Simplified Relational Schema for Astronomy Database [ERD REDUCTION]:

The ER diagram is reduced to a relational schema with the following tables:

Strong Entity Tables:

1. **USERS**

   o Primary Key: user_id

   o Attributes: name, email, role, password

2. **CELESTIAL_OBJECTS** (Superclass)

   o Primary Key: object_id

   o Attributes: name, type, discovery_date, distance_ly

3. **STARS** (Subclass of CELESTIAL_OBJECTS)

   o Primary Key: star_id

   o Foreign Key: object_id references CELESTIAL_OBJECTS

   o Attributes: name, spectral_type, temperature, luminosity

4. **GALAXIES** (Subclass of CELESTIAL_OBJECTS)

   o Primary Key: galaxy_id

   o Foreign Key: object_id references CELESTIAL_OBJECTS

- Attributes: name, type, redshift, mass, distance_ly

5. **ASTEROIDS** (Subclass of CELESTIAL_OBJECTS)

   - Primary Key: asteroid_id

   - Foreign Key: object_id references CELESTIAL_OBJECTS

   - Attributes: name, diameter, composition, orbit_type

Weak Entity / Dependent Tables:

6. **EXOPLANETS**

   - Primary Key: exo_id

   - Foreign Key: host_star_id references STARS

   - Attributes: name, orbital_period, mass, radius, atmosphere

7. **SPECTRAL_DATA**

   - Primary Key: spectra_id

   - Foreign Key: object_id references CELESTIAL_OBJECTS

   - Attributes: spectral_type, wavelength_nm

8. **OBSERVATION_LOGS**

   - Primary Key: log_id

   - Foreign Keys: user_id references USERS, object_id references CELESTIAL_OBJECTS

Key Design Decisions:

1. **Inheritance implementation**: Used foreign key references to implement the is-a relationships between CELESTIAL_OBJECTS and its subclasses (STARS, GALAXIES, ASTEROIDS)

2. **Many-to-many resolution**: Created a junction table (USER_OBJECT_STUDIES) to represent the many-to-many relationship between USERS and CELESTIAL_OBJECTS

3. **Weak entities**: Implemented using regular tables with foreign keys to their identifying strong entities

4. **Total participation**: Enforced through NOT NULL constraints on the foreign keys