Sprinklers and Vents

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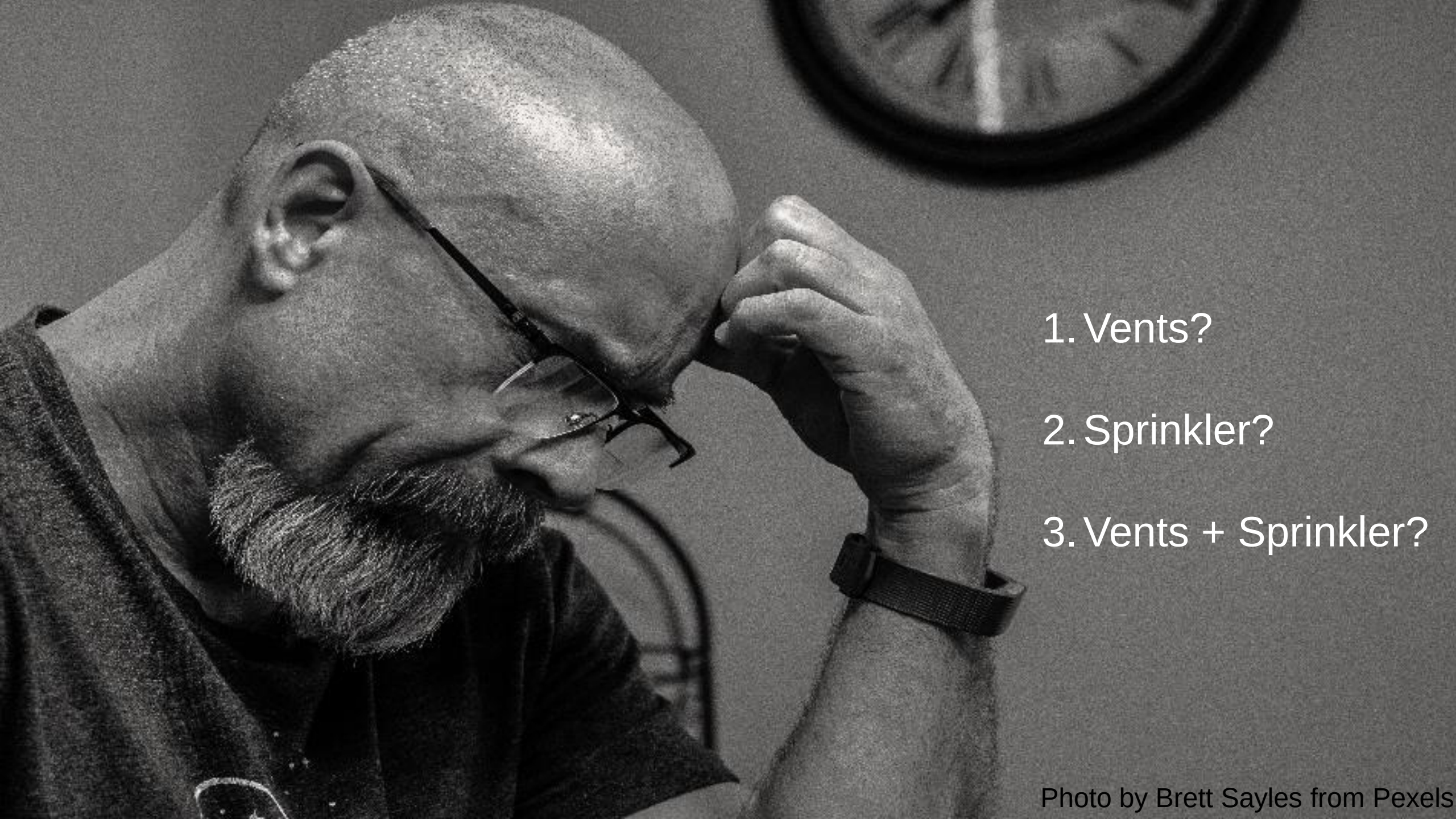
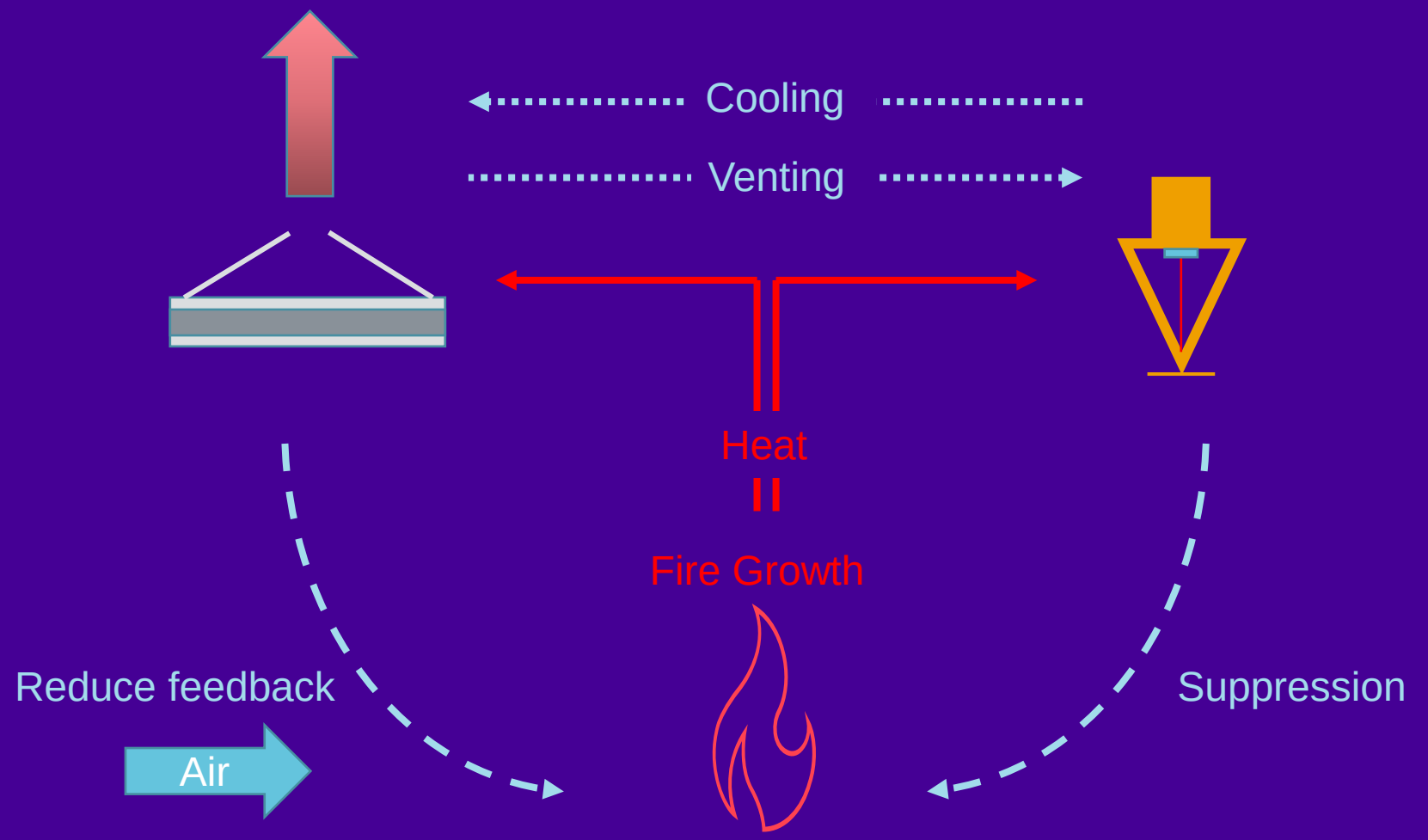


1. Vents?
2. Sprinkler?
3. Vents + Sprinkler?

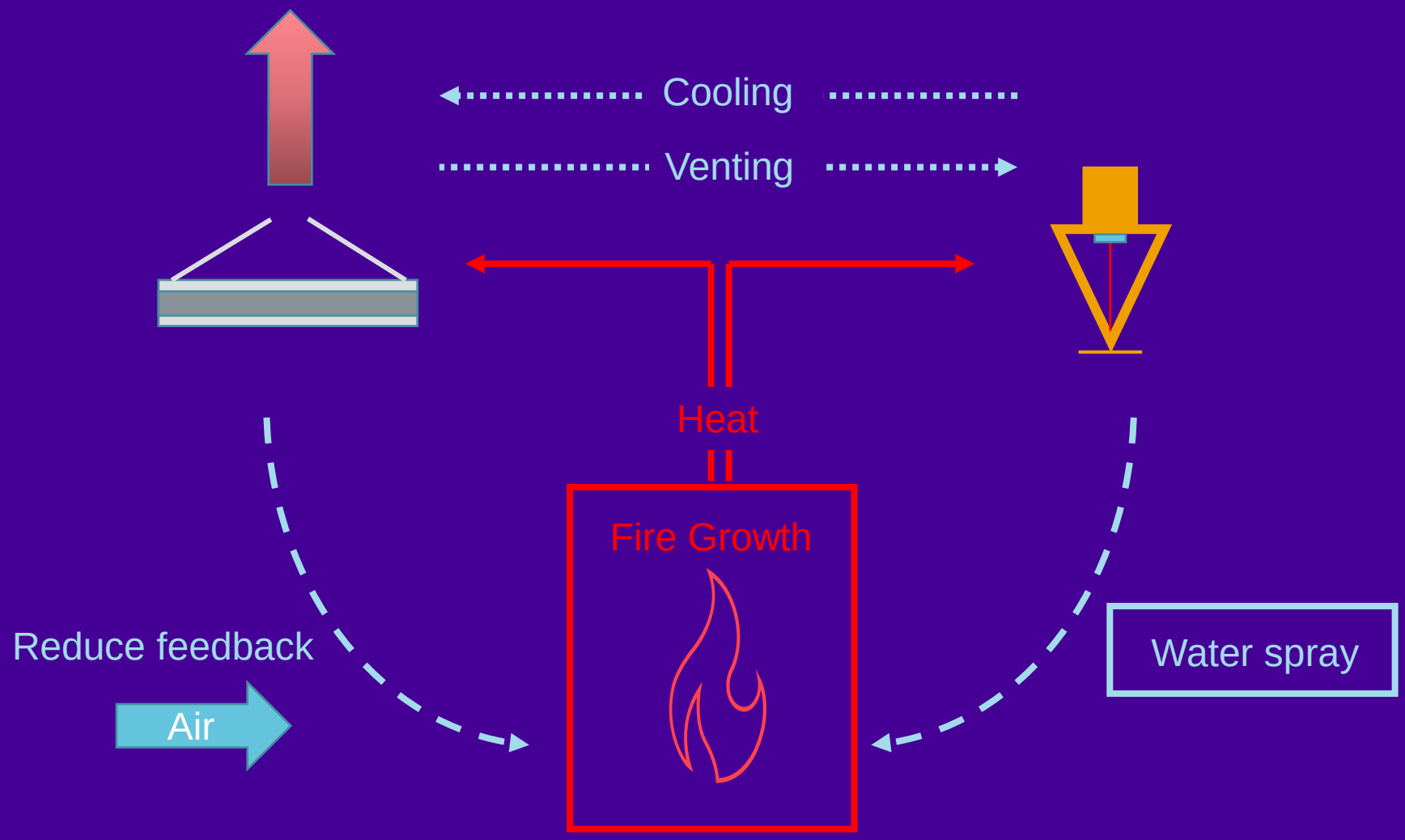
Photo by Brett Sayles from Pexels

A complex interaction



Background – differing conclusions

Observing an item or the whole interaction



A complete picture?

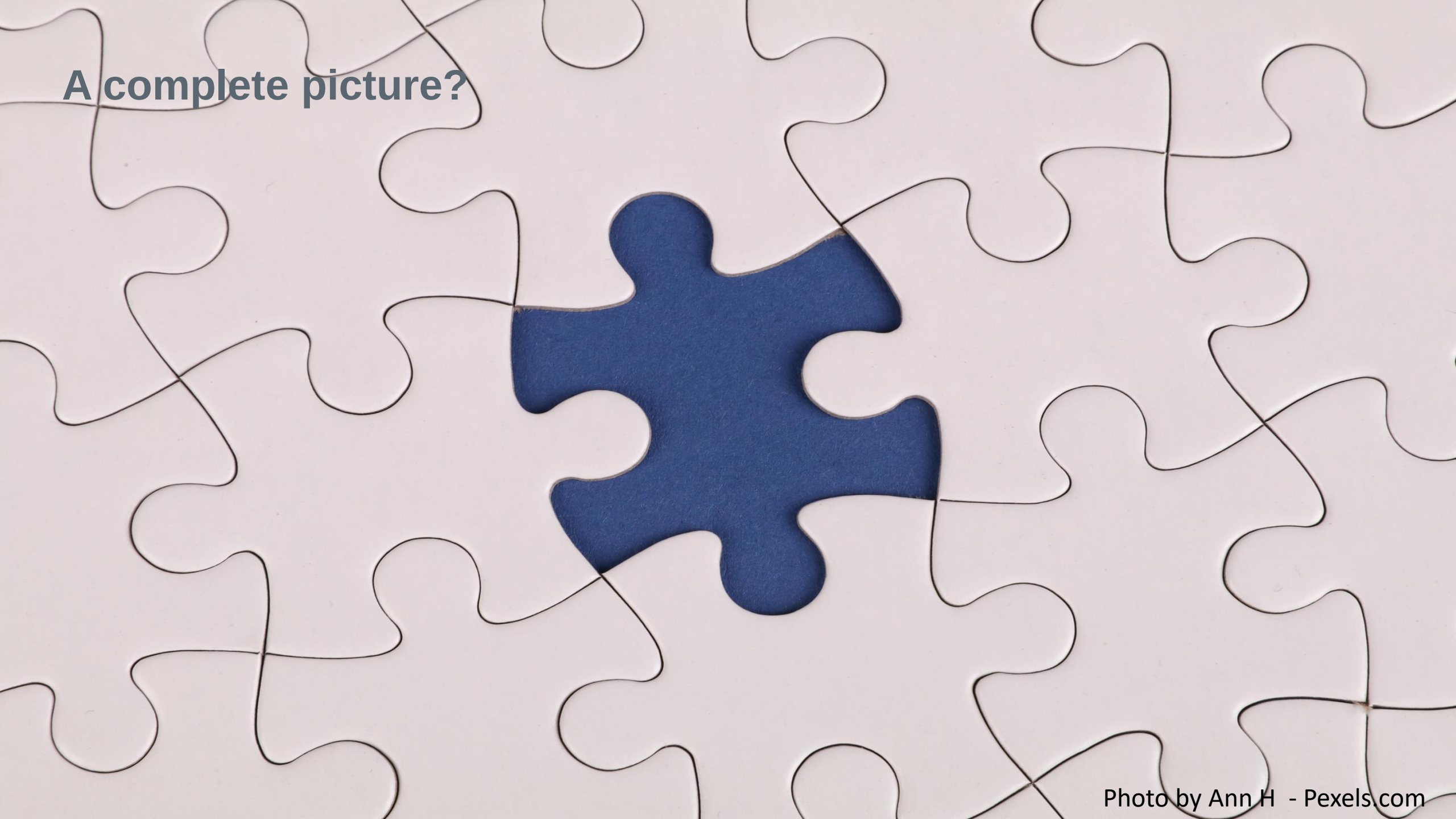
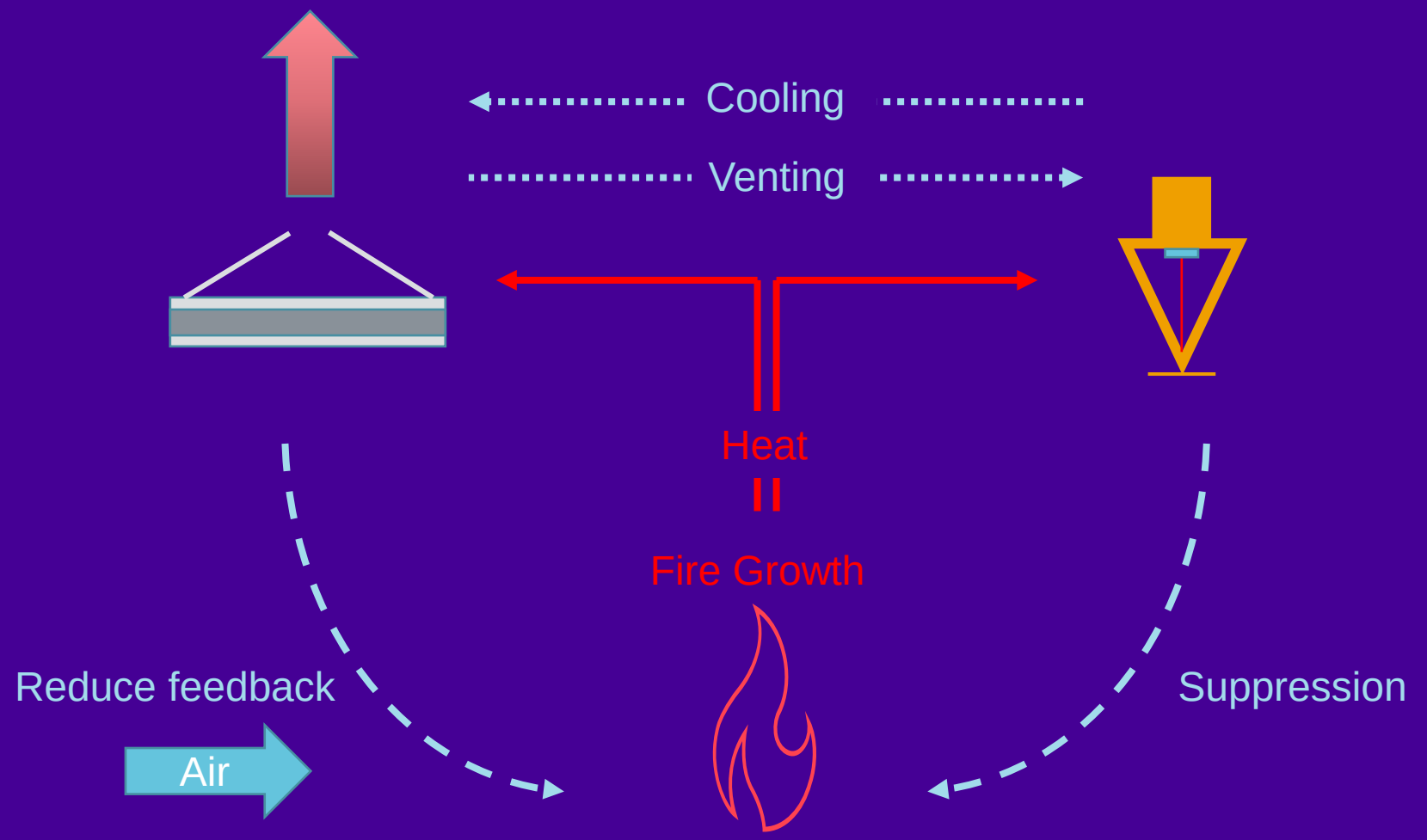


Photo by Ann H - Pexels.com

Test and observe the whole interaction



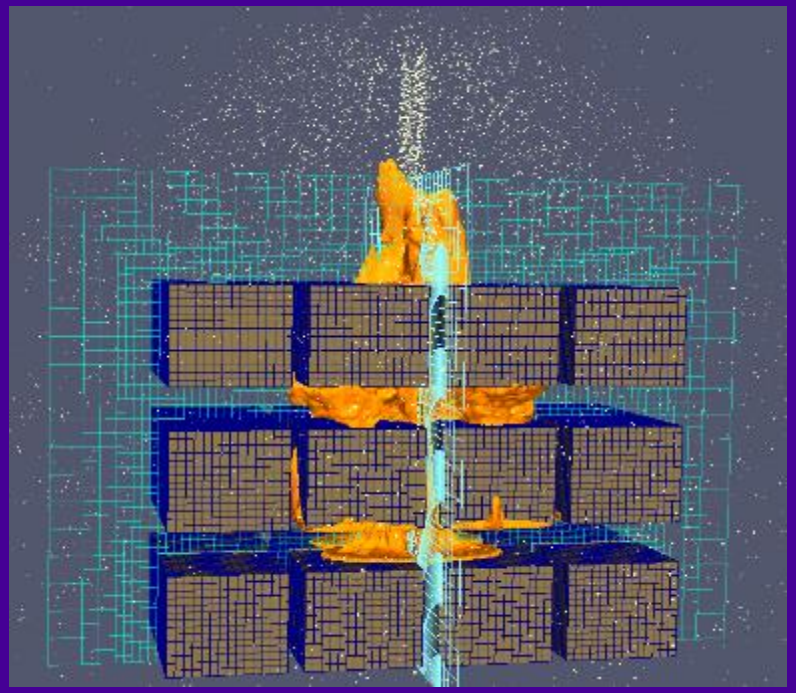
CFD Based Modelling

FireFOAM

- OpenFOAM toolbox
  - Imperial College
- Open source (*fmglobal.com/modeling*)
- Promote cooperation with academia and industry

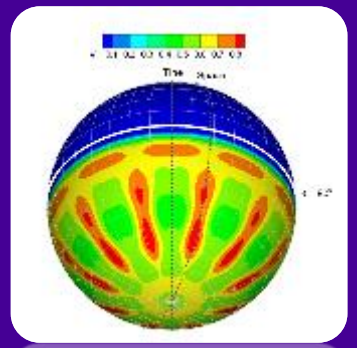
Technique

- All equations solved on grids in multiple time steps
  - Mass, Momentum, Energy, Chemistry, Soot
- Multiple Grid Transport
  - Solid, liquid, gas phase, spray droplets



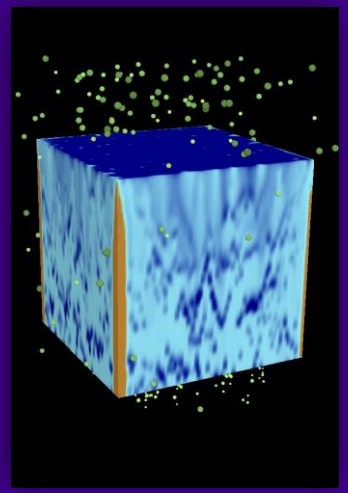
Suppression Model

Sprinkler Atomization



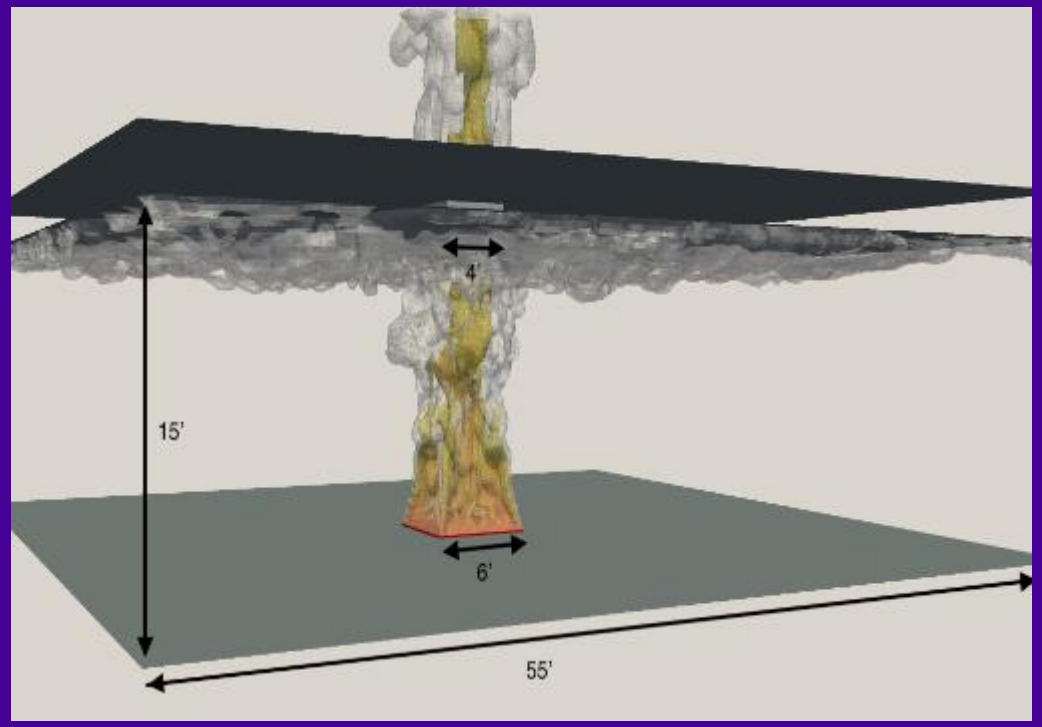
Spray-Plume Interaction

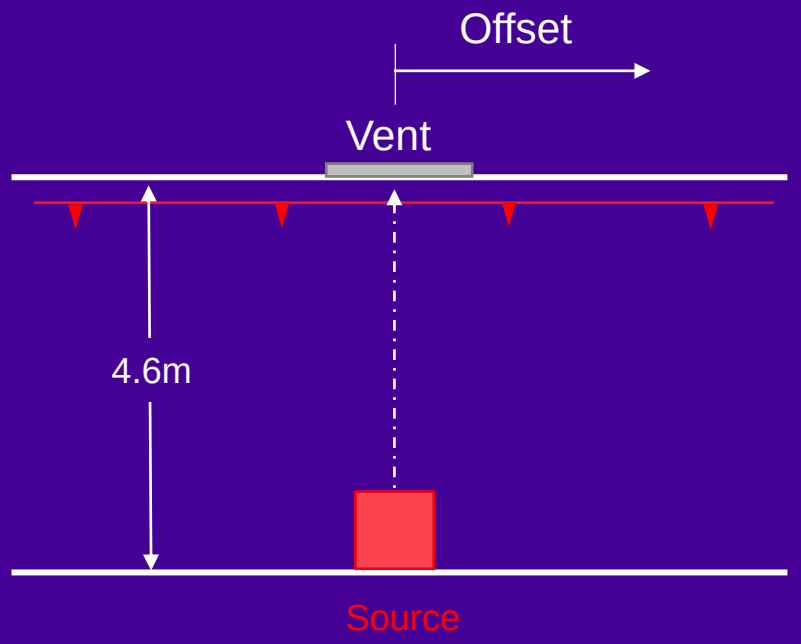
Surface-Film Flow



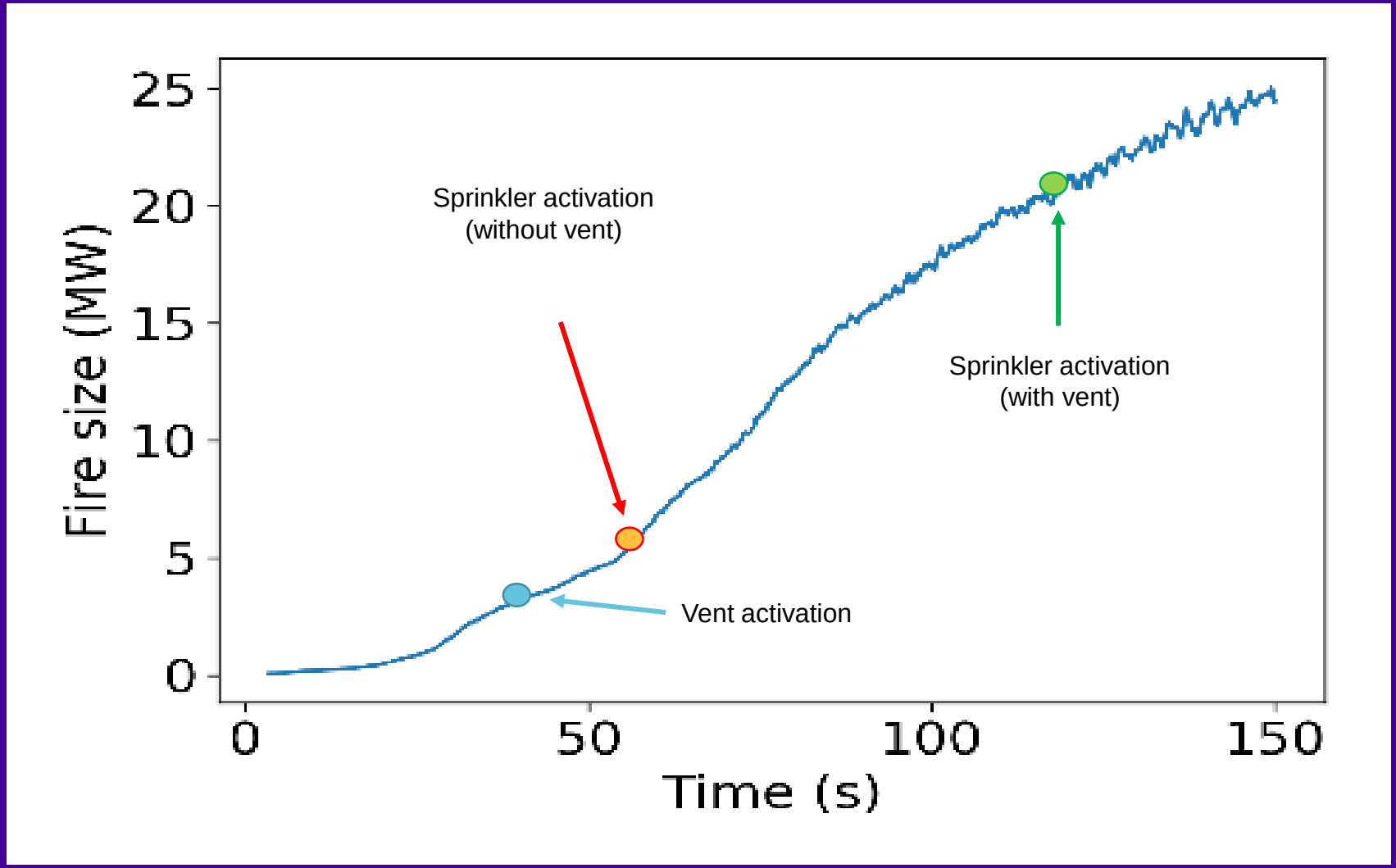
Rack Storage Suppression

Design fire modelling





Design fire modelling analysis



Vent location sensitivity

Vent offset (ft)	Vent activation (s)	Sprinkler activation (s)	Fire size at sprinkler activation (MW)
No Vent	--	61	7.5
0	39	120	21
5	42	65	8.2
10	86	61	7.5

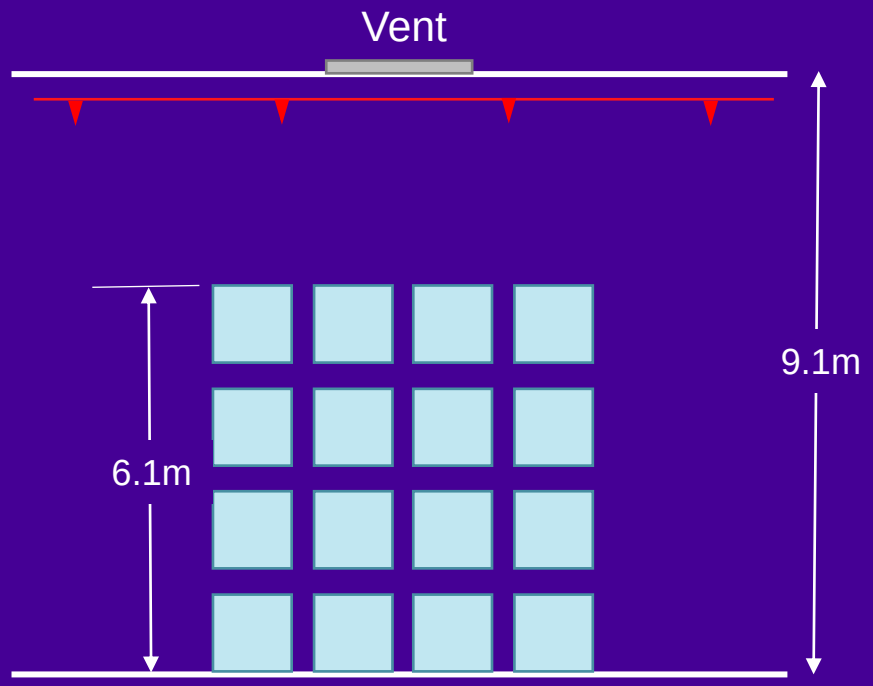
Design fire modelling

1. Vent location – sprinkler operation time and fire size

2. Vent thermal link setting - insensitive

3. Vent location – offset to ignition – impact smoke and heat removal

Commodity fire modelling

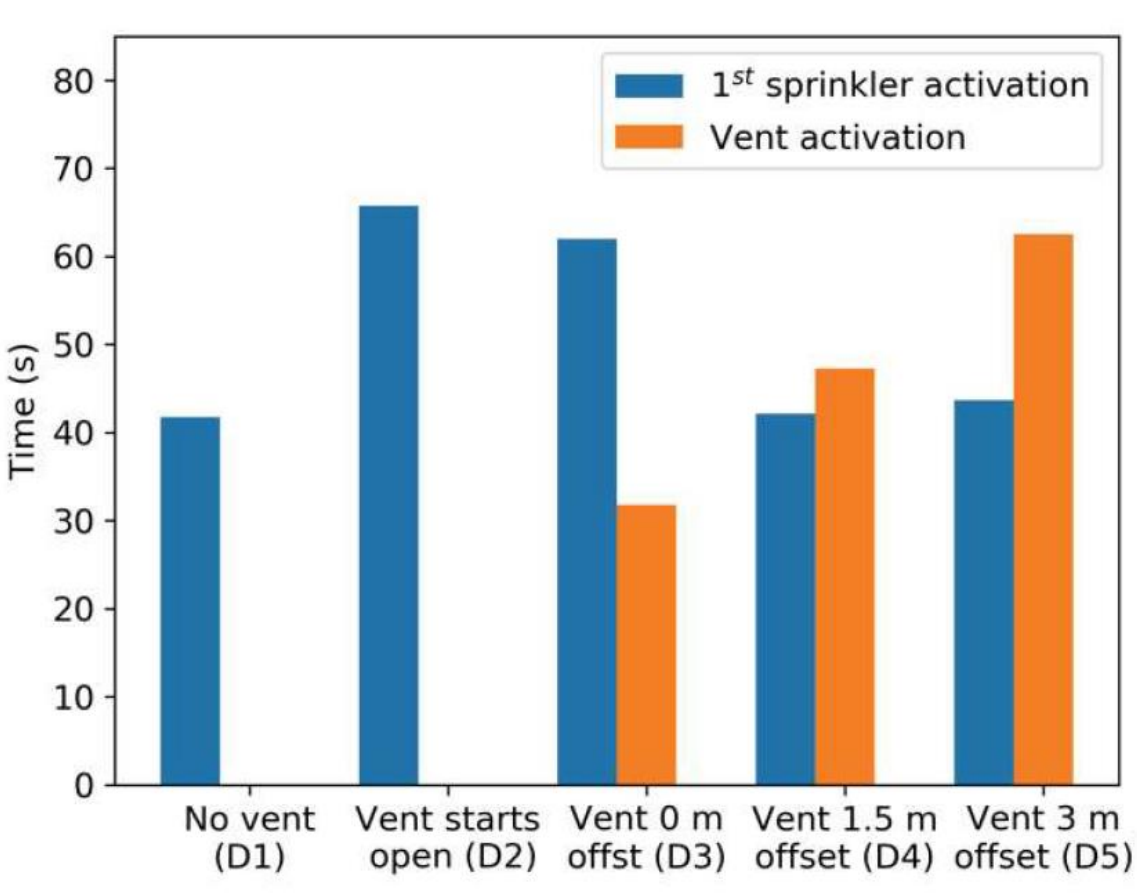


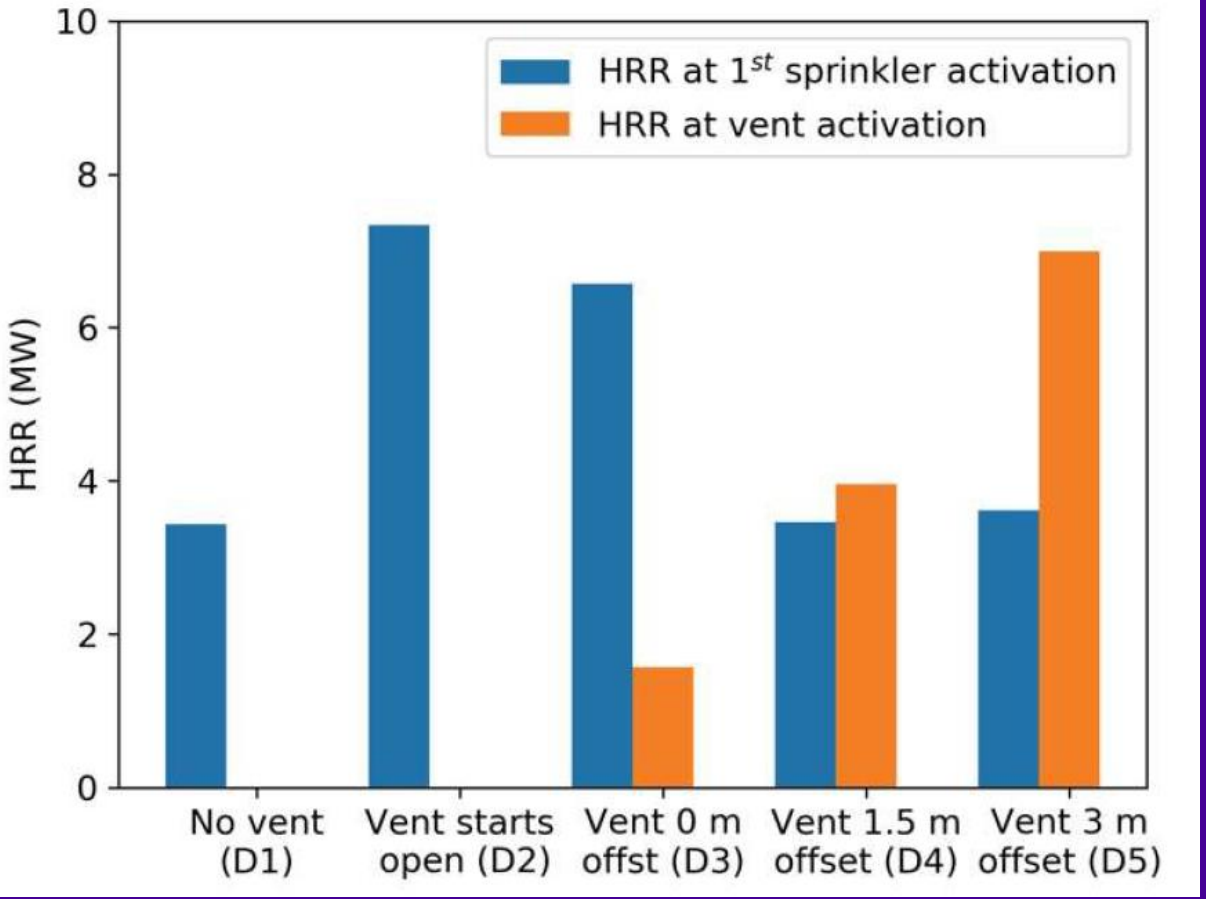
Commodity fire modelling

- Ignition among 4 sprinklers
- K 160, 1.1 barg (18 mm/min)
- Ignition under vent (worst case)
- Vent link: RTI=80 Tact=414K
- Sprinkler link: RTI=28 Tact=347K

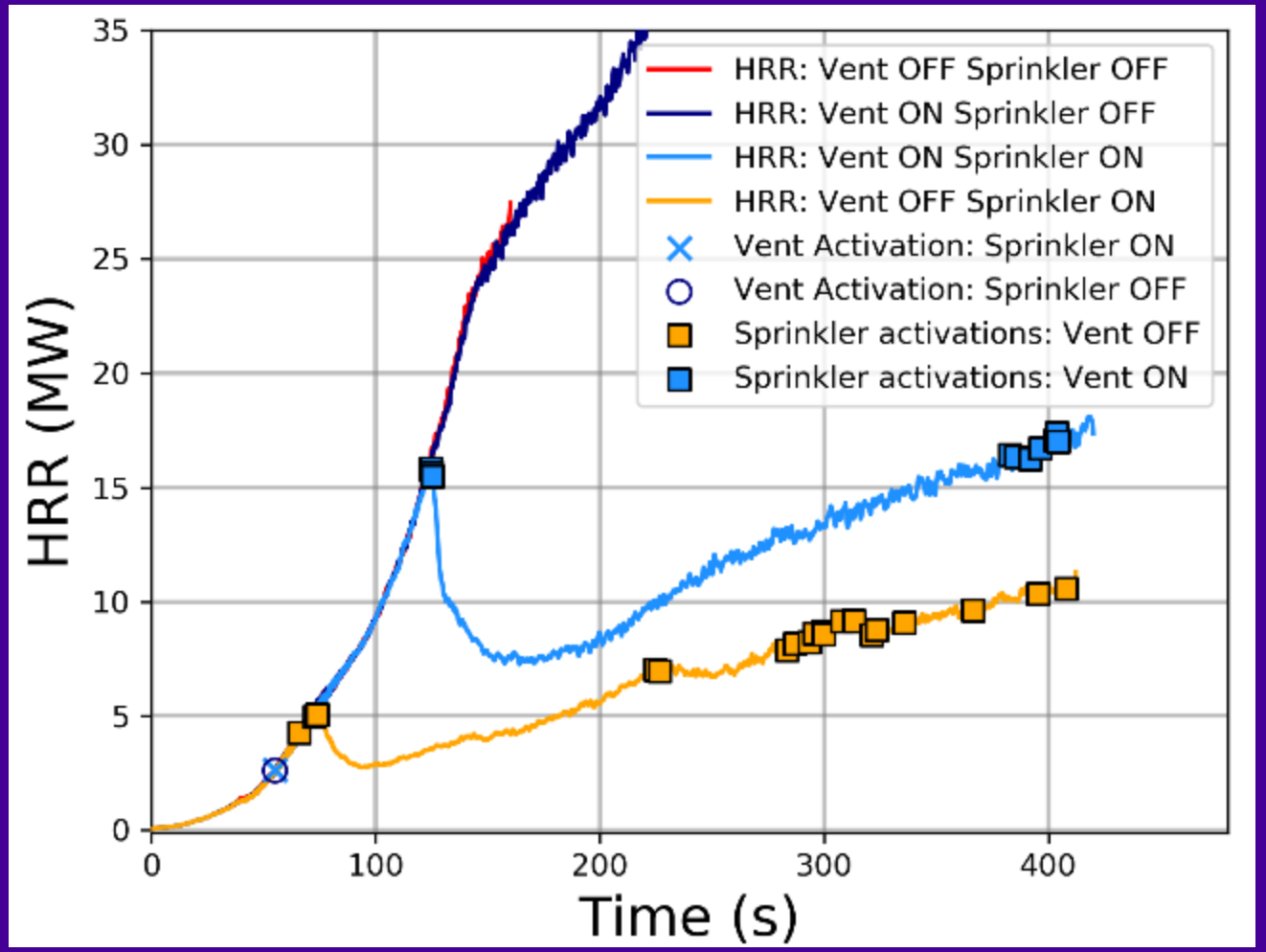
SHEV	Sprinkler	Notes
OFF	OFF	Free-burn
ON	OFF	Free-burn with vent
OFF	ON	Suppression, no vent
ON	ON	Suppression with vent
ON	ON	QR sprinkler in-vent as per FM-2.0

Observations





Observed outcome – sprinkler + vent



Commodity fire modelling

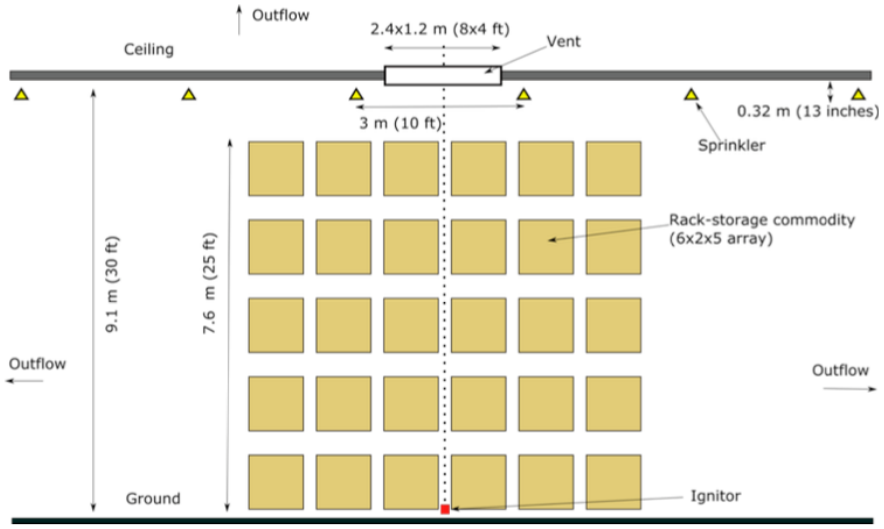
1. Sprinkler reduce fire size

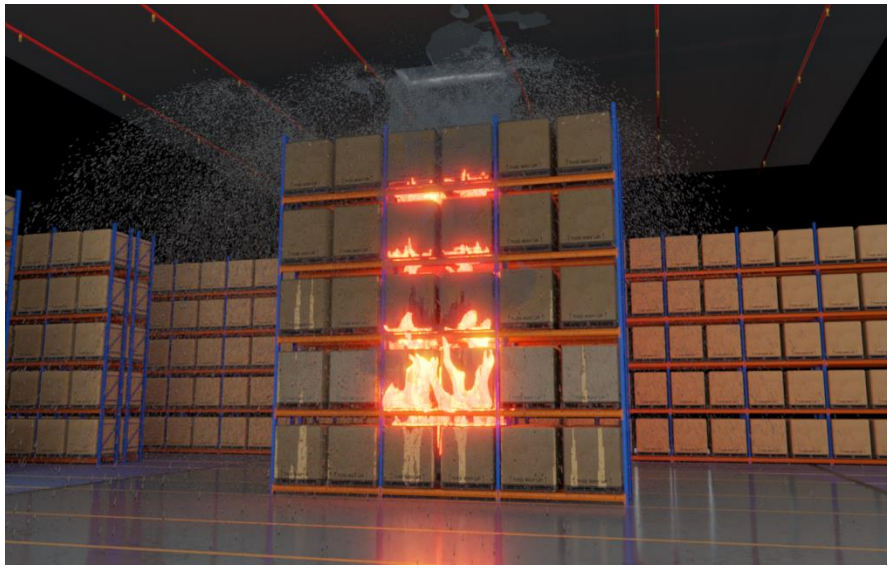
2. Vent does not stop fire growth.

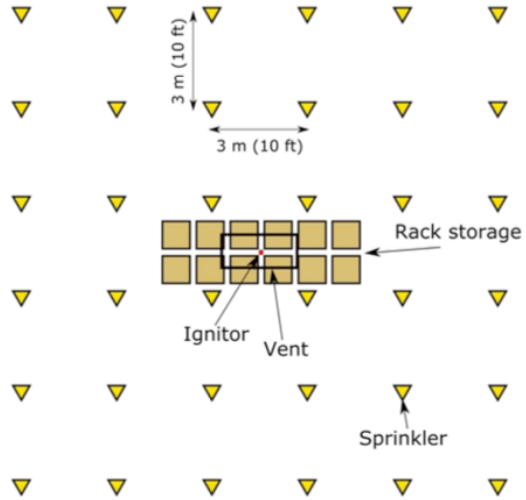
3. Sprinkler and vent location
   - delayed operation and increased fire size.
   - sprinkler still impact fire size.

4. Sprinkler directly under vent effective with fire under vent scenario.

New modelling







Full scale testing needed!

- Location, location, location
- Vents do not stop fire growth
- Vented - increased fire size possible – suppression still achieved?
- Vents – impact normally open and size?

Thank you. Any questions?

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