Cubesat Volume Constraints and Considerations

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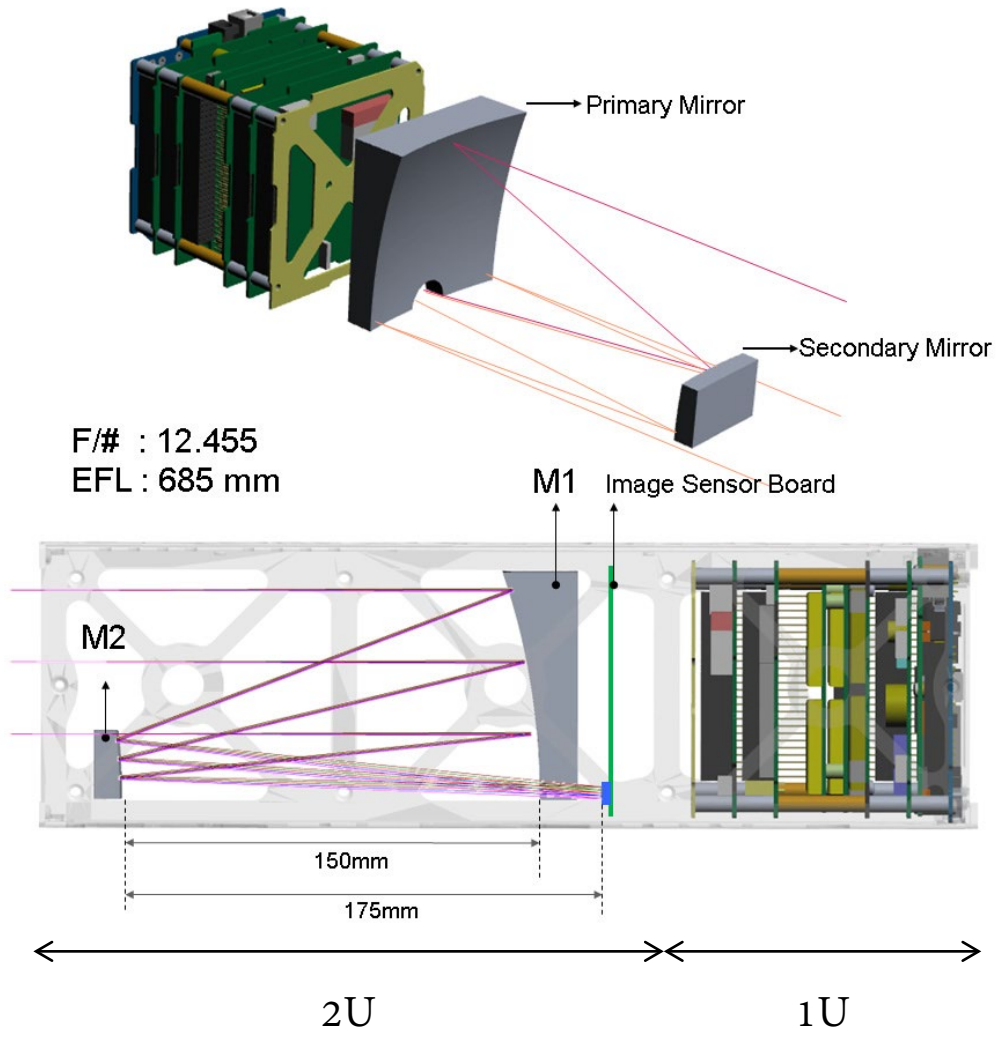
Volume/Aperture Constraints

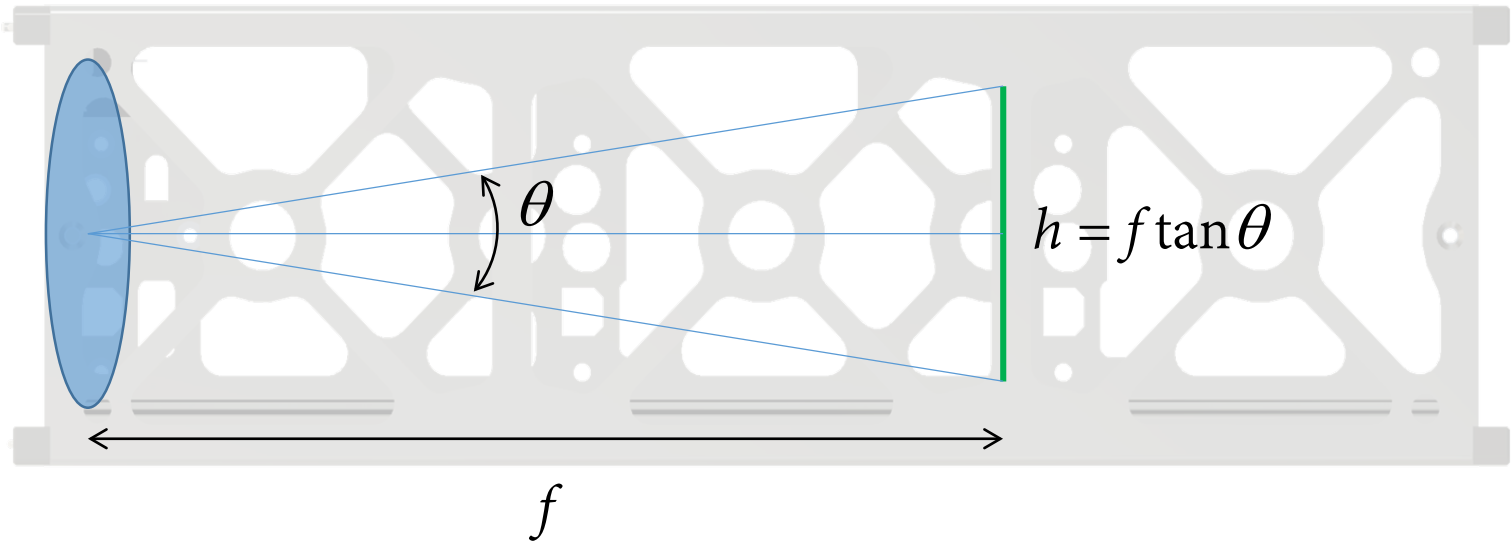
Based on Jin et al.'s work (2013):

- Maximum volume available for optics in a 3U Cubesat is **200 x 100 x 100mm,** or 2Us (giving room for electronics in the 3rd unit)
- Maximum aperture diameter that can fit into a 1U-3U Cubesat is ~ **80 mm** (need room for mounting the optics)

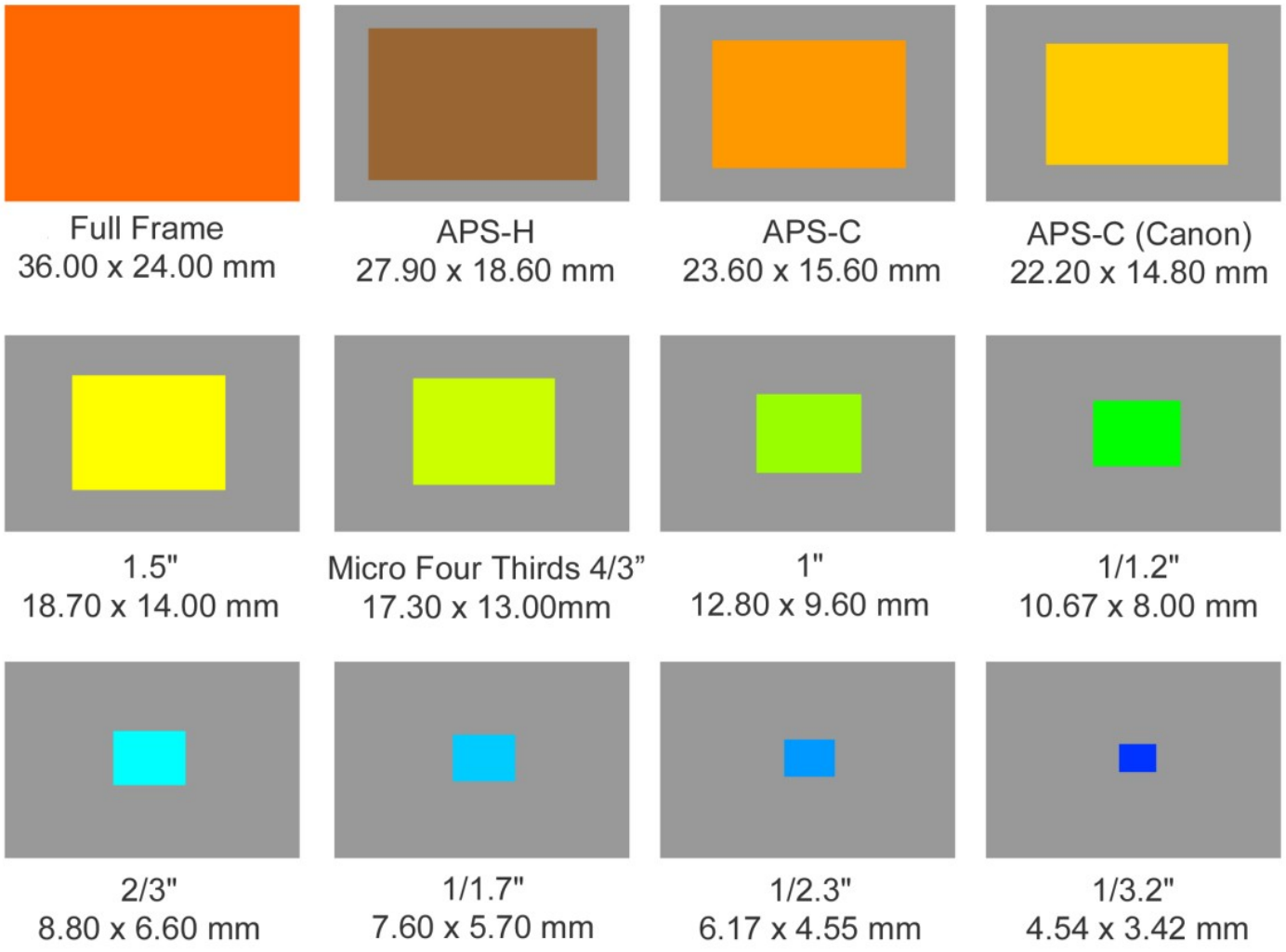


Focal Length Constraints

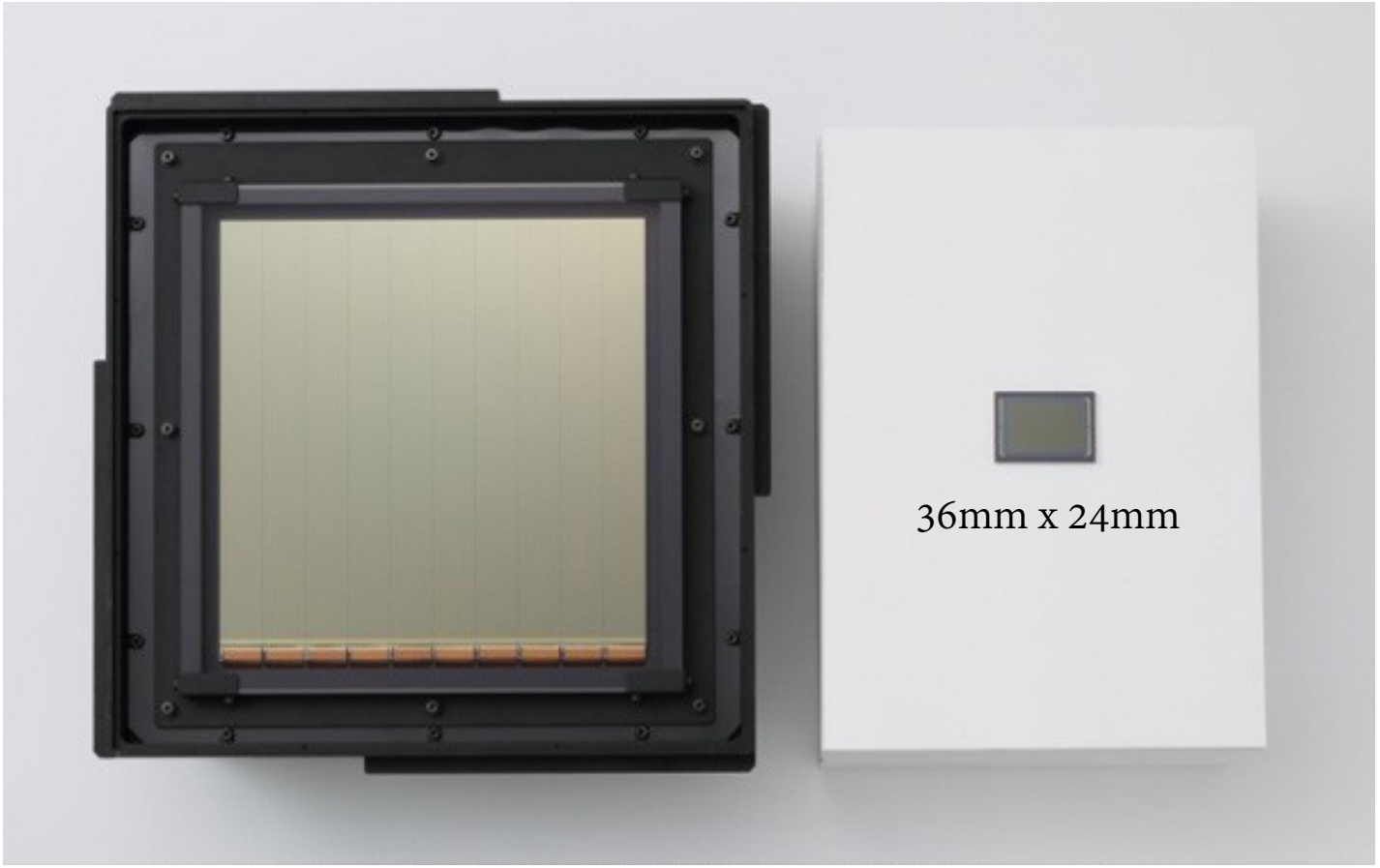
- For a *single* refractive lens, the maximum focal length we can fit is **200mm** (2 Us)
- We could increase the EFFL with more lenses or using reflective optics, but depending on the required FOV, the detector size will ultimately be the limiting factor, due to commercially available detector sizes (detector size = $f \tan\theta$)



Common Detector Sizes

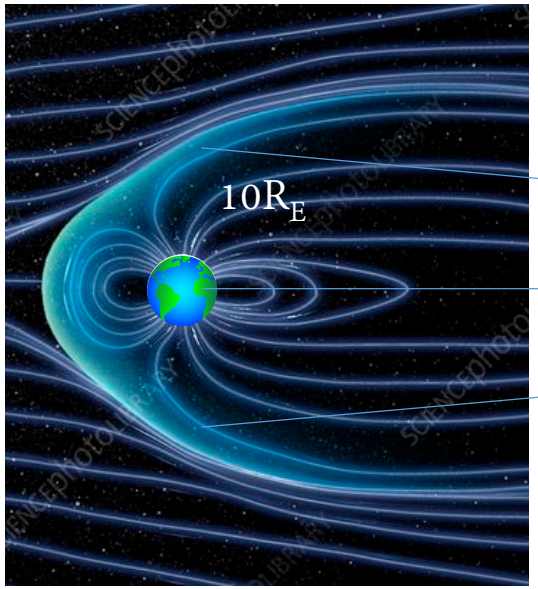


Canon’s 200mm x 200mm Sensor?



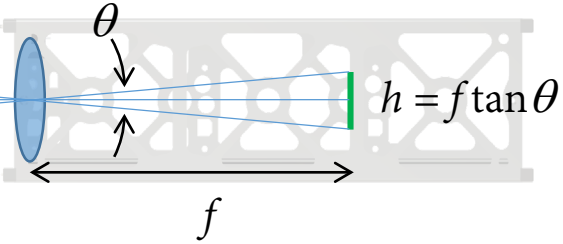
Example: Imaging the Earth's Magnetosphere

$R_E = 6{,}371{,}000$ m



FOV

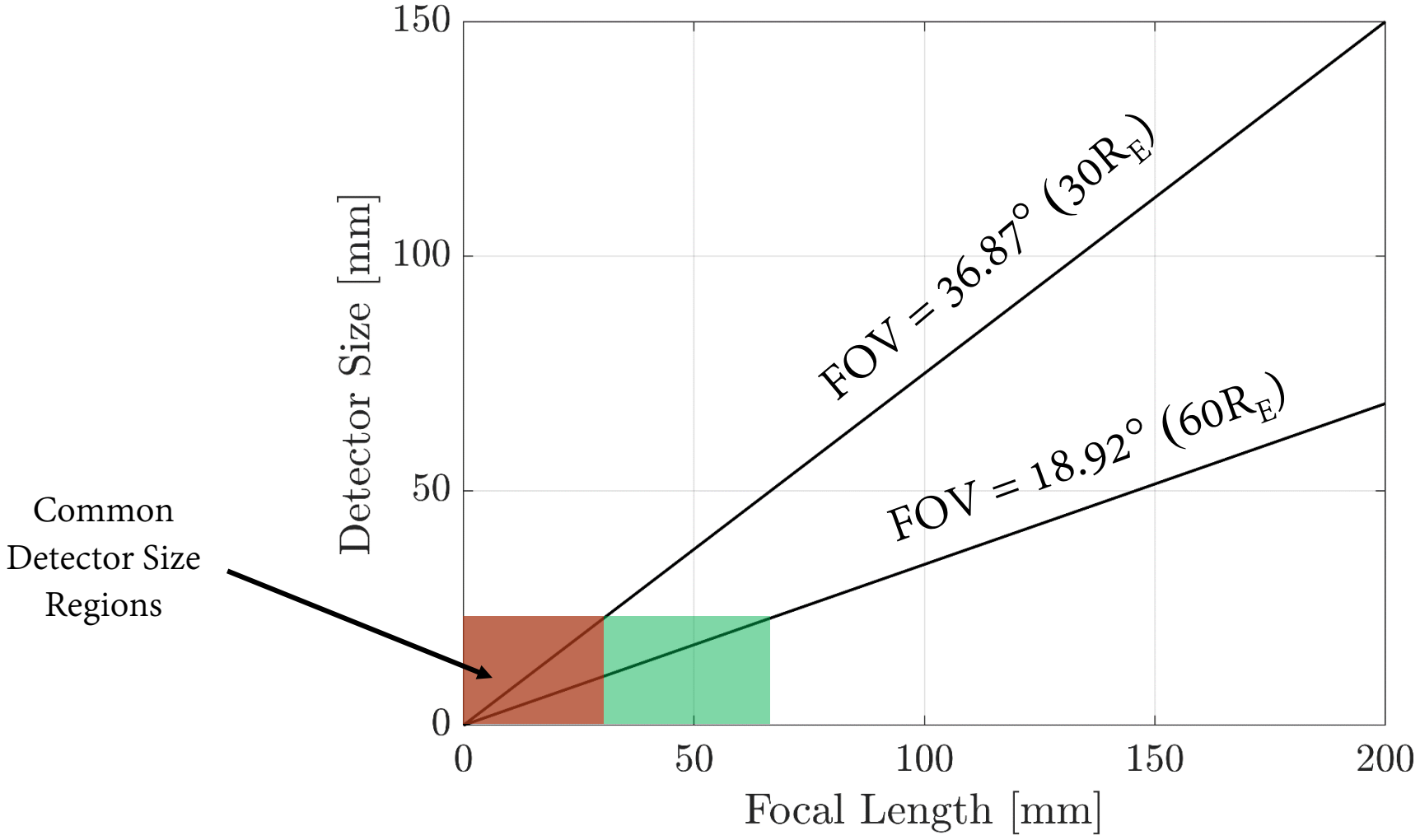
$\theta = 2\arctan(1/3) = 36.87°$



$30R_E$ - $60R_E$

(*Distance to moon:* ~ $60R_E$)

Detector Size vs. Focal Length



Summary of Constraints

- FOV: **19° - 36°**
  - Requirement for imaging the Earth's magnetic field
- Maximum Aperture: **80 mm**
  - Due to 100 mm x 100 mm volume of a 1U Cubesat
- Maximum Effective Focal Length: **60 mm**
  - Due to large FOV and assuming max available detector size is 36 mm x 24 mm
- Maximum Volume Available for Optics: **200 mm x 100 mm x 100 mm (2U)**
  - Due to the need for electronics