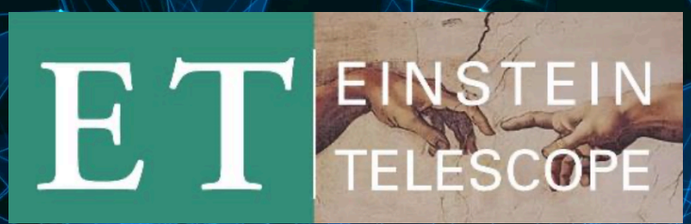
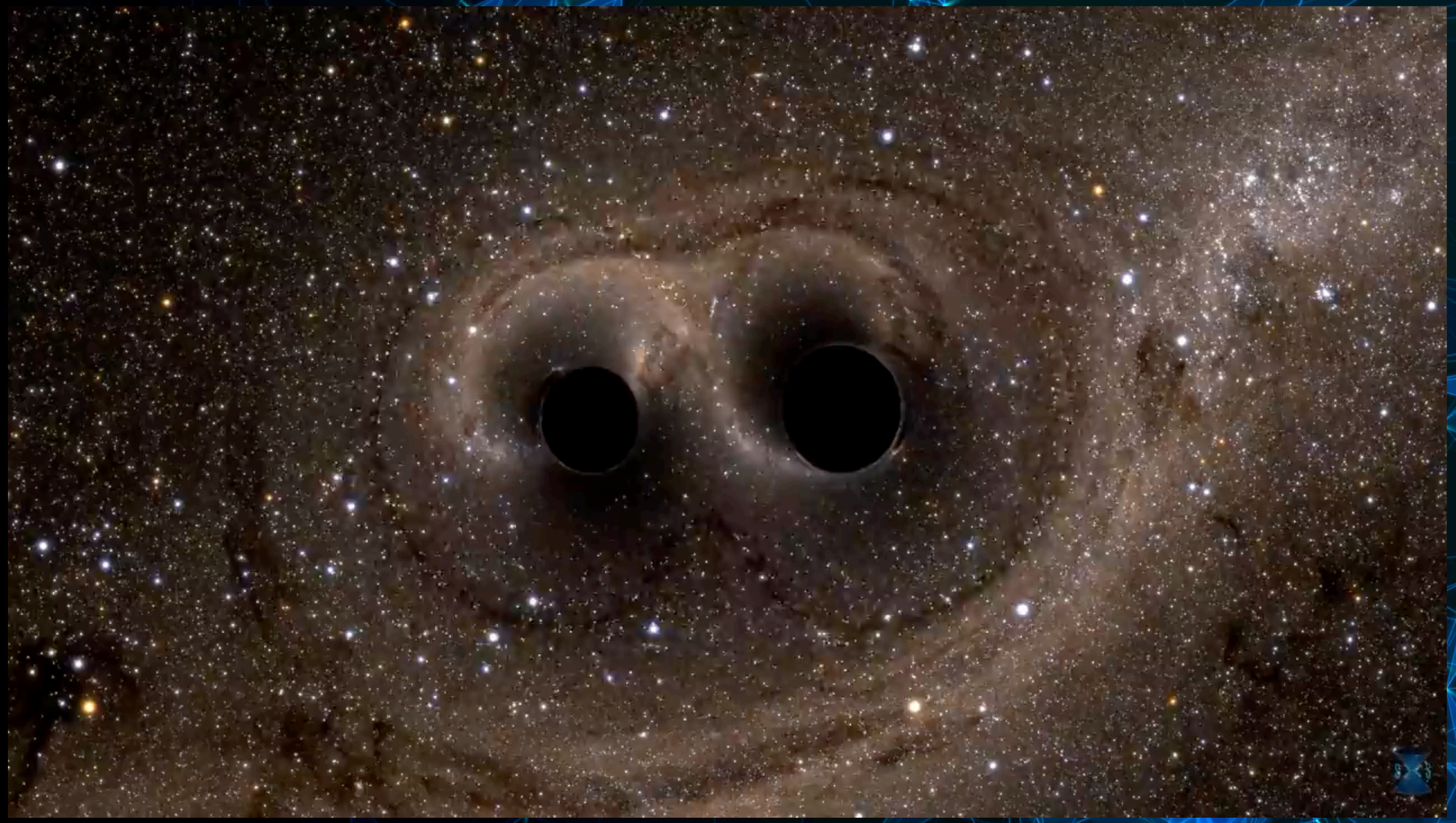
SIMULATING BLACK HOLE BINARIES

TOMAS ANDRADE

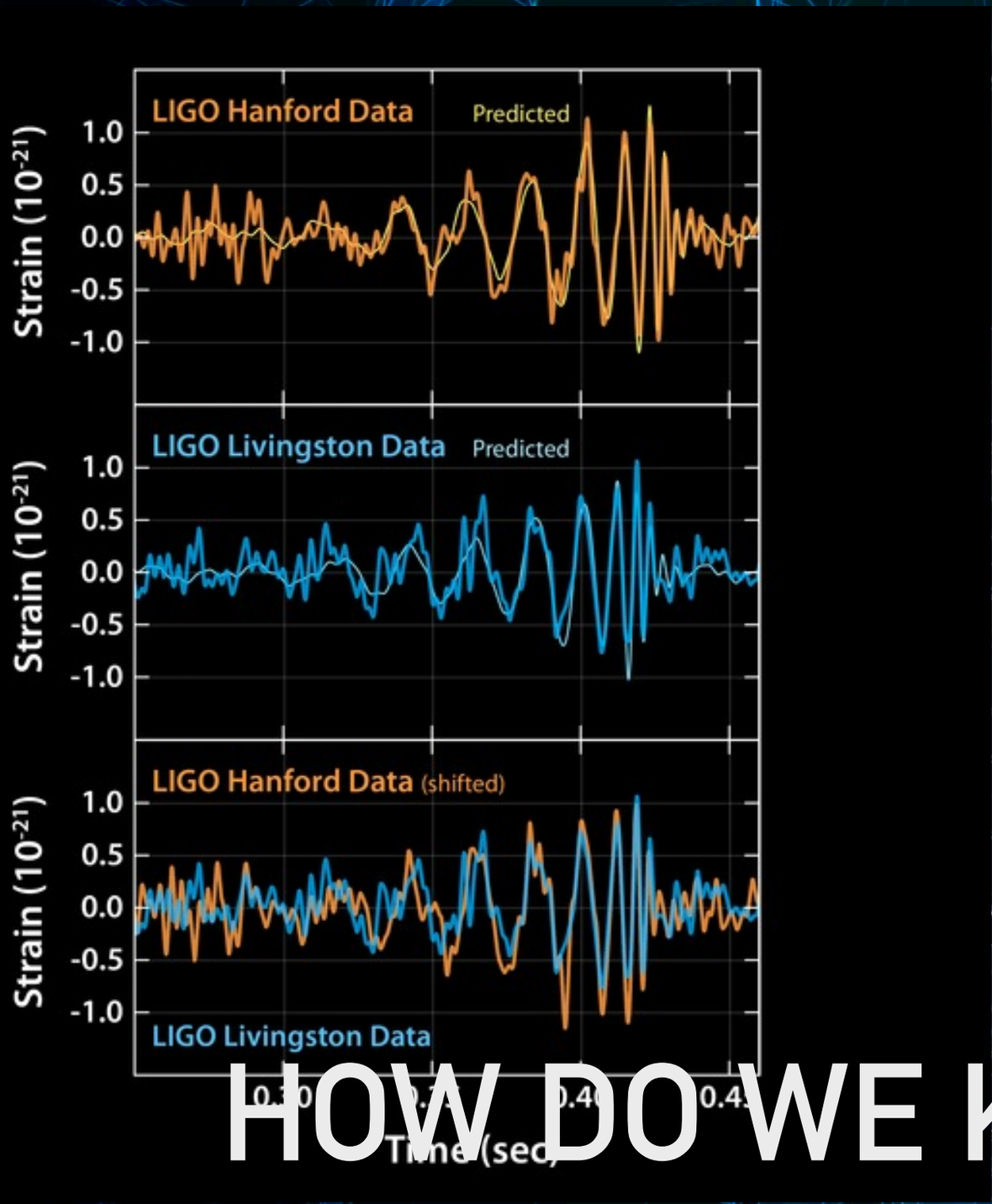


ALL GW TALKS START LIKE THIS

1.3 billion years ago in a galaxy far away ...



WHAT THE ACTUAL DATA LOOKS LIKE



HOW DO WE KNOW?

"HOW DO WE KNOW" HAS TWO PARTS

DETECTION

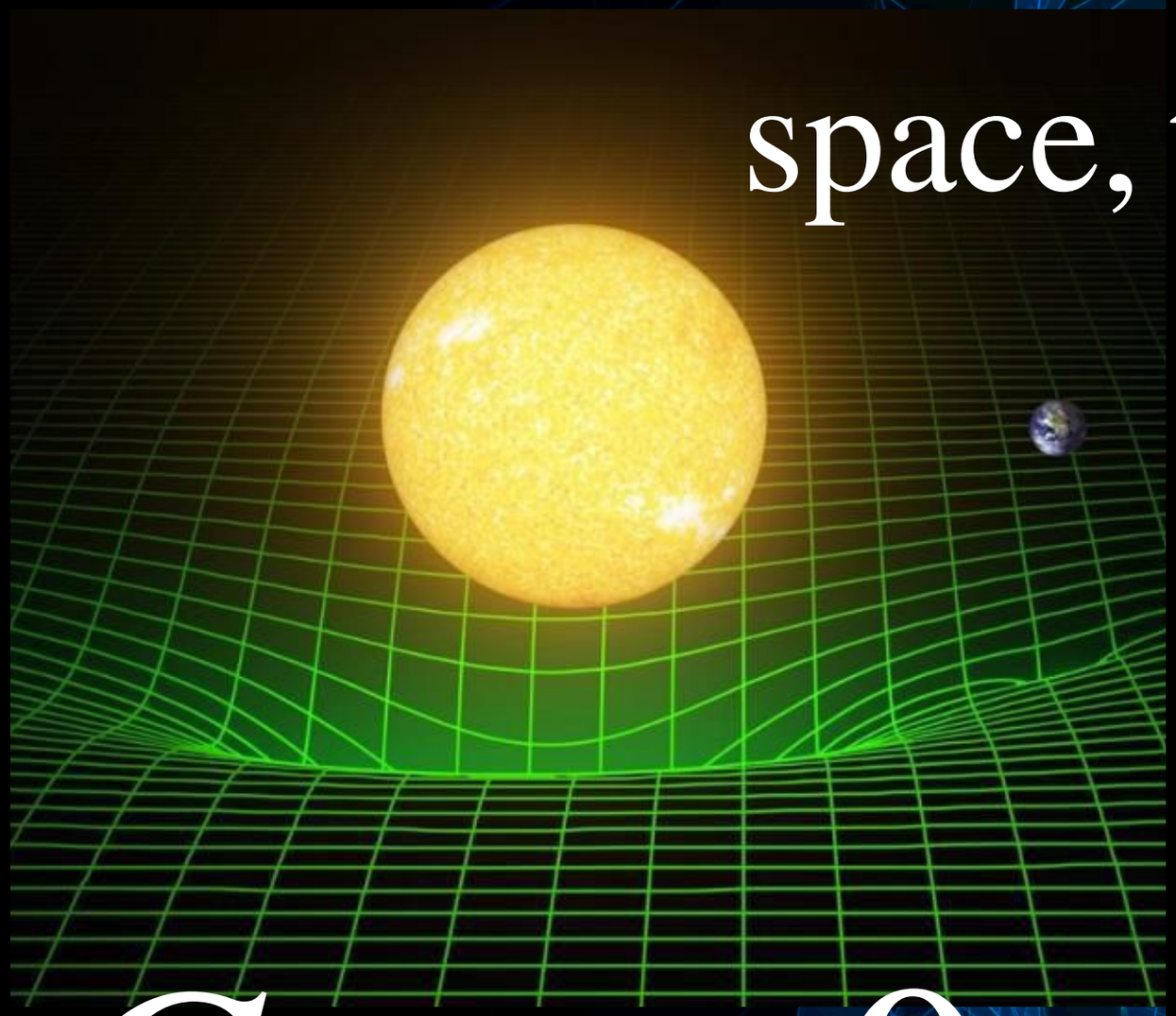
MATCHED FILTERING

PARAMETER ESTIMATION

BAYESIAN ANALYSIS

BOTH REQUIRE A MODEL

WE HAVE A THEORY!



$$G_{\mu\nu} = 0$$

space, time = spacetime

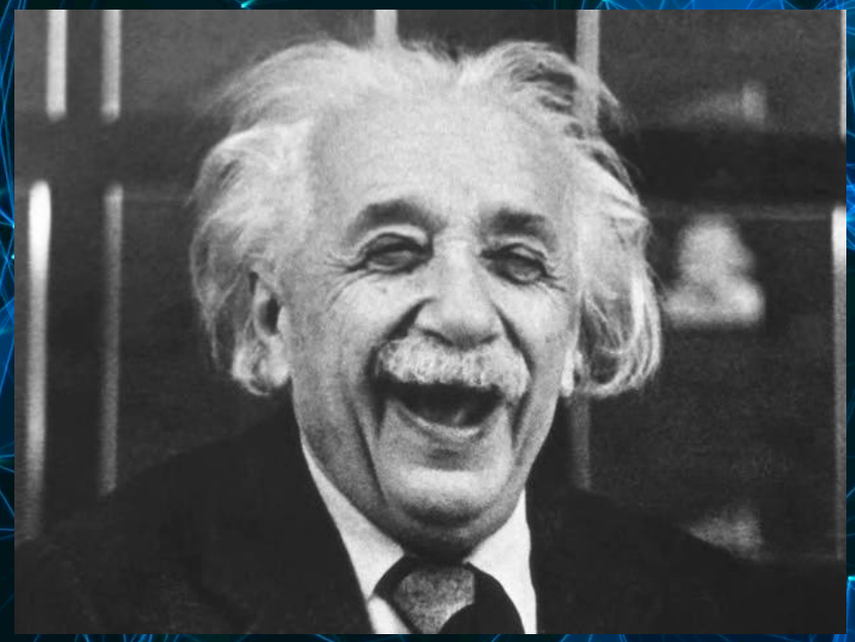
$$g_{ij}(t_0) = \text{two BHs}$$

$$\partial_t g_{ij} = F(g_{ij})$$

$$h(t) = \Phi(g_{ij}^{\infty}(t))$$

-0.76s

JUST DO LOTS OF SIMULATIONS



EXPENSIVE

DAYS - WEEKS FOR BBH

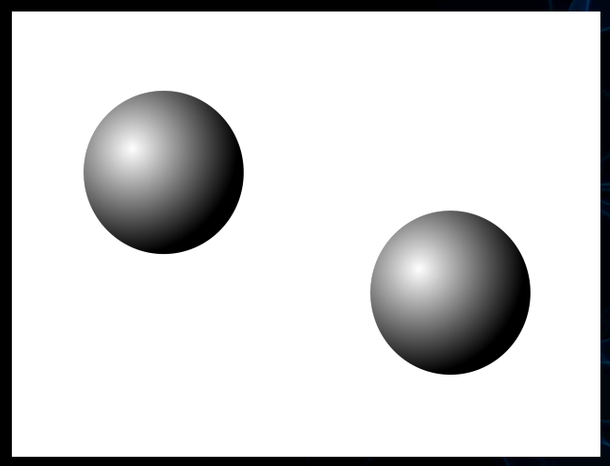
NEED ABOUT 10^5

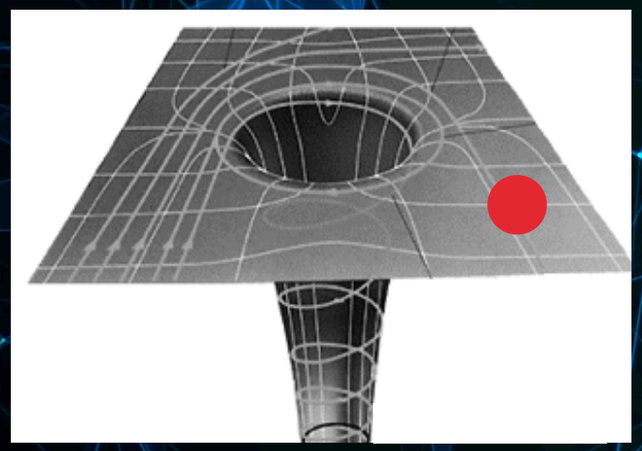
PARAMETER SPACE IS HUGE

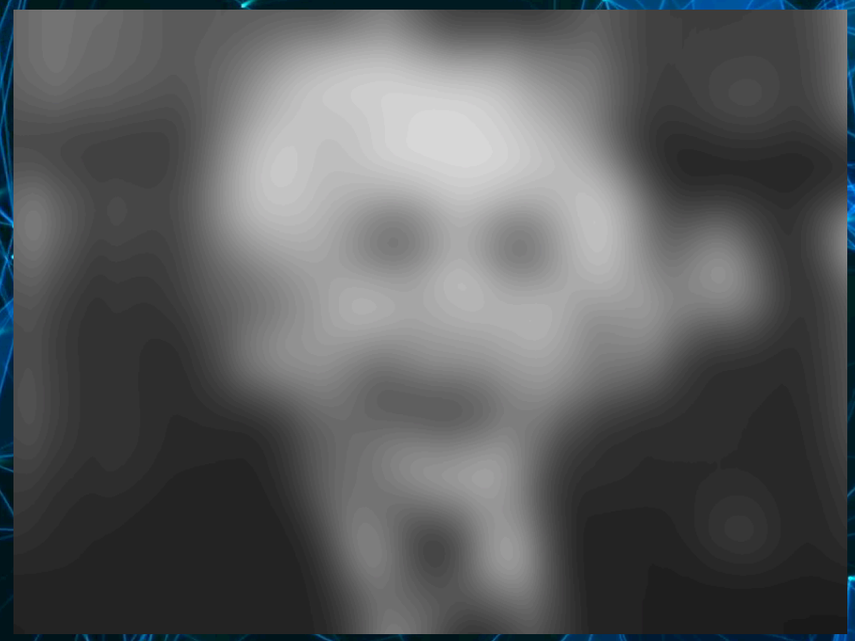
13 PARAMETERS

IN PRACTICE USE APPROXIMANTS

EFFECTIVE ONE BODY





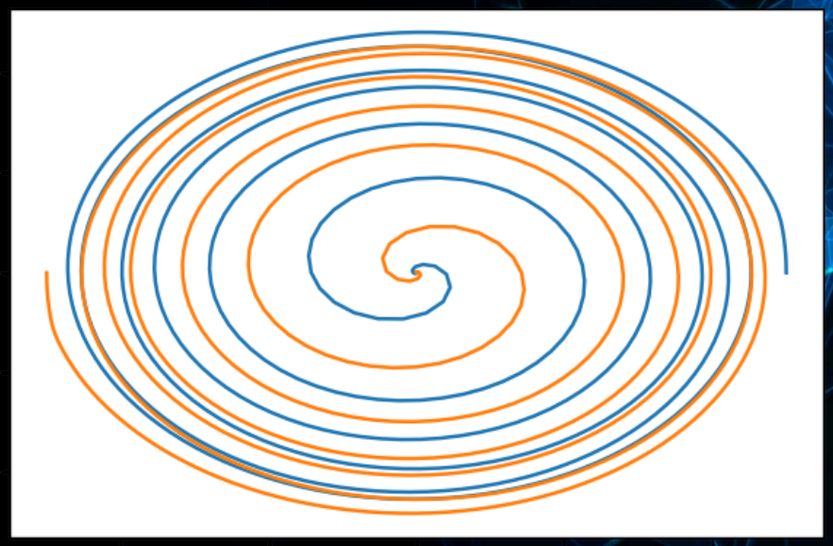


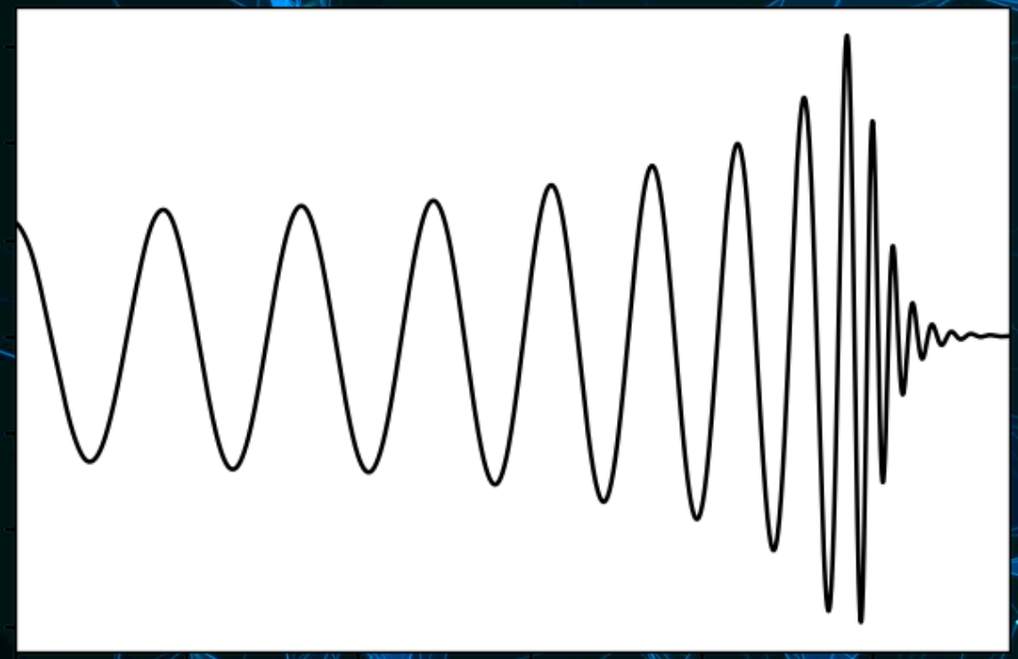
WEEKS TO SECONDS!

INFORM APPROXIMATE MODELS WITH NR

WHAT WE KNOW
QUASI-CIRCULAR BINARIES

credit: Juan Trenado





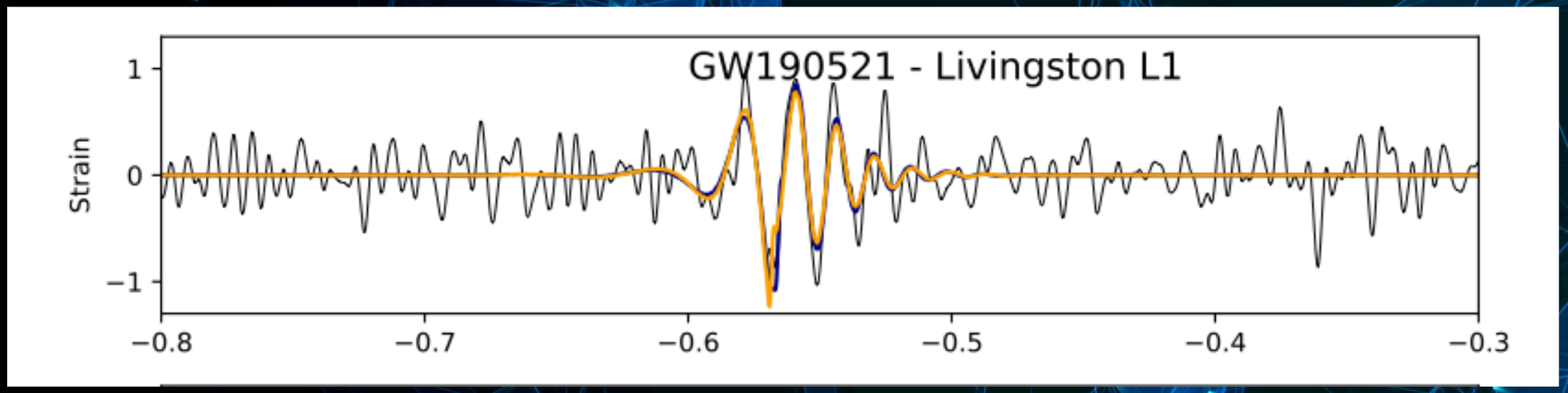
EXPECTED FROM STELLAR BINARY IN ISOLATION

MOST EVENTS SO FAR

CHALLENGING EVENTS

IMBH GW190521

[Gamba et al 2021]



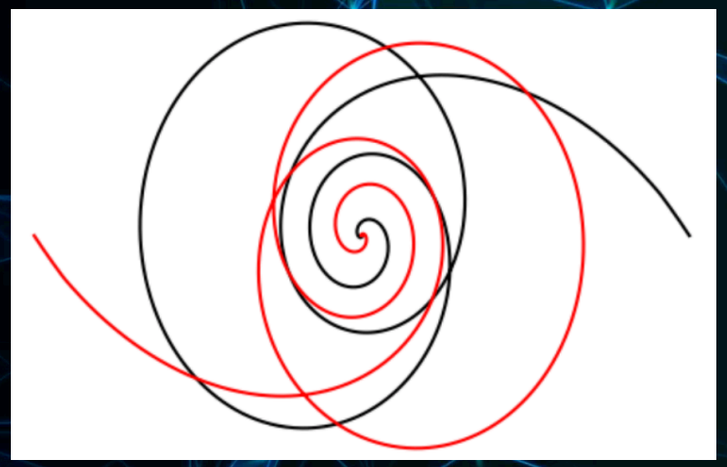
ECCENTRICITY AND PRECESSION

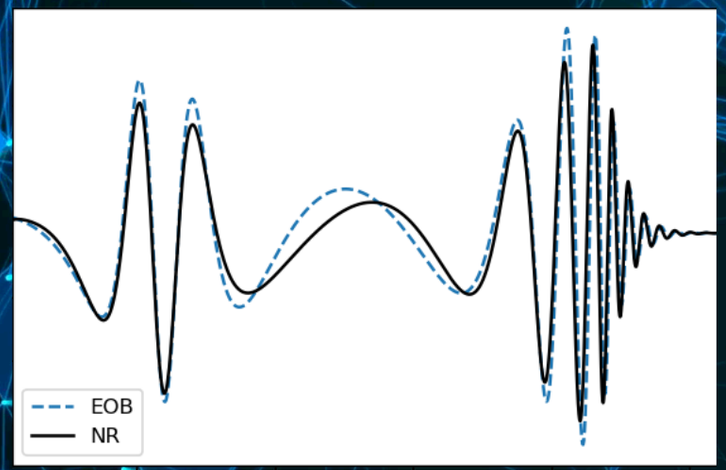
OTHER FORMATION CHANNELS

WHAT I AM DOING

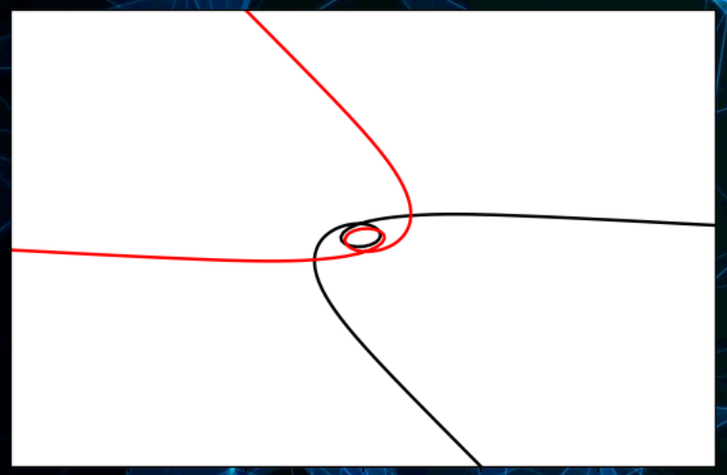
NR SIMULATIONS

DYNAMICAL CAPTURES



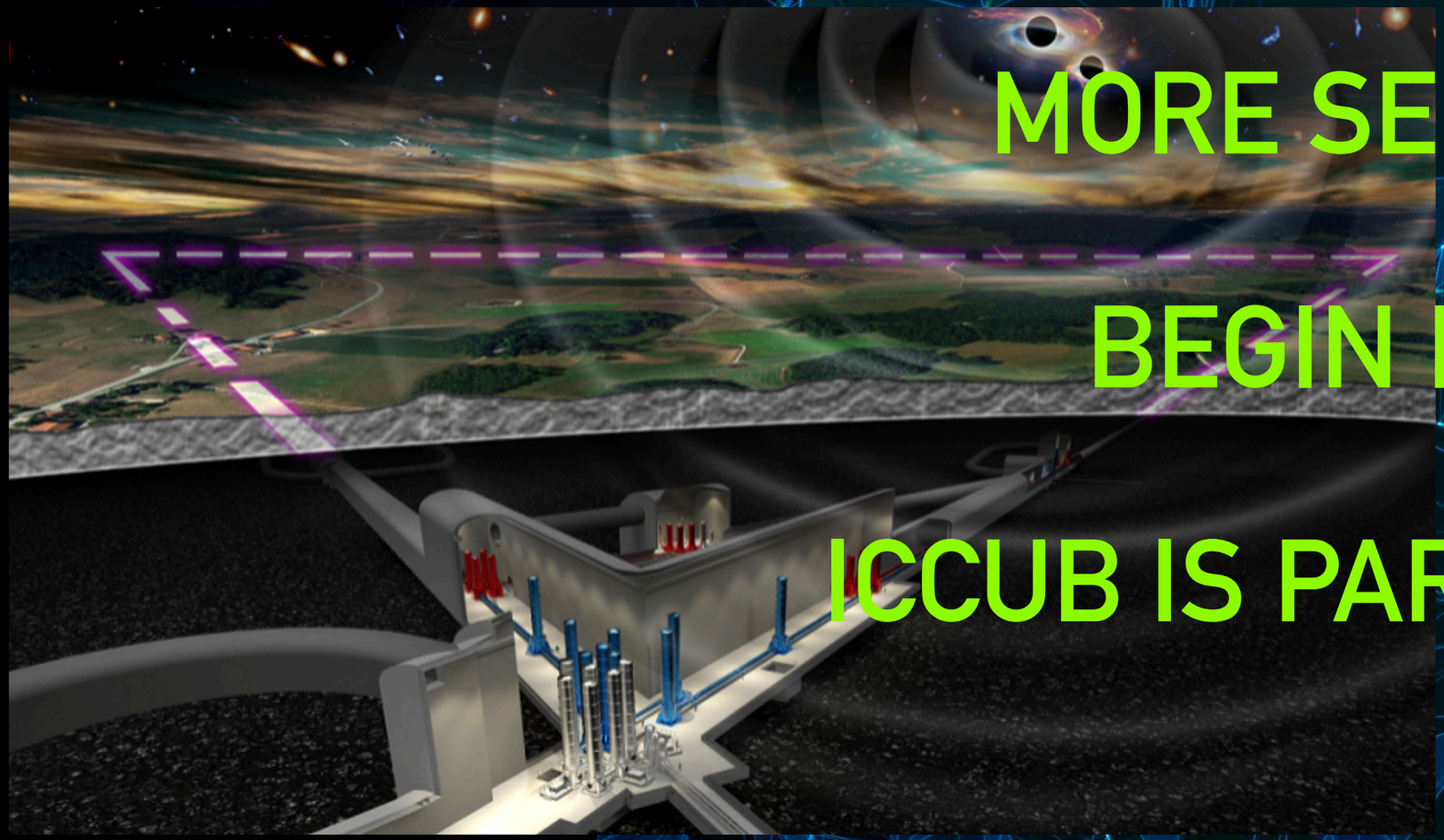


HYPERBOLIC ENCOUNTERS



OTHER FORMATION CHANNELS

EINSTEIN TELESCOPE



MORE SENSITIVE

BEGIN IN 2035?

ICCUB IS PART OF IT!

TAKE HOME

GW NEED MODELLING

NR INFORMS APPROXIMANTS

GENERALIZING QC ...

GET INVOLVED!

THANK YOU!