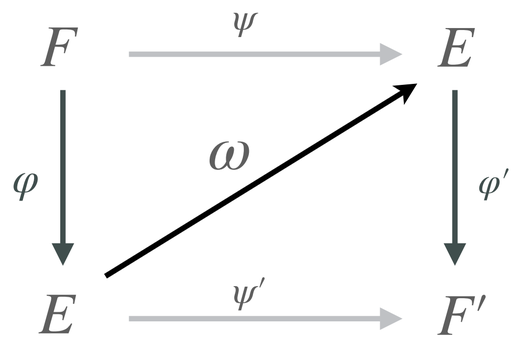
**PART 4**

# 2D Future

**Nakagawa - Onuki trick (2023)**




say we want to create such a square, but we only have $E$ and some $\omega \in \mathrm{End}(E)$ of degree $q(2^a - q)$

we can find a suitable isogeny $\varphi : F \to E$ using Kani!!!

**1**

If the square above existed, then Kani's lemma should apply

should give 2D isogeny $\Phi : E \times E \to F \times F'$ of degree $2^a$

**2**

(ignoring some isogeny maths) then the kernel of $\Phi$ should be given by $[q]P, \omega(P)$ for $P \in E[2^a]$

But we know these!! We can compute 2D $\Phi$ using Kani

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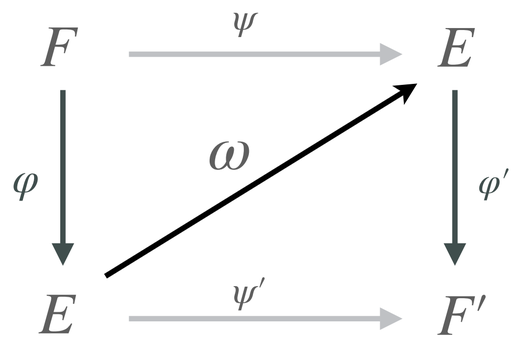


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But we know these!! We can compute 2D $\Phi$ using Kani

**3**

So we can also compute $\varphi : F \to E, \psi : F \to E$

that is, we can factor $\omega$ using Kani's lemma