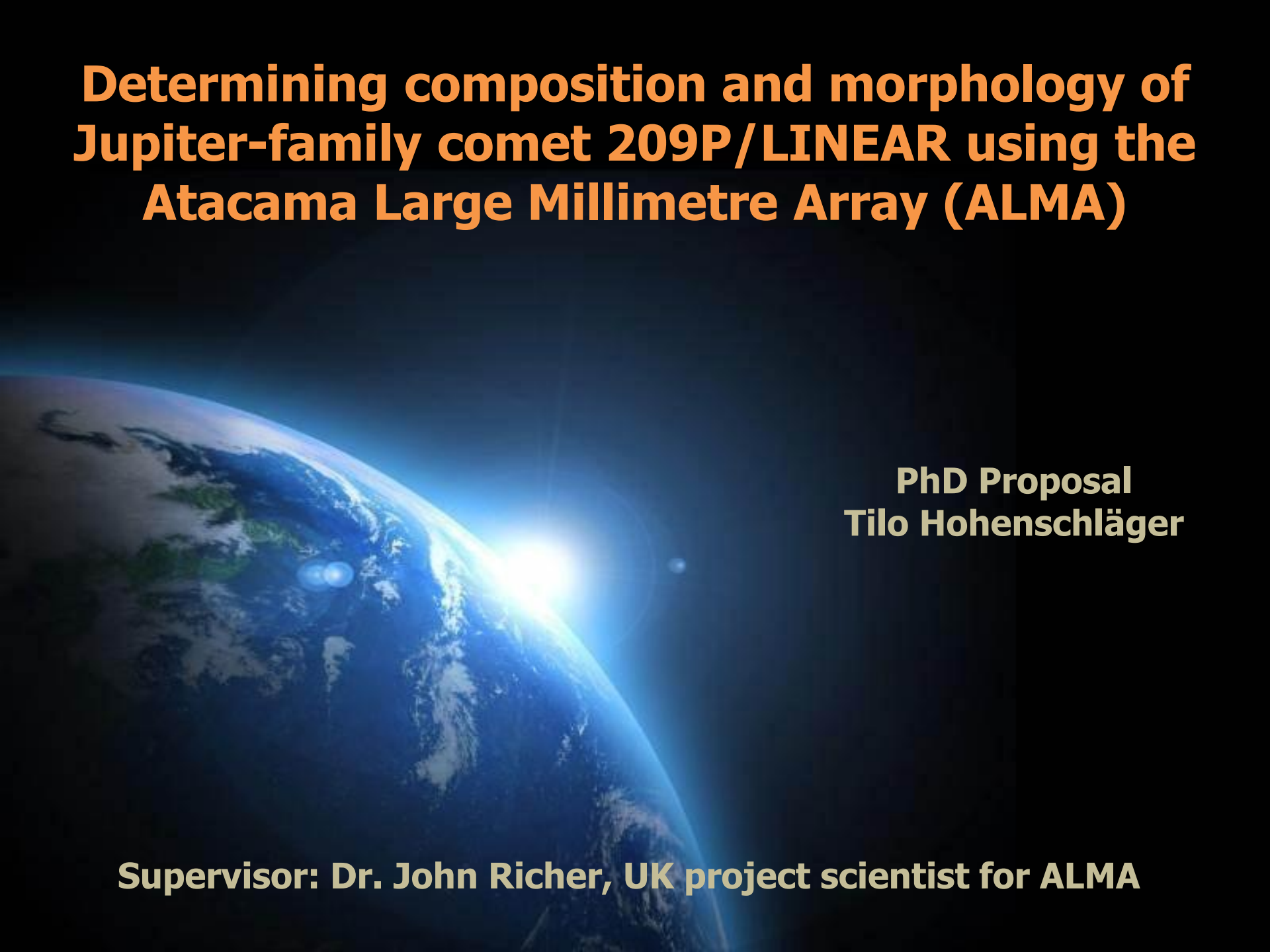
Determining composition and morphology of Jupiter-family comet 209P/LINEAR using the Atacama Large Millimetre Array (ALMA)

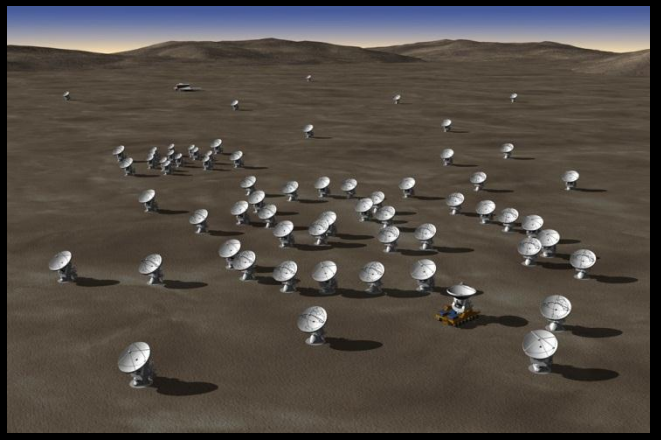


PhD Proposal
Tilo Hohenschläger

Supervisor: Dr. John Richer, UK project scientist for ALMA

- Project Motivation
- Comets
- Project Objectives
- Project Methods
- Project Costs and Timeline
- Summary

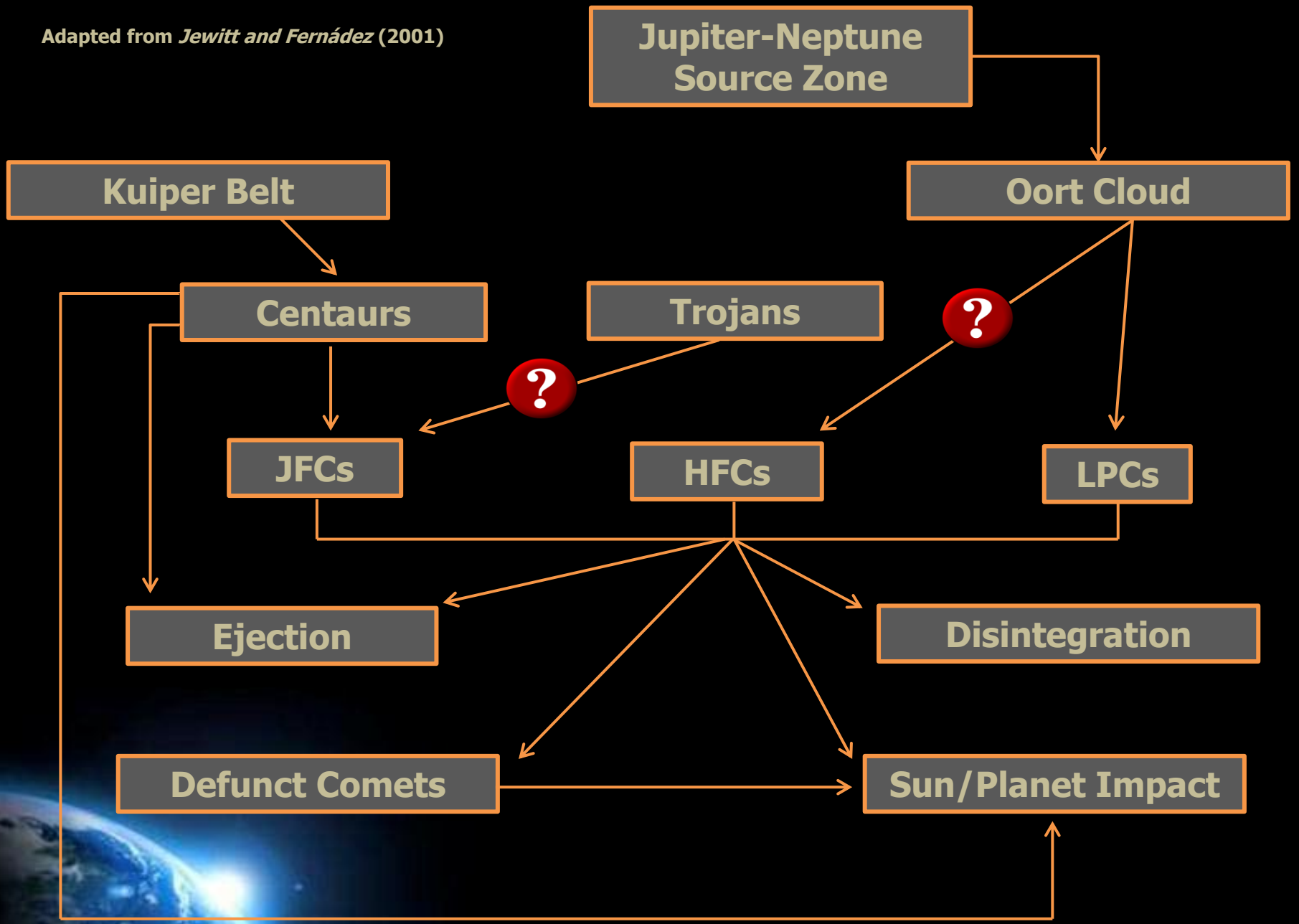
ALMA
ATACAMA LARGE MILLIMETER ARRAY



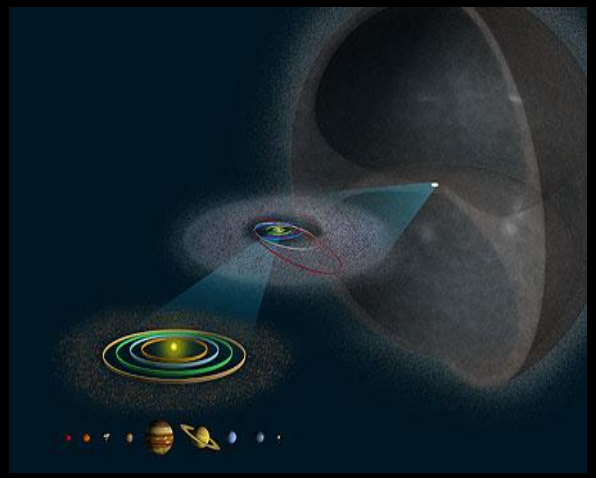
Project Motivation

- Comets supply information about formation, evolution, thermal, and collisional history of our solar system
- Unique record of the physical processes involved in their accretion
- Contain original material from solar nebula – interstellar grains and nebular condensates
- Affected formation and evolution of planetary atmospheres and source of water and organic material
- Earth impact hazard
- Evolutional connections

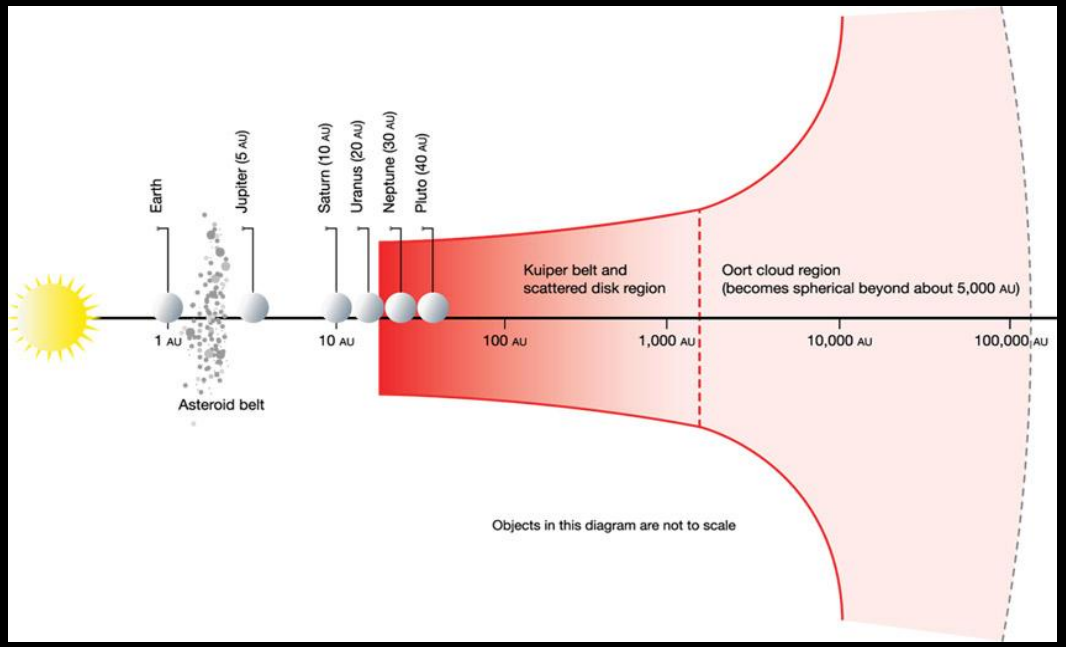
Adapted from *Jewitt and Fernández* (2001)



Comets



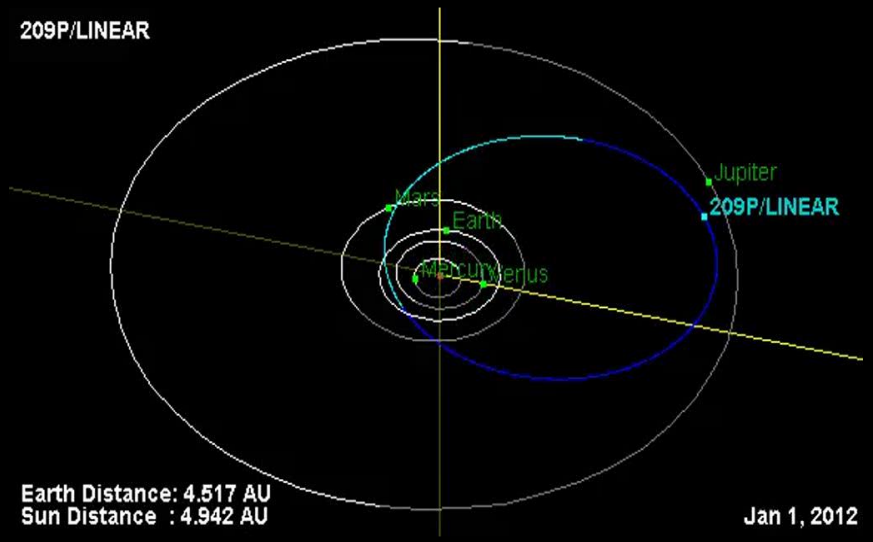
- JFCs - orbital period of ≤ 20 years
- T_j : 2 < T_j < 3
- $T_j = \frac{a_j}{a} + 2\left(\left(1 - e^2\right)\frac{a}{a_j}\right)^{1/2} cos(i)$



209P/LINEAR

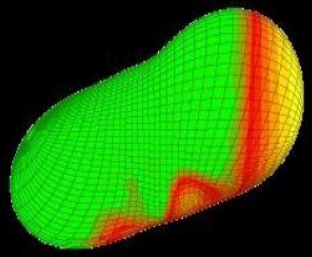
- discovered by Lincoln Near Earth Asteroid Research (LINEAR) program in 2004

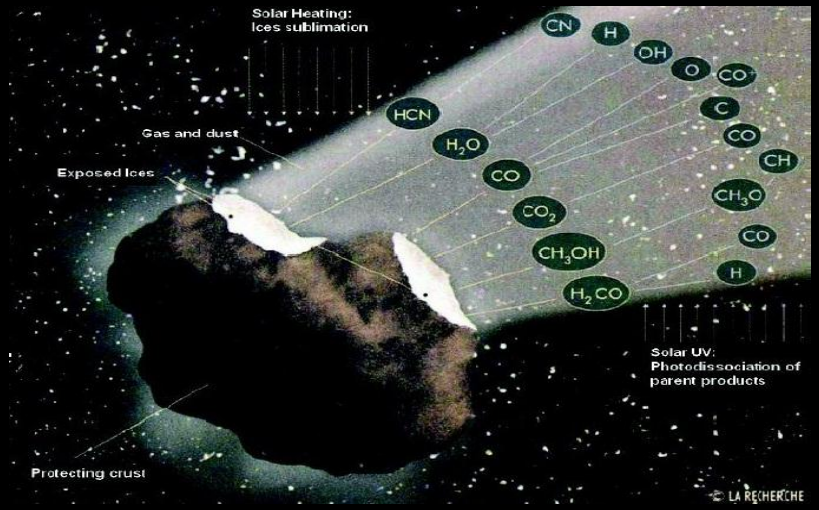
- T_j : 2.8
- orbital period: 5.04 y



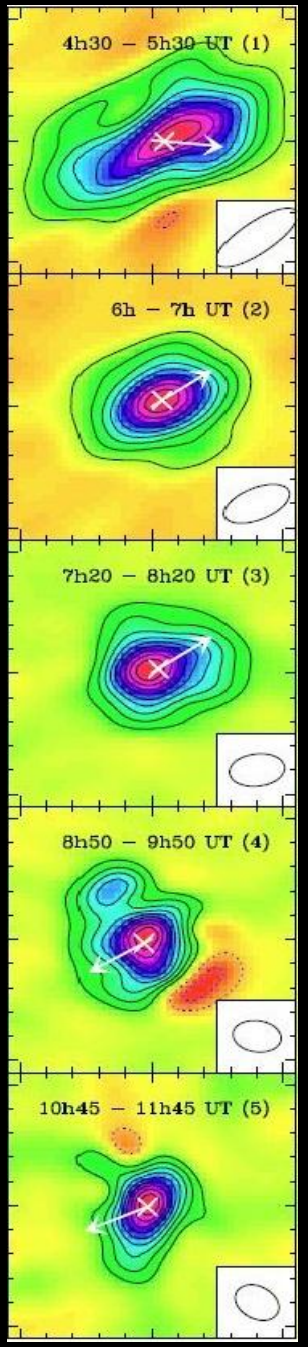
Project Objectives

- Detect and characterise the chemical composition of coma

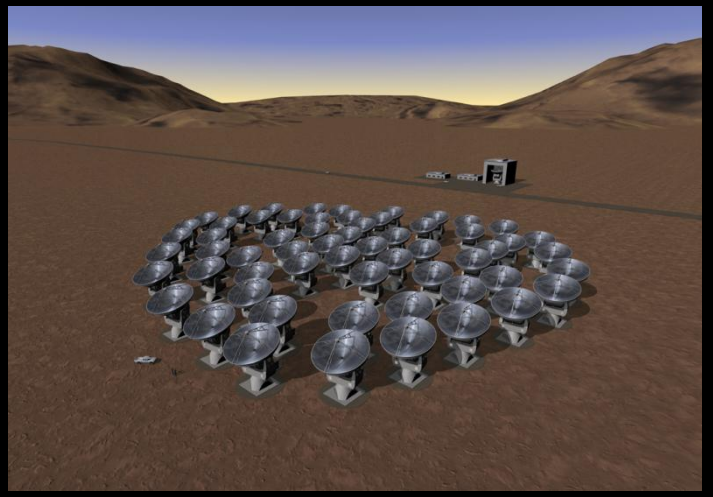




- Investigate and map the spatial distribution of dust and molecular species
  - Observation of gaseous jets and nucleus outgassing
  - Detection of thermal emission for nucleus size estimation



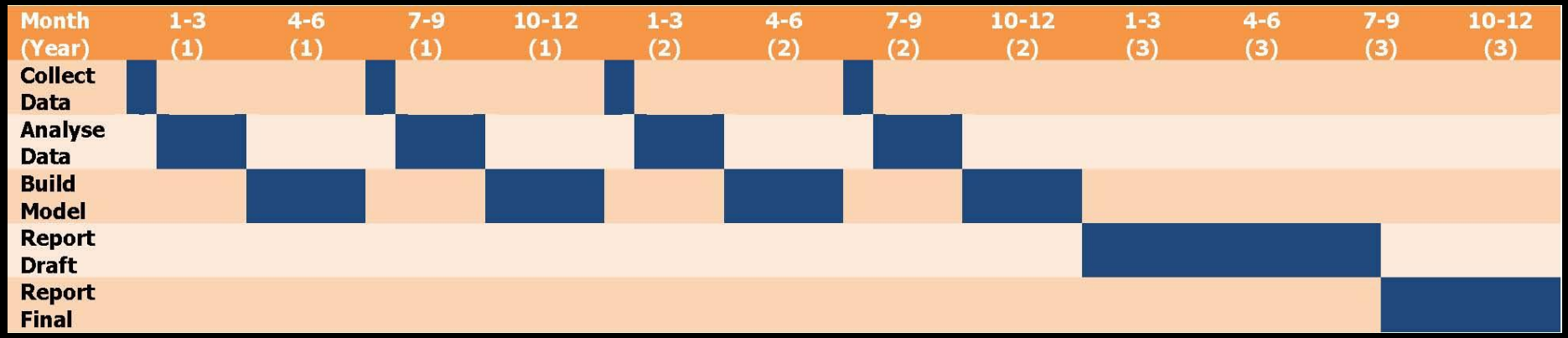
Methods



- Collect data of molecular composition and structure of comet 209P/LINEARs coma and nucleus using ALMA
- Analyse recorded data and compare with other previous accomplished comet research
- Build a code within IDL platform to use collected data to create 3D – models of dust, molecular distribution and the morphology of the nucleus and define rotational period
- Use the models derived to test against current observations and theories

Project Cost and Timeline

Timeline:



Costs:

Expense	Amount
Living expenses (per year)	£ 13,000
Tuition Fees (per year)	£ 3807
Travel to ALMA regional centre	£ 6000
PC for data analysis	£ 2000
IDL Licencing and Journal Access	Provided
Total	£ 58,421

Summary

- ***Problem:*** **There still remains a large gap in knowledge of small solar system bodies and their interrelation**

- ***Solution:*** **By observing Comet 209P/LINEAR, data of structure and molecular composition can be used to model these and find correlations**

- ***Required:*** **Project requires £58,421 in funding for a 3 year study under the supervision of Dr. John Richer**

- ***Method:*** **Project intends to use collected data from ALMA to create an extensive model of 209P/LINEAR**

- ***Expected Outcome:*** **A detailed study of a new comet will refine current models of the origin and evolution of cometary bodies**

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THANK YOU FOR LISTENING !

Any Questions ?