National Aeronautics and Space Administration
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Flight Instruments and Technology Future Opportunities

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Technology Infusion in Flight Instruments

- About a 60-40 split NASA to non-NASA across the Division
  - NASA work is developed through NASA's AO process
  - Non-NASA is opportunity development
  - JPL instruments distinguish themselves by technology, not cost
    - Many instances of MDL-centered technology
- NASA Business
  - Business is largely proposal-based
    - Few directed instruments for more than a decade
  - Instruments are selected entirely on competitive basis
    - Science and implementation evaluated
    - Competed missions usually come with the instrument provider arranged, not usually JPL (although last New Frontiers broke this mold)
- Non-NASA generally not space flight, more often airborne
  - Used at JPL to bridge a TRL gap from 4-6
  - Also technology distinguished
- Challenge - Technology infusion is almost always seen as RISK

Broad Instrument and Technology Portfolio

- **System-level product lines:**
  - Spectrometers, polarimeters, and radiometers
  - Imaging, optical, thermal, far-IR, microwave, submm., mass, Raman, FTIR, absorption, LIBS
  - Imaging systems
  - Cameras, microscopic imagers, imaging spectrometers
  - Advanced optical and metrology systems
  - High contrast, interferometer, active/adaptive, spaceborne telescopes
  - In-situ instruments for chemical and elemental analysis
  - Cryogenic coolers and cryogenic instruments
- **Components**
  - Semi- and superconducting detectors and focal planes
  - Advanced optical elements, gratings and precision slits
  - Black Silicon absorbers
  - Lasers
  - Amplifiers, mixers, receivers, digital filters, MMICs
  - Microfluidic devices
  - Quantum computing

The Plan Forward Today

- Deliver on current commitments
- More instrument developments today than any other period over the last 15 years
  - 4 Mars 2020 (SHERLOC, PIXL, MOXIE, EECam)
  - 5 Earth Science (EcoStress, MAIA, SWOT AMR, Sentinel AMR/HRMR, TEMPEST-D)
  - 3 Astrophysics (Euclid, WFIRST CGI, SPARCS)
  - 2 Europa Clipper (ICEMag, MISE)
  - 1 HEOMD (S.A.M.)
  - 1 non-NASA high fidelity testbed (ITB)
  - 1 Planetary Technology Demo (DSOC)

Note: Blue indicates MDL product development and delivery

The Plan Forward
For tomorrow & beyond

- Invest in the future
  - Infrastructure - new e-beam machine
    - Utilize 5-year plan for future investments
  - New science instrument capabilities based on technology
    - BIRD based spectrometers (CIRAS)
    - Delta-doped CCD based UV instrumentation
    - Chemical laptop (JPL NEXT)
    - Microseismometers
  - Look at system technologies
    - Get small, because small fits everywhere (TEMPEST-D, CalSPEC)
- Look at opportunities that allow technology risk for capability demonstration
  - ISS instrumentation
  - CubeSat-sized instrumentation
- Propose broadly because history shows no ability to predict future

Opportunities Near Term

- New Frontiers - 15 Instruments proposed to JPL and non-JPL missions
  - Some legacy-based (e.g. thermopile based, TLS, PIXL)
  - Some new technology based (e.g. quad-pole ion trap MS, green Raman, micro CE)
- Potential Europa Lander
  - Will propose 5 or 6 instruments/subsystems
    - Some as JPL lead, some as partnered subsystem delivery
    - Mostly new technology based
- MIDEX
  - FINESSE in Step 2 (grating based spectrometer to 5µm)
- Other (opportunity-based)
  - CaliSpec - VisIR Imagining spectrometer
  - Osprey – Cubesat-sized Dyson spectrometer

Summary

- The present is very busy
  - Multiple flight instruments dependent on MDL capabilities
  - Delivery is imperative
- 5 year outlook
  - Also looks strong although relies on continued success in NASA AO process
    - Mix of well-established instrument capabilities and instruments with New capability (technology)
    - Allow AO process to sort out acceptable development risk
  - Continue opportunity development with non-NASA sponsors
  - ROSES
  - RTD/JPL NEXT investments support new capability development and maturation