

## Distances in the solar system

These distances were calculated by randomly sampling points along the orbits and are hence long-term averages. For slowly moving bodies like the outer system planets distances will not change much over the timescale of a campaign. The calculation takes eccentricity but not inclination into account. Typically distances

### Average distance (AU)

|                        | Mercury | Venus | Earth | Luna  | Mars  | Ceres | Extropia | Jupiter | Saturn | Uranus | Neptune | Pluto | Eris  | Mars Trojans | Jupiter Trojans | Neptune Trojans |
|------------------------|---------|-------|-------|-------|-------|-------|----------|---------|--------|--------|---------|-------|-------|--------------|-----------------|-----------------|
| <b>Mercury</b>         | 0       | 0.78  | 1.04  | 1.04  | 1.55  | 2.77  | 3.2      | 5.21    | 9.54   | 19.2   | 30      | 39.49 | 67.8  | 1.55         | 5.21            | 30.01           |
| <b>Venus</b>           | 0.78    | 0     | 1.14  | 1.13  | 1.61  | 2.8   | 3.23     | 5.24    | 9.54   | 19.18  | 30.01   | 39.49 | 67.48 | 1.61         | 5.23            | 30.01           |
| <b>Earth</b>           | 1.04    | 1.14  | 0     | 0     | 1.69  | 2.85  | 3.26     | 5.27    | 9.57   | 19.2   | 30      | 39.48 | 67.5  | 1.71         | 5.24            | 30.02           |
| <b>Luna</b>            | 1.04    | 1.13  | 0     | 0     | 1.69  | 2.85  | 3.28     | 5.24    | 9.57   | 19.2   | 30.01   | 39.49 | 67.57 | 1.7          | 5.25            | 30.01           |
| <b>Mars</b>            | 1.55    | 1.61  | 1.69  | 1.69  | 0     | 2.98  | 3.4      | 5.33    | 9.61   | 19.2   | 30.01   | 39.49 | 67.95 | 1.52         | 5.32            | 30.04           |
| <b>Ceres</b>           | 2.77    | 2.8   | 2.85  | 2.85  | 2.98  | 0     | 3.85     | 5.58    | 9.74   | 19.28  | 30.04   | 39.53 | 67.76 | 2.96         | 5.56            | 30.03           |
| <b>Extropia</b>        | 3.2     | 3.23  | 3.26  | 3.28  | 3.4   | 3.85  | 0        | 5.69    | 9.82   | 19.33  | 30.14   | 39.57 | 67.56 | 3.37         | 5.73            | 30.1            |
| <b>Jupiter</b>         | 5.21    | 5.24  | 5.27  | 5.24  | 5.33  | 5.58  | 5.69     | 0       | 10.32  | 19.52  | 30.19   | 39.61 | 68.15 | 5.3          | 5.2             | 30.2            |
| <b>Saturn</b>          | 9.54    | 9.54  | 9.57  | 9.57  | 9.61  | 9.74  | 9.82     | 10.32   | 0      | 20.39  | 30.79   | 40.06 | 67.98 | 9.57         | 10.27           | 30.75           |
| <b>Uranus</b>          | 19.2    | 19.18 | 19.2  | 19.2  | 19.2  | 19.28 | 19.33    | 19.52   | 20.39  | 0      | 33.11   | 41.91 | 69.18 | 19.21        | 19.48           | 33.39           |
| <b>Neptune</b>         | 30      | 30.01 | 30    | 30.01 | 30.01 | 30.04 | 30.14    | 30.19   | 30.79  | 33.11  | 0       | 45.66 | 71.51 | 30.01        | 30.23           | 30              |
| <b>Pluto</b>           | 39.49   | 39.49 | 39.48 | 39.49 | 39.49 | 39.53 | 39.57    | 39.61   | 40.06  | 41.91  | 45.66   | 0     | 75.2  | 39.48        | 39.65           | 45.26           |
| <b>Eris</b>            | 67.8    | 67.48 | 67.5  | 67.57 | 67.95 | 67.76 | 67.56    | 68.15   | 67.98  | 69.18  | 71.51   | 75.2  | 0     | 67.82        | 67.68           | 71.97           |
| <b>Mars Trojans</b>    | 1.55    | 1.61  | 1.71  | 1.7   | 1.52  | 2.96  | 3.37     | 5.3     | 9.57   | 19.21  | 30.01   | 39.48 | 67.82 | 0            | 67.97           | 71.73           |
| <b>Jupiter Trojans</b> | 5.21    | 5.23  | 5.24  | 5.25  | 5.32  | 5.56  | 5.73     | 5.2     | 10.27  | 19.48  | 30.23   | 39.65 | 67.68 | 67.97        | 0               | 71.6            |
| <b>Neptune Trojans</b> | 30.01   | 30.01 | 30.02 | 30.01 | 30.04 | 30.03 | 30.1     | 30.2    | 30.75  | 33.39  | 30      | 45.26 | 71.97 | 71.73        | 71.6            | 0               |

## Maximum distance (AU)

|                        | Mercury | Venus | Earth | Luna  | Mars  | Ceres | Extropia | Jupiter | Saturn | Uranus | Neptune | Pluto  | Eris   | Mars Trojans | Jupiter Trojans | Neptune Trojans |
|------------------------|---------|-------|-------|-------|-------|-------|----------|---------|--------|--------|---------|--------|--------|--------------|-----------------|-----------------|
| <b>Mercury</b>         | 0       | 1.19  | 1.63  | 1.63  | 2.12  | 3.44  | 4.12     | 5.91    | 10.47  | 20.55  | 30.7    | 39.94  | 97.9   | 2.12         | 5.91            | 30.7            |
| <b>Venus</b>           | 1.19    | 0     | 1.89  | 1.89  | 2.38  | 3.71  | 4.39     | 6.17    | 10.73  | 20.81  | 30.96   | 40.2   | 98.16  | 2.39         | 6.17            | 30.96           |
| <b>Earth</b>           | 1.63    | 1.89  | 0     | 0     | 2.83  | 4.14  | 4.82     | 6.61    | 11.16  | 21.25  | 31.4    | 40.65  | 98.59  | 2.82         | 6.61            | 31.4            |
| <b>Luna</b>            | 1.63    | 1.89  | 0     | 0     | 2.82  | 4.14  | 4.81     | 6.61    | 11.17  | 21.25  | 31.4    | 40.65  | 98.57  | 2.83         | 6.61            | 31.41           |
| <b>Mars</b>            | 2.12    | 2.38  | 2.83  | 2.82  | 0     | 4.63  | 5.32     | 7.11    | 11.66  | 21.74  | 31.9    | 41.14  | 99.09  | 1.66         | 7.1             | 31.9            |
| <b>Ceres</b>           | 3.44    | 3.71  | 4.14  | 4.14  | 4.63  | 0     | 6.64     | 8.42    | 12.96  | 23.07  | 33.21   | 42.46  | 100.4  | 4.64         | 8.43            | 33.21           |
| <b>Extropia</b>        | 4.12    | 4.39  | 4.82  | 4.81  | 5.32  | 6.64  | 0        | 9.09    | 13.67  | 23.73  | 33.89   | 43.14  | 101.1  | 5.32         | 9.1             | 33.88           |
| <b>Jupiter</b>         | 5.91    | 6.17  | 6.61  | 6.61  | 7.11  | 8.42  | 9.09     | 0       | 15.44  | 25.53  | 35.68   | 44.93  | 102.85 | 7.11         | 5.45            | 35.69           |
| <b>Saturn</b>          | 10.47   | 10.73 | 11.16 | 11.17 | 11.66 | 12.96 | 13.67    | 15.44   | 0      | 30.08  | 40.23   | 49.48  | 107.43 | 11.66        | 15.45           | 40.23           |
| <b>Uranus</b>          | 20.55   | 20.81 | 21.25 | 21.25 | 21.74 | 23.07 | 23.73    | 25.53   | 30.08  | 0      | 50.32   | 59.57  | 117.49 | 21.75        | 25.52           | 50.31           |
| <b>Neptune</b>         | 30.7    | 30.96 | 31.4  | 31.4  | 31.9  | 33.21 | 33.89    | 35.68   | 40.23  | 50.32  | 0       | 69.72  | 127.65 | 31.9         | 35.68           | 30.24           |
| <b>Pluto</b>           | 39.94   | 40.2  | 40.65 | 40.65 | 41.14 | 42.46 | 43.14    | 44.93   | 49.48  | 59.57  | 69.72   | 0      | 136.91 | 41.14        | 44.93           | 69.72           |
| <b>Eris</b>            | 97.9    | 98.16 | 98.59 | 98.57 | 99.09 | 100.4 | 101.1    | 102.85  | 107.43 | 117.49 | 127.65  | 136.91 | 0      | 99.08        | 102.89          | 127.6           |
| <b>Mars Trojans</b>    | 2.12    | 2.39  | 2.82  | 2.83  | 1.66  | 4.64  | 5.32     | 7.11    | 11.66  | 21.75  | 31.9    | 41.14  | 99.08  | 0            | 102.76          | 127.63          |
| <b>Jupiter Trojans</b> | 5.91    | 6.17  | 6.61  | 6.61  | 7.1   | 8.43  | 9.1      | 5.45    | 15.45  | 25.52  | 35.68   | 44.93  | 102.89 | 102.76       | 0               | 127.61          |
| <b>Neptune Trojans</b> | 30.7    | 30.96 | 31.4  | 31.41 | 31.9  | 33.21 | 33.88    | 35.69   | 40.23  | 50.31  | 30.24   | 69.72  | 127.6  | 127.63       | 127.61          | 0               |

## Minimum distance (AU)

|                        | Mercury | Venus | Earth | Luna  | Mars  | Ceres | Extropia | Jupiter | Saturn | Uranus | Neptune | Pluto | Eris  | Mars Trojans | Jupiter Trojans | Neptune Trojans |
|------------------------|---------|-------|-------|-------|-------|-------|----------|---------|--------|--------|---------|-------|-------|--------------|-----------------|-----------------|
| <b>Mercury</b>         | 0       | 0.25  | 0.37  | 0.37  | 0.92  | 2.08  | 2.26     | 4.49    | 8.6    | 17.83  | 29.3    | 39.02 | 37.46 | 0.92         | 4.49            | 29.3            |
| <b>Venus</b>           | 0.25    | 0     | 0.11  | 0.11  | 0.66  | 1.81  | 1.99     | 4.23    | 8.33   | 17.57  | 29.04   | 38.76 | 37.17 | 0.66         | 4.23            | 29.04           |
| <b>Earth</b>           | 0.37    | 0.11  | 0     | 0     | 0.22  | 1.38  | 1.55     | 3.79    | 7.89   | 17.12  | 28.59   | 38.31 | 36.73 | 0.22         | 3.78            | 28.59           |
| <b>Luna</b>            | 0.37    | 0.11  | 0     | 0     | 0.22  | 1.37  | 1.56     | 3.79    | 7.89   | 17.13  | 28.59   | 38.31 | 36.74 | 0.22         | 3.8             | 28.59           |
| <b>Mars</b>            | 0.92    | 0.66  | 0.22  | 0.22  | 0     | 0.88  | 1.06     | 3.29    | 7.4    | 16.63  | 28.1    | 37.82 | 36.27 | 1.38         | 3.3             | 28.1            |
| <b>Ceres</b>           | 2.08    | 1.81  | 1.38  | 1.37  | 0.88  | 0     | 0.01     | 1.98    | 6.08   | 15.33  | 26.78   | 36.5  | 34.98 | 0.88         | 1.97            | 26.78           |
| <b>Extropia</b>        | 2.26    | 1.99  | 1.55  | 1.56  | 1.06  | 0.01  | 0        | 1.3     | 5.4    | 14.67  | 26.11   | 35.82 | 34.37 | 1.08         | 1.33            | 26.11           |
| <b>Jupiter</b>         | 4.49    | 4.23  | 3.79  | 3.79  | 3.29  | 1.98  | 1.3      | 0       | 3.62   | 12.86  | 24.32   | 34.03 | 32.53 | 3.3          | 4.95            | 24.32           |
| <b>Saturn</b>          | 8.6     | 8.33  | 7.89  | 7.89  | 7.4   | 6.08  | 5.4      | 3.62    | 0      | 8.34   | 19.76   | 29.47 | 28.01 | 7.4          | 3.61            | 19.77           |
| <b>Uranus</b>          | 17.83   | 17.57 | 17.12 | 17.13 | 16.63 | 15.33 | 14.67    | 12.86   | 8.34   | 0      | 9.69    | 19.39 | 17.89 | 16.63        | 12.84           | 9.68            |
| <b>Neptune</b>         | 29.3    | 29.04 | 28.59 | 28.59 | 28.1  | 26.78 | 26.11    | 24.32   | 19.76  | 9.69   | 0       | 9.25  | 7.86  | 28.11        | 24.32           | 29.76           |
| <b>Pluto</b>           | 39.02   | 38.76 | 38.31 | 38.31 | 37.82 | 36.5  | 35.82    | 34.03   | 29.47  | 19.39  | 9.25    | 0     | 0.18  | 37.82        | 34.03           | 9.24            |
| <b>Eris</b>            | 37.46   | 37.17 | 36.73 | 36.74 | 36.27 | 34.98 | 34.37    | 32.53   | 28.01  | 17.89  | 7.86    | 0.18  | 0     | 36.25        | 32.48           | 7.68            |
| <b>Mars Trojans</b>    | 0.92    | 0.66  | 0.22  | 0.22  | 1.38  | 0.88  | 1.08     | 3.3     | 7.4    | 16.63  | 28.11   | 37.82 | 36.25 | 0            | 32.5            | 7.96            |
| <b>Jupiter Trojans</b> | 4.49    | 4.23  | 3.78  | 3.8   | 3.3   | 1.97  | 1.33     | 4.95    | 3.61   | 12.84  | 24.32   | 34.03 | 32.48 | 32.5         | 0               | 7.71            |
| <b>Neptune Trojans</b> | 29.3    | 29.04 | 28.59 | 28.59 | 28.1  | 26.78 | 26.11    | 24.32   | 19.77  | 9.68   | 29.76   | 9.24  | 7.68  | 7.96         | 7.71            | 0               |

## Average lightspeed delay (hours)

|                 | Mercury | Venus | Earth | Luna | Mars | Ceres | Extropia | Jupiter | Saturn | Uranus | Neptune | Pluto | Eris  | Mars Trojans | Jupiter Trojans | Neptune Trojans |
|-----------------|---------|-------|-------|------|------|-------|----------|---------|--------|--------|---------|-------|-------|--------------|-----------------|-----------------|
| Mercury         | 0       | 0.11  | 0.14  | 0.14 | 0.21 | 0.38  | 0.44     | 0.72    | 1.32   | 2.66   | 4.16    | 5.47  | 9.39  | 0.21         | 0.72            | 4.16            |
| Venus           | 0.11    | 0     | 0.16  | 0.16 | 0.22 | 0.39  | 0.45     | 0.73    | 1.32   | 2.66   | 4.16    | 5.47  | 9.35  | 0.22         | 0.72            | 4.16            |
| Earth           | 0.14    | 0.16  | 0     | 0    | 0.23 | 0.4   | 0.45     | 0.73    | 1.33   | 2.66   | 4.16    | 5.47  | 9.35  | 0.24         | 0.73            | 4.16            |
| Luna            | 0.14    | 0.16  | 0     | 0    | 0.23 | 0.4   | 0.45     | 0.73    | 1.33   | 2.66   | 4.16    | 5.47  | 9.36  | 0.23         | 0.73            | 4.16            |
| Mars            | 0.21    | 0.22  | 0.23  | 0.23 | 0    | 0.41  | 0.47     | 0.74    | 1.33   | 2.66   | 4.16    | 5.47  | 9.41  | 0.21         | 0.74            | 4.16            |
| Ceres           | 0.38    | 0.39  | 0.4   | 0.4  | 0.41 | 0     | 0.53     | 0.77    | 1.35   | 2.67   | 4.16    | 5.48  | 9.39  | 0.41         | 0.77            | 4.16            |
| Extropia        | 0.44    | 0.45  | 0.45  | 0.45 | 0.47 | 0.53  | 0        | 0.79    | 1.36   | 2.68   | 4.18    | 5.48  | 9.36  | 0.47         | 0.79            | 4.17            |
| Jupiter         | 0.72    | 0.73  | 0.73  | 0.73 | 0.74 | 0.77  | 0.79     | 0       | 1.43   | 2.7    | 4.18    | 5.49  | 9.44  | 0.73         | 0.72            | 4.18            |
| Saturn          | 1.32    | 1.32  | 1.33  | 1.33 | 1.33 | 1.35  | 1.36     | 1.43    | 0      | 2.82   | 4.27    | 5.55  | 9.42  | 1.33         | 1.42            | 4.26            |
| Uranus          | 2.66    | 2.66  | 2.66  | 2.66 | 2.66 | 2.67  | 2.68     | 2.7     | 2.82   | 0      | 4.59    | 5.81  | 9.58  | 2.66         | 2.7             | 4.62            |
| Neptune         | 4.16    | 4.16  | 4.16  | 4.16 | 4.16 | 4.16  | 4.18     | 4.18    | 4.27   | 4.59   | 0       | 6.32  | 9.91  | 4.16         | 4.19            | 4.16            |
| Pluto           | 5.47    | 5.47  | 5.47  | 5.47 | 5.47 | 5.48  | 5.48     | 5.49    | 5.55   | 5.81   | 6.32    | 0     | 10.42 | 5.47         | 5.49            | 6.27            |
| Eris            | 9.39    | 9.35  | 9.35  | 9.36 | 9.41 | 9.39  | 9.36     | 9.44    | 9.42   | 9.58   | 9.91    | 10.42 | 0     | 9.39         | 9.38            | 9.97            |
| Mars Trojans    | 0.21    | 0.22  | 0.24  | 0.23 | 0.21 | 0.41  | 0.47     | 0.73    | 1.33   | 2.66   | 4.16    | 5.47  | 9.39  | 0            | 9.41            | 9.94            |
| Jupiter Trojans | 0.72    | 0.72  | 0.73  | 0.73 | 0.74 | 0.77  | 0.79     | 0.72    | 1.42   | 2.7    | 4.19    | 5.49  | 9.38  | 9.41         | 0               | 9.92            |
| Neptune Trojans | 4.16    | 4.16  | 4.16  | 4.16 | 4.16 | 4.16  | 4.17     | 4.18    | 4.26   | 4.62   | 4.16    | 6.27  | 9.97  | 9.94         | 9.92            | 0               |

***Distances within the Jupiter system (thousand kilometers):***

|          | Jupiter | Amalthea | Io      | Europa  | Ganymede | Callisto |
|----------|---------|----------|---------|---------|----------|----------|
| Jupiter  | 0       | 181.01   | 299.19  | 670.15  | 1070.38  | 1881.86  |
| Amalthea | 181.01  | 0        | 327.8   | 683.22  | 1078.17  | 1887.95  |
| Io       | 299.19  | 327.8    | 0       | 702.5   | 1091.51  | 1894     |
| Europa   | 670.15  | 683.22   | 702.5   | 0       | 1184.62  | 1942.36  |
| Ganymede | 1070.38 | 1078.17  | 1091.51 | 1184.62 | 0        | 2036.91  |
| Callisto | 1881.86 | 1887.95  | 1894    | 1942.36 | 2036.91  | 0        |

***Average lightspeed delay within the Jupiter system (seconds)***

|          | Jupiter | Amalthea | Io   | Europa | Ganymede | Callisto |
|----------|---------|----------|------|--------|----------|----------|
| Jupiter  | 0       | 0.6      | 1    | 2.23   | 3.57     | 6.27     |
| Amalthea | 0.6     | 0        | 1.09 | 2.28   | 3.59     | 6.29     |
| Io       | 1       | 1.09     | 0    | 2.34   | 3.64     | 6.31     |
| Europa   | 2.23    | 2.28     | 2.34 | 0      | 3.95     | 6.47     |
| Ganymede | 3.57    | 3.59     | 3.64 | 3.95   | 0        | 6.79     |
| Callisto | 6.27    | 6.29     | 6.31 | 6.47   | 6.79     | 0        |

### ***Distances within the Saturn system (thousand kilometers):***

|                   | Saturn  | Pan     | Pandora | Epimetheus | Mimas  | Enceladus | Tethys  | Dione   | Rhea    | Titan   | Phelan's Recourse |
|-------------------|---------|---------|---------|------------|--------|-----------|---------|---------|---------|---------|-------------------|
| Saturn            | 0       | 133.58  | 141.72  | 151.38     | 184.02 | 237.87    | 294.71  | 376.99  | 523.6   | 1221.73 | 1196.21           |
| Pan               | 133.58  | 0       | 176.88  | 181.51     | 208.8  | 256.16    | 309.86  | 387.98  | 532.29  | 1225.79 | 1212.45           |
| Pandora           | 141.72  | 176.88  | 0       | 188.36     | 212.29 | 259.51    | 312.24  | 388.26  | 532.65  | 1226.13 | 1194.69           |
| Epimetheus        | 151.38  | 181.51  | 188.36  | 0          | 216.9  | 263.07    | 314.09  | 392.21  | 535.26  | 1227.09 | 1220.23           |
| Mimas             | 184.02  | 208.8   | 212.29  | 216.9      | 0      | 272.74    | 322.99  | 401.22  | 541.55  | 1229.2  | 1205.8            |
| Enceladus         | 237.87  | 256.16  | 259.51  | 263.07     | 272.74 | 0         | 345.22  | 412.93  | 551.11  | 1232.23 | 1232.98           |
| Tethys            | 294.71  | 309.86  | 312.24  | 314.09     | 322.99 | 345.22    | 0       | 438.34  | 563.58  | 1241    | 1250.78           |
| Dione             | 376.99  | 387.98  | 388.26  | 392.21     | 401.22 | 412.93    | 438.34  | 0       | 594.82  | 1249.1  | 1273.19           |
| Rhea              | 523.6   | 532.29  | 532.65  | 535.26     | 541.55 | 551.11    | 563.58  | 594.82  | 0       | 1274.22 | 1325.18           |
| Titan             | 1221.73 | 1225.79 | 1226.13 | 1227.09    | 1229.2 | 1232.23   | 1241    | 1249.1  | 1274.22 | 0       | 1694.8            |
| Phelan's Recourse | 1196.21 | 1212.45 | 1194.69 | 1220.23    | 1205.8 | 1232.98   | 1250.78 | 1273.19 | 1325.18 | 1694.8  | 0                 |

### ***Average lightspeed delay within the Saturn system (seconds)***

|                   | Saturn | Pan  | Pandora | Epimetheus | Mimas | Enceladus | Tethys | Dione | Rhea | Titan | Phelan's Recourse |
|-------------------|--------|------|---------|------------|-------|-----------|--------|-------|------|-------|-------------------|
| Saturn            | 0      | 0.45 | 0.47    | 0.5        | 0.61  | 0.79      | 0.98   | 1.26  | 1.75 | 4.07  | 3.99              |
| Pan               | 0.45   | 0    | 0.59    | 0.61       | 0.7   | 0.85      | 1.03   | 1.29  | 1.77 | 4.09  | 4.04              |
| Pandora           | 0.47   | 0.59 | 0       | 0.63       | 0.71  | 0.87      | 1.04   | 1.29  | 1.78 | 4.09  | 3.98              |
| Epimetheus        | 0.5    | 0.61 | 0.63    | 0          | 0.72  | 0.88      | 1.05   | 1.31  | 1.78 | 4.09  | 4.07              |
| Mimas             | 0.61   | 0.7  | 0.71    | 0.72       | 0     | 0.91      | 1.08   | 1.34  | 1.81 | 4.1   | 4.02              |
| Enceladus         | 0.79   | 0.85 | 0.87    | 0.88       | 0.91  | 0         | 1.15   | 1.38  | 1.84 | 4.11  | 4.11              |
| Tethys            | 0.98   | 1.03 | 1.04    | 1.05       | 1.08  | 1.15      | 0      | 1.46  | 1.88 | 4.14  | 4.17              |
| Dione             | 1.26   | 1.29 | 1.29    | 1.31       | 1.34  | 1.38      | 1.46   | 0     | 1.98 | 4.16  | 4.24              |
| Rhea              | 1.75   | 1.77 | 1.78    | 1.78       | 1.81  | 1.84      | 1.88   | 1.98  | 0    | 4.25  | 4.42              |
| Titan             | 4.07   | 4.09 | 4.09    | 4.09       | 4.1   | 4.11      | 4.14   | 4.16  | 4.25 | 0     | 5.65              |
| Phelan's Recourse | 3.99   | 4.04 | 3.98    | 4.07       | 4.02  | 4.11      | 4.17   | 4.24  | 4.42 | 5.65  | 0                 |