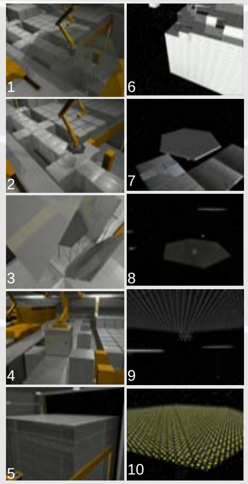
SMART architecture from start to finish

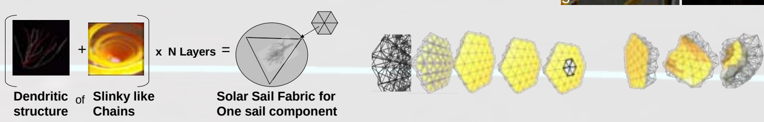
SMART assembly, shipping, and deployment using SMART boxes
- Autonomous assembly from SMART components
- 3D tetrahedral 3D truss structure from layers of MEMS nodes (1-2)
- Sail (shell) and subsystems deployed from specialized nodes
- Stowed to 1/100 size in propulsion/communication capable box for shipping (3-4)
- 1000 boxes form 1 meter cube package shippable to launch location (5-6)
- Spacecraft deployed from boxes for launch in space (7)



SMART deployable spacecraft (8)
- Uses SMART Sail, Subsystem Platform, Tethers
- Can be multiple tethered platforms
- Optimized for pre and post deployment ops

SMART deployable subsystems (9)
- SMART Space Frame and Separate Platform for subsystems
- Communication either thin wire or wireless
- Nodes (MEMS) spool/unspool carbon nanotubules form tethers, struts, fibers or act as attach points for subsystems

SMART Solar Sail characteristics (10)
- 10 to 100 times linear stretch from multilayer dendritic polymers
- Polymers consist of layers of Slinky-like helical nanotubule chains
- Multilayer fabric has sufficient reflectivity when fully extended
- Self-configuring morphology for attitude control or adaptation
- Self-deploying surface and struts for attitude control or repair



SMART deployable Nuclear Propulsion Craft
Uses SMART Nuclear Propulsion self-configuring for control of thrust
- Expand or Contract to control Critical Mass Properties
- Vary thermal coefficient to control Heat Flow
- Other Subsystems can be tethered to shell
- Pre-deployment size much smaller than post

SMART Hive Carrier characteristics
Sail special reflective shell material
- Individual spacecraft self-tether for transport
- Self-configuring/Self-deploying for attitude control

SARA: The Saturn Autonomous Ring Array
ANTS application to survey dense, dynamic, high G population
- 1000 spacecraft swarm
- 10 types of 'specialists' with common spacecraft bus
- 10 subswarms, ~100 spacecraft each, ~10 each specialist

Hybrid propulsion for operation in two regimes:
- Solar Sail Transport 'Hive Ship' cruise to outer solar system
- Nuclear Propulsion for individual craft navigate around rings

Small nuclear batteries for 100's of mWatt power requirements

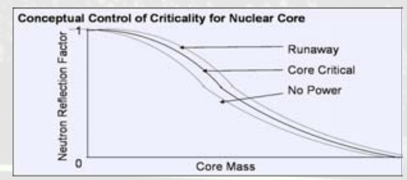
Primary objective is in situ exploration of Saturn's Rings to understand formation and origin of planetary systems

ANTS Application: SARA, Saturn Autonomous Ring Array

Time Frame:	2025-2030. NEMS
Environment:	Space, High G, High density dynamic population
Power:	100's mWatts, Solar<3.5AU Nuclear Battery>3.5AU
Material:	1-3 kg, 100 m^2/kg
Locomotion:	Solar Sail Carrier<3.5 AU, Nuclear Thermal>3.5AU
Challenges:	Rapid reconfigurability of nuclear source required for attitude control to avoid collisions, take samples

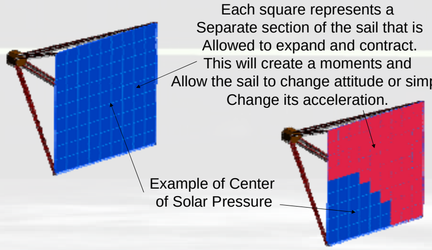
SMART Nuclear Propulsion System Self-Configuration
Design of Self-configuring nanostructures for nuclear propulsion and power control necessary Such autonomous control would be essential in maneuvering the craft and the instrument for collection of rather than collision with ring particles.

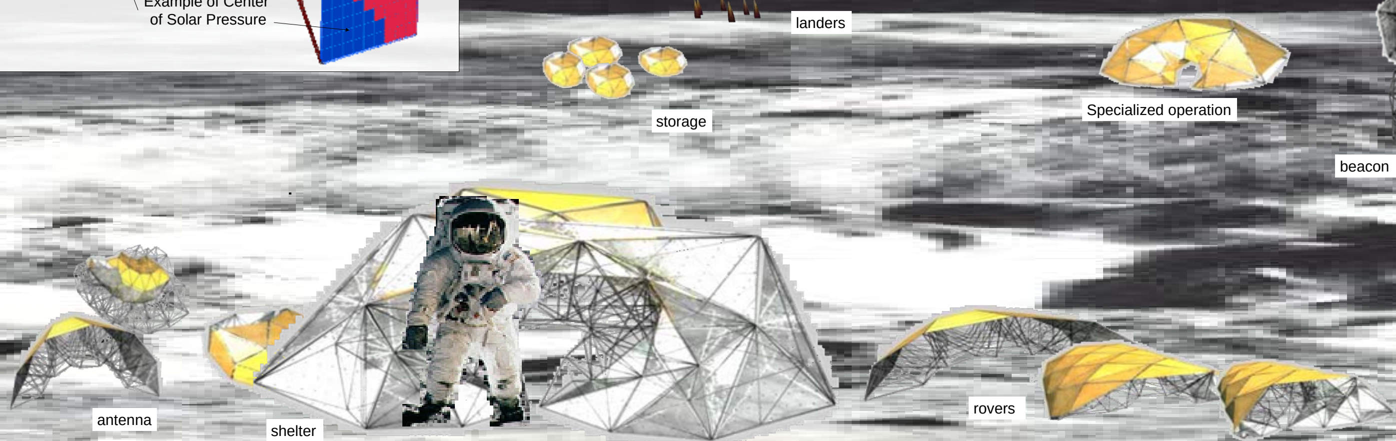
The power and speed of the nuclear propulsion drive system proposed would be varied by controlling the temperature and criticality of the fuel element using ANTS technology.



Attitude Control: Using SMART Sail or Surface Self-Configuration
Sail achieves dynamic attitude control through capability for dynamic change in its morphology, thus changes the effective area and distribution of solar reflectivity to change its acceleration and momentum vectors to achieve required orbit and orientation.

Attitude Control: Using SMART Sail or Surface Self-Deployment
Each square represents a Separate section of the sail that is Allowed to expand and contract. This will create a moments and Allow the sail to change attitude or simply Change its acceleration.





ANTS Development Enabling Technologies
- Intelligent systems
  - Synthetic neural system
  - Advanced autonomous systems
  - Multi-agent systems
  - High performance computing
- Solar sail navigation
- Gossamer structures
- MEMS technology for deployable structural elements
- NEMS technology for nano-struts, fibers, tethers, fabric
- Autonomous in-space manufacturing

See ANTS website: http://ants.gsfc.nasa.gov