

Enhanced and Enabled Astrophysical Observations with System-Level Autonomy

Rashied Amini, Steve Chien, Lorraine Fesq, Sara Seager



Jet Propulsion Laboratory
California Institute of Technology

using autonomy in astro, like in our personal lives



\$76B globally 2014-2017!!

\$100M-\$1B at NASA over the decades

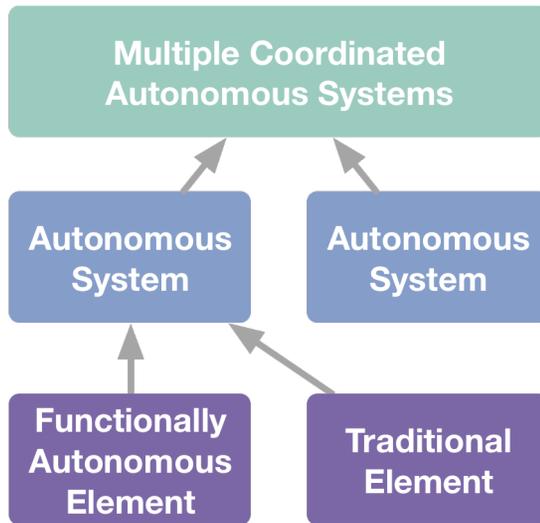
But we need direct investment in capability so engineering can match our science ambitions!

But what can autonomy do for my space- or ground-based observatory?

- **More reliable observatories will result in 5% more observing time – more PIs!**
- **New mission concepts**
- **Lower cost, higher impact transient event observatories**
- **Mandatory servicing, in-space assembly**

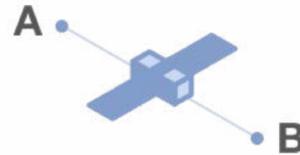
so what *is* autonomy?

Levels of Autonomy



Consider one or multiple spacecraft (e.g. for interferometry or distributed apertures)

Task Networks



Sequences provide one execution path



Tasknets provide flexibility to achieve activities

System Autonomy Framework

system level



function level



systems autonomy on missions

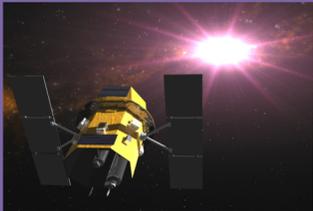
Past

SWIFT

Launched 2004

GRB detection & follow-up in optical, UV, X-ray

Point design, cannot be easily replicated



Present

ASTERIA

Launched 2017

Exoplanet photometry

Retrofitted with FRESCO autonomy framework demo!



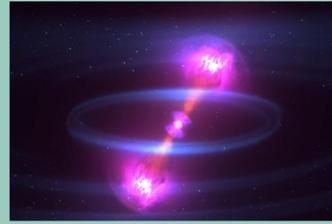
Future

GW Follow-Up

Launching 2020s?

Choose your band!

Autonomy with FRESCO framework by any space vendor



ASTERIA extended mission is funded as an in-space autonomy platform:

- Continuing exoplanet science
- Testing autonomous planning & execution
- Responding to exogenous events
- Autonomous navigation

SPIKE uses automated scheduling...how about execution?

you can help make the future happen

Our White Paper Recommendations

- 1. Fund the use of planning and execution for ground-based observatories now.**
- 2. NASA, academia, and industry need to share the same autonomy assumptions so everyone can work together in the 2020s and beyond.**
- 3. Fund work between NASA and industry partners to commercialize autonomy tech in preparation for future Explorer calls to support Flagships & Probes.**
- 4. Fund research in on-board data processing to support autonomous operations.**

Contact me to sign-on or for more info!

ramini@jpl.nasa.gov



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