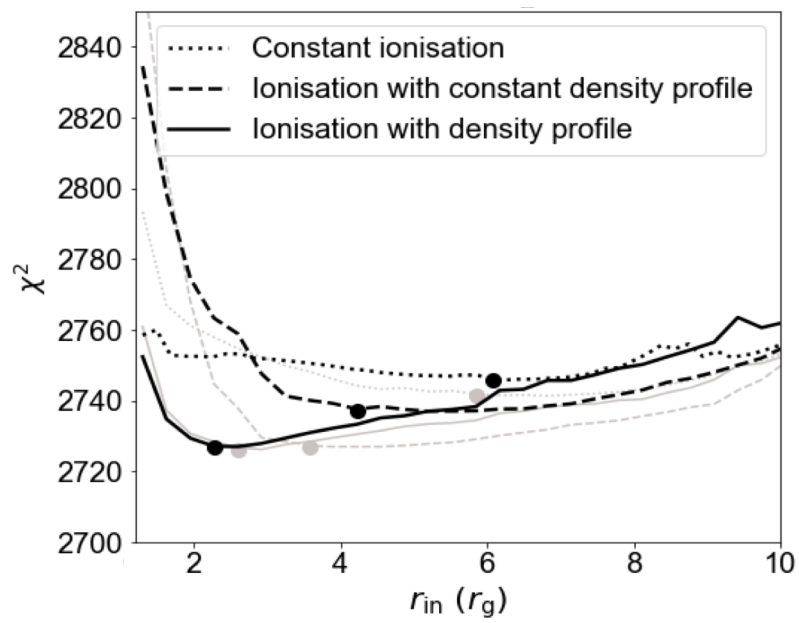

Fig 3: Disc inner radius of GRS 1915+105 measured using RELTRANS assuming three different ionization profiles.

References

[1] Ingram et al (2019) MNRAS 488 p324
[2] Garcia et al (2013) ApJ 768 p146
[3] Mastroserio et al (2019) MNRAS 488 p348
[4] Mastroserio et al (submitted to MNRAS)
[5] Shreeram & Ingram (submitted to MNRAS)

UNIVERSITY OF OXFORD