NASA-Selected Europa Instruments

- **Europa-UVS** UV Spectrograph
  - surface & plume/atmosphere composition

- **MASPEX** Mass Spectrometer
  - sniffing atmospheric composition

- **EIS**
  - Narrow-Angle Camera + Wide-Angle Camera
  - mapping alien landscape in 3D & color

- **SUDA** Dust Analyzer
  - surface & plume composition

- **ICEMAG** Magnetometer
  - sensing ocean properties

- **PIMS** Faraday Cups
  - plasma environment

- **E-THEMIS** Thermal Imager
  - searching for hot spots

- **REASON**
  - Ice-Penetrating Radar
  - plumbing the ice shell

- **Gravity Science Working Group**
  - confirming an ocean

**In Situ**

- **Radiation Science Working Group**
  - radiation environment

- **MISE**
  - IR Spectrometer
  - surface chemical fingerprints

- **Remote Sensing**
Europa Instrument Overview: EIS

EIS-NAC  Europa Imaging System Narrow Angle Camera

Produces visible maps of the surface of Europa, to describe its topography (including possible lander landing sites), understand its geology, and to search for plumes.

PI: Zibi Turtle
Johns Hopkins Applied Physics Laboratory
Europa Instrument Highlights: EIS

Europa Imaging System (EIS): Zibi Turtle, PI

- Adding color capability to NAC
  - Scattered light analysis shows that addition of color stripe filters will not impede plume detection
  - Increases opportunities to gimbal-target coordination with other instruments, extrapolating to small scales and other regions
  - 10 m color resolution from 1000 km
  - Can join the “joint scan” planned for each flyby giving 200 - 400 m/pixel hemispheric color
  - Extrapolate composition information to smaller scales and other regions

Thera & Thrace: Galileo 220 m/pixel combined with 1.4 km/pixel color
Europa Instrument Overview: REASON & MISE

**REASON**

*Radar for Europa Assessment and Sounding: Ocean to Near-surface*

Uses VHF and HF bands to investigate Europa’s ice shell, subsurface ocean, plumes, tides, and potential landing sites

PI: Don Blankenship
University of Texas Institute for Geophysics

**MISE**

*Mapping Imaging Spectrometer for Europa*

Produces maps of organic compounds, salts, hot spots and ices to assess habitability of the ocean and investigate geologic history of the surface

PI: Diana Blaney
Jet Propulsion Laboratory
Radar for Europa Assessment and Sounding: Ocean to Near-surface (REASON): Don Blankenship, PI

- REASON can use both topography from EIS stereo imaging and VHF interferometry to distinguish off-nadir-surface from subsurface reflectors
- Developed tools to quantify the suppression and interferometric discrimination of surface clutter
  - Assists spacecraft design and future analyses
- Helps to clarify issues affecting REASON performance, esp. below 50 km
Europa Instrument Highlights: MISE

Mapping Imaging Spectrometer for Europa (MISE): Diana Blaney, PI

• Thermal accommodation is critical to MISE
  – Cryocooler performance testing is currently underway

• Changed from Offner to Dyson spectrometer design, permitting reduction from 2 to 1 cryocooler
  – Reduces instrument mass, energy, cost
  – More compact, so less to cool
  – Greater light gathering improves S/N
  – No change to spectral range or requirements
Europa-UVS *Europa Ultraviolet Spectrograph*

Obtains ultraviolet images to explore Europa's composition and chemistry, search for plumes, and investigate connections with Europa's environment

PI: Kurt Retherford
Southwest Research Institute

E-THEMIS *Europa Thermal Imaging System*

Characterizes thermal anomalies, active plumes, and surface properties to support landing site assessment and geology.

PI: Phil Christensen
Arizona State University
Europa Ultraviolet Spectrograph (Europa-UVS): Kurt Retherford, PI

- Working design to reduce angle to solar port, to permit smaller turns for solar occultations, while avoiding sun on SUDA
- Designing open/close solar port door actuator

Europa Thermal Imaging System (E-THEMIS): Phil Christensen, PI

- Candidate detectors undergoing radiation and spectral response testing
- Spacecraft scanning permits observing a range of local times of day on the surface
Europa Instrument Overview:
SUDA & MASPEX

**SUDA**  
*Surface Dust Analyzer*

Measures the composition of dust particles and constrains geological activities on and below the surface of Europa

PI: Sascha Kempf  
LASP, University of Colorado Boulder

Sniffs Europa’s atmosphere and exosphere to determine their chemical composition

PI: Hunter Waite  
Southwest Research Institute

**MASPEX**  
*Mass Spectrometer for Planetary Exploration*

Pre-Decisional Information — For Planning and Discussion Purposes Only
Europa Instrument Highlights: SUDA & MASPEX

SUrface Dust Analyzer (SUDA): Sascha Kempf, PI

- SUDA is oriented directly into dust ram at closest approach, when particle number density is highest
- Sun must be out of FOV while making dust measurements
- Improving TRL on Ir-coated detector through prototype testing
- Investigating innovative ways to lower instrument mass

MAss Spectrometer for Planetary EXploration (MASPEX): Hunter Waite, PI

- VAT valve to reduce leak rate, facilitating cryosample analysis
- Performing lifetime testing on ion pump
- Fabricating parts for detector
- Contamination control is key
  - spacecraft cleanliness, FOV/KOZ incursions, thruster products

Feb. 22, 2017
Europa Instrument Overview: PIMS & ICEMAG

**PIMS**  
*Plasma Instrument for Magnetic Sounding*

Measures the plasma surrounding Europa to characterize its subsurface ocean, its ice shell, and plumes

PI: Joe Westlake  
Johns Hopkins Applied Physics Laboratory

**ICEMAG**  
*Interior Characterization of Europa using Magnetometry*

Infers location, thickness and conductivity of Europa’s ocean using electromagnetic sounding

PI: Carol Raymond  
Jet Propulsion Laboratory
Europa Instrument Highlights: PIMS & ICEMAG

Plasma Instrument for Magnetic Sounding (PIMS): Joe Westlake, PI
- 2 sensors, each with 2 Faraday cups (90° FOV each)
- Moved electronics to within cups, improving grounding
- Modeling demonstrates mag cleanliness can be relaxed
- Developing tools to assess potential science impacts of spacecraft charging, which can affect ion or electron measurements

Interior Characterization of Europa using Magnetometry (ICEMAG): Carol Raymond, PI
- Optimized location on the boom of the FG and SVH sensors
- Working with spacecraft team on sensor attitude knowledge and magnetic cleanliness requirements
Magnetometer Boom Deployment

- Single hinge design
- Simple deployment
- Fewer unknowns reduces magnetometer pointing uncertainty
Spacecraft Deployment Sequence
Europa Flyby Animation