中国科学技术大学
University of Science and Technology of China

第一届全国青年燃烧学术会议，上海，2015

火灾科学与技术论坛总结

刘乃安　胡隆华

研讨主题

- 陈海翔：飞火点燃研究进展
- 范传刚：隧道火灾发展特性及竖井自然排烟
- 方俊：烟颗粒粒径、分形形貌对湍流火焰辐射的影响
- 龚俊辉：聚合物材料热解与火蔓延
- 霍岩：火蔓延与爆炸
- 雷佼：火旋风燃烧动力学
- 唐飞：密闭空间内可燃气体层流预混火焰动力学
- 王青松：锂离子电池热安全
- 谢启源：材料火蔓延模型研究
- 张孝春：顶棚射流特征参数演化

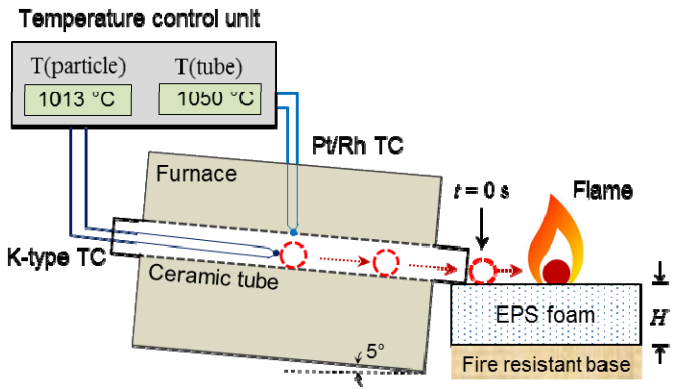
前沿问题：飞火点燃研究

Witch Fire （2007）
Photos from Carlos Fernandez-Pello

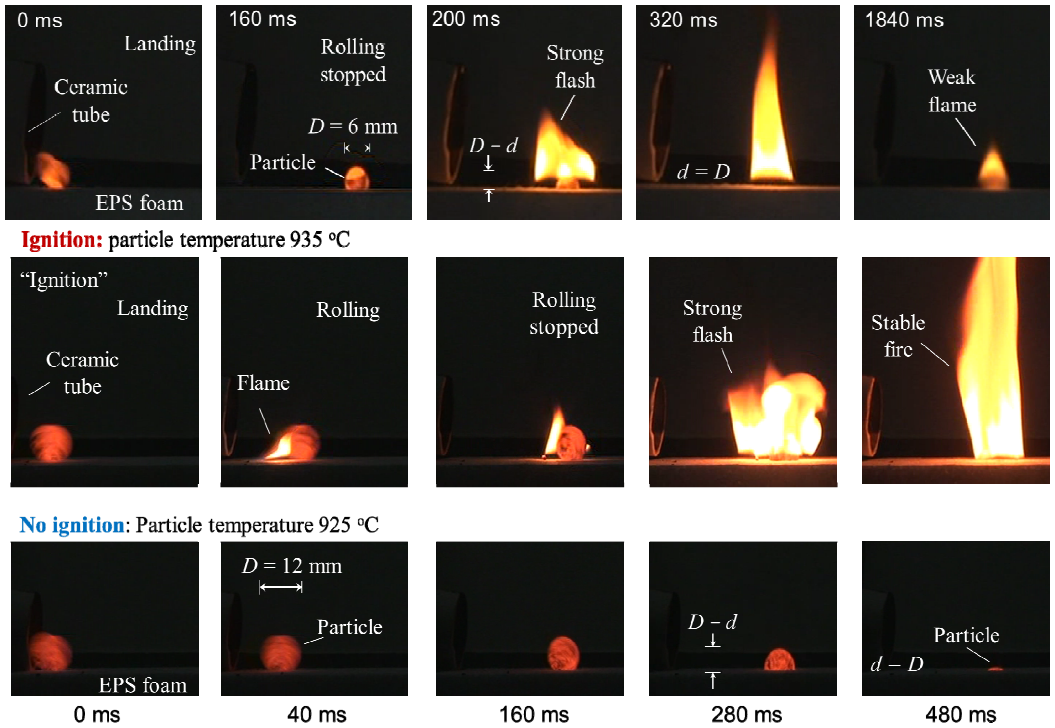
飞火：环境风或热气流能将未燃尽的炽热可燃物颗粒（firebrand or ember）传播到火前锋前方，落地时引燃地表可燃物，形成新的火点。

飞火点燃是森林-城镇交界域火灾中建筑焚毁的主要起因*。

前沿问题：飞火点燃研究



Specific background



颗粒在加热材料并嵌入的过程中点燃（颗粒温度1022℃）

颗粒在材料表面运动过程中点燃

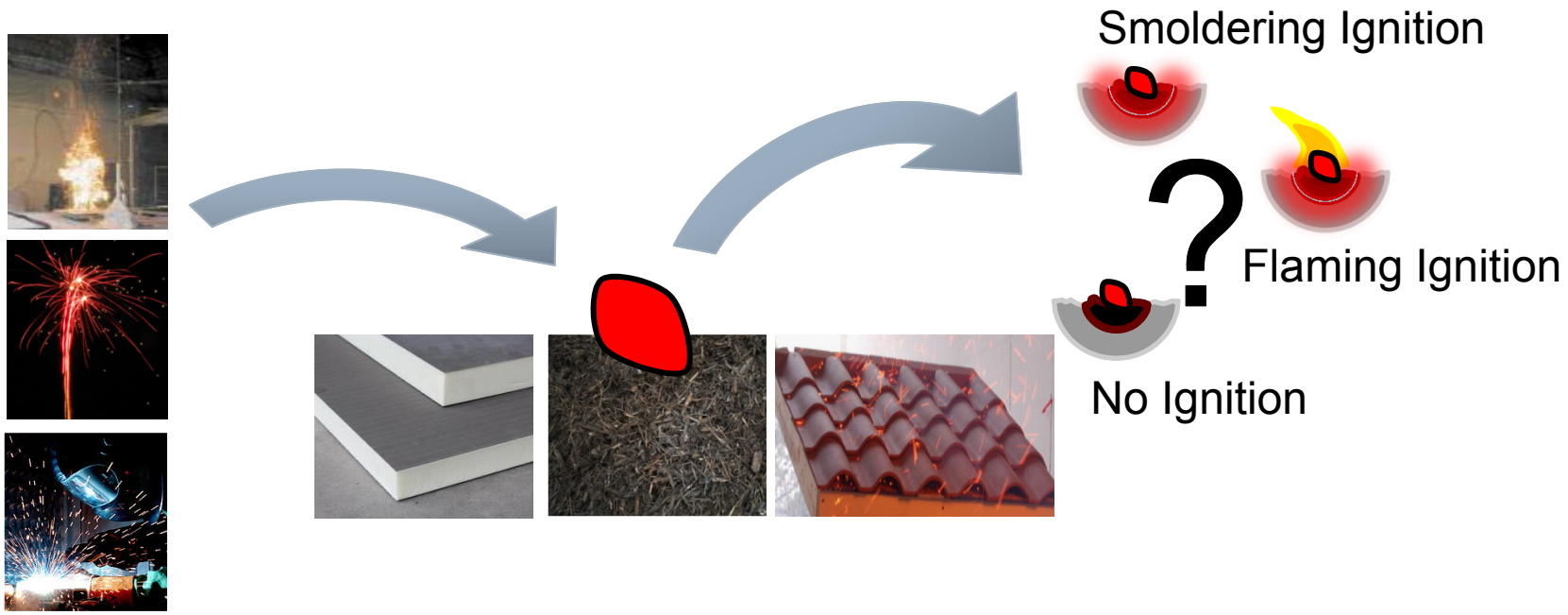
不点燃

Supan Wang, Xinyan Huang, Haixiang Chen,, Naian Liu, Guillermo Rein, *Ignition of low-density expandable polystyrene foam by a hot particle*, **Combustion and Flame** （2015）

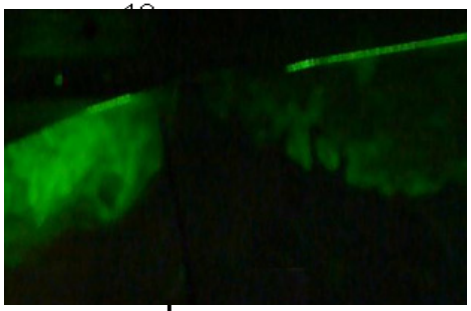
前沿问题：飞火点燃研究

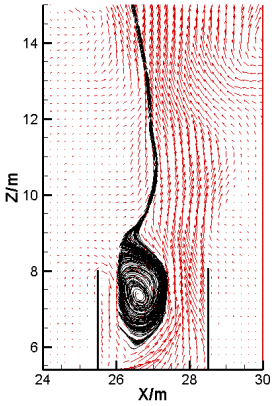
关键问题：

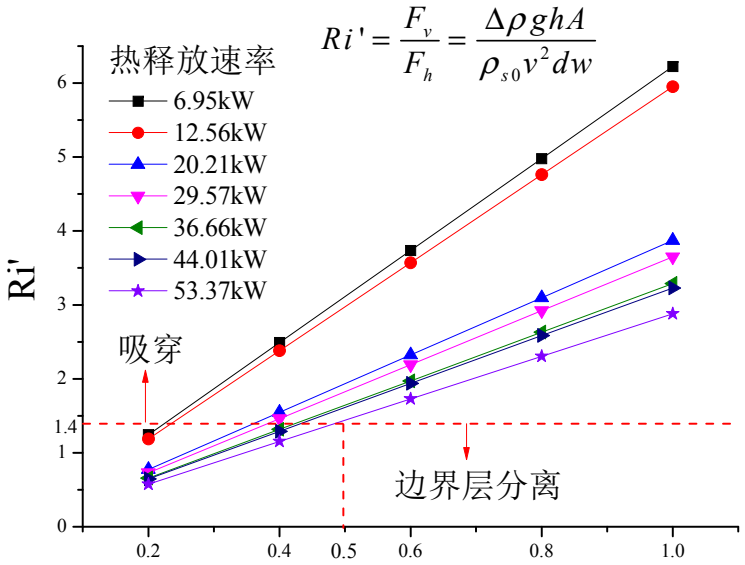
- 建筑结构飞火点燃倾向性
- 高温颗粒引燃保温材料的临界条件
- 固体热解—气相燃烧耦合的颗粒点燃数值模型



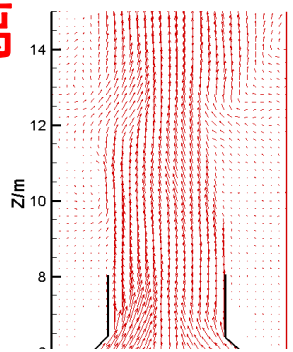
前沿问题：隧道火灾发展特性及竖井自然排烟







边界层分离

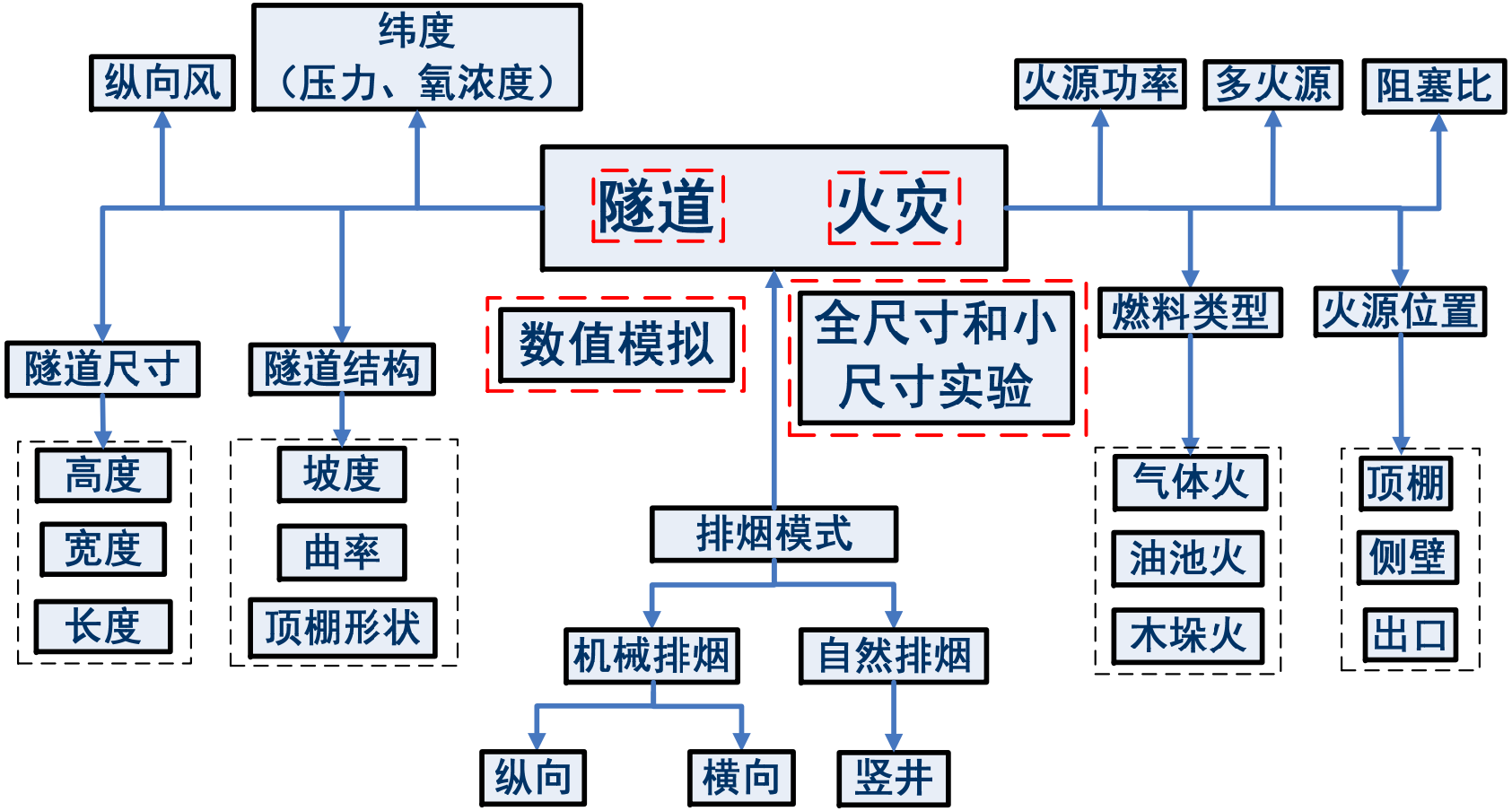


斜角竖井

Int J Heat Mass Tran, J Civil Eng Manage

前沿问题：隧道火灾发展特性及竖井自然排烟

隧道火灾相关因素



从简单到复杂，从单因素到多因素

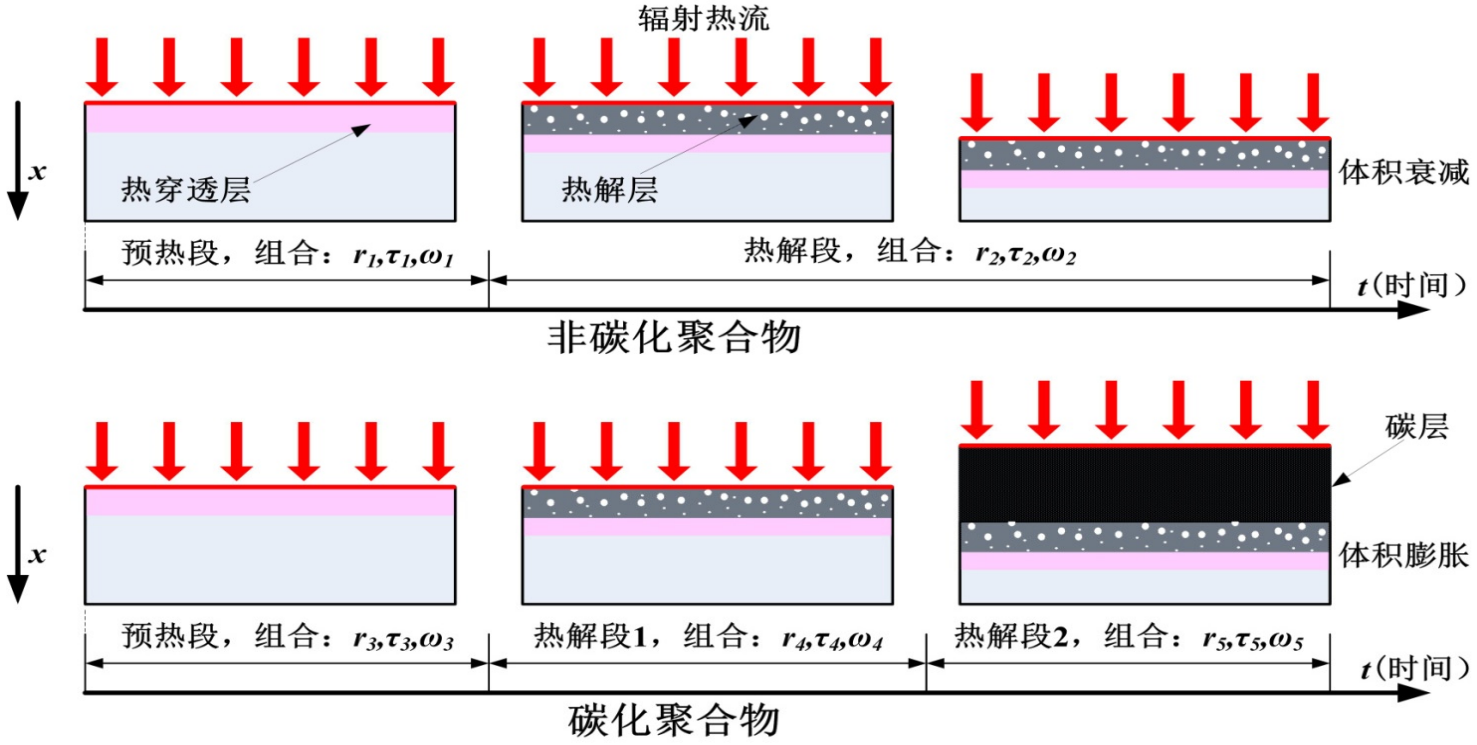
前沿问题：隧道火灾发展特性及竖井自然排烟

关键问题：

- 纵横向排烟与障碍物阻塞效应耦合作用下的隧道火灾烟气运动
- 喷水灭火和纵向通风耦合作用下隧道火灾烟气输运与控制
- 狭长隧道火灾燃烧行为

前沿问题：聚合物材料热解与火蔓延

聚合物热解过程



$$\rho_s C_s \frac{\partial T_s}{\partial t} = \frac{\partial}{\partial x}\left(k_s \frac{\partial T_s}{\partial x}\right) + \omega_i \dot{q}''_{ext} \kappa e^{-\kappa x} + \rho_s S_v \left[\Delta H_v + \left(T_s - T_\infty\right)\left(C_s - C_g\right)\right] - \dot{m}'' C_g \frac{\partial T_s}{\partial x}$$

能量方程

$$x = 0: \quad \tau_i \dot{q}''_{ext} - \varepsilon_{pol}\sigma\left(T_s^4 - T_\infty^4\right) - h_{conv,top}\left(T_s - T_\infty\right) = -k_s \frac{\partial T_s}{\partial x}$$

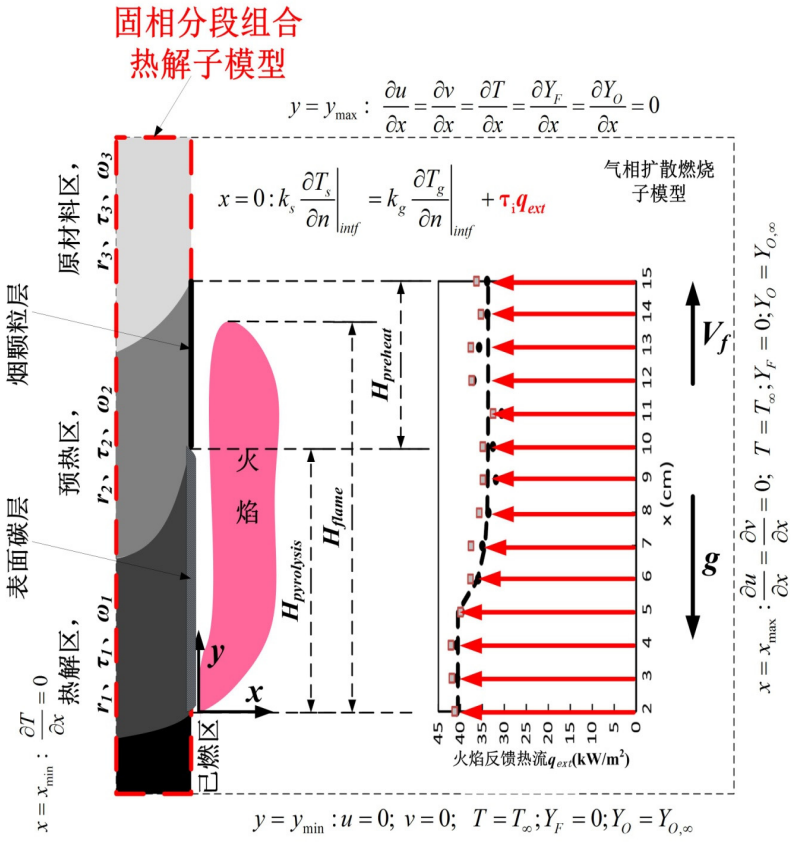
边界条件

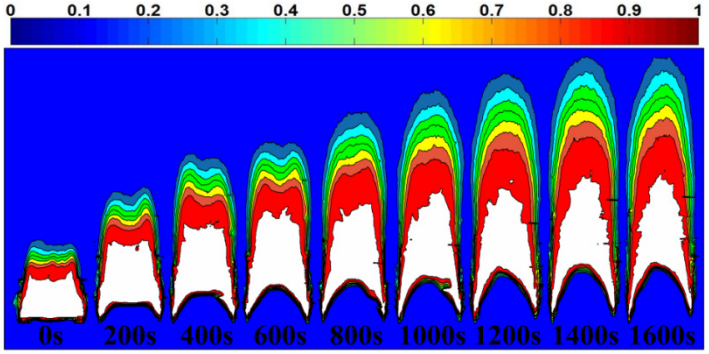
$$\tau_i + \omega_i + r_i = 1 \qquad i=1、2、3、4、5$$

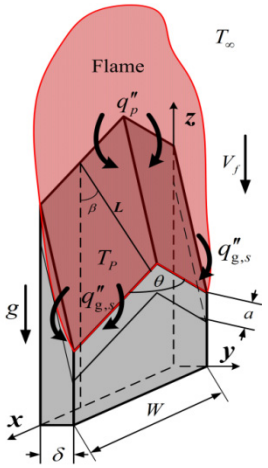
前沿问题：聚合物材料热解与火蔓延

关键问题：

- 炭化与非碳化聚合物热解物理－化学耦合作用模型
- 聚合物材料表面逆流火蔓延模型与数值模拟方法







前沿问题：火旋风燃烧动力学

- 火旋风的相关不稳定性研究

- 火旋风的进动行为

  Lei Jiao, et al., PCI, 2013. 34(2): 2607-2615

- 火旋风形成前的火行为

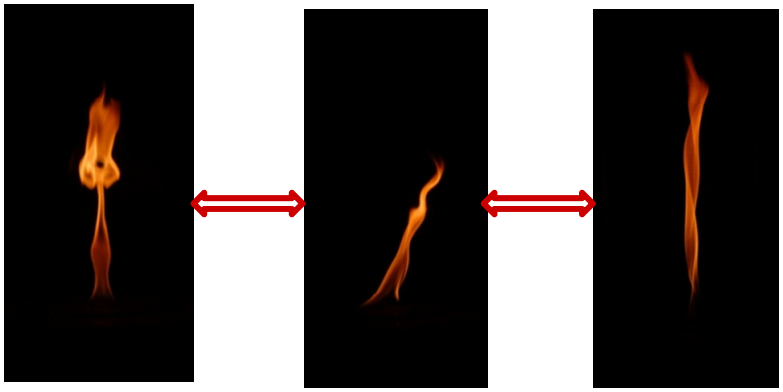
  Lei Jiao, et al., PCI, 2015, 35(3): 2503-2510

- 浮力池火与火旋风的转捩

  层流 $\Gamma/\dot{Q}^{4/4} = \text{const}$；湍流： $\Gamma/\dot{Q}^{4/3} = \text{const}$

  Lei Jiao, et al., CNF, 2015.

- Emmons (1967): "This wander appeared to be caused by some inherent instability of the fire whirl, since 6 months of effort failed to find any external cause."



浮力池火与火旋风转捩

前沿问题：火旋风燃烧动力学

关键问题：

- 火旋风燃烧动力学的不稳定性研究
- 火旋风与其他极端火行为的相互转化
- 火旋风的尺度效应
- 结合天气和地形条件的火旋风工程模型

前沿问题：锂离子电池热安全

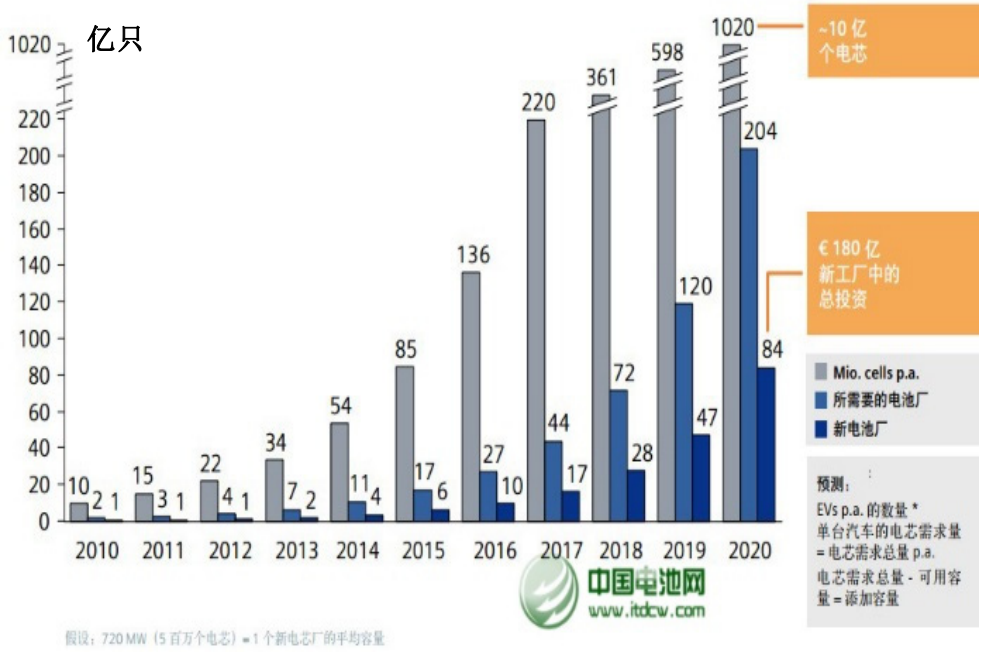
- **存在问题：锂离子电池存在严重的安全隐患**

- 亟需解决日益增长的锂电需求与安全性之间的矛盾
- 锂离子电池灾害特点及难点
  - ✓ 主要形式：热失控导致火灾爆炸
  - ✓ 灾害孕育：锂离子的赋存状态主导锂离子电池的热安全性
  - ✓ 灾害发生：热失控发展迅速、火灾危险性大
  - ✓ 灾害防控：缺少有效的防控手段（2003年之前）

前沿问题：锂离子电池热安全

关键问题：

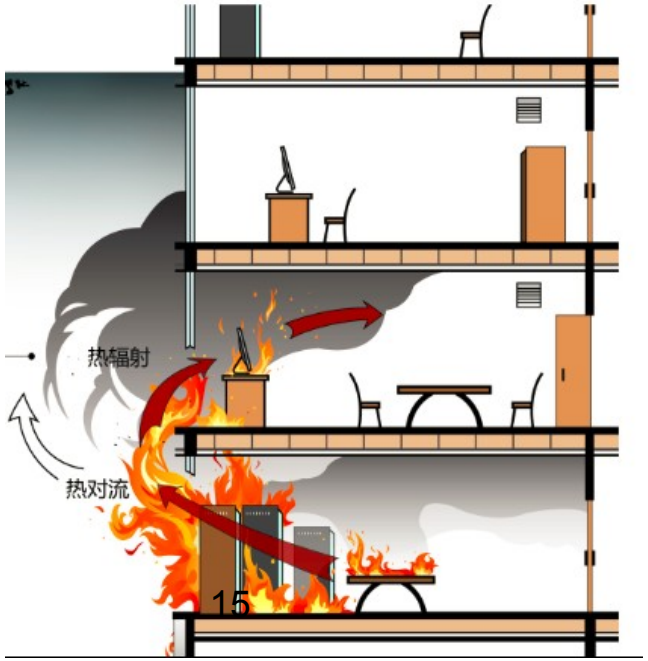
- 热-电耦合下锂离子电池电解液反应的热动力学规律
- 锂离子电池热失控演化机理及火灾危险性
- 锂离子电池本质安全方法及系统的消防解决方案



前沿问题：建筑开口火溢流研究

建筑外立面**开口火溢流**是大型**立体火蔓延**的**初始阶段**。

火焰和高温烟气从房间开口溢出，沿外壁面逐渐向上层和周边建筑物传播蔓延，形成外部燃烧，并引燃外墙材料等。



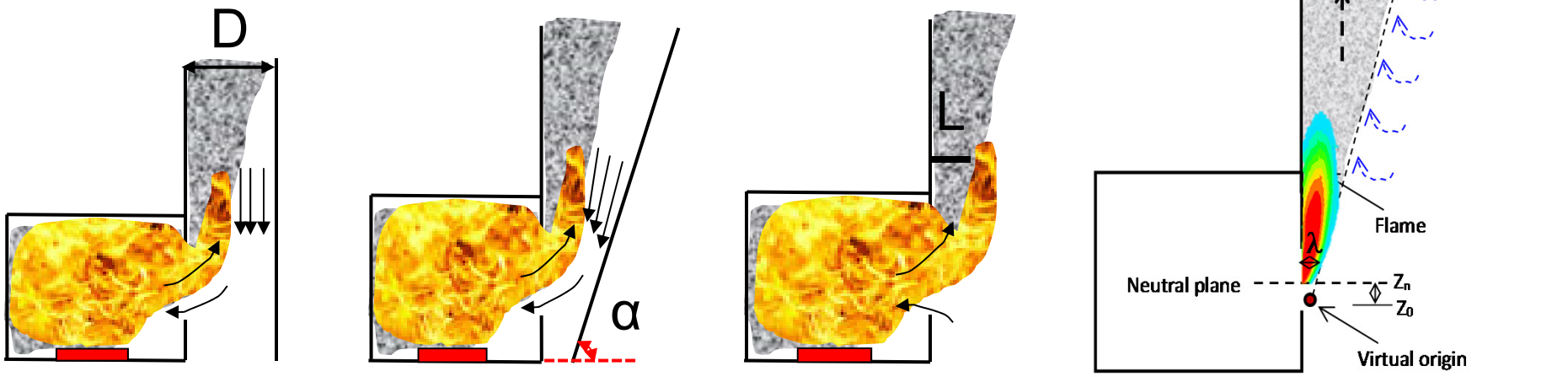
研究热点：

- 火焰溢出条件
- 关键参数及其分布规律
- 外部边界条件的影响

前沿问题：建筑开口火溢流研究

关键问题：

- 不同开口和外部边界条件下的火溢流火焰形态特征
- 低气压环境下的火溢流卷吸差异与特征参数分布
- 环境风和热浮力耦合作用对火溢流的影响
- 建筑物立体火蔓延的阻控方法



研讨体会

- 总共11人，规模适中
- 年轻人主要谈自己的方向、思路，具有很强探讨性，促进了广泛而热烈的讨论。
- 周怀春教授和范玮教授担任特邀专家，具有意想不到的效果

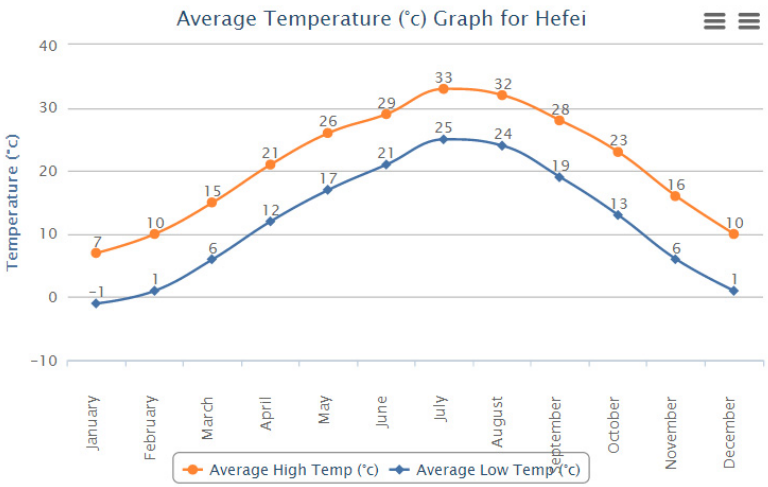
第二届全国青年燃烧学术会议筹备

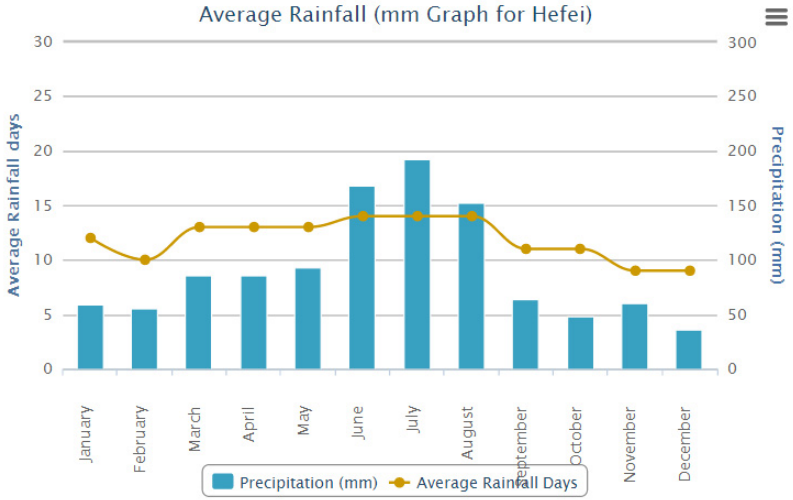
地点：安徽合肥

承办：火灾科学国家重点实验室

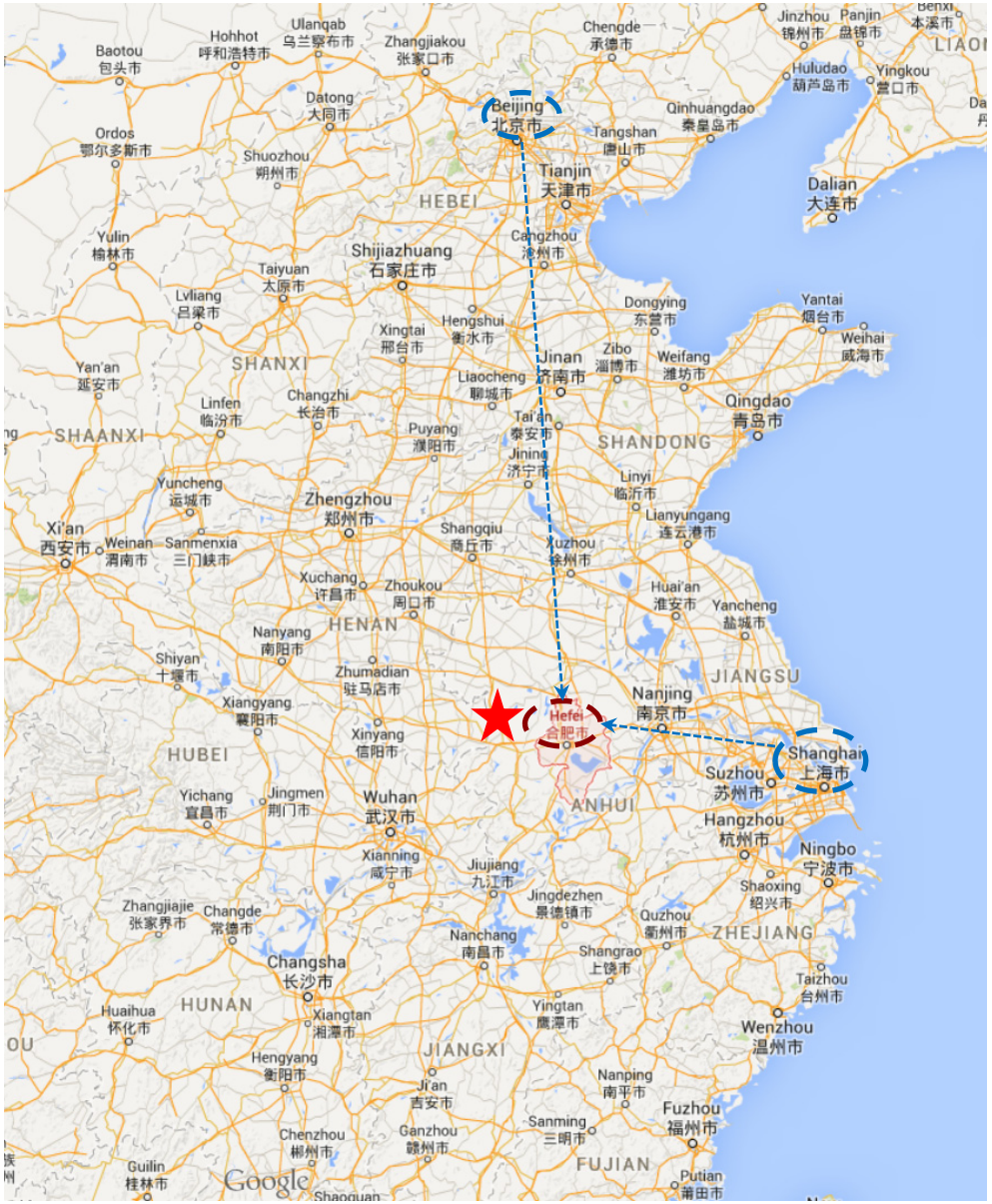
Suggested dates

- **April 9-10, 2016**
  - ☑ Best season in China and Hefei (Temperature in Hefei: 15-25 degrees Celsius)
  - ☑ No conflict with the 36th Combustion Symposium to be held in Korea (July 31-August 5, 2016)
  - ☑ After the conference, there will be national holidays for China and Japan.



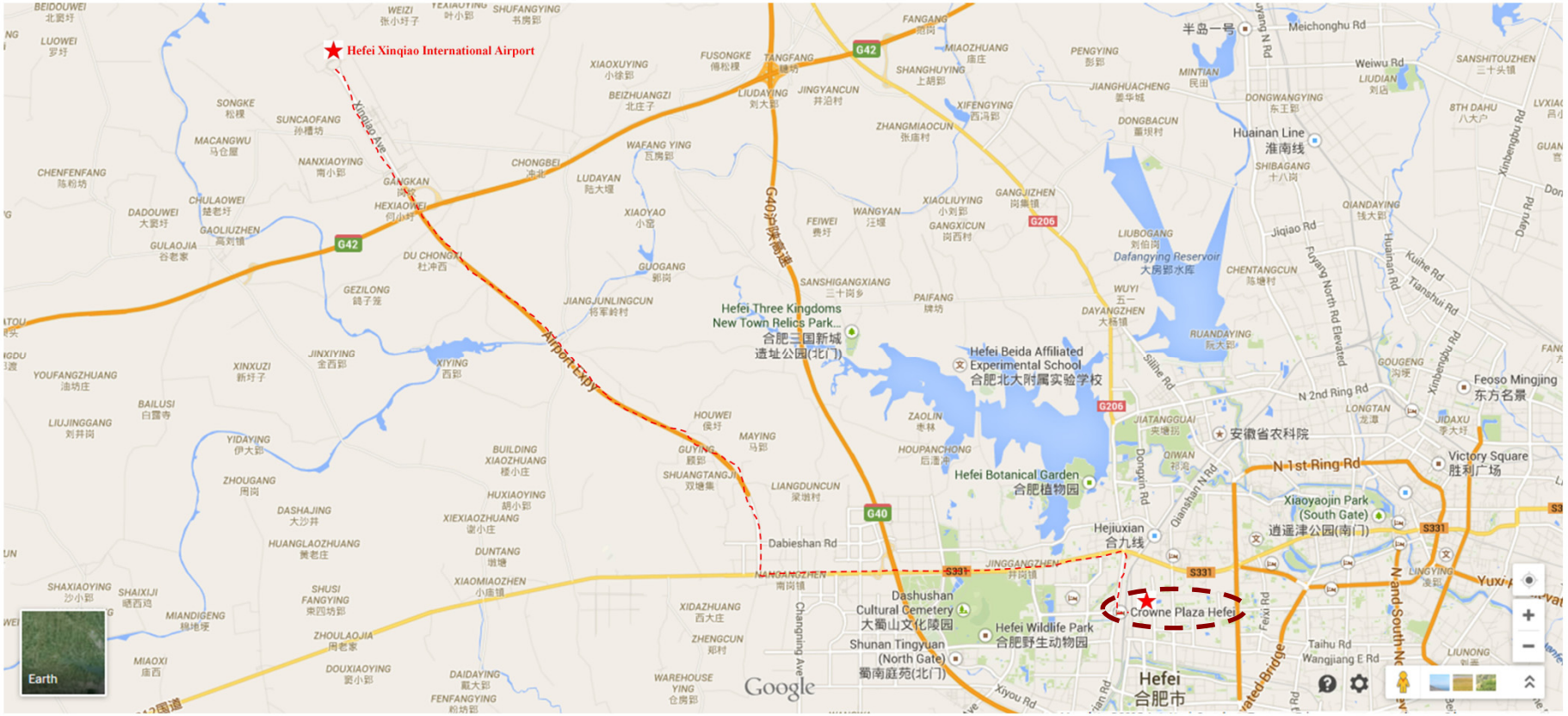


Conference city: Hefei



- **Hefei with a history of more than 2,200 years is:**
  - ☑ the capital of Anhui Province
  - ☑ the hometown of the famous honest and upright official in Chinese history---Bao Zheng
  - ☑ featuring a landscape of mountains and lakes
  - ☑ known as “a modern garden city and “the most suitable city for people to live in.”
  - ☑ a city of science and education and one of the four major bases of scientific research and education of the nation
- **From Beijing to Hefei (1100km)**
  - ☑ By flight: 1.5h, 10 flights every day
- **From Shanghai to Hefei (600km)**
  - ☑ By high speed railway: >250km/s, 2.5-3h.
  - ☑ By Flight: 1h, but only 2 flights every day

Accommodation and meeting place



Crowne Plaza Hefei

Destination	Distance (km)	Transportation	Duration (min.)
Xin Qiao Intl. Airport	35	By Vehicle	40
Hefei South Railway Station	10	By Vehicle	20
Hefei Railway Station	13	By Vehicle	25

Accommodation and meeting place

CrownePlaza Hefei is an international upper upscale hotel located in Hefei’s High-technology Development Zone with the Government District in it’s neighborhood, and accommodates both business and leisure guests, making the Hotel the ultimate choice for “Travelling for Success”. The Hotel is also complemented by it’s 3,000sqm of meeting space, 11 meeting rooms, wedding chapel and breakout areas which makes it the perfect venue for hosting both business and social events.

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel lobby

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel F&B

Steakhouse The Grill provides a twist to traditional steak cooking. The skillful combination of fresh seasonal ingredients adds spice and flavor. The Chefs signature dishes and inventive cuisine will delight the senses and ensure a memorable evening in a chic setting.

The Welcome reception of 8th ISFEH will be arranged here.

1. **Located at Level 1**

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel F&B

Fiesta Café All-Day-Dining restaurant is set in a relaxed and comfortable atmosphere, offering a variety of authentic cuisines. “West Meets East”, international cuisines with live cooking. The dynamic open kitchen allows guests to interact with the talented and friendly chefs.

The lunches of 8th ISFEH will be arranged here.

1. Located at Level 2
2. Seats: 234
3. Operation Hours: 06:00 – 23:00
4. Room Service 24 Hours
5. Breakfast Buffet: 06:00 – 10:30

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel rooms

Room Type	Quantity	Area (sq.m)
Superior Room	69 Twin 42 King	40
Deluxe Room	116 Twin 112 King	40
Superior Suite	86	58
Club Floor		
Deluxe Room	3 Twin 54 King	40
Executive Suite	9	58
Deluxe Suite	24	97
Crowne Suite	4	147
Presidential Suite	1	278

523 rooms including 188Twins, 211 Kings, and 124 Suites

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel rooms

1. 42 inches PHILIPS LCD Satellite Television
2. Hi-fi with Iphone Connectivity
3. Ergonomic work area with high speed Internet access
4. Bathroom equipped with Rain Shower Head and separate bathtub
5. In-room Safe Deposit
6. YORK Climate Controlled Air-conditioning System

Superior Floor：4-9F
Deluxe Floor：10-22F
Club Floor：23-26F

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel rooms

CROWNE PLAZA
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Hotel rooms

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Hotel rooms

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HEFEI
合肥皇冠假日酒店

Hotel meeting place

No.	Name	Area(m^2)	Capacity						
			Banquet	Cocktail	Theatre	Classroom	U-shape	Hollow Square	Boardroom
1	Fenghua Ballroom1	500	240	300	450	265	n/a	n/a	n/a
2	Oak Room	82	50	60	60	40	27	36	n/a
3	Birch Room	84	50	60	60	40	27	36	n/a

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合肥皇冠假日酒店

Hotel meeting place

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Hotel Recreation

Swimming Pool

GYM

Elements Spa

Entertainment Room

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Tourism Attractions around Hefei

1. Golden Peacock Hot Spring (40min)
2. Tianzhushan Mountain (2 hours)
3. Former Residence of Li Hongzhang (20min)
4. Zipeng Bay International Golf Club (30min)
5. Baogong Temple (20min)
6. Chaohu Lake (1 hour)
7. Jiuhuashan Mountain (2 hours)
8. Yellow Mountain (1 hour by train, 3 hours by bus)
9. Shushan Forest Park (10min)

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Tourism Attractions around Hotel

The new & fascinating entertainment complex & bar street “1912” in Hefei, just 2 minutes walking distance from the Hotel.

CROWNE PLAZA
HEFEI
合肥皇冠假日酒店

Social program

- Other selections for delegates after the conference
  - ☑ Yellow Mountain: 1.5 hours from Hefei by train, and 3 hours by bus

Social program

- **Other selections for delegates after the conference**
  - ☑ **Yellow Mountain: 1.5 hours from Hefei by train, and 3 hours by bus**

Social program

- **Other selections for delegates after the conference**
  - ☑ **Yellow Mountain: 1.5 hours from Hefei by train, and 3 hours by bus**

Social program

- **Other selections for delegates after the conference**
  - ☑ **Jiuhua Mountain: 2 hours from Hefei by bus**

Social program

- **Other selections for delegates after the conference**
  - ☑ **Jiuhua Mountain: 2 hours from Hefei by bus**

Social program

- Other selections for delegates after the conference
  - ☑ Tianzhu Mountain: 2 hours from Hefei by bus

欢迎踊跃建议：

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