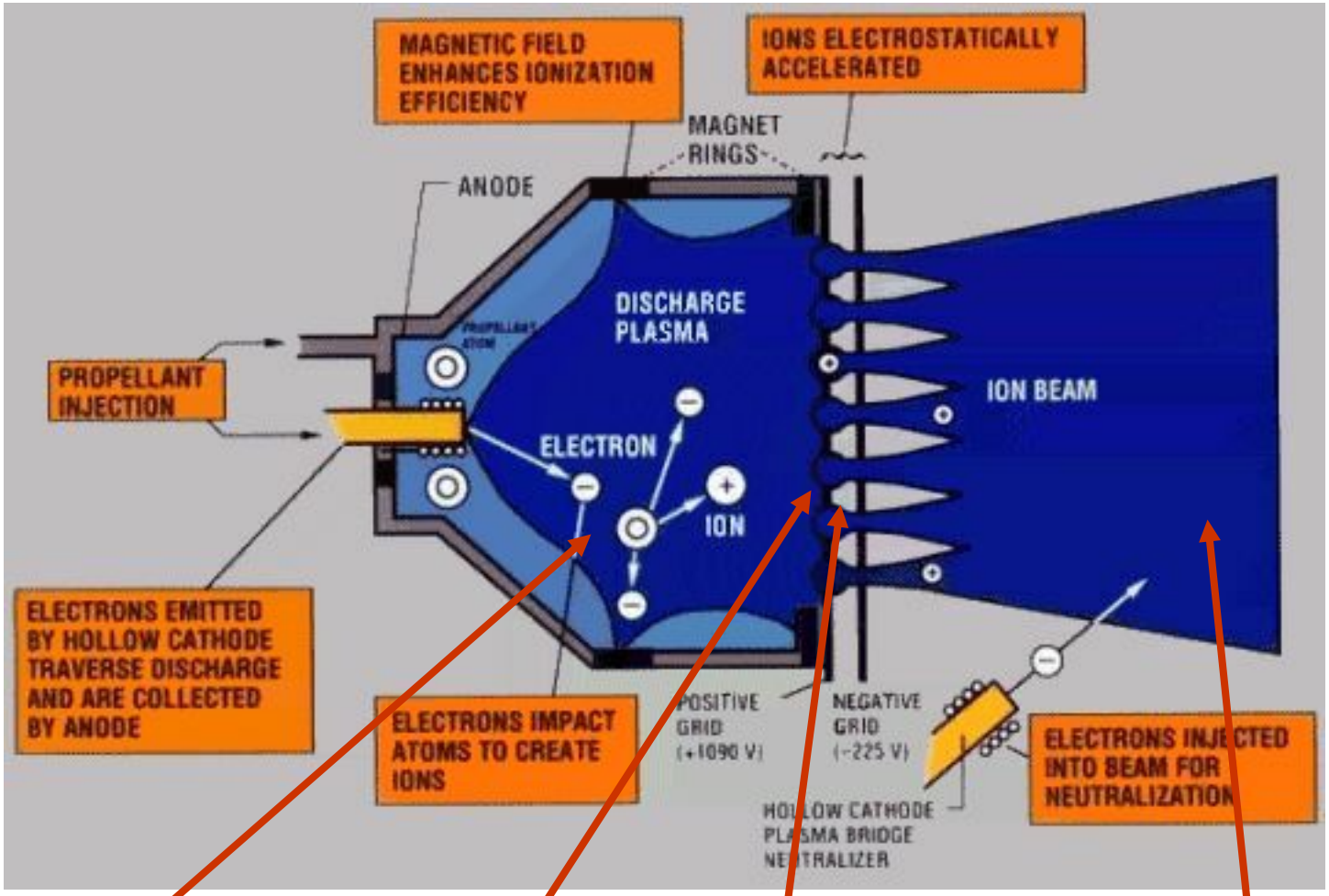
The Trip
of
One Xenon Atom Through an Ion Engine

Dawn

Simplified Graphic

As a Xenon atom moves through an Ion Engine…it is



1. Ionized *2. Attracted* *3. Accelerated* *4. Neutralized*

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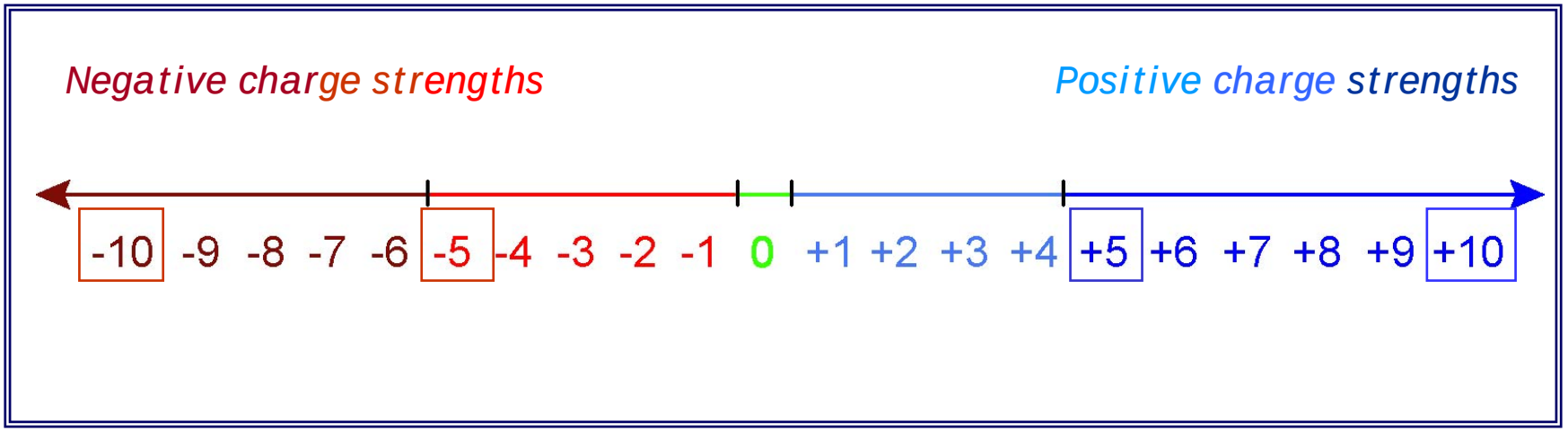
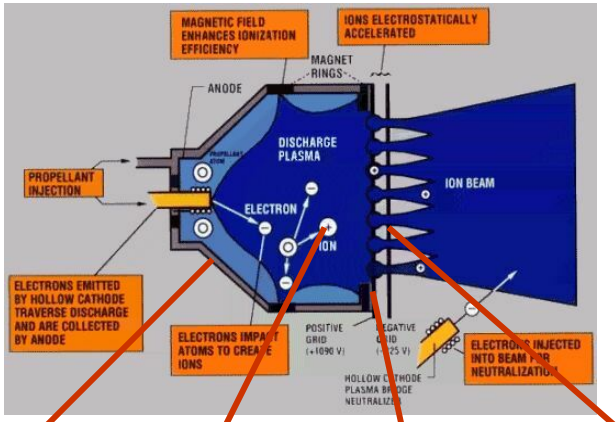
Why Xenon?

- *it is an inert gas*
- *it has a low first ionization energy*
- *its charge-to-mass ratio can provide exhaust speeds of approximately 10^6 km/h*
- *it is not radioactive*

Relative Charge Number Line



Relative Charges in Ion Engine



Engine walls < Xenon ion plasma < First electrode grid < Second electrode grid

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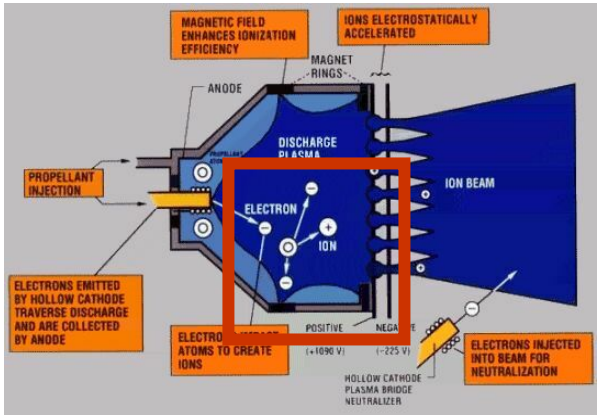
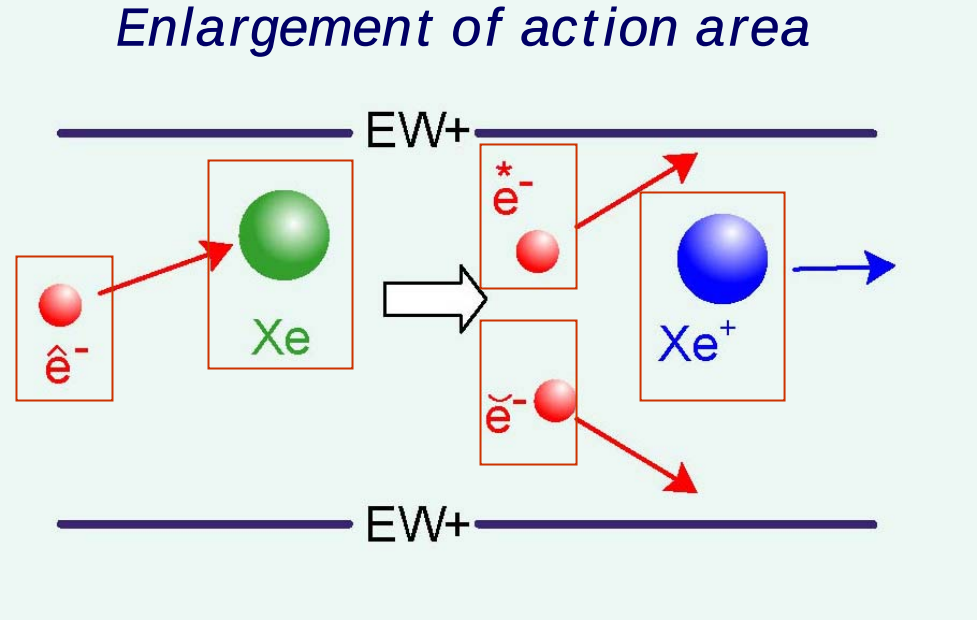
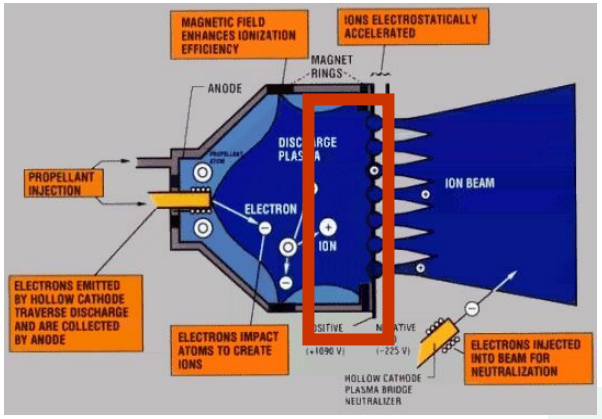
Ionization



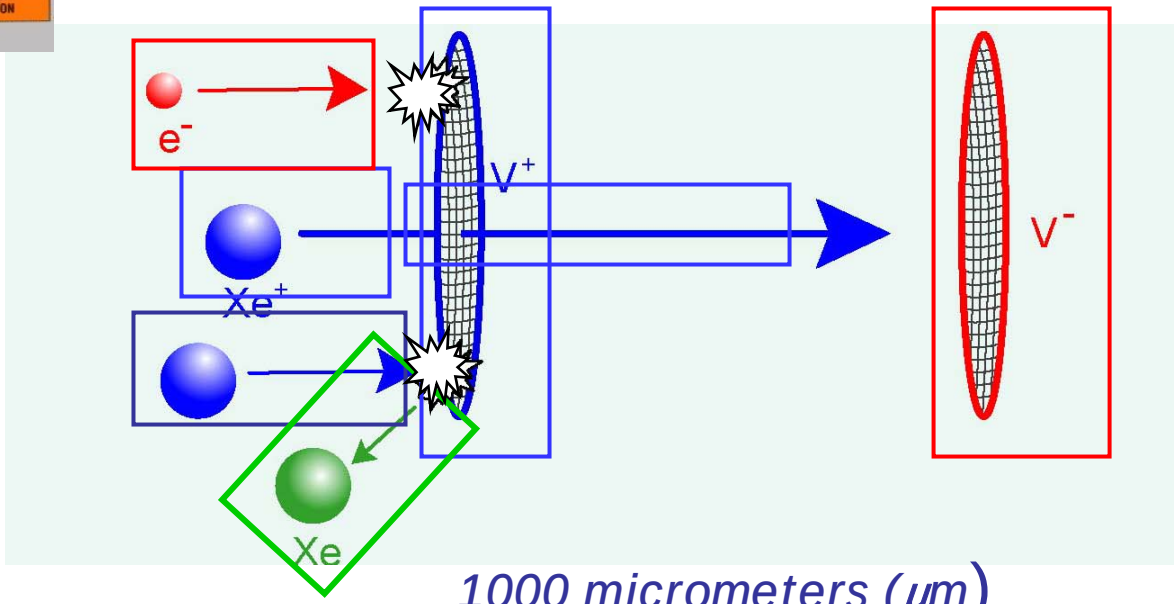


- *Electron collides with xenon atom*
- *Collision forms a xenon ion and two free electrons*

Attraction to Positive Grid



Enlargement of action area



1000 micrometers (μm)

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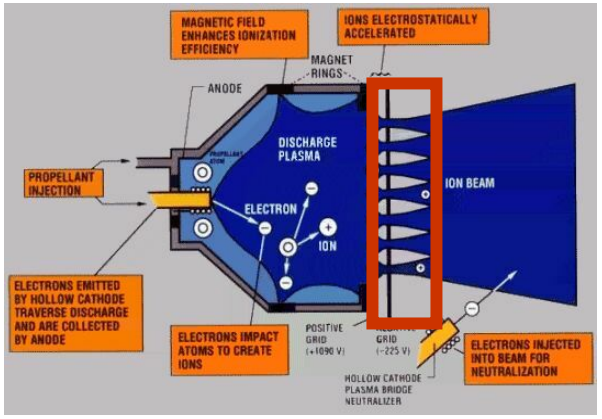
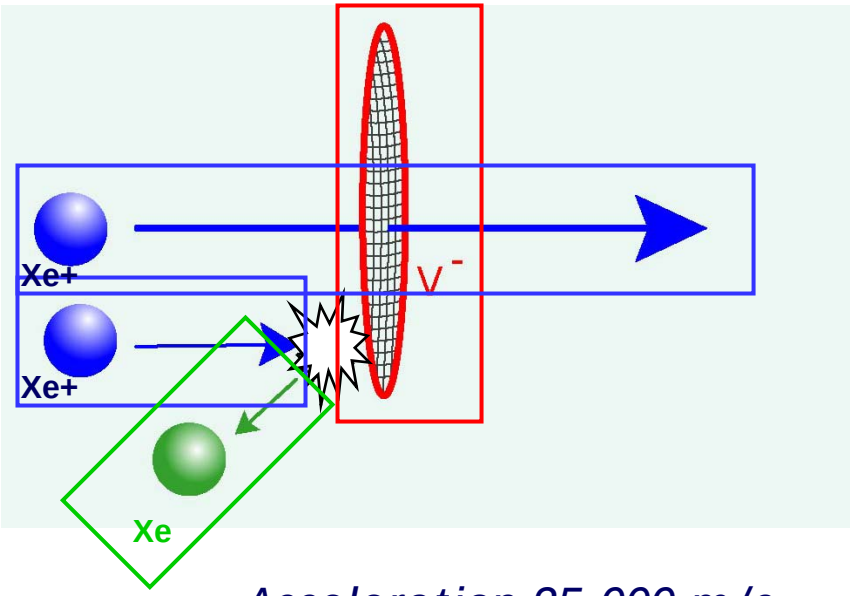
Acceleration



Enlargement of action area



Acceleration 35,000 m/s →

←1/50th of a pound thrust

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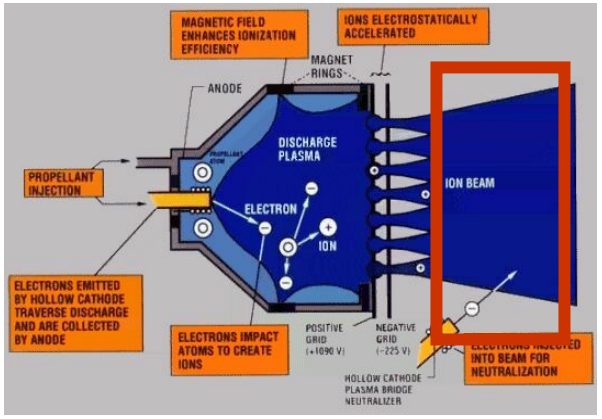
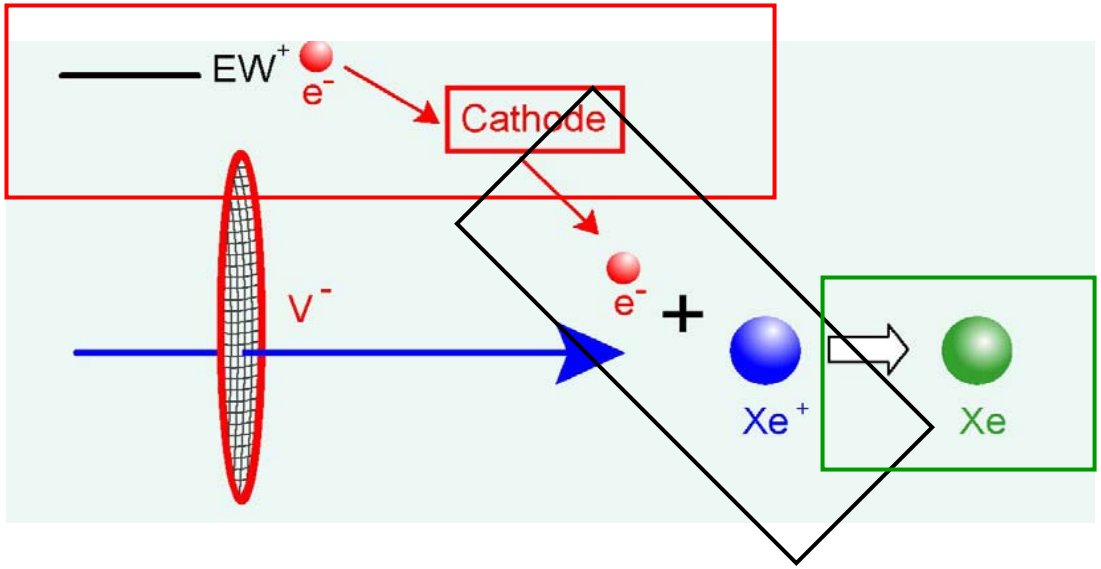
Neutralization



Enlargement of action area



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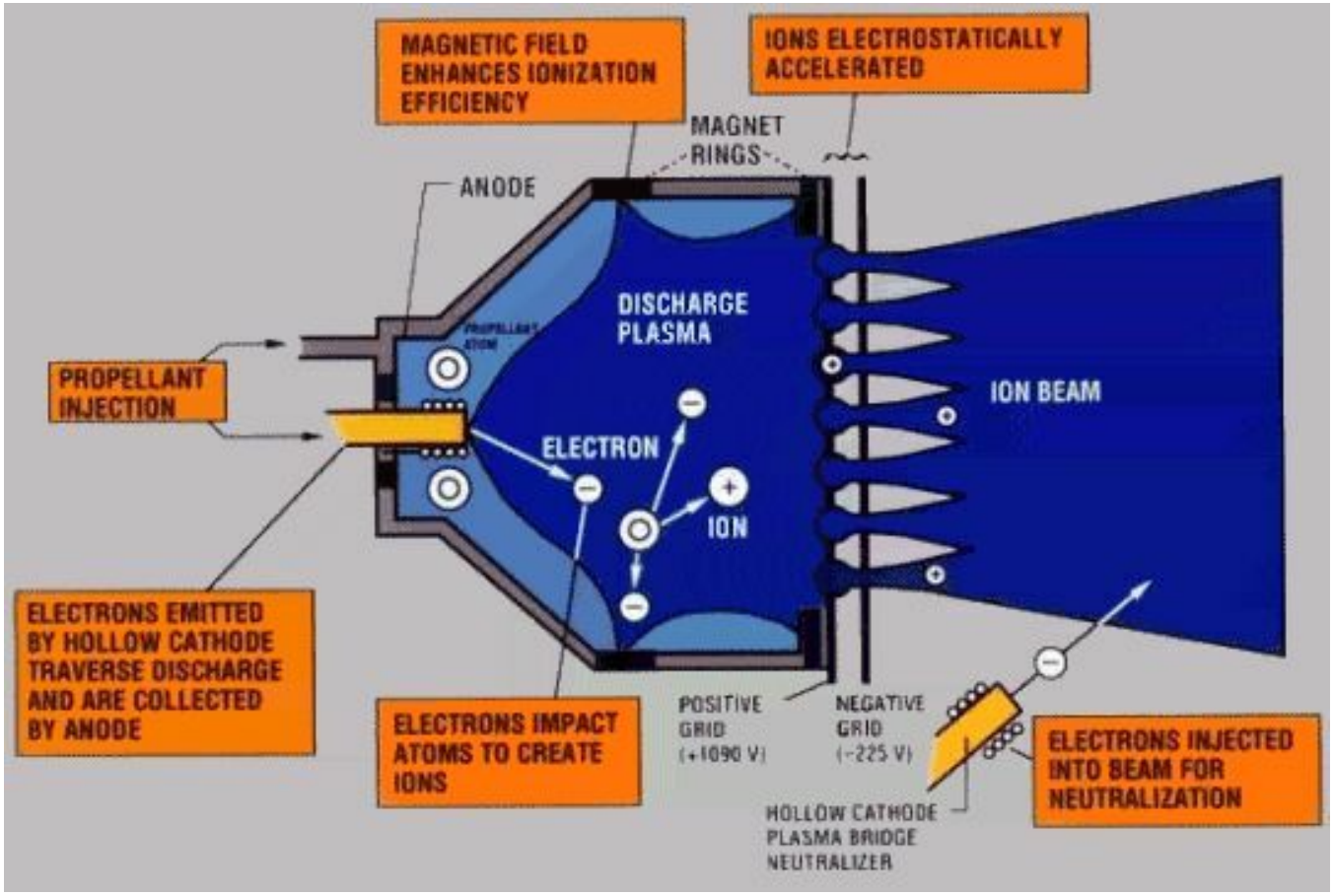
Xenon Ions Provide Thrust



$$\leftarrow m_e v_e = m_i v_i \rightarrow$$

750-kg Dawn spacecraft $\Delta v = 10^{-5}$ *m/s*

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