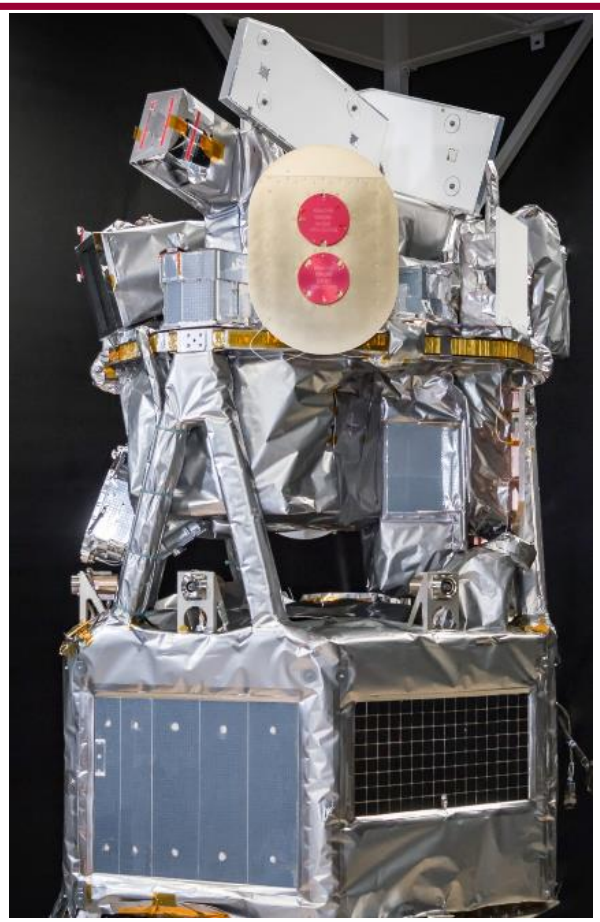

ICON
Ionospheric Connection Explorer
Orbital ATK
UT DALLAS
Mission PI Perspective
Dr. Thomas J. Immel
The Ionospheric Connection Explorer

ICON : NASA Explorer Mission Programmatics

Mission Summary	
Cost	$184.1 M (RY)
Launch vehicle	Pegasus XL Cape Canaveral AFB
Spacecraft	Northrop Grumman LEOStar-2 3-axis stabilized, no consumables
Launch	October 10, 2019
Orbit	590 km circular, 27° inclination
Ground segment	Berkeley Ground Station, WGS, Santiago
Mission & Science Ops	24 months Phase E Operated from UCB



- ICON is on orbit, in Phase E, and achieved mission success. All instruments green. One safe mode in February 2020.

ICON's Science Objectives require measurements of I-T-M system drivers and responses.

The Ionospheric Dynamo, driven by the neutral atmosphere, governs the motion of the plasma:

- We need to measure the **drivers**:

Neutral winds that carry the energy and momentum that drives the dynamo.

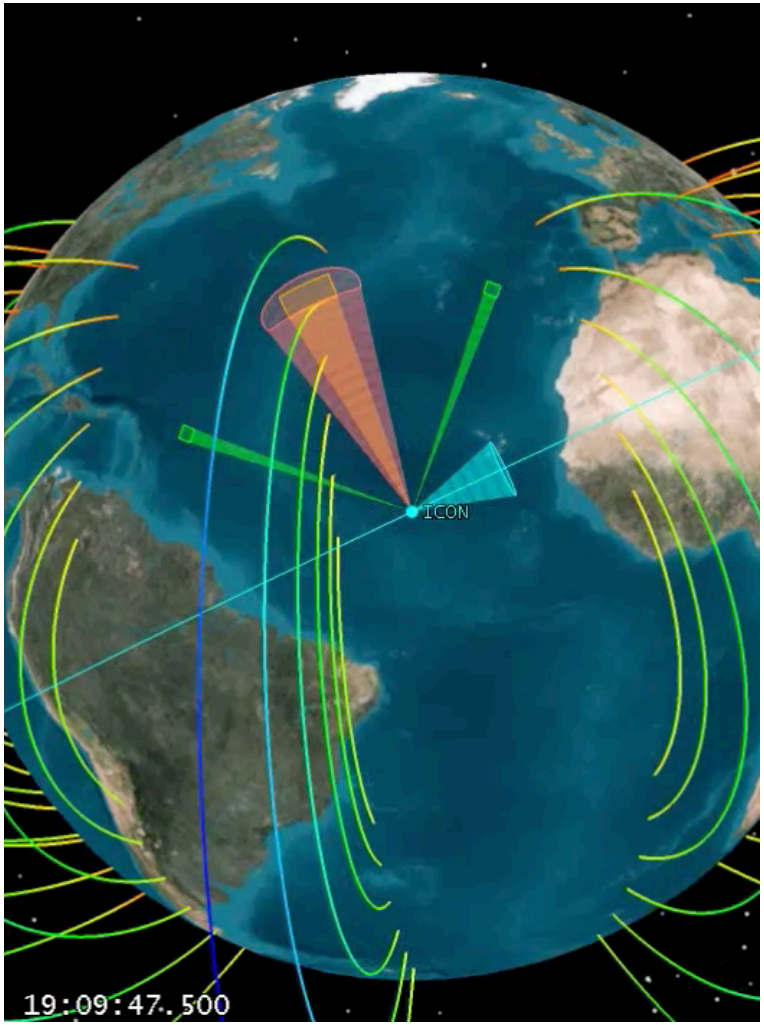
Composition of the atmosphere that controls the chemical production and loss rates of plasma.

Temperature of the atmosphere that reveals the atmospheric waves entering space from below.

- With the **responses**:

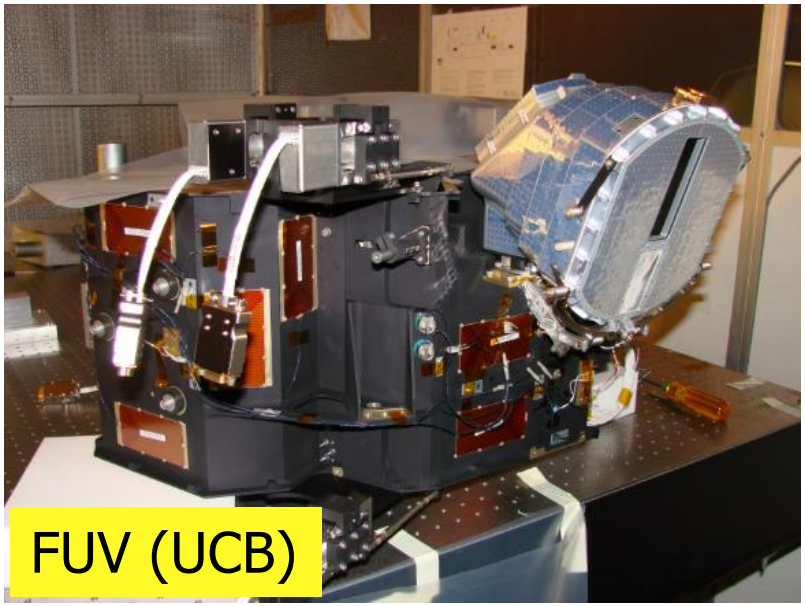
The electric field and **the plasma velocity distribution**, which are directly related.

Plasma density of the ionosphere, the combined result of solar production and plasma motion.

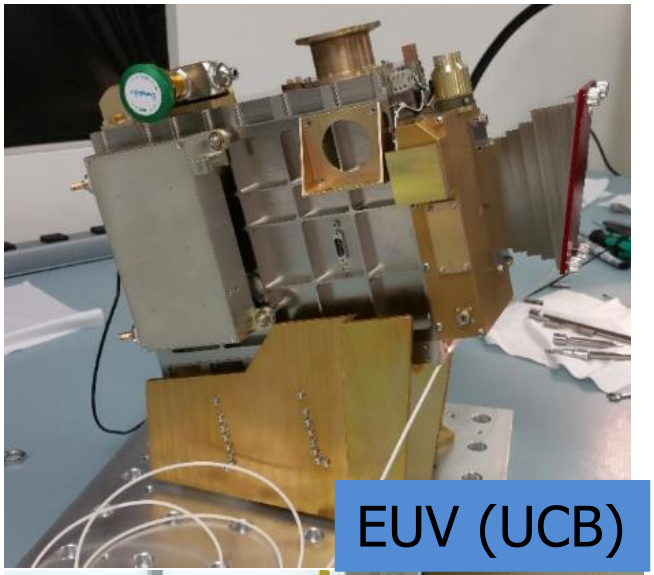


All baseline measurements being made. No science descopes exercised

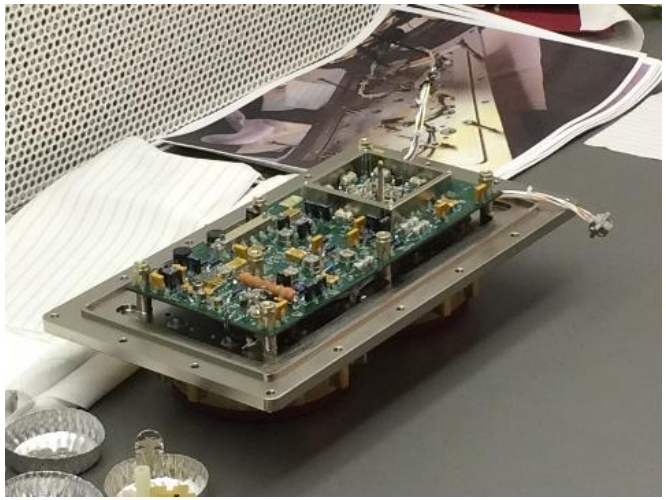
ICON carries a set of instruments to make all the necessary measurements.



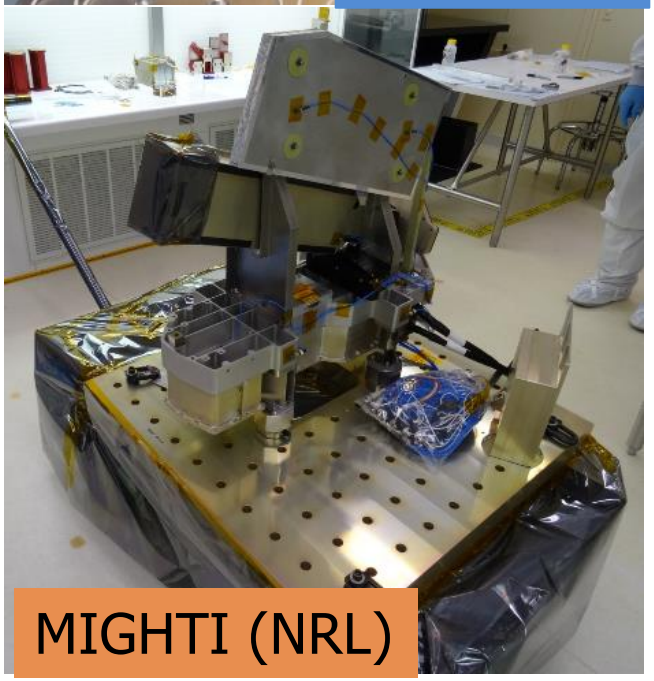
FUV (UCB)



EUV (UCB)

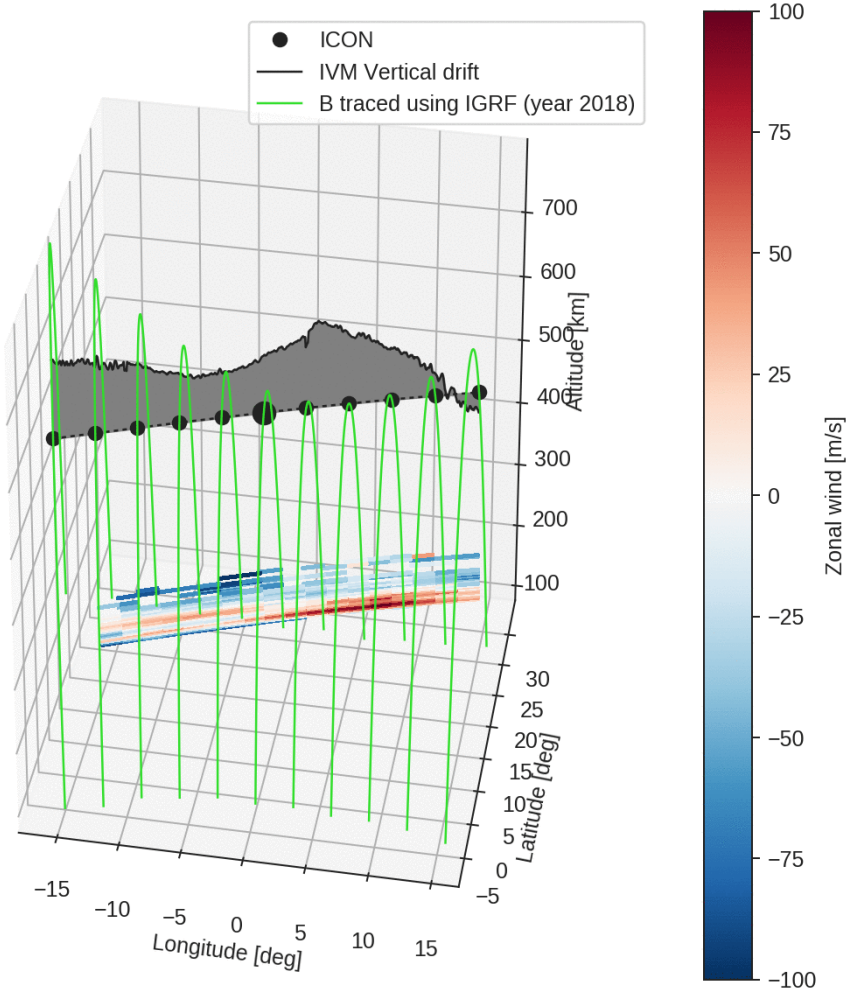


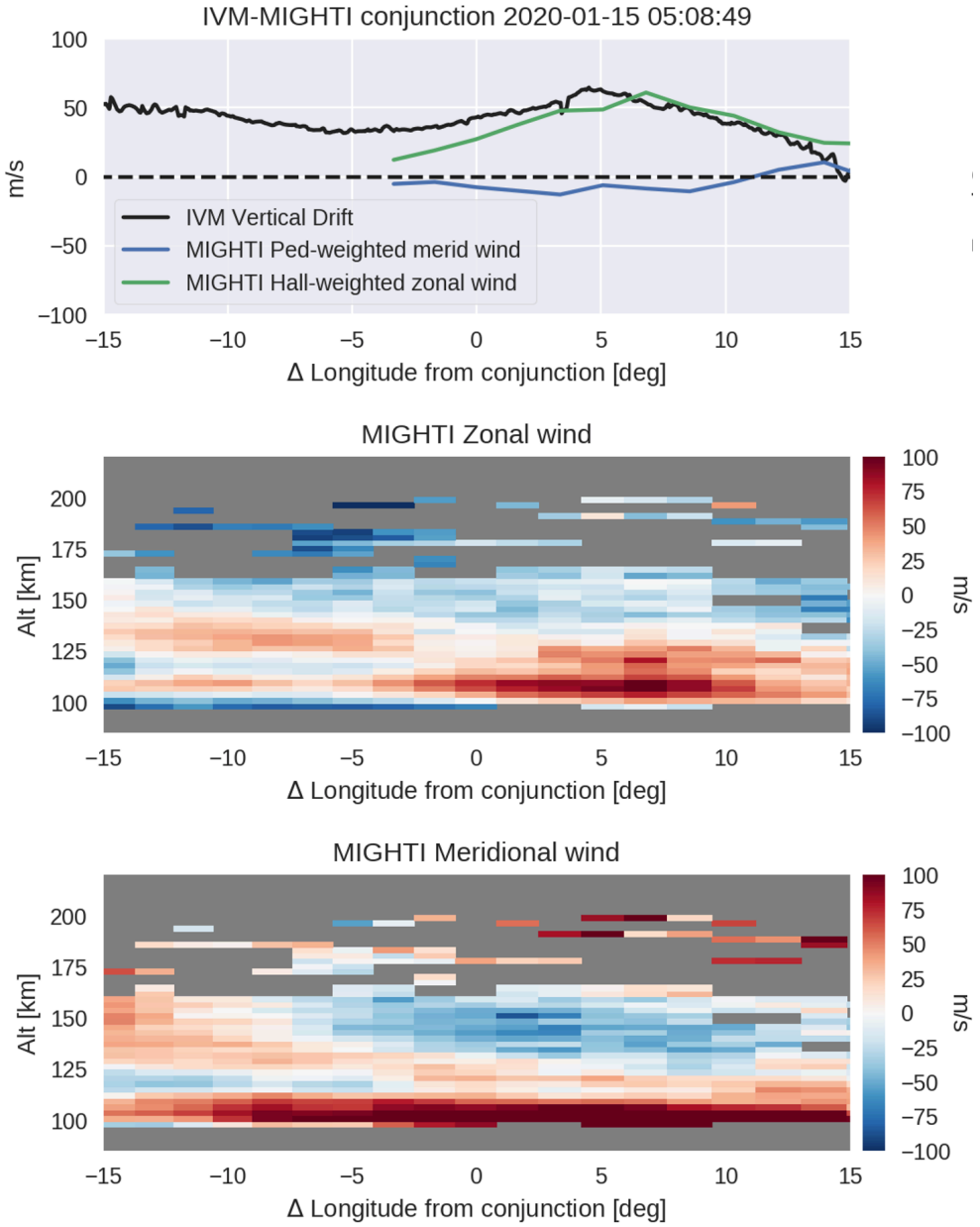
IVM (UTD)



MIGHTI (NRL)

ICON data enable exactly the research we worked for!





PI Tasks – Abbreviated list, rough temporal order, Phase B, C, D

- Develop PLRA w/HQ and GSFC.
- Review development of all requirements documents to L4 (Instruments).
- Maintain L2 science requirements.
- Drive agenda for all Science Team Calls and Meetings.
  - Monthly calls, weekly working groups
- Lead project science validation/verification effort, w/peer reviews of algorithm performance.
  - In concert w Project Scientist and Project Sys. Engineer.
- Participate in project weekly calls/mtgs – Management, Systems, Science Operations, Science Communications.
- Participate in all SRB and GSFC project reviews, and all KDP reviews both at GSFC and HQ.
- As long as science descopes are still viable options, participate in Risk Management Board discussions.
- Present status of WBS 4 at Monthly Management Reviews.
- Manage/delegate development of Space Science Review issue and mission reports therein.
- Participate in SOC organization and SDC development.

PI Tasks – Part 2

Science Communcations

- SMD Policy regarding science communications changed in 2015 has been guiding A/O language.
- It identifies the PI as the sole project contact for science communications; all efforts to be undertaken by the designated NASA center at the mission level on behalf of the project.
- The PI and project specifically have no budget to support this activity.
- If new missions are to have any support at the project level, it will probably be a significant ask. Until policy changes, the PI (or their designee) is solely responsible for science communications at the project level.

- But you don't have funding for any designee to make any effort at all.

- You will get attention from your NASA center in rough proportion to your burn rate. In Phase E, that ramps down significantly and you should be ready for that.

- You will repeatedly revisit your science requirements and the PI ultimately is called to explain every change.
  - It is important enough to hold significant margins that the PI controls.
    1. In the development of the Program Level Requirements, and Requirements Agreement, strive to maintain margins between the Program (Level 1) and the Project (Level 2) science requirements. Level 2 should not be a pass-through of the Program Requirements down to the mission elements.
    2. Payload and Spacecraft (Level 3) and Instrument (Level 4) requirements will be developed and reviewed after selection, and the systems engineering effort will expose performance hits that will put pressure on Project requirements. You will get more on orbit! Only with margin to the Program requirements can the mission proceed and eventually meet success criteria.
    3. Strategy for achieving this can be agreed upon with mission (GSFC) and program (SMD) scientists. Your strategy will be discussed at length with your Standing Review Board.

  Recommendation: Upon selection, expand your Science Traceability Matrix to a Project Document (ICON: Science Rationale and Traceability Document) that explains the approach and defends the requirements in the PLRA.

- You have the responsibility to build and deliver the science mission you proposed to SMD.
  - NASA can be very helpful but:
    1. Should there be discussions needed regarding scope; be prepared to stake out your position and stick to it for as long as it takes. The easiest solution is always to tap reserves; a very precious resource. This should be your last course of action!
    2. You manage, your NASA center provides oversight. Oversight can be very useful; take advantage of it where you can. Recognize, however, that you will need to manage the oversight as well to control cost and schedule.
    3. Even while "pushing back", it is vitally important to maintain a collegial, respectful, and open relationship with your NASA center and your SRB. Threats to this can come up on either side. Addressing them as early as possible will make your life easier.
    4. Your Mission Assurance Requirements document, MAR, can have significant cost implications (e.g. EEE parts). Be sure your project personnel understand the implications of each and every clause. It is much easier to negotiate in advance than it is to write waivers later.

Other Lessons

- Your PM defends your science budget from cost and schedule threats. For the PI to be able to trust the PM's choices and discretion implicitly is a great benefit.
  - This includes staffing decisions, making sure every element of the mission has a team that can execute all aspects of design, built, test, deliver, including reviews.
- Your SE defends your science mission from technical threats. They are your #1 advocate. Work to bring your SE up to a good understanding of the mission science so they can manage the requirements for the mission.
  - Having the SE involved in L2 science requirement validation supports this goal.
- If the SE and PM understand the science mission and the mission risks, they can do their job and you can do yours. The PI, PM and SE are a team whose decisions can enhance the mission's capability.
- Become conversant in the NASA process for risk management so that you can participate in the Risk Management Board activities. It is only through this process that reserves can be effectively managed.
  - RMB is not a science discussion panel. Working closely with the SE and PM, it doesn't have to be.