# Progress of Phytosanitary Irradiation Facility in China

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June 18, 2018

# Content

- Application of PI in China
- EB PI Facilities in China
- X-Ray Irradiator for PI

# Study on irradiation treatment for fruit insects in China

- Study on fruit insects: ⟹ minimum dose
  - Fruit fly
  - Fruit borer
  - Fruit mites; Gray Pineapple Mealybugs
- Study on fruit quality: ⟹ maximum dose
  - apple, mango, pitaya, guava, wax apple, etc.
  - Test items:

    Appearance: visual determination

    Chemical indicators: sugar, acid, vitamin

# Phytosanitary Irradiation in China

- **Convert ISPM No.18 to Chinese National Standard GB/T21659-2008**
- **Standard and Operation Guide of phytosanitary irradiation has been published**
- **The government is developing the phytosanitary irradiation , building Laboratories and Demonstration projects**
- **Applications of imported fruit treatment**
- **NOT YET: sign any bilateral agreements with other countries on phytosanitary irradiation**

# Irradiation Treatment of imported fruits in China

- **MOA Standard (Ministry of Agriculture):**
  - **NY/T 2319-2013** ***"Guide for the irradiation of tropical fruits in electron beam irradiation facility"***
    - **This standard specifies the technical requirements before, during and after irradiation process. Also storage and labeling specifications.**
    - **Applies to electron beam radiation treatment for quarantine purpose: mango, wax apple, Annona, guava and carambola and other tropical fruits**
- **For some types of quarantine pests found in imported fruit: can be send to some designated agencies in China for irradiation treatment then allowed to enter Chinese market**

# Example

- A company in Shanghai was selected as demonstration unit for irradiation treatment
- Standard of Shanghai CIQ; *procedure of irradiation treatment for fruits and vegetables*
- Irradiation treatment of imported fruit 280000kg in 2008-2011

# Standards Established (National)

- GB 14891.5-1997: Hygienic standard for irradiated fresh fruits and vegetables
- GB 18524-2016 National standard for food safety: Hygienic standard for food irradiation processing
- GB/T21659-2008: Guidelines for the use of Irradiation as a phytosanitary measure

# Standards Established (Professional)

- SN/T 3707-2013 Irradiation as a phytosanitary treatment for *Dysmicoccus neobrevipes* Beardsley in banana
- SN/T 4070-2014 Minimum Absorbed Dose for the Phytosanitary Irradiation of Bactrocera dorsalis in Mango and Litchi
- SN/T 4071-2014 Technical Requirements for Phytosanitary Irradiation of Bactrocera dorsalis in Wax-apple and Papaya Fruits
- SN/T 4330-2015 General requirement of quarantine treatment of entry fruits
- SN/T 4331-2015 Basic requirement for Phytosanitary treatment of importing fruits
- SN/T 4409-2015 Irradiation treatment for Cydia pomonella
- SN/T 4409-2015 Irradiation treatment for Grapholitha molesta Busck
- SN/T 4980-2017 The Minimum Absorbed Dose for Phytosanitary Irradiation Treatment against Carposina sasakii, Bactrocera tau, and Pseudococcus jackbeardsleyi

# Standards under development (Professional)

- Operational Rules for Phytosanitary Irradiation Treatment Using Electron Beams
- Minimum Absorbed Dose for the Phytosanitary Irradiation of *Bactrocera correcta*
- Minimum Absorbed Dose for the Phytosanitary Irradiation of *Dysmicoccus lepelleyi*
- Technical Schedules for Phytosanitary Irradiation Treatment of *Planococcus lilacius* in Fruits

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# Electron Beam Phytosanitary Irradiation Facility in China

- Phytosanitary irradiation and detection lab in TJCIQ
- CHINA-ASEAN Pingxiang Fruit Phytosanitary Irradiation Processing Center

# Phytosanitary irradiation and detection lab in TJCIQ

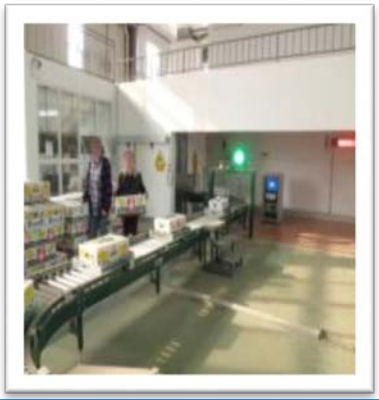
## ——NUCTECH™ IS0705 E-Beam Irradiation Phytosanitary & processing System

- Key Laboratory of CIQ
  - Application: Research, confirmatory tests, and small scale PI， also capable of irradiation processing
  - Hosted by: Tianjin CIQ
  - Location: Tianjin, Operation since 2009

# Phytosanitary irradiation and detection lab in TJCIQ

## ——NUCTECH™ IS0705 E-Beam Irradiation Phytosanitary & processing System

- **Parameters:**
  - 7.5MeV　LINAC
  - 0.25~5kW (tunable ) , very wide range!
  - 40Gy~20kGy/single E-Beam irradiation
  - Can be converted to X-ray irradiation



# CHINA-ASEAN Pingxiang Fruit Phytosanitary Irradiation Processing Center

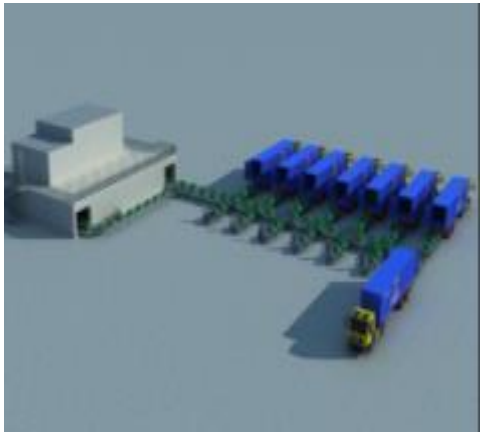

- China largest import and export ports for ASEAN fruits, the border of China and Vietnam
- A large amount of fruits from Viet Nam through Pingxiang Port
  - dragon fruit, mango, rambutan, longan, litchi and banana……
- The variety and quantity of dangerous exotic pets are increasing rapidly
- A great threat to the regional fruit and vegetable planting industry

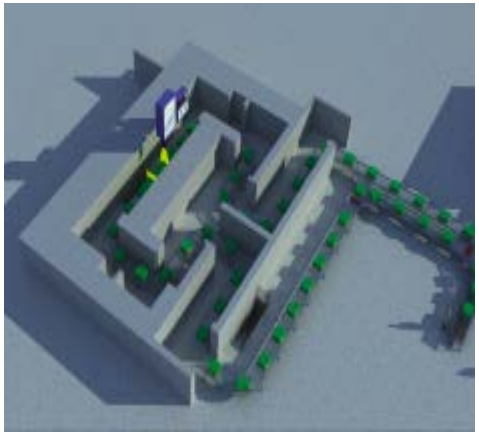
# CHINA-ASEAN Pingxiang Fruit Phytosanitary Irradiation Processing Center

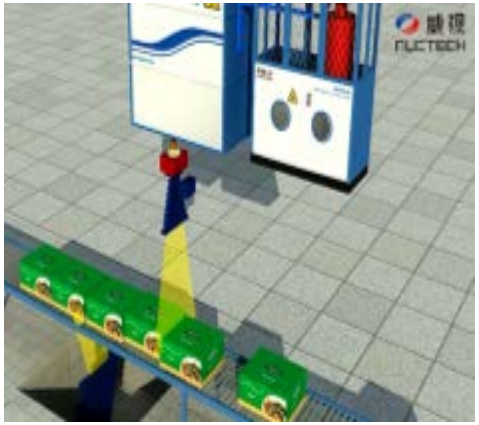
- Since 2010, a new China - ASEAN fruit trade zone in Pingxiang planning and construction
- EB irradiation technology suitable for Phytosanitary treatment in Port
- Joint construction by Chinese Academy of Inspection and Quarantine, Guangxi government, Tsinghua University and NUCTECH
- NUCTECH$^{TM}$ IS1007D E-Beam Irradiation Quarantine System
- The facilities have been passed the acceptance since the beginning of 2016
- Now in experimental running status

# EB Irradiation Facility

## Nuctech™ IS1007D EB irradiation system





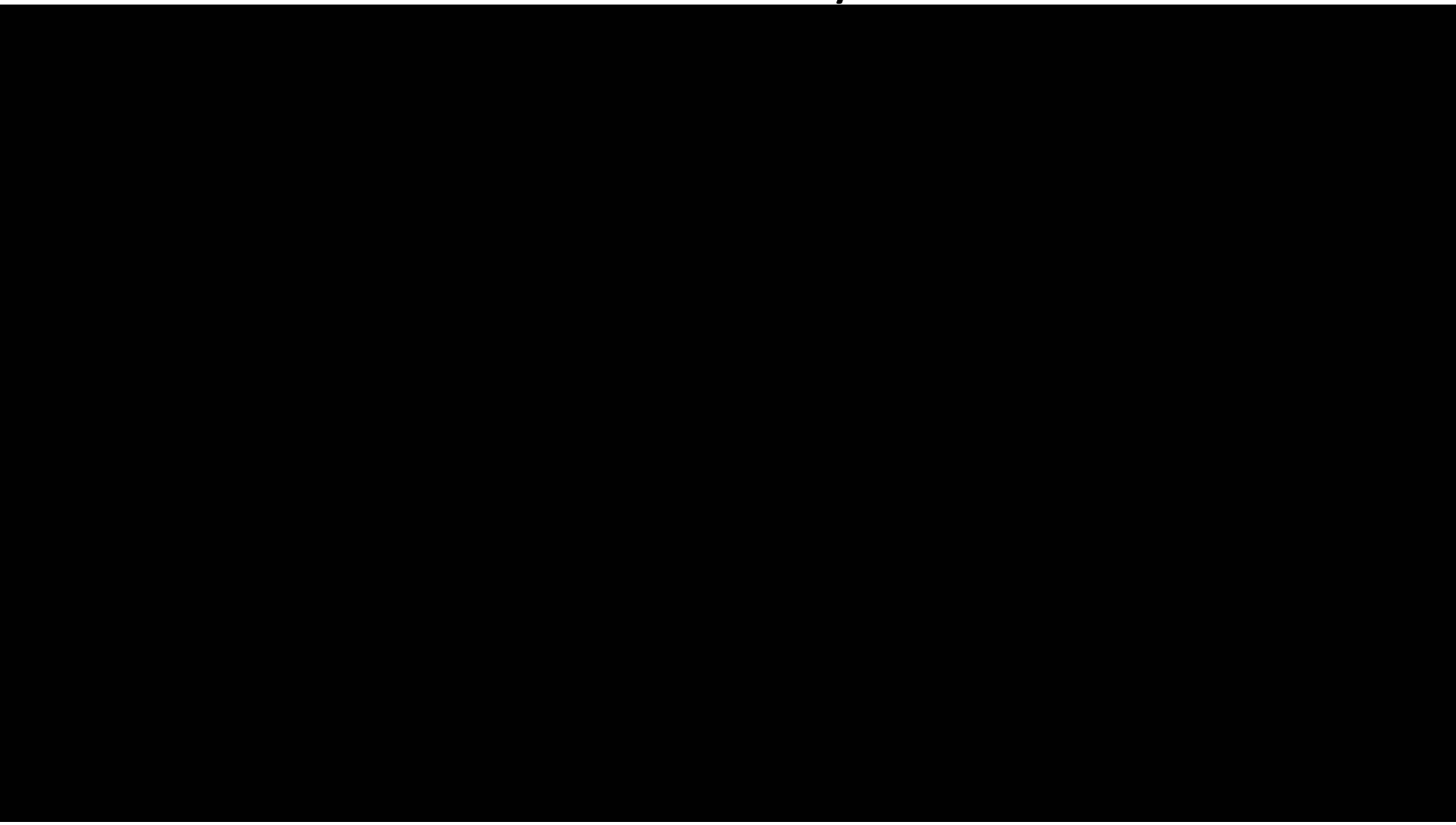


- Two accelerator irradiate from the top and bottom of the goods, respectively
- Direct docking up to 7×2 vehicles and equipment system
- Precise delivery is guaranteed with advanced management software

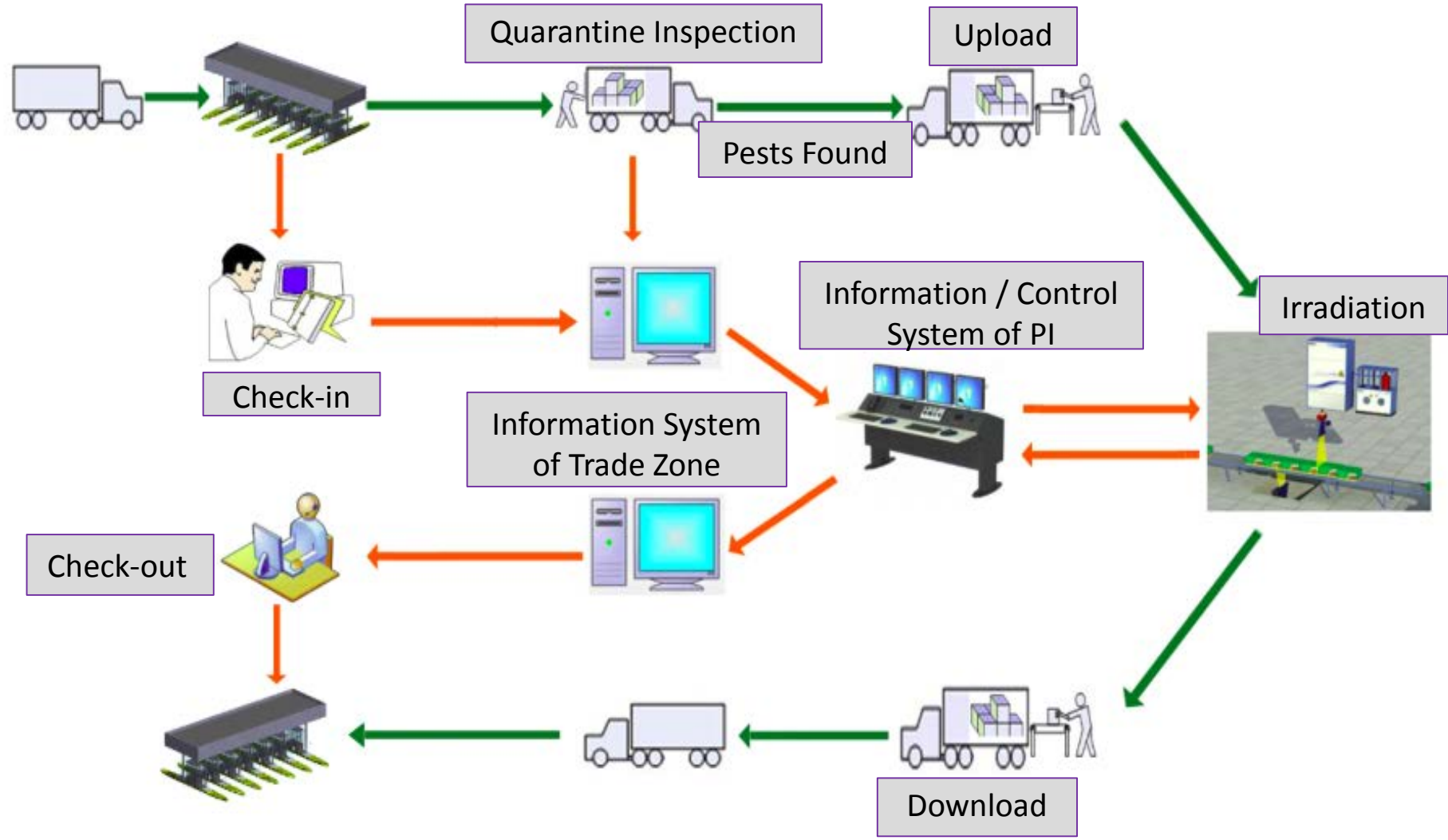
# EB Irradiation Facility

| Parameters | Objects |
|---|---|
| Number of sources | 2 LINACs |
| Beam energy | 10MeV |
| Max. beam power per accelerator | 7.5kW |
| scanning width | 82cm |
| surface scanning uniformity | <5% |
| Conveyor speed under beam | 8~200mm/s |
| speed Accuracy of the conveyor under beam | <0.5% |
| surface Dose range per single irradiaton | 200Gy~18K Gy |
| Output | 20 ton/h |

# EB Irradiation Facility



# Planning of Quarantine Business In the Trade Zone



# Project Status

- Now The EB Phytosanitary Irradiation Center is in experimental running status, due to:
  - Some unfinished infrastructure in the trade zone, including part of the construction, management system and so on
  - The technical standards and regulations of Phytosanitary Irradiation are setting up

# Ongoing work

## 1. Confirm quarantine pests species and minimum dose

| Quarantine pests (intercepted in 2015) | Batch |
|---|---|
| *Bactrocera correcta* | 71 |
| *Bactrocera cucurbitae* | 59 |
| *Bactrocera dorsalis* | 976 |
| *Bactrocera invadens* | 34 |
| | |
| *Dysmicoccus neobrevipes* | 168 |
| *Planococcus lilacius* | 78 |
| *Planococcus minor* | 1815 |
| *Pseudococcus longispinus* | 73 |
| | |
| *Sternochetus frigidus* | 31 |
| *Sternochetus mangiferae* | 369 |
| *Sternochetus olivieri* | 246 |

- For pests within standard, carry out the validation and pilot-scale processing on-site.
- For pests without standard, research on minimum dose
  - Confirm the most tolerant insect states
  - Dose-response to confirmatory tests
  - laboratorial experiment and pilot-scale processing on-site.

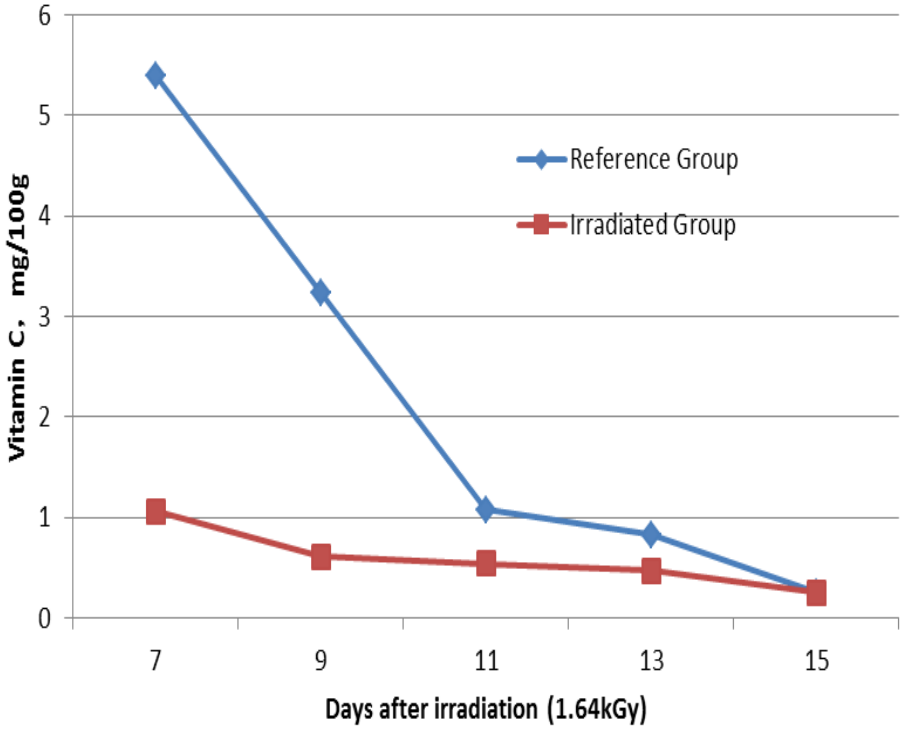
# Ongoing work

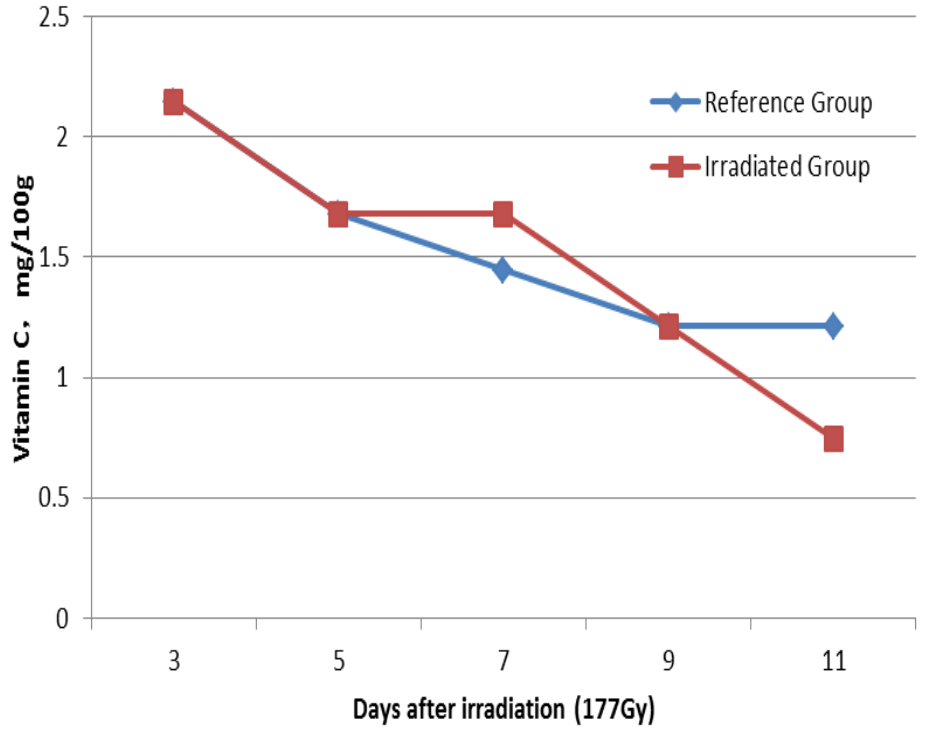
## 2. Fruits Tolerance to Radiation and Quality Tests

- Varieties: dragon fruit, mango, rambutan, longan and litchi
- Quality testing items
  - sensory characteristics
  - physicochemical indexes: sugar, acid, vitamin C …

***Objective: general dose of PI for each import fruit***

# Variation of VC in Dragon Fruit after irradiation

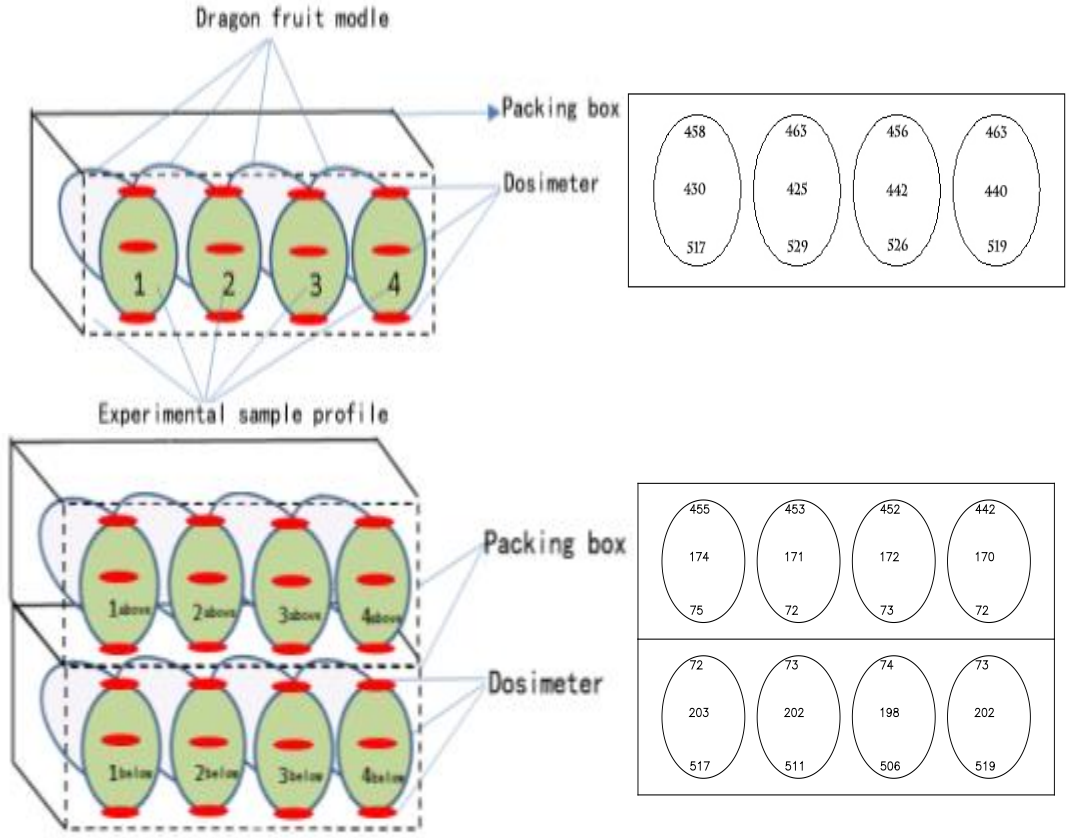


# Ongoing work

## 3. Fruit Packing and Dose Distribution

Case： Packing within one layer or two layers dragon fruit and dose distribution （Under 5.4kW, 200mm/s）




- One layer: DUR ca. 1.5;
- Two layers: DUR~6, only available when min-dose about 100Gy

# Ongoing work

## 4. Regulations / Specifications

- Technical regulation for phytosanitary treatment of ASEAN border trading fruits using EB irradiation
- Supervision regulation of EB phytosanitary irradiation for ASEAN (Viet Nam) border trading fruits
- 3~5 items: Code of good phytosanitary irradiation practice for …..(dragon fruit, mango, rambutan, longan and litchi )

# Challenge and Prospect of the PI Project

- Still a lot research and regulation work to do
- The public's acceptance of fruit's phytosanitary irradiation
- Promote the development of border trade between China and Vietnam
- As a good demonstration for PI in China, this project will vigorously promote the practical application, as well as the implement of technology and standards

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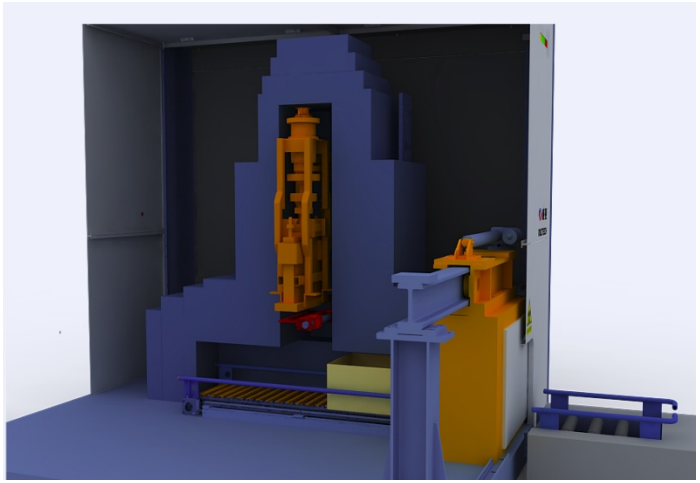
- **X-Ray Irradiator for PI**

# EB/X-Ray Dual Irradiation System



- For scientific research and application
  - Sterile insect technique
  - PI experiments
  - Seed/seedling breeding
  - Sterilization of small-scale items
  - etc.
- Self-shielding, miniaturized instrument
- 2.5MeV/1kW; EB/X-ray, dual source
  - X-ray : a dose rate of 10 to 250 Gy/min; minimum throughput 3,000 L·Gy/hr
  - E-beam: 4~35kGy once
- <2.5×2.5×2 m (w×d×h)

# X-Ray Irradiation System


- For scientific research and application
  - Sterile insect technique
  - PI experiments
  - Cell irradiation research
  - etc.
- Self-shielding, miniaturized instrument
- 160kV/6~12kW; X-ray source
  - Dose rate： 3~250Gy/min
  - Output ≥1,500 L·Gy·hr$^{-1}$(@100Gy, 0.45 g·cm$^{-3}$,U<1.3)
- 1.2m×0.9m×1.9m (w × d × h)


# Thank you for your attention!