Commercial Suborbital Spacecraft in China

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I  Background

II  Typical programmes

III  Spacecraft alternatives in China
Background

- Commercial Suborbital Flight
- Max altitude >100km, usually 35-300km
- Provide suborbital flight service
- For commercial profit
- Different from government space activities mostly operated by private companies
Background

• Remarkable points
  ✓ High Risk
  ✓ Huge investment
  ✓ Attractive returns or reward
Typical programmes

- Commercial suborbital flight industry is becoming more and more popular recently

<table>
<thead>
<tr>
<th>Company</th>
<th>SRLV</th>
<th>Seats</th>
<th>Locker equivalents</th>
<th>Cargo (Kg)</th>
<th>Price</th>
<th>Operational date</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP Aerospace</td>
<td>SpaceLoft XL</td>
<td>0.5</td>
<td>36</td>
<td>$360k/launch</td>
<td>2006</td>
<td></td>
</tr>
<tr>
<td>Armadillo</td>
<td>STIG A</td>
<td>1</td>
<td>10</td>
<td></td>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>Aerospace</td>
<td>STIG B Hyperion</td>
<td>2</td>
<td>50</td>
<td>Not announced</td>
<td>$120k/seat</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>200</td>
<td></td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>XCOR</td>
<td>Lynx Mark I</td>
<td>1</td>
<td>120</td>
<td>$95k/seat</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>Aerospace</td>
<td>Lynx Mark II</td>
<td>1</td>
<td>120</td>
<td>$95k/seat</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lynx Mark III</td>
<td>1</td>
<td>770</td>
<td>$95k/seat</td>
<td>2017</td>
<td></td>
</tr>
<tr>
<td>Virgin Galactic</td>
<td>SpaceShip Two</td>
<td>6</td>
<td>600</td>
<td>$200k/seat</td>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>Masten Space Systems</td>
<td>Xaero Xogdor</td>
<td>4</td>
<td>25</td>
<td>Not announced</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>Blue Origin</td>
<td>New Shepard</td>
<td>3+</td>
<td>120</td>
<td>Not announced</td>
<td>Not announced</td>
<td></td>
</tr>
</tbody>
</table>
## Typical programmes

### Multiple Application

<table>
<thead>
<tr>
<th>Commercial Spaceflight</th>
<th>Basic and Applied Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human spaceflight experience for tourism or training</td>
<td>Basic and applied research (Biological, physical, earth science, human research)</td>
</tr>
<tr>
<td><strong>Aerospace Technology Test and Demonstration</strong></td>
<td>Media and Public Relations</td>
</tr>
<tr>
<td>Aerospace engineering to advance technology maturity,</td>
<td>Film and television, media advertising, public relation</td>
</tr>
<tr>
<td>achieve space demonstration</td>
<td>and outreach, space novelties and memorabilia</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td><strong>Satellite Deployment</strong></td>
</tr>
<tr>
<td>Providing opportunities to K-12 schools, colleges and</td>
<td>The use of SRLV to launch small payload into orbit</td>
</tr>
<tr>
<td>universities access to and awareness of space</td>
<td></td>
</tr>
<tr>
<td><strong>Remote Sensing</strong></td>
<td><strong>Point-to-point Transportation</strong></td>
</tr>
<tr>
<td>Acquisition of imagery of earth systems for commercial,</td>
<td>Future transportation of cargo or humans between</td>
</tr>
<tr>
<td>civil government or military application</td>
<td>different location</td>
</tr>
</tbody>
</table>
Typical programmes

- Extremely attractive potential revenue
Typical programmes

• Suborbital tourism programme

Virgin Galactic SS2

XCOR Lynx

Blue Origin New Shepard
Typical programmes

- Other Commercial Service
Spacecraft alternatives in China

• Suborbital Balloon Ride
Spacecraft alternatives in China

- Suborbital Balloon Ride
Spacecraft alternatives in China

• Rocket Powered Suborbital Vehicle
  More quickly, low cost, on response into space and back safely, commercial operate
Spacecraft alternatives in China

• Rocket Powered Suborbital Vehicle for tourism
Spacecraft alternatives in China

• Rocket Powered Suborbital Vehicle for tourism

<table>
<thead>
<tr>
<th></th>
<th>Launch Weight 100t</th>
<th>Launch Weight 10t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reuse time</td>
<td>&gt;50</td>
<td>&gt;50</td>
</tr>
<tr>
<td>Tourist number</td>
<td>6-20</td>
<td>3-5</td>
</tr>
<tr>
<td>Altitude (km)</td>
<td>120-140</td>
<td>60-80</td>
</tr>
<tr>
<td>Mach Number</td>
<td>7-8</td>
<td>5-6</td>
</tr>
</tbody>
</table>
Spacecraft alternatives in China

• Rocket Powered Suborbital Vehicle for commercial launch
  ✓ As reusable booster
  ✓ Flyback to launch site autonomously
  ✓ Reduce launch cost significantly
Spacecraft alternatives in China

• Rocket Powered Suborbital Vehicle for commercial

<table>
<thead>
<tr>
<th></th>
<th>SRLV+ Small upstage</th>
<th>2 SRLV+ Core stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSO</td>
<td>500kg</td>
<td>1t</td>
</tr>
<tr>
<td>LEO</td>
<td>1t</td>
<td>2.2t</td>
</tr>
<tr>
<td>Launch cost</td>
<td>$3870k</td>
<td>$6450k</td>
</tr>
</tbody>
</table>

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Spacecraft alternatives in China

- Extended business
  - Suborbital tourism
  - Sky diving
  - Tourist driving
  - Suborbital show
  - Suborbital culture garden
  - Suborbital tourism business base
  - Media advertising
  - Science test
  - Earth observation
  - Telecommunication
  - Remote sensing
  - Suborbital flight training
  - Hypersonic test
  - Space rescue
  - Emergence communication
  - Security guarantee
Spacecraft alternatives in China

• Extended business

- Media advertising
- Space industrial base
- Space Theater
- Space pharmaceuticals
- Environmental Monitoring
- Remote Sensing
- Scientific Experiment
- Suborbital Show
- Cabin Experience
- Emergence Communication

Production
Spacecraft alternatives in China

- Commercial Suborbital flight

- Rapid and low cost into space
- Suborbital environment research
- Emergency sensing
- Low cost scientific research
THANK YOU

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