

The Akon Europa Penetrator

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on behalf of the International Akon Team
(>90 members in 10 countries)

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- **Akon** proposal involves the delivery of one or two instrumented penetrators to Europa
- Impact at ~300 m/s; penetrator(s) survive, delivered to 0.5-few m below surface
- Direct access to Europa's subsurface: instruments would obtain observations to address several key scientific areas including habitability/astrobiology, geophysics

Why "Akon"?

Zeus gave Europa three priceless gifts; one was a javelin that always hit its target.

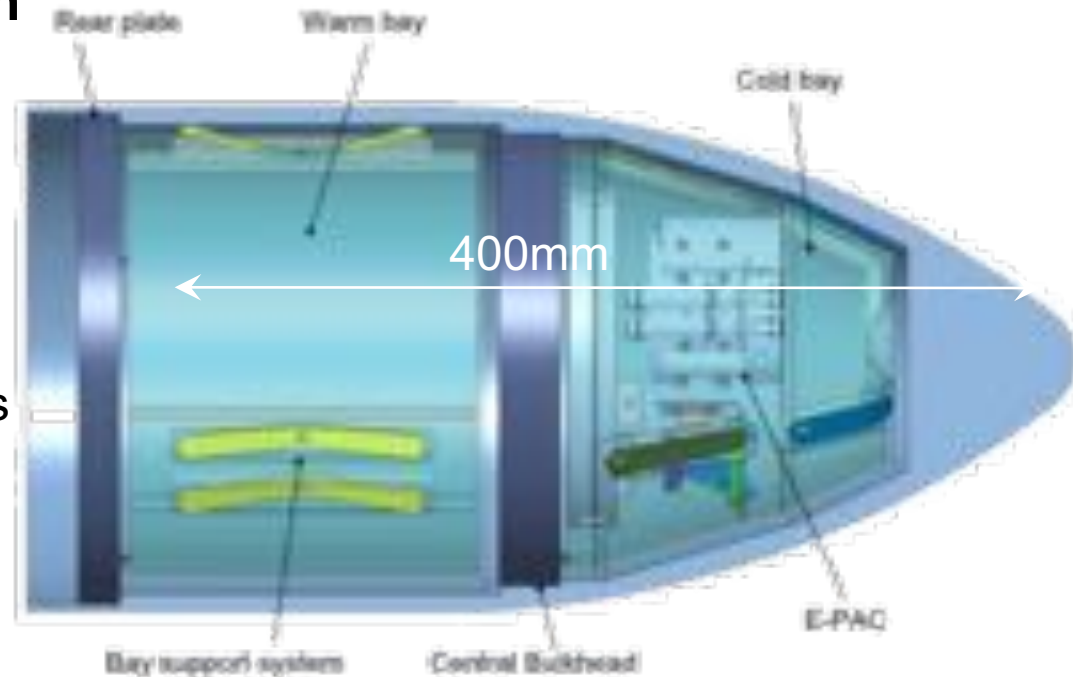
Ancient Greek for javelin: **Ἄκων**



- Design of penetrators based on ESA funded penetrator studies carried out over past several years, specifically designed for icy surfaces in the outer Solar System
- Mature technical design of penetrator; ideal delivery is freefall from ~30km altitude.
- Studies have also covered long-term battery technology and model sample acquisition system to bring samples inside penetrator for analysis

Europa Penetrator Configuration

- Two separate bays
- 80K ice, rapid cool down of instruments
 - **Front** short lifetime bay houses most instruments
 - **Rear** longer lifetime for data storage and relay
- Bays protected from impact loads
 - Torlon Leaf Springs
 - Provides thermal isolation from shell
- Communications via extended UHF antenna connected to the rear plate



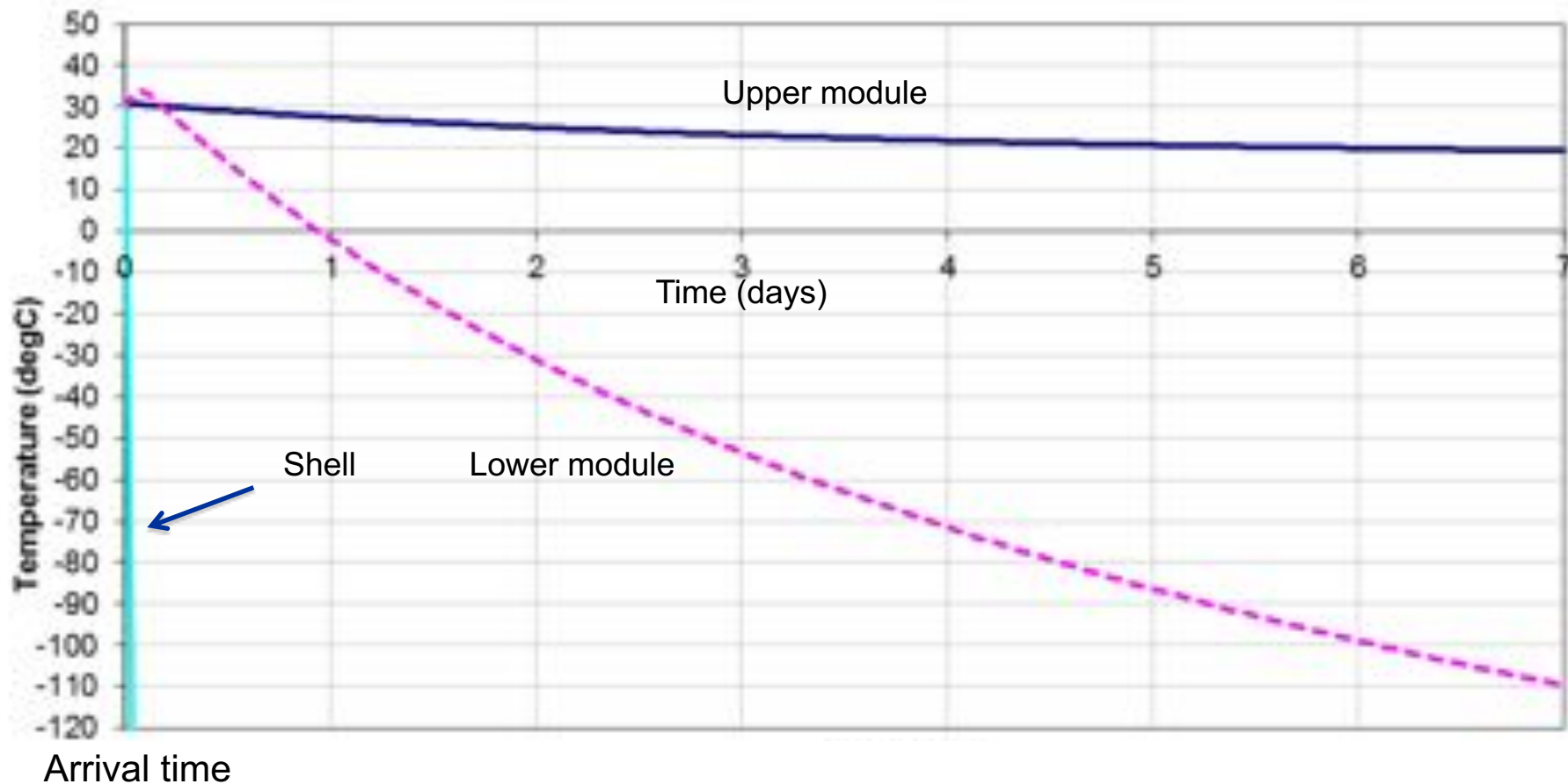
Full Scale Testing – Summer 2013

- Mechanical design proven
- Impact conditions survived harsher than expected (340 m/s impact, 25 deg pitch angle)
- Environmental tests before and after impact proved thermal concept was valid
- Video: <http://bit.ly/ch4penet>



Power and Thermal

- Vacuum flask design minimises heat leaks
- Most science operations are carried out in the first day, plus longer term magnetometer and seismometer observations
- Data from penetrator is returned via relay



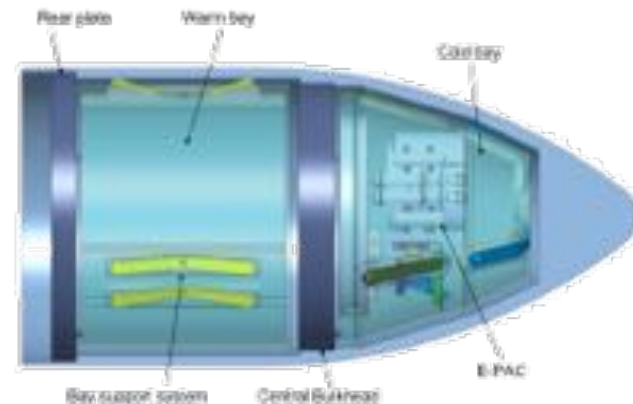
Experiments

<i>Descent Imager</i>
<i>Accelerometer</i>
<i>Energetic particle detector</i>
<i>Habitability Conditions Package</i>
<i>Magnetometer</i>
<i>Mass spectrometer for volatile characterization</i>
<i>Mechanical sensors</i>
<i>Nanopore-based detector</i>
<i>Permittivity probe</i>
<i>Radio transponder for geophysics</i>
<i>Regolith Imager & IR spectrometer</i>
<i>Silicon Seismic Package</i>
<i>Temperature & thermal conductivity</i>
<i>VISTA micro-thermogravimeter</i>
<i>Wet Chemistry Package</i>
(Earth-based) Radio detection for VLBI

Possible experiments listed at left. List to include will depend on mass allocation for penetrator(s).

If two penetrators flown, core instruments could be included on both (including geophysics), with some experiments only included on one penetrator each.

We are very open to US instrumentation being provided.



Inclusion on NASA Soft Lander Mission

Optional delivery scenarios:

- **Direct trajectory to landing site from Jovian orbit**
 - similar delivery system studied in detail to that proposed for Europa Mission (formerly Clipper)
- **Delivery from Europa orbiter**
 - Lower delta V; lower mass for delivery system, lower cost
 - Selection of scientifically-valuable landing site more straightforward (dependent on inclination of orbit compared to latitude of possible landing sites)
- **Delivery from descending Europa Soft Lander**
 - Lander responsible for orientation of Akon on release
 - Larger mass budget
 - Possible disadvantage: Soft lander + penetrators would be relatively close together
 - If no penetrator delivery system, sacrificial descent camera to be included on penetrator itself

Inclusion on a NASA Soft Lander Mission

Scientific Implications

- Multiple observation points for geophysical measurements (seismometer, magnetometer)
- **Three well-spaced seismometers (soft lander + 2 penetrators) can provide location of Europa quakes.**
- Seismic detection of impact of soft lander delivery system (as well as Akon delivery system if included)
- Landing sites complementary to NASA lander to provide information on variation of surface/near-surface conditions for:
 - composition
 - habitability
 - astrobiology

Penetrators would complement and enhance
scientific return from Soft Lander