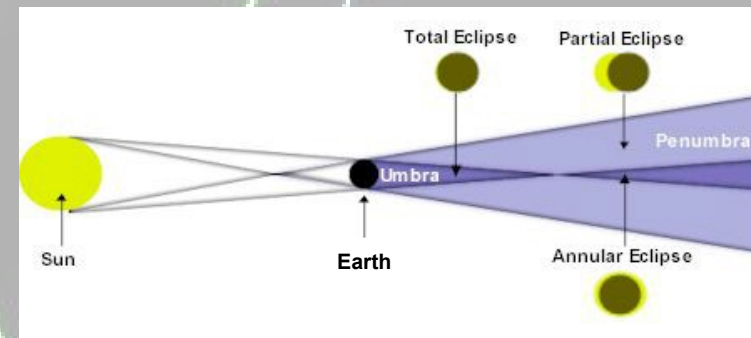


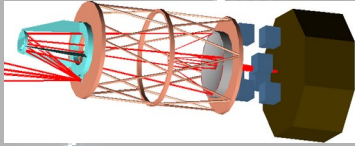
# Infrastructure Options for Earth Observatory at L2

## Mission Challenges for Infrastructure:

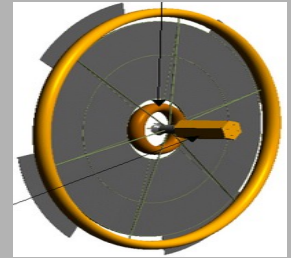
- Launch & Transfer to L2 point
- On-orbit Assembly vs. Self-Deployment
- Astronaut EVA vs. Robotic Operations
- Servicing & Refueling
- Technology



# Infrastructure Options for Earth Observatory at L2



Phase 1: Launch → L2



## Option 1: Completely Automated

- Launch to LEO or GTO
- Low thrust spiral to Earth-Sun L2, with or without transfer vehicle

- Telescope self-deploys en route to L2
- No systems checkout before reaching L2
- Transfer vehicle (if used) returns to LEO

### Technology Requirements

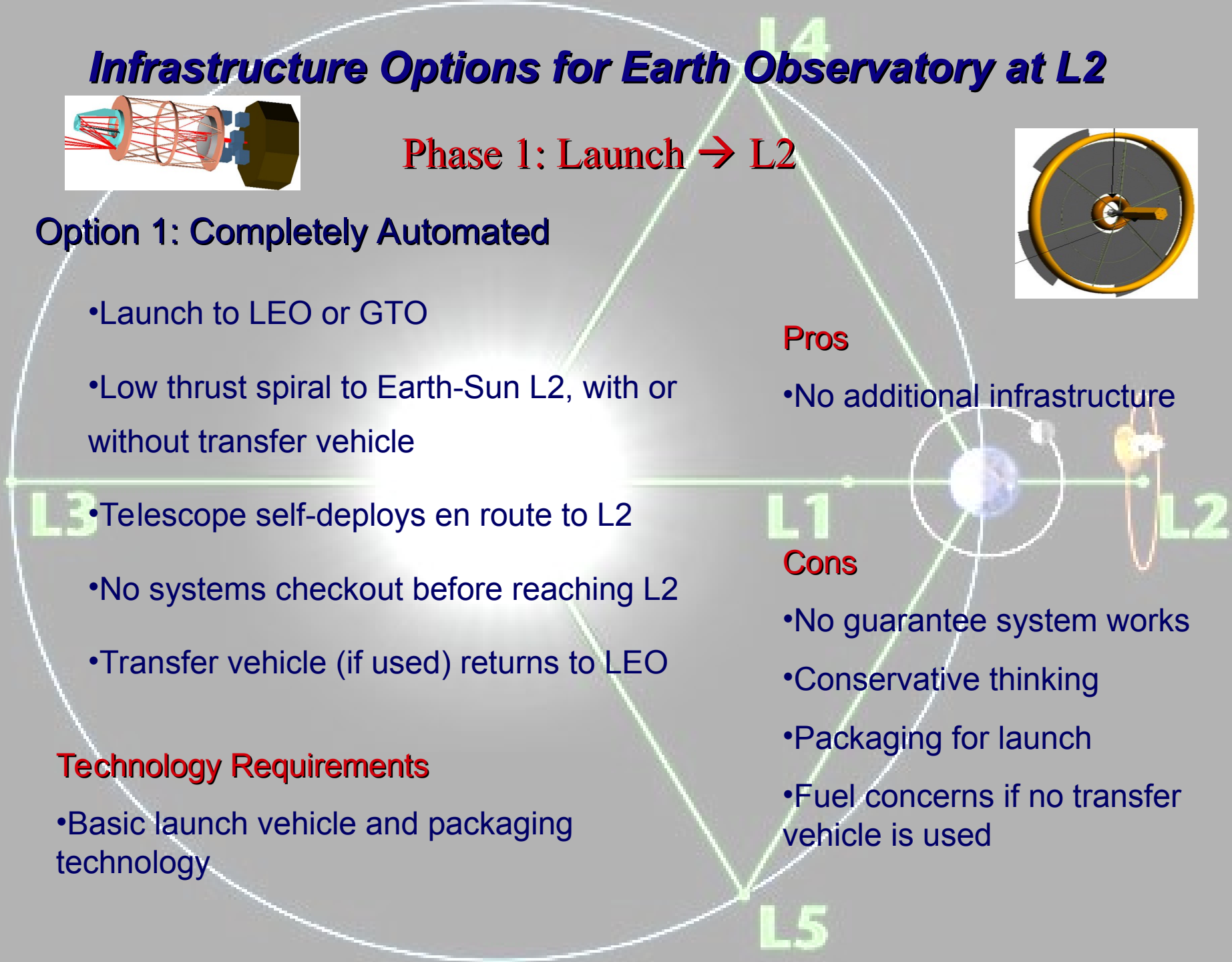
- Basic launch vehicle and packaging technology

### Pros

- No additional infrastructure

### Cons

- No guarantee system works
- Conservative thinking
- Packaging for launch
- Fuel concerns if no transfer vehicle is used



# Infrastructure Options for Earth Observatory at L2

## Phase 1: Launch → L2

### Option 2: Assembled

- Launch to LEO
- Transfer to Earth-Moon L1 Gateway via Hybrid Propellant Module
- Partially or completely assembled at L1, either by EVA or robotically, pre-placement system verification
- Transfer to Earth-Sun L2, transfer vehicle returns to L1 or LEO

### Pros

- Handle unforeseen issues
- Revolutionary thinking
- Simplifies packaging, servicing if telescope is assembly-designed

### Cons

- Requires new infrastructure
- Greater human interaction
- Meeting technology requirements

### Technology Requirements

- Tools for assembly (station, robots, launch and transfer vehicles, etc.)



L4

L3

L1

L2

L5

# Infrastructure Options for Earth Observatory at L2

## Phase 1: Launch → L2

### Option 3: Partially Automated

- Launch to LEO or GTO
- Transfer to L2 (possibly low thrust spiral) with piggybacking autonomous robot
- Telescope deploys or is partially constructed by robot (or human EVA, in alternate situation) at L2
- Robot performs systems checkout at L2
- Robot and transfer vehicle return to LEO

### Technology Requirements

- Autonomous robot or human-rated vehicle capable of reaching L2
- Launch and packaging technology

### Pros

- Minimal additional infrastructure
- System verification possible
- Simplifies packaging etc.

### Cons

- Meeting technology requirements
- Uncharted territory for space operations
- Launching robot w/ system



# Infrastructure Options for Earth Observatory at L2

## Phase 2: Servicing

### Option 1: Completely Automated

- Repair vehicle (autonomous vehicle such as ASTRO or human rated vehicle) transfers to L2 (NEP?)

- On-site repair, refueling, and part-replacement (robotically or human EVA)

- Repair vehicle returns, either to L1 Gateway or LEO

### Technology Requirements

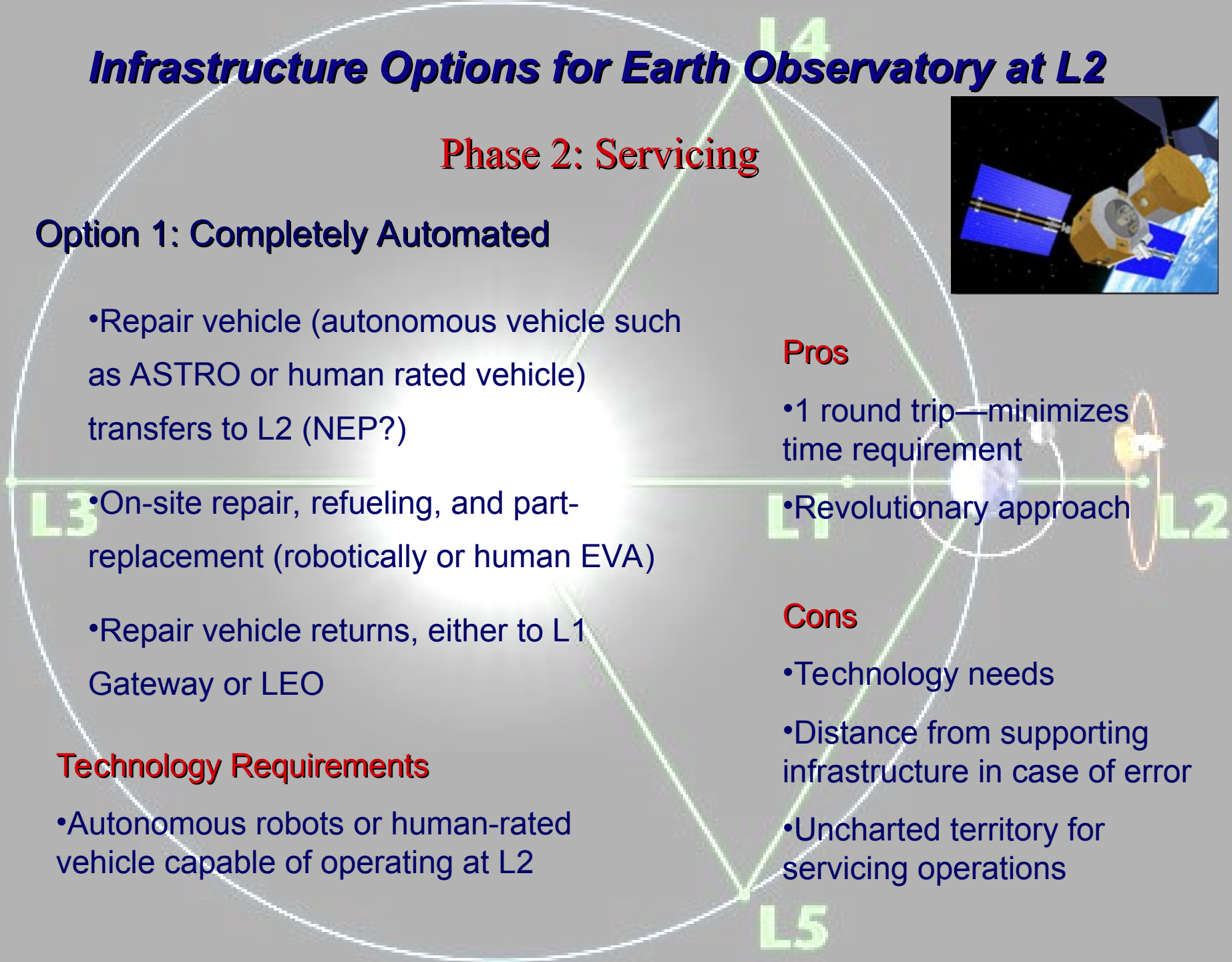
- Autonomous robots or human-rated vehicle capable of operating at L2

### Pros

- 1 round trip—minimizes time requirement
- Revolutionary approach

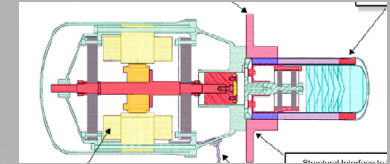
### Cons

- Technology needs
- Distance from supporting infrastructure in case of error
- Uncharted territory for servicing operations



# Infrastructure Options for Earth Observatory at L2

## Phase 2: Servicing



### Option 2: Partially Automated

- Transfer vehicle intercepts telescope at L2, ferries back to L1 (LEO not a good option)
- Repair, refueling, and part replacement at station (L1 Gateway, other vehicle) using robots or humans
- Transfer vehicle ferries telescope back to L2, returns to L1 or LEO

### Pros

- Reliable servicing method
- Greater range of options at base station

### Cons

- Transfer time—2 round trips
- Additional infrastructure
- Must potentially transfer both sections of telescope both directions

### Technology Requirements

- Servicing technology at L1

