# On the production of energy and helium in low energy nuclear reactions

John C. Fisher

Carpinteria, CA

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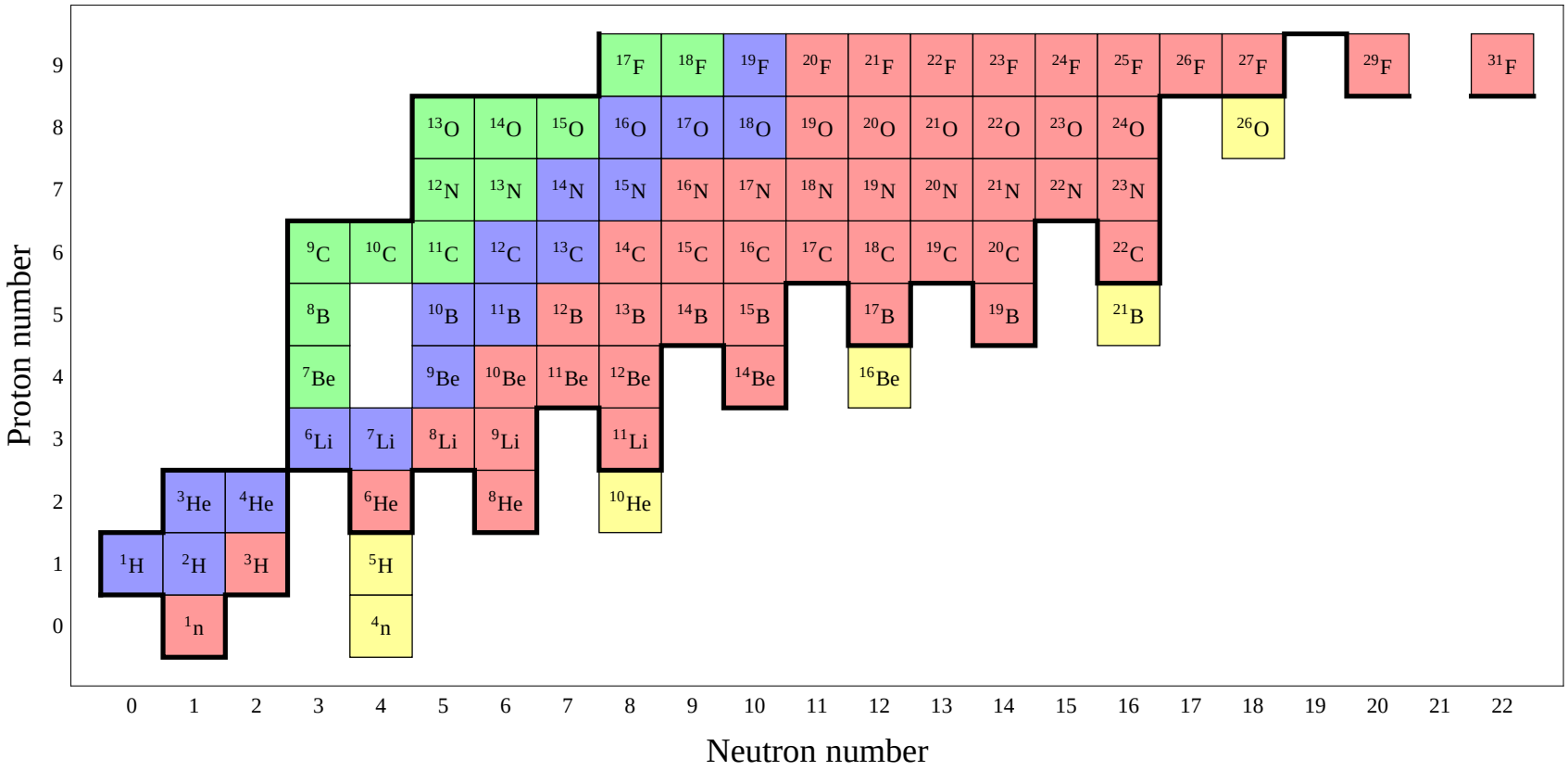
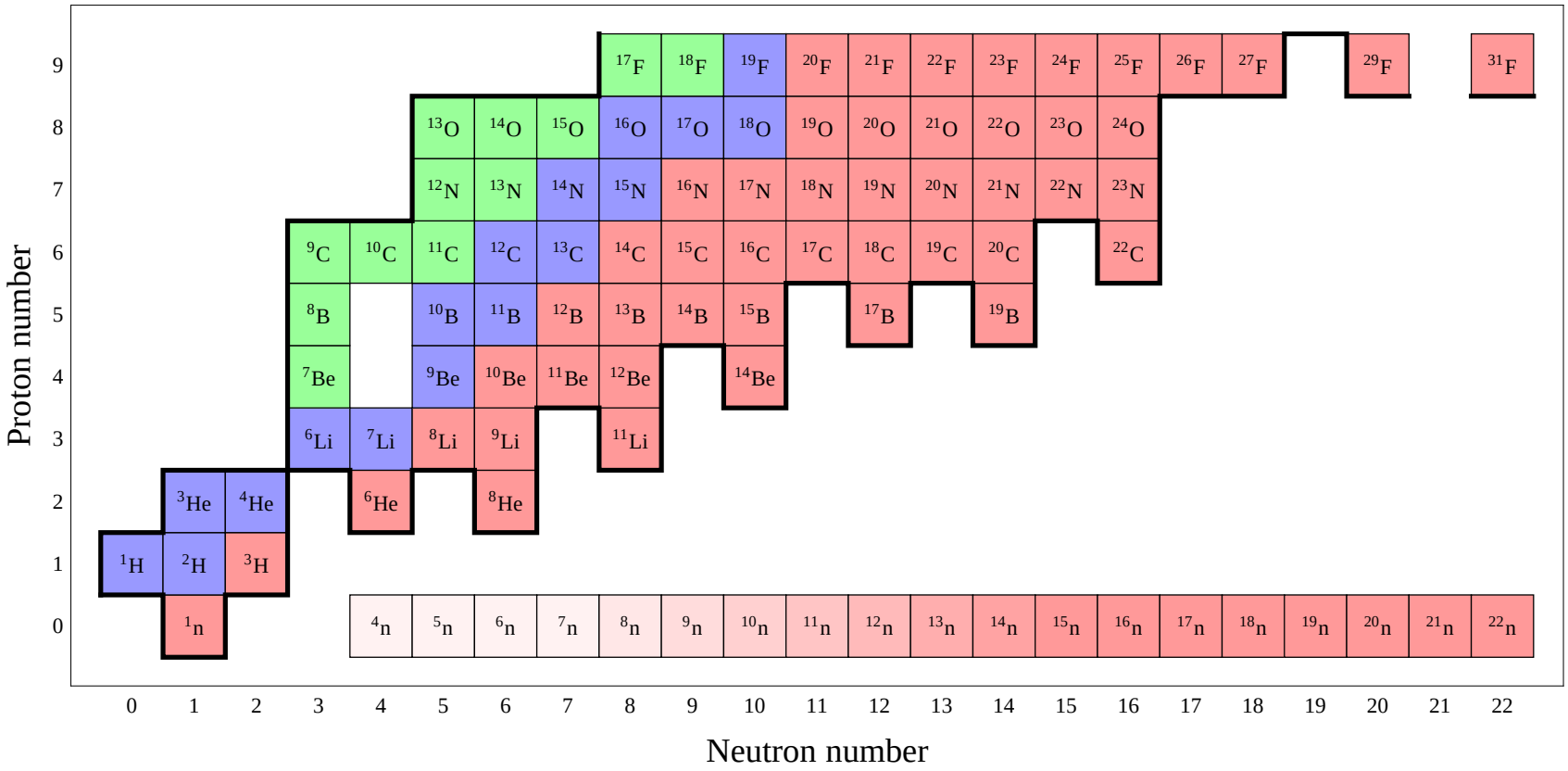
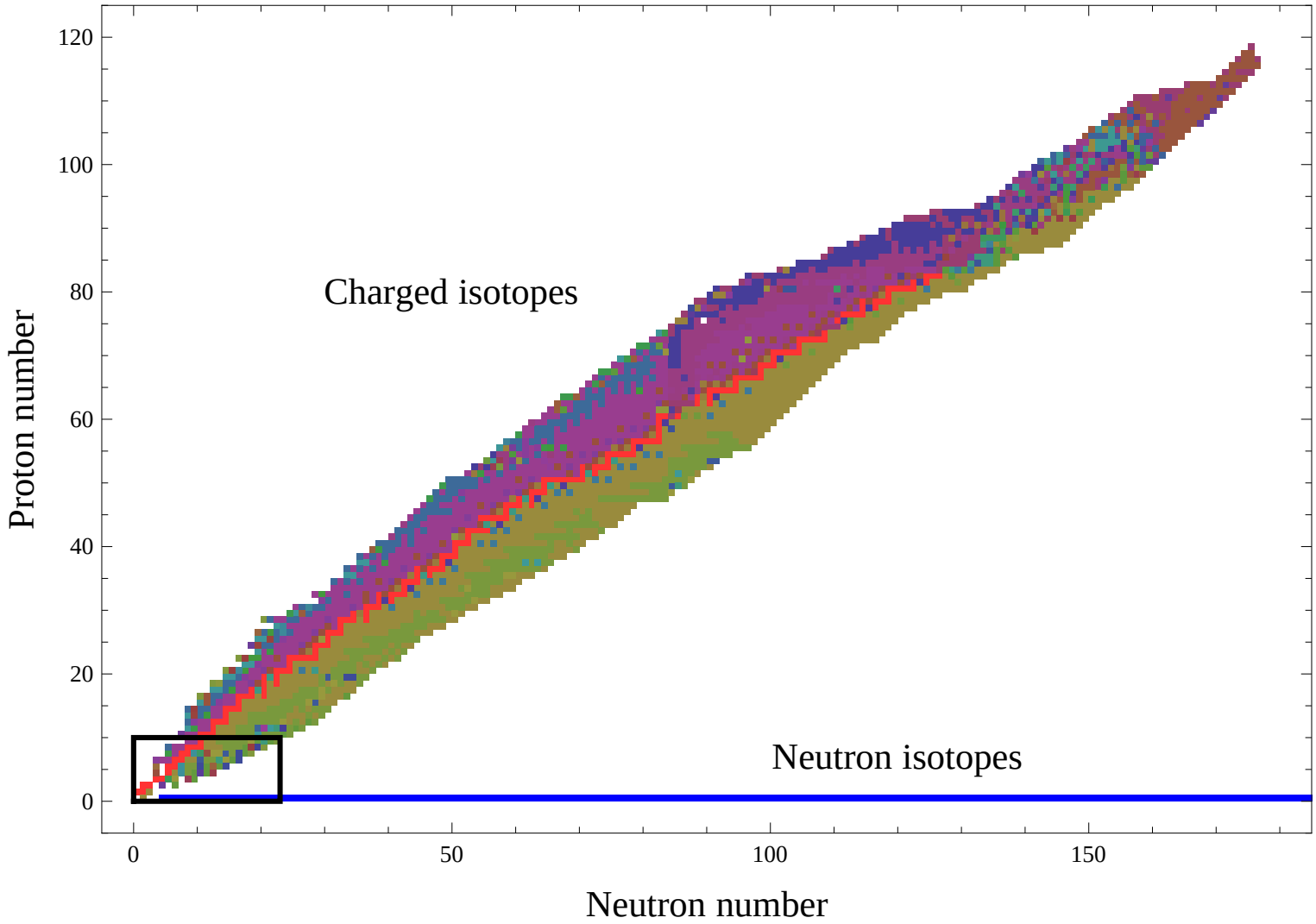
# Table of Isotopes (small nuclei)



# Table of Isotopes (including hypothetical neutron isotopes)



# Full table of isotopes



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- We need a model

# Liquid-drop model

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- We need also a surface energy proportional to $A^{2/3}$.
  - Hypothesize: $A^{2/3}$.
- Now we have the hypothetical neutron isotope mass excess

$$\Delta(^{A}n) = A + A^{2/3}$$

# Neutron isotope detection by radioactive decay (exothermic $\beta\beta\alpha$)

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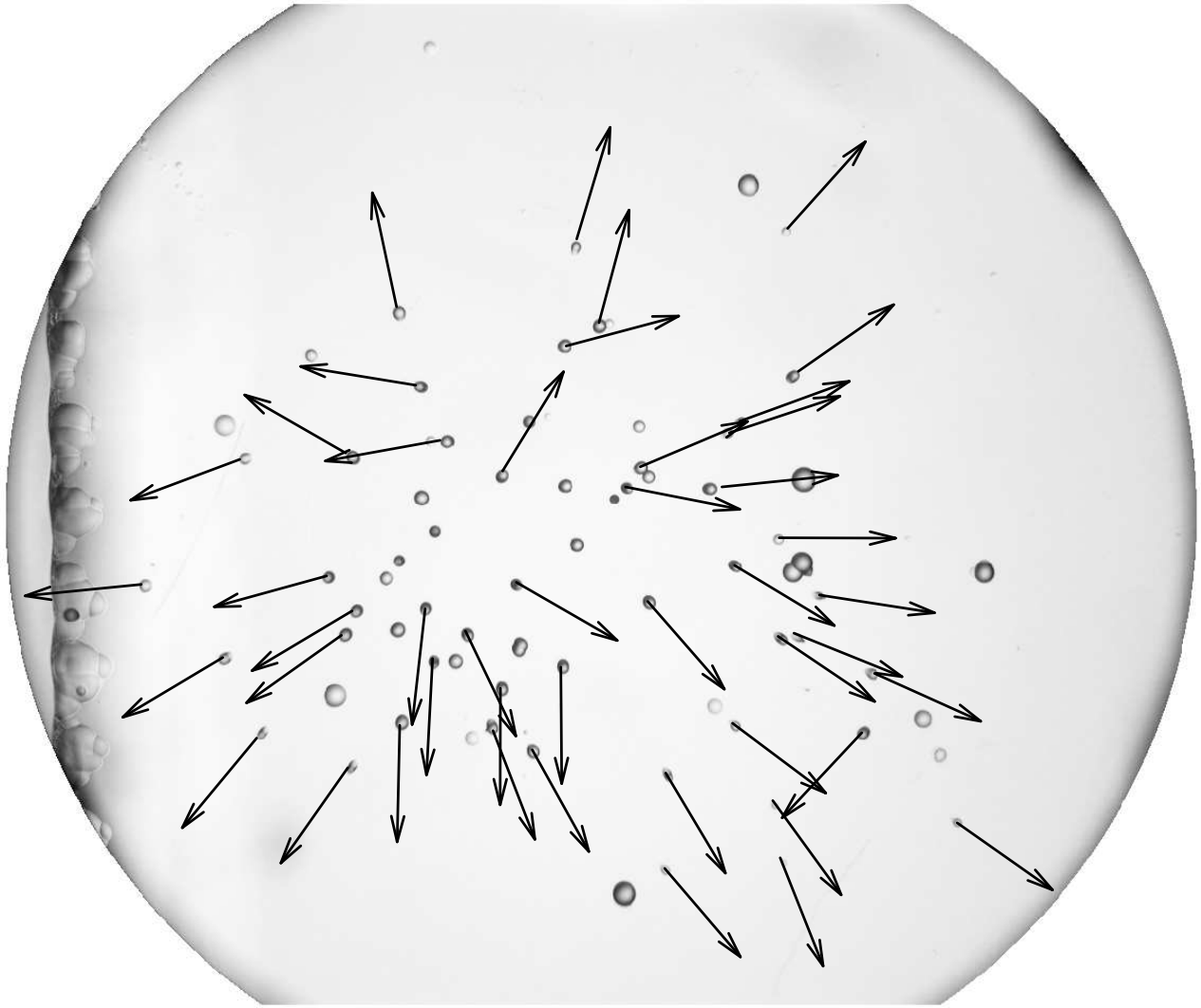
- We can detect the alpha particles.

# Alpha particle shower

## Etch pits on a detector chip in air under a nickel cathode (Oriani)



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- Consistent with helium production

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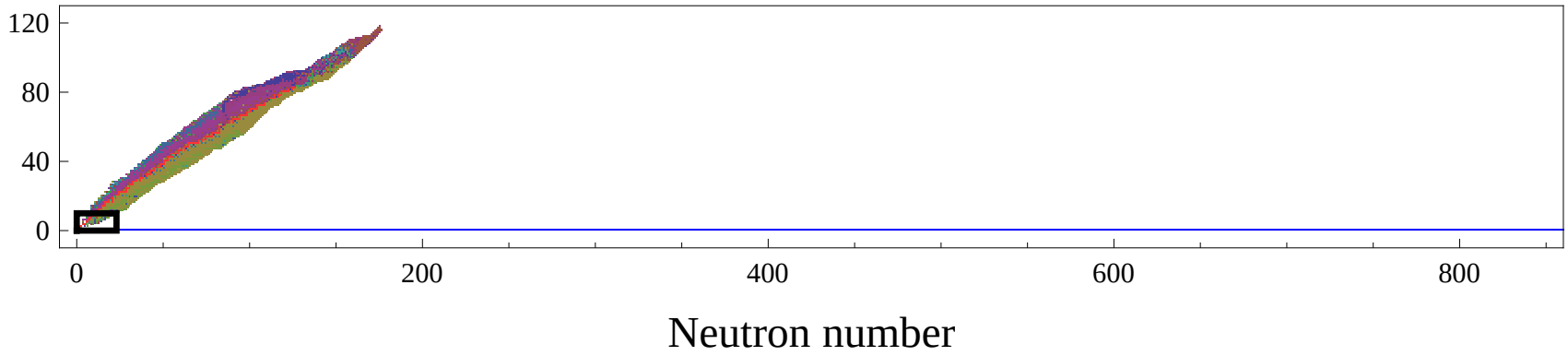

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$$^{A+4}n \longrightarrow {}^{A}n + {}^{4}He$$

- Overall (steady state)

$$4(^{2}H) \longrightarrow 4(^{1}H) + {}^{4}He + 20MeV$$

# Neutron isotope detection by lithium-6 reactions

Isotope growth

$$^{6}\mathrm{Li} + {}^{A}\mathrm{n} \longrightarrow {}^{A+1}\mathrm{n} + {}^{5}\mathrm{Li}$$

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Isotope decay

$$^{A+4}\mathrm{n} \longrightarrow {}^{A}\mathrm{n} + {}^{4}\mathrm{He}$$

Overall (steady state)

$$4(^{6}\mathrm{Li}) \longrightarrow 4(^{5}\mathrm{Li}) + {}^{4}\mathrm{He}$$

$$\longrightarrow 4(^{1}\mathrm{H}) + 5(^{4}\mathrm{He}) + 14\mathrm{MeV}$$

# Neutron isotope detection by lithium-7 reactions

Isotope growth

$$^{7}\mathrm{Li} + {}^{A}\mathrm{n} \longrightarrow {}^{A+2}\mathrm{n} + {}^{5}\mathrm{Li}$$

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Isotope decay

$$^{A+4}\mathrm{n} \longrightarrow {}^{A}\mathrm{n} + {}^{4}\mathrm{He}$$

Overall (steady state)

$$2(^{7}\mathrm{Li}) \longrightarrow 2(^{5}\mathrm{Li}) + {}^{4}\mathrm{He}$$

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- Energetic protons and alphas
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  - Identify and quantify nuclear fuels
- Transmutation (more expensive)
  - Confirm and extend reaction dynamics

# Helium and heat

Steady state reactions for selected fuel isotopes

$^{2}\mathrm{H}$: $\quad 4(^{2}\mathrm{H}) \longrightarrow 4(^{1}\mathrm{H}) + {}^{4}\mathrm{He} + 20\mathrm{MeV}$

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$^{232}$Th: Complex, ambiguous,

$^{238}$U: not worked out.

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  - It's risky to ignore lithium and beryllium and other fuels