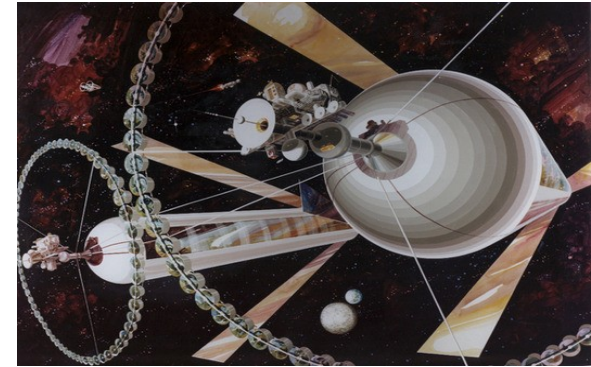


# *World Space Programs & Prospects*

## *- Global New Space -*

- Sir Richard Branson and Virgin Galactic
- Abu Dhabi's Aabar Investments has put \$380M in Virgin Galactic
- Michiel Mol and Maarten Elshove - Dutch backers of Space Exploration Curacao and XCOR Lynx.
- Korean Space Center deal with XCOR
- Spaceport projects in Sweden & Scotland.
- Space Adventures and Russian projects
- Substantial fraction of space tourism tickets are to non-US citizens.
- Of 7 ISS tourists: 2 were non-US citizens, 2 were naturalized US citizens.

# A New Space Timeline



20XX

??  
*Filling in  
the gap*

2015-2020



2012



# *Prospects for New Space*

## *- More Global Involvement Needed -*

<i>Industry Requirements</i>	<i>Status</i>
Markets	Signs are very good <b>4 Stars</b>
Transportation	Robust development underway <b>4 Stars</b>
Habitats	Only one robust developer <b>2 stars</b>
In-Space infrastructure	Lagging in development of space tugs, fuel depots, debris removers, ECLSS, spin gravity, food production, etc <b>1 star</b>

# Markets

- **Tourism:**

- Queue for flights to ISS despite \$20M-\$35M prices, 6 months training, Russian language learning, etc.
- About 700 people signed up for suborbital flights despite no vehicles flying yet.
- Global market - several hundred million new middle & upper class people in the world.

- **Science/Tech:**

- R&D interest in commercial suborbital very high.
- Microgravity R&D thought to be a zero nonexistent market but shows signs of life – Richard Garriott made a few million dollars during his ISS stay.
- International interest - universities, research institutes & firms will get involved.

# Commercial Space Transportation

- **Suborbital**: several robustly funded US commercial space vehicles in development and close to flight.
  - Diversity of design provides for evolutionary optimization, i.e. survival of the fittest design.
- **Orbital**: several robustly funded US commercial vehicles in development, some close to flight.
  - *Fully and rapidly* reusable orbital also in development, e.g. SpaceX and Blue Origin,
  - Suborbital projects have plans for orbital next-gen systems based on lessons from suborbital systems.
- **International**: Skylon, Excalibur Almaz, Tranquility Aerospace, Copenhagen Suborbitals, etc.
- Technically interesting but don't appear to be robustly funded. Skylon would need ~\$12B.

# *Habitats*

- Bigelow Aerospace
  - Robert Bigelow committed to spending several hundred million dollars
  - 2 prototypes in orbit.
  - Aiming for sovereign clients – i.e. national space programs
  - *Sudden downsizing last year after starting major plant expansion and talk of ramp up to BA-330*
- Need more viable commercial habitat enterprises.
- Some international activity - Russian Orbital Technologies, Spanish Galactic Suite – but not clear if these are financially viable.

# *Other Infrastructure Components*

- For space development and the long term goal of settlement, need in-space infrastructure:
  - Space tug – move space modules, cargo, etc between orbits
  - Fuel depots
  - Spin gravity + rad shielding
  - Sustained environmental control & life support
  - Food production
  - Manufacturing, machining, 3-D printing, etc.
  - Etc.
- Some entrepreneurial efforts in these areas currently but need a lot more and need more funding.
- **Global involvement needed.**