High Velocity Penetrating Weapon Program Overview

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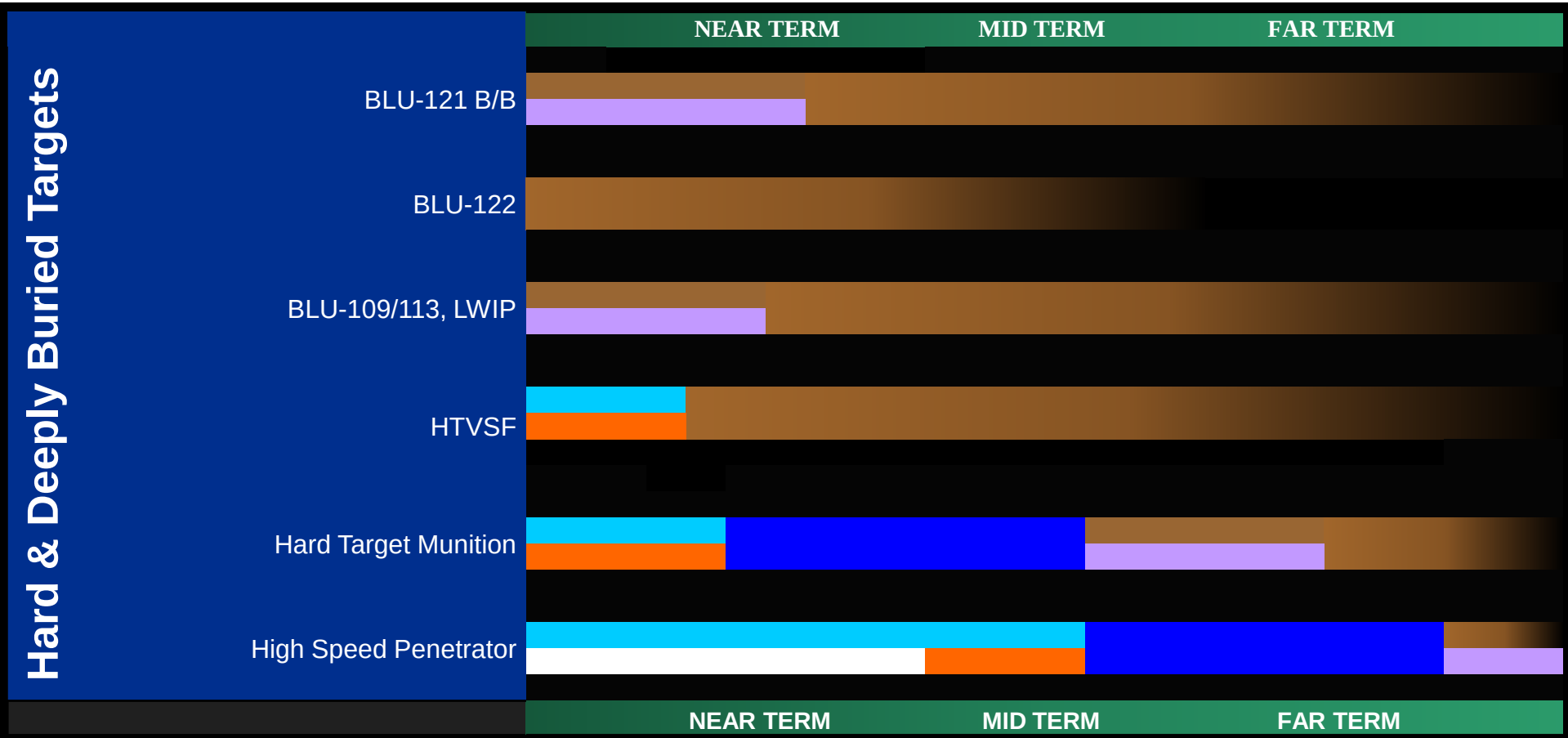
HDBT Weapons Roadmap

(Notional)



CP DP S&T Acq Program
Future Acq Program O&S Production

High Velocity Penetrating Weapon (HVPW)

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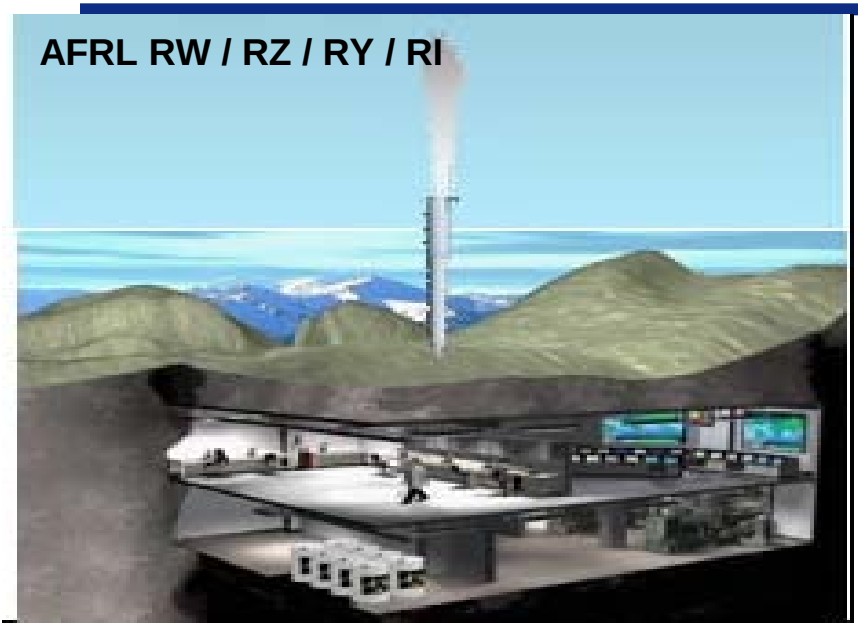

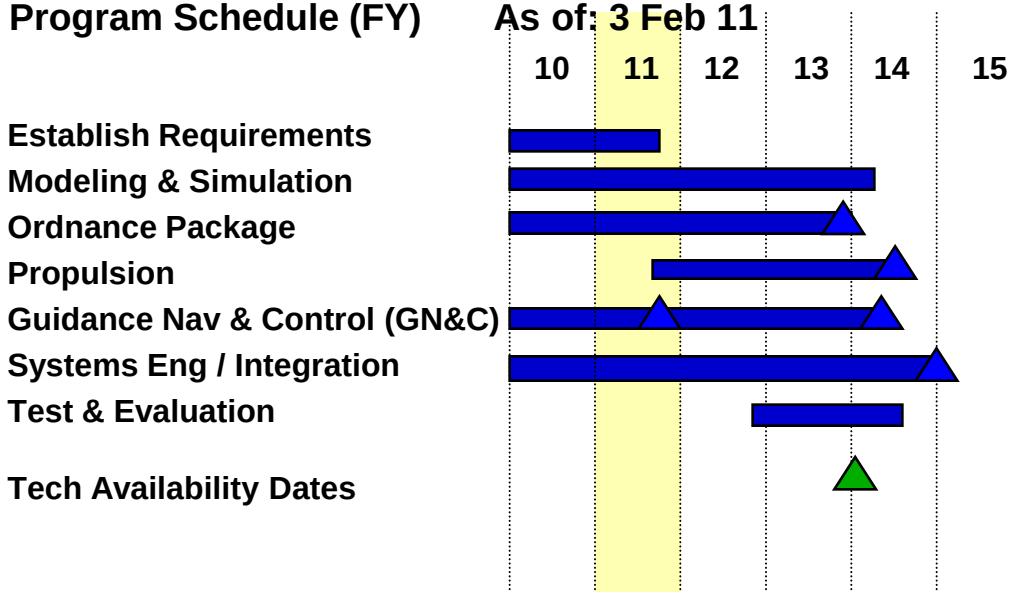

Description

Provides improved penetration capability of hard, deep targets with boosted impact

Technology

- Survivable ordnance package
- GN&C (precision navigation, terminal flight control)
- Propulsion (performance, GN&C interactions, IM)

Benefits to the War Fighter

- Defeats emerging hard targets
- 2000 lb weapon
- Internal carriage on F-35
- Increased loadout for other bomber/fighters

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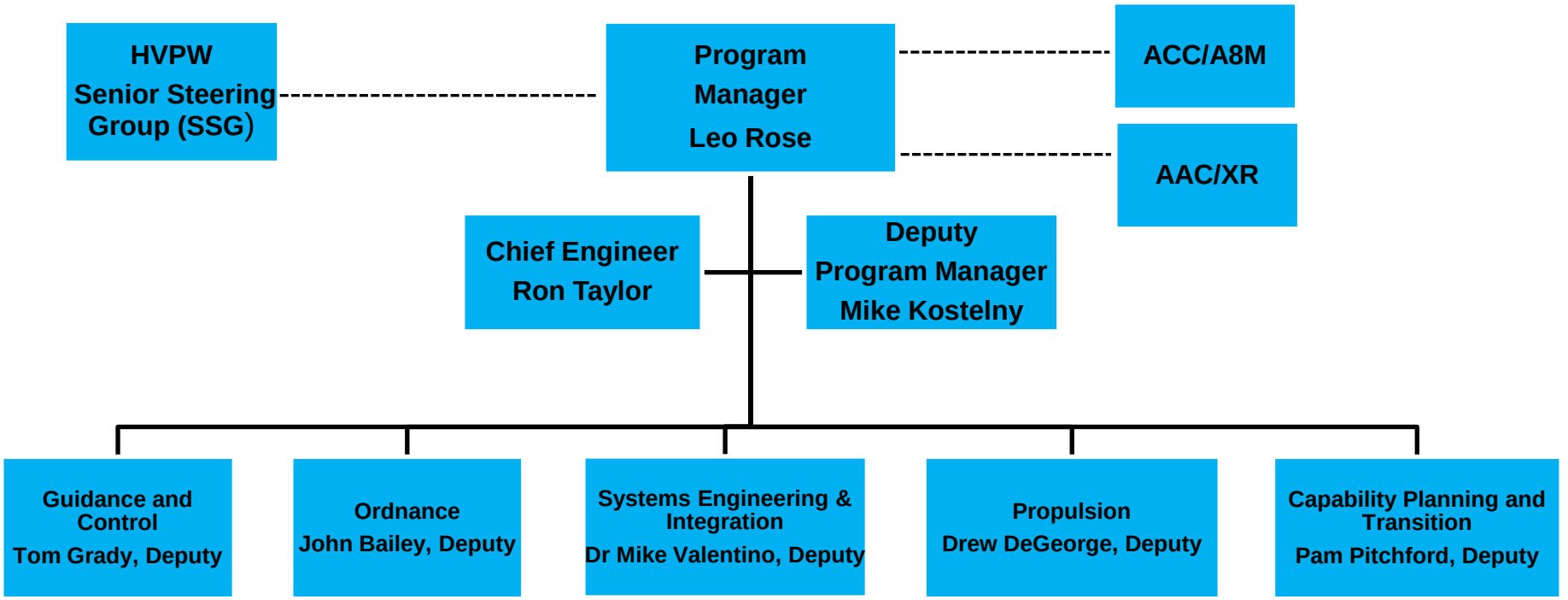
High Velocity Penetrating Weapon Team



High Velocity Penetrating Weapon
Sys Engineering & Flight Vehicle Integration

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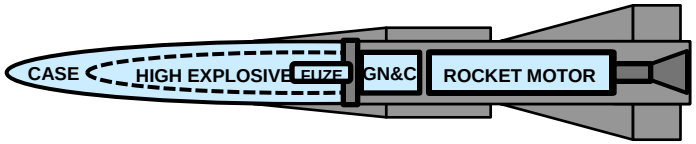
Systems Engineering & Flight Vehicle Integration



- **Flight Vehicle Integration**
  - **Subsystem requirements, specs, models for subsystem trades, M&S**
  - **System trades of GN&C, warhead/fuze, and airframe/propulsion**
  - **Initial Technology Demonstration flight test vehicle concept development**
- **Aircraft Integration, Carriage & Release**
  - **F-35 internal carriage**
  - **Platform electrical and physical constraints**

Flight Vehicle Integration Major Technical Challenges

- **Focus on *integration* issues associated with terminal accuracy and vehicle orientation**
  - **Airframe / control surfaces**
  - **GN&C algorithms**
  - **Booster misalignment, shock & vibration**
- **Scope of effort varies dramatically depending on desired TRL**
  - **AFRL/RW effort will end at subcomponent demonstrations not integrated flight test**
  - **AAC/XR CCTDs will provide initial trade space**

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HVPM Integration with F-35

- **F-35 physical fit requirement**
  - **F-35 physical fit requirement will be validated to a “stay within volume”**
- **Bay Acoustics and Temperature Issues**
  - **Goal is to use standard design practices as those of current systems**
- **Bomb Rack, Launcher**
  - **Goal is to use current F-35 equipment (e.g. BRU-68)**
  - **1760 / 1553 Weapon-Store Interface/Data Bus**
  - **Some electrical and message content changes as typical with new weapons**
- **Ground Handling Equipment (e.g. loaders)**
  - **Goal is to design to current systems; minimize use of adaptors**

High Velocity Penetrating Weapon Ordnance Package

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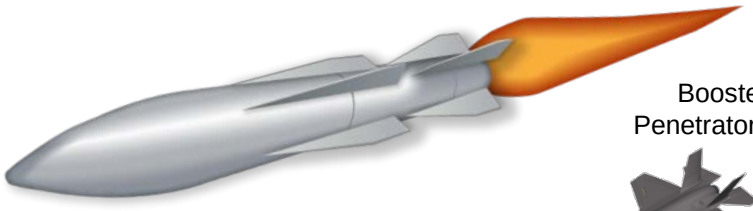
Conventional Survivable Ordnance Package (CSOP)

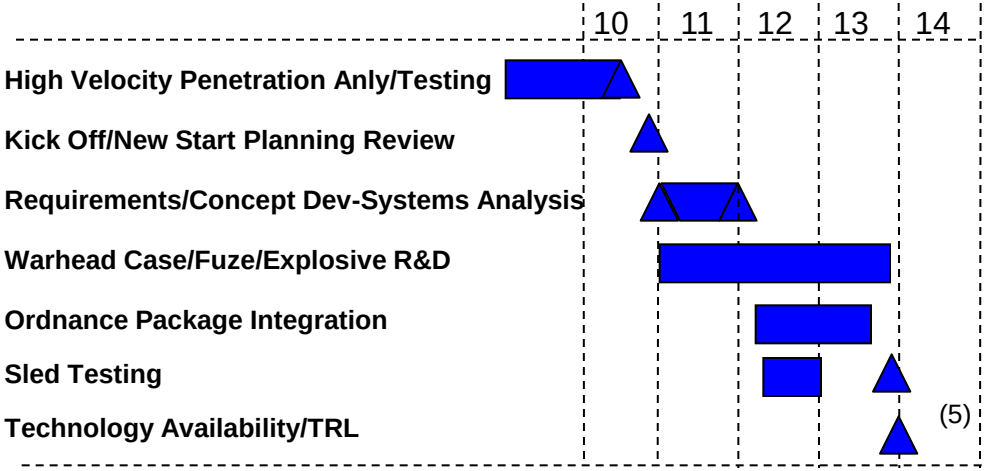


Boosted Penetrator/F-35

Survivable explosive payload

Miniaturized, survivable, intelligent fuzing

Technology Investment Schedule (FY)



Description	Benefits to the Warfighter
Warhead that survives and functions after a boosted impact into hard target	• **Penetrating weapon capability for F-35 in a 2000 lb class weapon** • **Increased reliability with innovative fuze design which allows for redundancy** • **Safer munitions through improved high explosive development**
Technology	
• **Survivable intelligent-fuze technology** • **Survivable energetic explosive** • **Survivable warhead case** • **Modeling & Simulation Tools – Penetration mechanics, lethality & material characterization** • **Leverage ongoing R&D**	

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Fuze Technology

- **Hardened Miniature Fuze Technology (HMFT) Post Impact Module**
  - **Successfully demonstrated survivability and post impact burst point system functionality**
  - **Very High G (VHG) and airgun shock test environments**

Laboratory-VHG Test

Laboratory-Airgun Test

- **Task added to existing HMFT Contract for FY11 HMFT Feasibility Study for CSOP**
  - **Conduct contractor laboratory testing**
  - **Mechanical design updates**
  - **Assess and document HMFT axial/lateral shock survivability in cannon tests**
- **HMFT Feasibility study & analysis**
  - **Requirements evaluation (signal, power, communications, arming)**
  - **Interfaces**
  - **Mechanical packaging & mounting**

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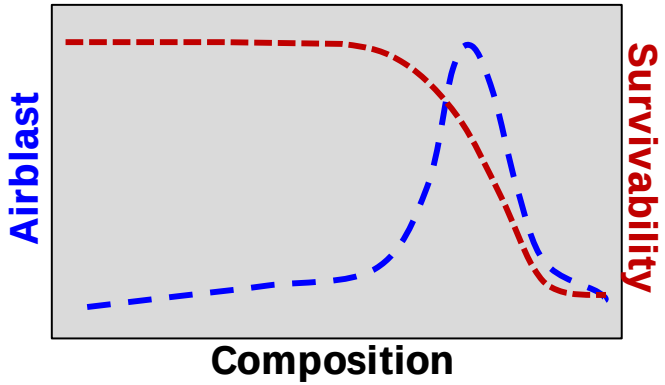
Explosive

New Development

Approach

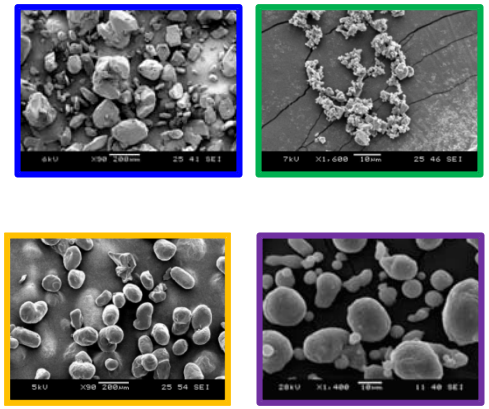
- Map out the formulation design space via systematic “Mixture Design” methodology
  - A type of statistical, “Design of Experiments”
- Quantify the tradeoff in design parameters
  - Airblast, sensitivity – survivability, & mechanical properties
- Apply residual knowledge
  - Validation data for theory and M&S
  - Reduce formulation time for future application requirements
  - Identify the range of possibilities for current ingredients

Hypothetical Trade-off in Properties



Progress

- Ingredients selected, all existing with MIL-SPEC’s
- Composition limit inputs found – 45 run matrix generated
  - Mixture viscosity was primary constraint
- Gathered extensive laboratory-scale safety test data



High Velocity Penetrating Weapon
Guidance Research S&T Plan

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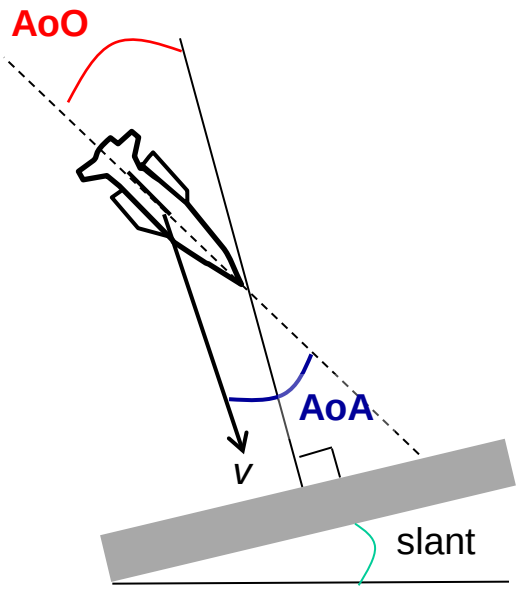
Control

- **Boosting with a rocket adds some issues:**
  - **Motor/thrust misalignment**
  - **Control authority, especially with oblique trajectories (*e.g.* slant targets)**
  - **Vibration / acceleration effects**
- **HVPW could have significant problems during boost**
  - **Angle of Obliquity (AoO) – could be unknown**
  - **Angle of Attack (AoA) – interacts with AoO**
- **Must control closely to ensure:**
  - **Maximum penetration**
  - **Fuze survives impact**



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Risk Assessment

Largest risk / least maturity in following component areas:

- **CEP control**
- **Angle of Attack (AoA) sensing & control**
- **Trajectory shaping for optimized rocket firing**
- **Rocket integrated control**

Philosophy: methodical modeling and tool-up to:

1. **Show maturity of guidance subsystem**
2. **Prepare for more than one MS-A contractor conceptual design**

High Velocity Penetrating Weapon Propulsion

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HVPW Propulsion

- HVPW derived operational systems will require a new rocket motor
- HVPW propulsion potential design/technology challenges include
  - Thrust alignment/alignment control
  - Energy management
  - Tight propellant burn rate specification
  - Increased performance
  - Wrap-around motor
  - Service life through extreme environments

Questions

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