Question: Which paper proposes a novel method that could be utilized to attract the attention of, and ultimately communicate with, extraterrestrial intelligence?

Paper 1 shows the best method to attract alien life. By manipulating the light curve of the sun, the most noticeable object within the solar system, we will be able to attract the attention of potential alien life in an extremely large range that is only limited by time, the speed of light, and the power of alien civilization telescopes.

Paper 1: Transit Light-Curve Signatures of Artificial Objects

Transiting objects can be a consideration for the search for intelligent life and also interstellar communication.

Simulated light curves of artificial objects indicate that with sufficient telescopic power, differences in light curves of a transiting planet (spherical in nature) and an artificial object (non-spherical) can be identified at the ingress (entering the view of a star) and egress (exiting the view of a star).

* Assumptions:
  + Star has ~15% larger radius than our Sun.
  + Planet/Object is approximately 116% the shadow of Jupiter
  + Planet/Object is orbiting at 1AU from the simulated star.
* An arbitrarily-shaped object (in this case a triangle) has a light curve similar to that of a ringed planet. – better telescopes will be needed to resolve this.
* Louver-shaped objects have a very different light curve and from planet-shaped transits.

Transits of artificial objects, especially louver-shaped objects, can be used as an alternative method to radio/laser emissions to attract the attention of intelligent species. It can also be used as a communication method between interstellar civilizations with similar range but slower data transmission as to lasers.

Paper 2: Searching for GEMS: Confirmation of TOI-5573B, a Cool, Saturn-like Planet Orbiting an M Dwarf

* Notes:
  + M Dwarf is equivalent to red/brown dwarf star still on main sequence
  + Giant Exoplanets around M-Dwarf Stars (GEMS - extremely rare in prediction models)
    - Unusually large discs
    - Favorable disc environments (?)
    - Gravitational instability (not as likely as it doesn’t explain why the planet is Saturn-sized instead of Jupiter-sized)
    - Core Accretion (most likely)
      * High dust concentration reduces efficiency of heat transfer causing cooling and reduces accretion causing a limit to size
  + TOI-5573B – Saturn-sized planet with 8.79 days orbit
    - Transits were initially detected with TESS
    - Further confirmation with ground telescopes
    - Background stars were scanned
  + Star was observed in near infrared at multiple instances and its radial velocity was derived from this
  + The RV was then double checked with another instrument
  + Using known parameters of the star, it was compared to other similar stars to determine that it does not rotate very fast but has high metallicity (with significant error)
  + “Steller mass, radius, luminosity, and age” were inferred with spectral energy distribution
  + A Monte Carlo algorithm was used with the defined parameters to infer that the planet has ~9.75x the radius of Earth, ~112x the mass of Earth, and 0.66g/cm3 density.
* Comparing TOI-5573B to other GEMS, the researchers noted that GEMS are often Saturn-like in size and density.
* GEMS could be more likely to form around high metallicity dwarf stars (high uncertainty due to the potential error surrounding the metallicity)

Paper 3: Parallax Effect in Microlensing Events Due to Free-floating Planets

* Due to the rotation of the Earth around the Sun, stars in the night sky can appear to move. This movement can be measured at a rate of 1kpc / 1mas. As long as instruments are sensitive enough to detect these minute movements, the distance of a star can be accurately measured through the “parallax effect”.
* Microlensing occurs when an object with a gravitational field is aligned in such a way that it is collinear between an observer and an object emitting light. This increases the brightness of the distant object.
  + Microlensing can often have multiple parameters to explain the flux increase, resulting in inaccurate calculations of the gravitational object. The parallax effect distorts the straight line of light into a cycloid path which can then be used to further constrain the parameters.
  + The time of the microlensing effect must be much lower than the period of Earth, otherwise the parallax effect will significantly alter the path of light to a more complex path, rather than an easier straight path.
  + Stars / gravitational objects closer to the observer will experience a greater parallax effect leading to misinterpretation
  + Large/bright sources can cause magnification to be near 1 and therefore be harder to detect/measure
  + When the lens-source relative trajectory and parallax vector are nearly parallel, this can heavily alter the duration of microlensing effect, leading to inaccurate extrapolation.
* Useful in finding far, cold, and dark planets (that can be as small as Mars)

Paper 4: Earth as an Exoplanet: Investigating the Effects of Cloud Variability on the Direct-imaging of Atmospheres

* Direct imaging involves the host star being covered so that planets that revolve around the star can be seen through the light
* The light that reflects from the planet can give clues as to the atmospheric composition of the planet through the absorption and reemission of light
* When looking at terrestrial, earth-like planets, cloud cover should be considered as a possible parameter altering observations
  + In this sample study, light signatures from H20, O2, O3 were looked at
  + A sample earth with variable cloud models obtained from historical climate records
  + Cloud coverage overall increases the albedo of the planet leading to increased detection of atmospheric makeup
    - Cloud coverage in the lower atmosphere is most ideal as it allows light to penetrate most layers of the atmosphere
    - Coverage in the higher parts of the atmosphere can obscure the lower atmosphere and lead to degeneracy