An Interactive Interferometer for Outreach

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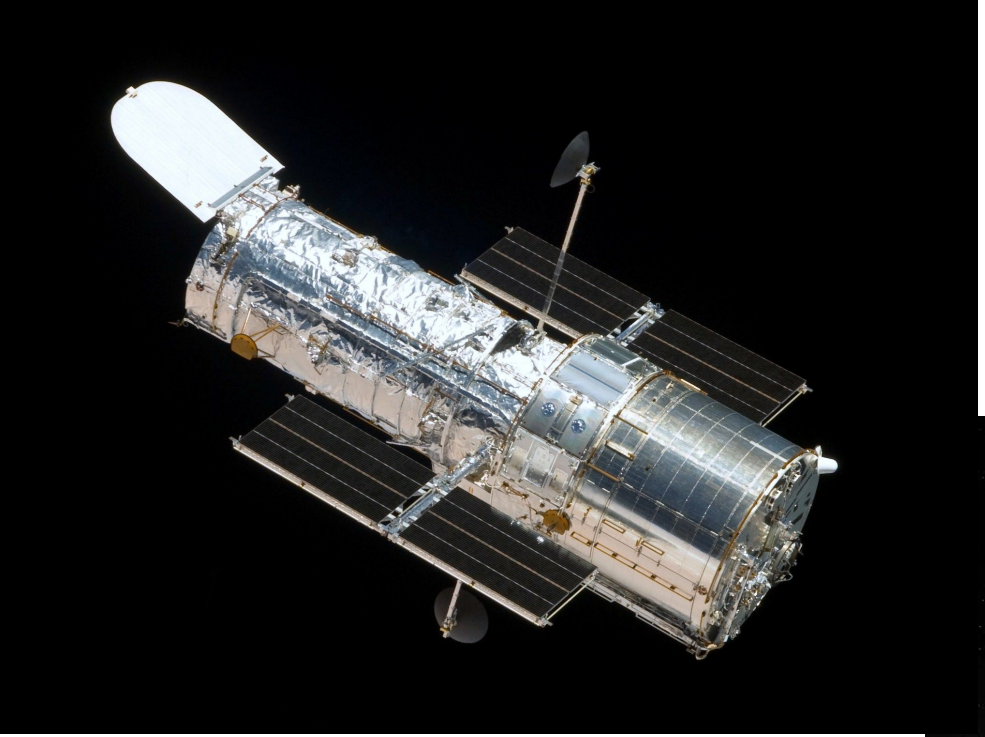
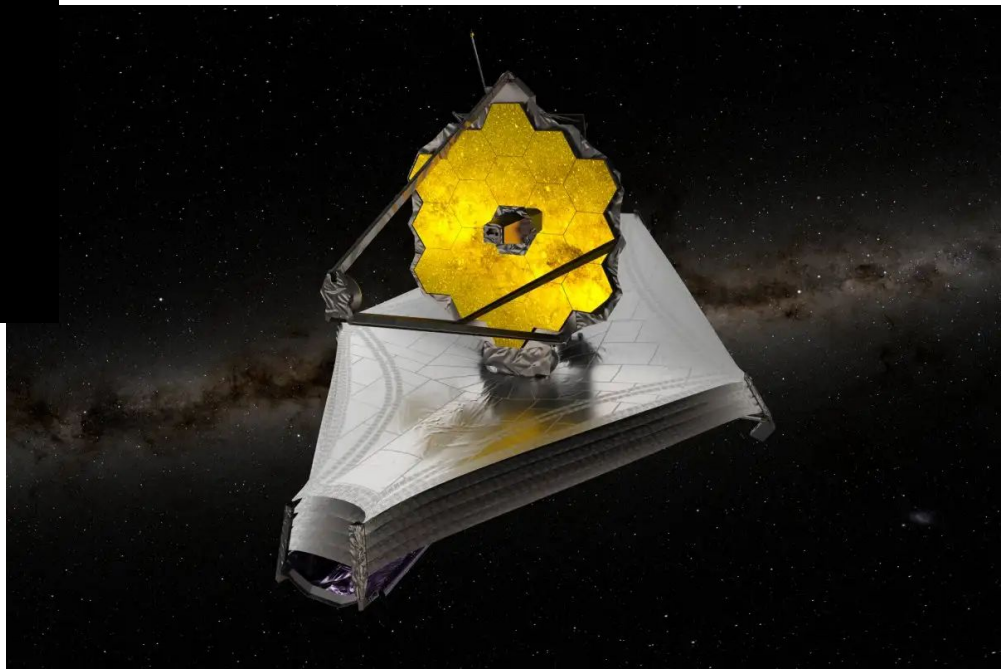
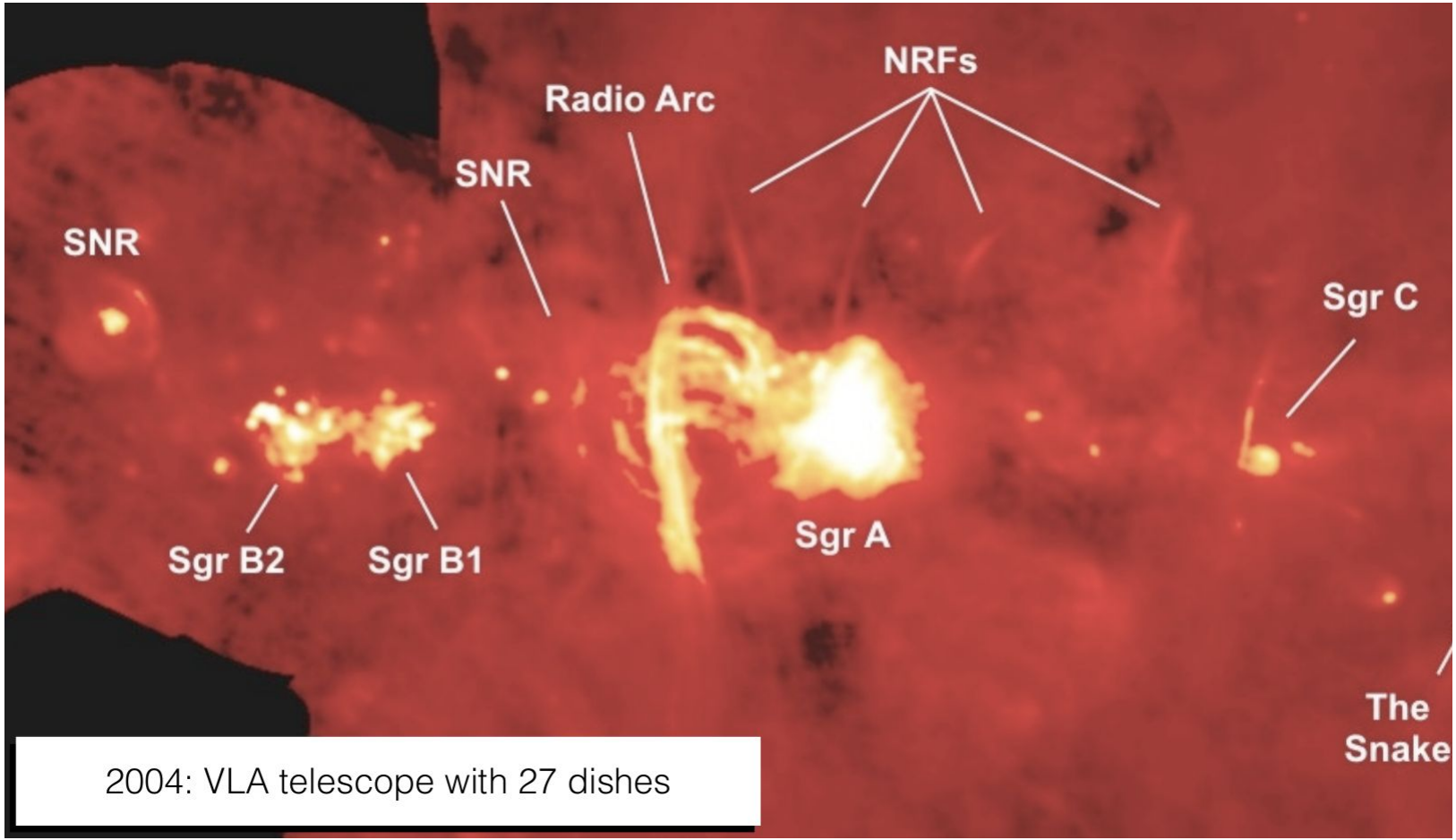
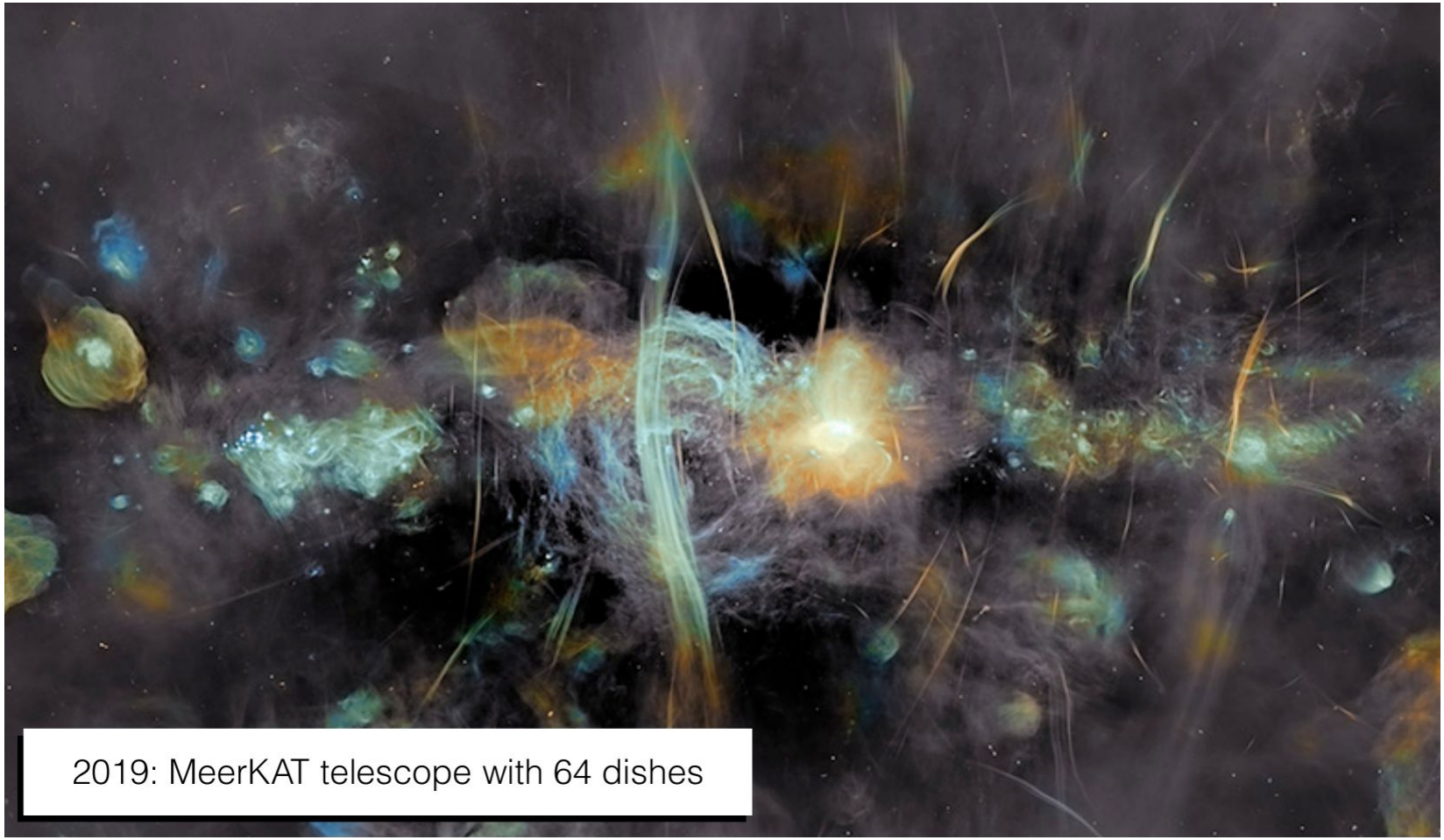
SKACH Spring Meeting 1/6/2023

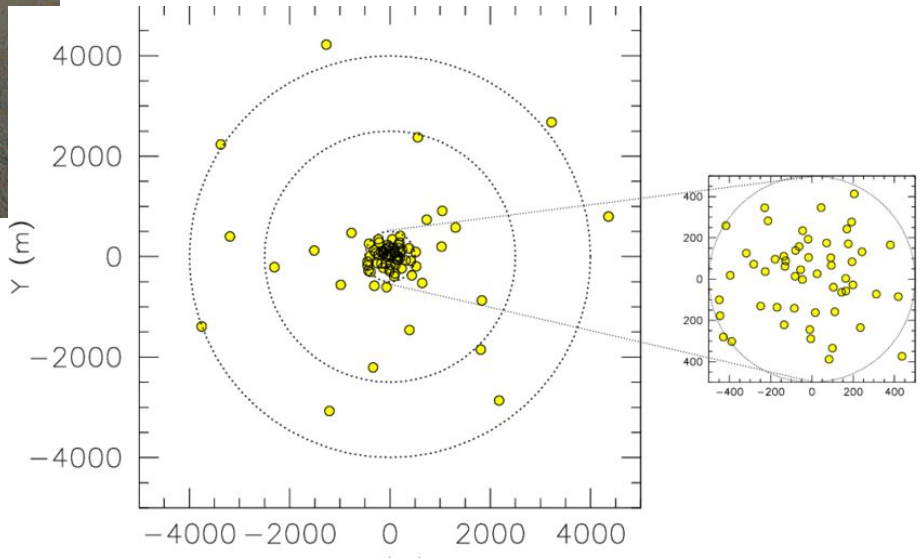






2004: VLA telescope with 27 dishes


2019: MeerKAT telescope with 64 dishes

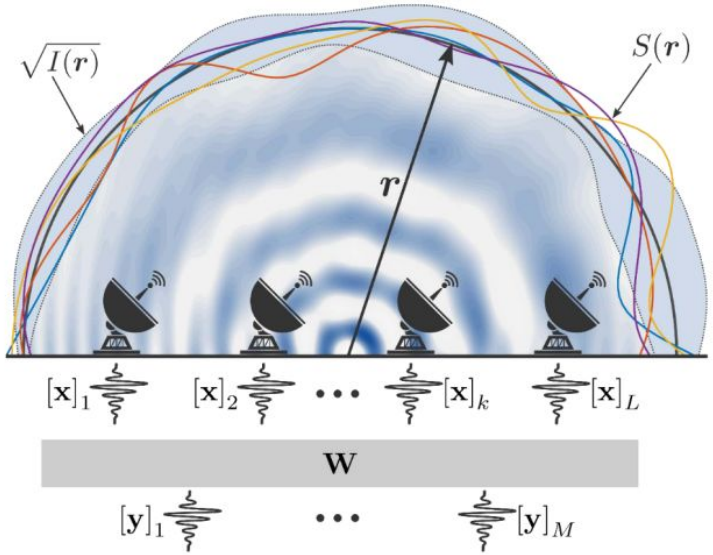

4000
2000
0
−2000
−4000
Y (m)
−4000 −2000 0 2000 4000
400
200
0
200
400
−400 −200 0 200 400

Radio Interferometric Imaging Process

$$x_l(t) = \int S(r) g_l^*(r) e^{-j\frac{2\pi}{\lambda_c}(t-<p_l,r>)} dr$$

Discretization

$$x_l(t) = \sum\sum S[i,j] g_l^*(r_{ij}) e^{-j\frac{2\pi}{\lambda_c}(t-<p_l,r_{ij}>)} dr$$



Notation

$$x = AS$$

Beamforming

$$y = W^H AS = B^* S$$

$$y = B^* S$$

Correlator

$$y_i y_j = Y$$

Best reconstructed source emissions

$$\hat{S} = \tilde{B} y$$
$$\hat{I} = \tilde{D} Y$$

Find a least squares fit for the sky image.

Learning Goals:

- Interferometry not trivial to explain, especially without mathematics!
- Tool to help with the explanation
  - Visual
  - Demonstrative
  - Intuitive understanding
  - Tunable - more/less detail depending on the audience

EPFL HOME CHAPTER 1 CHAPTER 2 CHAPTER 3 EN

INTRO TO ASTROPHYSICS I

Help us improve by submitting (anonymous) feedback here!

This website contains interactive applications for learning and visualising concepts in astrophysics. The apps are being developed by Dr. Austin Peel and Prof. Frédéric Courbin to accompany the Introduction to Astrophysics I course at EPFL. This project was supported by the Digital Resources for Instruction and Learning (DRIL) Fund.

We recommend viewing the apps in a **Chrome**, **Firefox**, or **Brave** browser window.

Special thanks to Théo Damiani and Noah Kaltenrieder for their work on the Tidal Locking and Mass of a Globular Cluster apps!

CHAPTER 1 : PLANETARY MOTION

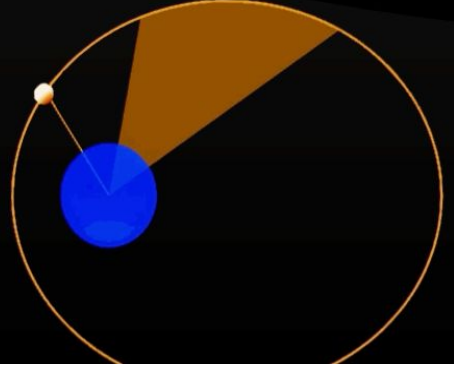
Explore the motion of celestial bodies through interactive web applications. Understand Kepler's famous three laws of planetary motion.

Two-Body Problem

Kepler's First Law

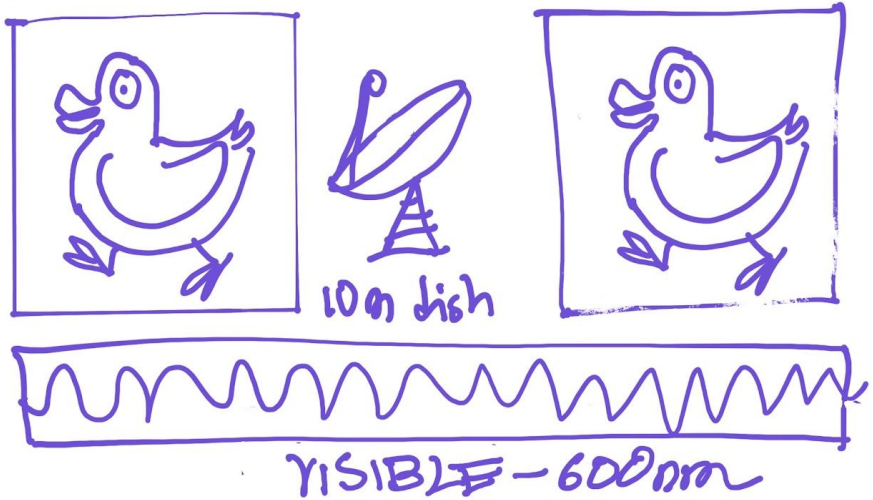
Kepler's Second Law

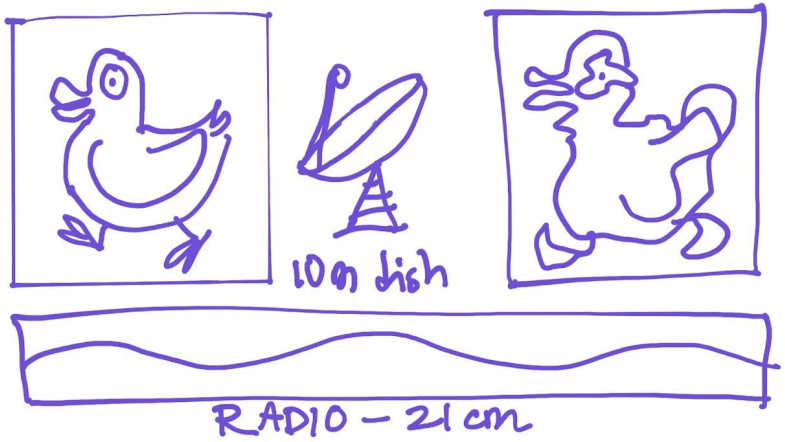
Kepler's Third Law



https://epfl-astrophysics-i.github.io/home/

Mockup Idea





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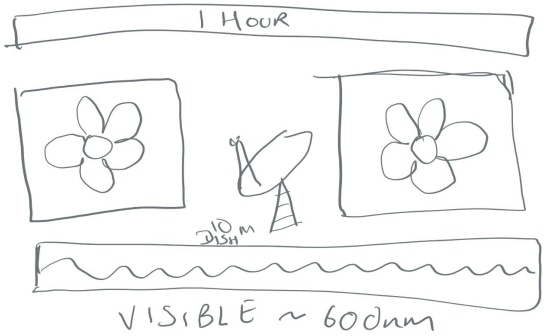
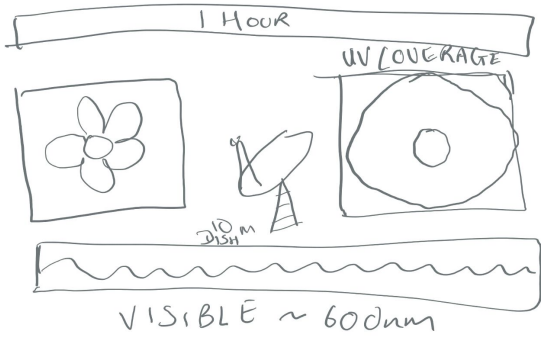

1 HOUR
10m DISH
VISIBLE ~ 600nm


1 HOUR
UV COVERAGE
10m DISH
VISIBLE ~ 600nm

1 HOUR
3x10m Dishes
RADIO 21

1 HOUR
3x10m
UV COVERAGE
RADIO 21cm

Future Plans:

- Multiple time-step UV sampling
- Comparison with Optical