

INTEGRAL PHYSICS

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Cast of Characters

1. SIDDHARTH
2. AMBIKA
3. PREM
4. MANOHAR
5. BALWINDER
6. TUHINA
7. CHRIS
8. NICOLE
9. AKRITI
10. SNEHA
11. PRAJWOLITA

ACT I (THE ONLY ACT)

Scene 1 (The only scene)

The stage is at the center of the theater (an open air theater is ideal) with audience galleries all around. Ten students namely AMBIKA, PREM, MANOHAR, BALWINDER, TUHINA, CHRIS, NICOLE, AKRITI, SNEHA, and PRAJWOLITA are out in the open; they are sitting rather casually on benches scattered around. There is no blackboard. In case the play is being staged indoors, artificial trees with toy birds could be used to depict an outdoor setting.

AMBIKA: So today we are going to have our classroom in the open.

BALWINDER: Under the blue sky.

PREM: Why is he doing this anyway?

AKRITI: Who? The new Physics teacher you mean?

PREM: Who else? All this is his brainchild.

NICOLE: But I am really enjoying it, it really feels wonderful to have the breeze caress you as you learn.

MANOHAR: O come on...it's not going to be a poetry class.

SNEHA: I agree with Nicole, it is wonderful to sit outside.

PRAJWOLITA: I wonder why Mr. SIDDHARTH wants an open classroom, indeed if he were to teach us English poetry it would still be understandable...but the idea of teaching Physics in the open is surely strange.

CHRIS: Mr. Siddharth was impressive yesterday!

AMBIKA: You really think so?

CHRIS: Yes.

AMBIKA: But he just came for five minutes yesterday...he did nothing except for introducing himself, what was so impressive about that?

CHRIS: The way he speaks is impressive...his voice has an unmistakable warmth.

TUHINA: That is right, he is very impressive no doubt. He asked each one of us to talk about ourselves, and in the end he told us briefly about himself and how he wants to approach the subject.

AKRITI: His approach appears to be interesting, isn't it?

CHRIS: Well, I find it interesting...he said that he wants us to feel the subject rather than studying it mechanically. But what special is he going to do, there is not even a blackboard over here, where is he going to write.

NICOLE: He also said that good learning is possible only when the student finds the learning process enjoyable. I am really waiting to see how he makes Physics enjoyable, this subject has been a real thorn in my neck for a long time.

BALWINDER: Even I don't believe Physics can be interesting...all those derivations and numericals, I would never have opted for Physics had it been an optional subject.

Siddharth, a man appearing to be in his early forties, enters. The students stand up and quickly organize their benches in rows and sit.

SIDDHARTH: Good morning everyone.

ALL TOGETHER: Good morning Sir.

SIDDHARTH: Well, before we proceed I want to make one thing very clear, I wouldn't want to be addressed as 'Sir'. You (more)

SIDDHARTH: (cont'd) can call me 'Siddharth' straightaway. I will appreciate that. Also do not sit in rows like this. Rather make a circle around me.

The students re-organize their benches with Siddharth roughly in the center.

SIDDHARTH: Now let me see if I remember your names correctly. Well... please raise your hands if I take your names correctly...if I make a mistake, any kind of mistake including pronunciation errors, kindly correct me.

Siddharth thinks for a while.

SIDDHARTH: (Pointing at Ambika) I will start with you and then move anti-clockwise. Okay let's see...Ambika, Prem, Manohar, Balwinder, Tuhina, Chris, Nicole, Akriti, Sneha, and Prajwolita.

The students raise their hands turnwise as their names are taken.

TUHINA: (Impressed) But Sir, you heard our names just once yesterday... how could you remember them all.

SIDDHARTH: Well Tuhina, before I answer your question I would like to remind you and all other students in the class that I prefer to be called by my name. Don't call me 'Sir'. The words 'Sir' and 'Madam' are good ways of addressing people for there's an element of respect in these words but somehow in my scheme of teaching, or should I say facilitating for nothing can really be taught, addressing one another by names fits far better than any other way of addressing. The words 'Sir' and 'Madam' could cause a bit of a distance between the learners and the facilitator, I mean the teacher in your terminology. So it is better that you call me 'Siddharth'. As for your question as to how I remember all your names, all I can say is that there is no big deal in it. You can all have good memories provided your are ready to train and exercise your memories. I don't claim to have a very good memory but it is reasonable...and this reasonable memory is a result of regular meditation. Yes friends, I meditate every evening and I have been doing so for over three decades now. And trust me it has helped. But one doesn't have to meditate for years to have a good memory. Even a few (more)

SIDDHARTH: (cont'd) months of regular practice can give you remarkable powers of concentration and memory. We can discuss all this later when there is time to spare...now it is time for Physics, some real hard core Physics. First tell me which of you find Physics boring?

Ambika, Prem, Manohar, Balwinder, Nicole, and Sneha raise their hands.

SIDDHARTH: O that constitutes a majority.

The students giggle.

SIDDHARTH: Let's hope by the time we finish this class, the number will change. Okay, now when I was coming over I heard Balwinder say that it is hard to believe that Physics could be interesting. Well, with all due regards to him and all of you who think likewise I must say that nothing could be further than the truth. Look, Physics per se is extremely interesting but I don't blame any of you for thinking otherwise...perhaps you didn't get to study the subject in an interesting way. Let's see if I can help you enjoy Physics. Unfortunately, I am joining you in the middle of your session. Therefore, I cannot take up the entire syllabus with you but let us all try to make the best of the remaining time. I have been given to understand by the Academic Head that when your previous teacher left, the topic being discussed in the class was Special Theory of Relativity... you were studying time dilation, right?

Manohar raises his hand.

SIDDHARTH: Yes Manohar.

MANOHAR: Siddharth, to be very honest we hardly understood anything about the Special Theory of Relativity.

SIDDHARTH: Okay, so would you all like me to take up the topic right from the beginning?

ALL TOGETHER: Yes.

SIDDHARTH: All right, as you say. Before we start with Special Theory of Relativity, I have a question for all of you just to demonstrate how interesting Physics could be.

AMBIKA: We have already started enjoying it Siddharth.

SIDDHARTH: That's very nice to know Ambika, I hope I can sustain this interest in all of you. All right then, it's time for the question.

Students appear interested and full of attention.

SIDDHARTH: (Addressing Balwinder) Balwinder, I guess you, and for that matter all other students in the class, were born either in 1994 or 1995.

BALWINDER: That's right Siddharth, I guess all of us were born in 1994.

SIDDHARTH: All right, I was born in 1951, and I am due for retirement in 2011. Incidentally, yours is the last batch I am facilitating.

The students look amazed.

BALWINDER: That's incredible Siddharth!

SIDDHARTH: What's so incredible?

BALWINDER: Siddharth, you don't even look fifty! It is unthinkable that you are going to turn sixty.

NICOLE: What fifty, you hardly look more than forty two or forty three. Sixty is hard to believe!

SIDDHARTH: (Smiling) Well, I take that as a compliment, thank you very much. Again the reason for looking much younger than my real age is because of regular meditation. Meditation is one of the highest forms of yoga and it can really retard the process of ageing, that's scientifically proved. And now, the question...I was born in 1951 and Balwinder in 1994. You have to tell me who is older in terms of physical age. Let me repeat the question and please pay attention -who is older in terms of physical age. I will give you three options, only one (more)

SIDDHARTH: (cont'd) of these is the correct answer. The options are -Balwinder is older than I, I am older than Balwinder, or Balwinder and I are of the same age. Please think hard...the question may not be as simple as it sounds.

All the students seem to work on the question in their minds. A minute's silence follows.

SIDDHARTH: All right, you can come up with your answers but just the answer will not do, you must also substantiate it. I will ask each one of you turnwise starting with Balwinder...after Balwinder, it will be Tuhina, then Chris, and so on. Okay then, your answers please...

BALWINDER: Obviously you are older for you were born much before me.

TUHINA: Yes Siddharth you are older for the same reasons given by Balwinder.

CHRIS: Same answer, Siddharth.

NICOLE: I think there's a trick involved...may be Balwinder is older in the sense that he has a lot many more years to live, therefore there are more possibilities open to him, that is, he is richer in possibilities in terms of available physical age...that perhaps makes him older although I am not sure.

AKRITI: I have a gut feeling that Nicole is right.

SNEHA: Nothing doing, surely Siddharth is older for the simple reason that he was born in 1951 and Balwinder in 1994.

PRAJWOLITA: I completely agree with Sneha and others who say that Siddharth is older in terms of physical age.

AMBIKA: Me too, same answer and for the same reasons -Siddharth is older.

PREM: I have this strange feeling that for some reasons Balwinder is older.

MANOHAR: No one has chosen the third option, so I go by it -both are of the same physical age, but please don't ask me the reasons.

The students laugh, Siddharth also smiles.

SIDDHARTH: Okay, it's my turn now. First I will give the answer and then the reason. Well, you can clap for Manohar, his answer is correct.

The students clap.

SIDDHARTH: But I wish he had known the reasons as well...anyway I will tell you the reasons now. Every entity in the physical universe, animate or inanimate, is made up of two things only -matter and energy. Putting it differently, everything that you see or perceive in the physical universe is nothing but an agglomeration of matter and energy. Now there are two fundamental laws in Physics which you have studied while you were in Standard VI or VII -the law of conservation of matter, and the law of conservation of energy. Have you studied or not?

ALL TOGETHER: Yes.

SIDDHARTH: Who will explain the laws?

All raise hands.

SIDDHARTH: Okay, let Nicole answer, yes Nicole...

NICOLE: Sir, the law of conservation of matter states that neither can matter be created nor can it be destroyed. And according to the law of conservation of energy neither can energy be created nor can it be destroyed. Of course matter and energy can change into each other, but the sum total of matter and energy in the physical universe will always remain the same.

SIDDHARTH: Perfect, now, by the logic that all entities in the physical universe are made up of only matter and energy both I and Balwinder are also made up of the same. Now the matter and energy I am composed of always existed, still exists, and will continue to exist by virtue of (more)

SIDDHARTH: (cont'd) law of conservation of matter and law of conservation of energy. Because of the same reasons the matter and energy constituting Balwinder always existed, still exists, and shall continue to exist. So nothing is really born, and nothing really dies. This is exactly what Bhagawad Gita teaches. But then this is true even from the perspective of pure Physics as we have just seen. Since the constituents that make me and Balwinder up are ageless in terms of Physics, it could be said in broader terms that Balwinder and I are of the same physical age -no body is older or younger than the other. Putting it differently, I and Balwinder always existed, still exist, and shall continue to exist -so none of us can claim to be older or younger than the other. I believe the reason is clear.

TUHINA: It's a great explanation, Siddharth, never thought about this aspect of physical age. So we are also perfectly justified in calling you by name, isn't it? After all, all of us are of the same age.

SIDDHARTH: (Smiling) Indeed, consider any two entities of the physical universe -living or non-living -they are bound to be of the same age. Let's now start with Special Theory of Relativity. In fact we shall start with time dilation, don't worry, although I am starting at the point where your previous teacher left you, I shall cover Special Theory of Relativity fully. Today, honestly speaking, I am not going to tell you much about the theory. I just want you to feel the subject of Special Theory of Relativity first before you jump into learning its deeper aspects. Now, can someone tell me who wrote the novel 'The Time Machine'?

Ambika, Akriti, and Chris raise their hands.

SIDDHARTH: Okay Akriti, it's your take.

AKRITI: Siddharth, 'The Time Machine' was written by H.G. Wells...what a novel it is!

SIDDHARTH: Perfect answer, now can someone tell me what is the theme of that novel?

Again Ambika, Akriti, and Chris raise their hands.

SIDDHARTH: Yes Chris.

CHRIS: Siddharth, it's about time travel. With the help of the time machine the protagonist could move back and forth in time.

SIDDHARTH: That's right, now how many of you have wondered as to whether time travel is possible?

All raise their hands.

SIDDHARTH: Tell me now, can you travel in time?

Students look at one another.

SNEHA: No Siddharth, I don't think so.

SIDDHARTH: (Addressing Sneha) All right, I will come back to time travel a little later, before that I shall talk about something similar. Tell me Sneha, can we peep into the past?

SNEHA: No Siddharth.

SIDDHARTH: Okay, let's find out. Look around yourselves, the answer whether we can peep into the past lies around you.

The students look around appearing curious.

SIDDHARTH: What do you think now Sneha?

SNEHA: My answer is still the same, Siddharth. We cannot peep into the past.

SIDDHARTH: Would anyone like to differ?

Nobody responds.

SIDDHARTH: I am afraid Sneha's answer is incorrect. We are actually always peeping into the past. The truth is we (more)

SIDDHARTH: (cont'd) can never see the present. For example you can never see how I look at the present moment. What you see is how I looked in the past. I will tell you why...we see an object only when light after getting reflected from that object reaches our eyes. Now although light is very fast it would still need some time, no matter how small that period of time is, to reach the observer's eyes after getting reflected from the object. So practically, the observer can only see how the object looked that much time back. If the object is luminous, we shall see the object as it looked as much time back as its light rays would need to reach our eyes. For instance, light needs roughly eight minutes to travel from Sun to earth. So we can see the Sun as it existed eight minutes back. We can

never see the present state of Sun or for that matter of any other object. There are numerous stars in the sky that exploded and died millions of years back. They are no longer present. And yet we can see them for light from those stars took millions of years to reach our eyes. I am sure many of you already knew this but you could not answer my question for you did not think creatively. Now I will revert to my original question -can we travel in time? Kindly note, I am not talking about peeping into the past, I am clearly asking you if we can go into the past or into the future? Sneha has already answered in the negative, would anyone like to differ.

The students look at one another for a while.

MANOHAR: I am sure Sneha's answer is incorrect, but none of us can tell you why.

Students laugh, Siddharth also smiles.

SIDDHARTH: Manohar is again correct; Sneha's answer is incorrect. Special Theory of Relativity suggests that we can actually travel in time. Now travelling into past and travelling into the future are two different aspects altogether. Travelling into the past could cause some extremely difficult paradoxes. Can you think of such a paradox? Please think, may be with your eyes closed.

The students begin to think, some with closed and others with open eyes. Siddharth waits for a minute for them to think.

SIDDHARTH: Okay, any answers.

Akriti and Prajwolita raise their hands.

SIDDHARTH: Prajwolita.

PRAJWOLITA: Siddharth, say I go into the past and look at myself. How can two 'I's exist at the same time?

SIDDHARTH: Great answer, that could be a paradox for future time travel as well. Very good. Okay, Akriti.

AKRITI: What if I go into the past and change the sequence of events. Suppose I don't let my parents to ever meet in the past. How will I be born then? And if I was never born, who is this 'I' who has travelled from the present to the past?

SIDDHARTH: Great answer again...this class has real brains, I can see. Okay, two wonderful paradoxes have been identified, or must I say

discovered, by Prajwolita and Akriti. These paradoxes have led many physicists to suggest that travelling into the past is not possible. But future time travel is possible, at least theoretically.

The students listen to Siddharth intently.

SIDDHARTH: According to the principle of time dilation, the time in respect of a moving object moves slower than the corresponding time in respect of a stationary object. Putting it plain and simple time is not a constant physical quantity as we normally tend to believe. The elapse of time could vary in accordance with the speed of the object concerned. So time in a planet that travels faster than earth would move slowly as compared to the rate of passage of time on earth. Making it even simpler, when I am walking my watch should move slower as compared to when I am standing. Similarly, when I am running, my watch should move even slower than when I am walking. Is the concept clear.

The students nod.

TUHINA: O Siddharth, I am really feeling Physics!

SIDDHARTH: Great to know that, I shall continue. Now it must be clear that the faster a body moves the slower should be the passage of time in it. The fastest possible speed known in the physical universe, I am sure all of you know, is that of light. So if an object can move at speeds comparable to that of light then its time will move extremely slowly. Although it is not practically possible at the moment to achieve speeds even distantly comparable to speed of light, but suppose one day our science develops so much so as to achieve this feat! Can you tell me what will happen then? Just close your eyes and think for sometime.

The students close their eyes for a while.

SIDDHARTH: Any answers, my friends.

Manohar, Tuhina, and Chris raise their hands.

SIDDHARTH: Yes Manohar.

MANOHAR: Well, Siddharth the people travelling by a spacecraft moving at speeds comparable to that of light will age slowly as compared to those who are ageing normally on planet earth. When the spacecraft returns to earth, the travellers will still be young while their contemporaries will have grown older.

SIDDHARTH: Great answer Manohar! In the light of what Manohar said, understand this that the travellers of that spacecraft will have virtually travelled into the future. Do you people understand?

The students nod.

TUHINA: We never understood this subject better, Siddharth.

SIDDHARTH: Great, that's indeed great going. So if you have understood what I have told you so far, you have also understood time dilation. This is how we are going to understand all the topics of Special Theory of Relativity, and also the other topics in your syllabus. Don't worry about the mathematical derivations that go alongside these concepts. If you grasp the concept well, that is if you begin to feel the concept, then the mathematics that goes alongside it will be a real cakewalk.

The students appear contended and happy.

SIDDHARTH: Now tell me, which of you find Physics boring?

No hands are raised.

SIDDHARTH: Okay, which of you find Physics interesting?

All hands go up.

SIDDHARTH: Fantastic, I am really very happy.

TUHINA: Siddharth, you are amazing!

SNEHA: Undoubtedly, you are an amazing teacher!

BALWINDER: If someone can raise interest for Physics in me, then he surely has to be amazing!

SIDDHARTH: Thank you very much all of you for all these kind words. But trust me, whether I am amazing or not, you all are truly amazing! I hardly taught you anything, you learnt the subject yourself...by listening with interest, assimilating, and then expressing what you understood.

AMBIKA: It's really true, I feel as if what you explained was already inside me...it just came out because of some push given by you.

PREM: I perhaps can understand now as to what is feeling a subject like.

SIDDHARTH: I am very happy that you all have been able to feel Physics. I took special permission from your Principal to give me an extended class, that's because I did not want the topic to be lost midway due to the end of what we call 'period'. Tell me, like Ambika, have all of you felt

that the topic of discussion was already inside you and it just came out because of a bit of fuelling. (continued)

ALL TOGETHER: Yes.

SIDDHARTH: That is how you should approach every subject and for that matter life itself, for life is the greatest subject to be learned. Internal learning is the best learning...trust me everything is inside you, what is needed to bring it out is a little push...the push can come from a facilitator like me or it can even come from yourself. You might have wondered when you people assembled here in the morning today as to how can Physics be taught or learnt without a blackboard. Remember, the blackboard may be needed of and on, but the real blackboard is inside you. You should always work upon the topic of discussion on the internal blackboard first before expressing it on an external blackboard or your notebooks. So is it a promise that you will never again say that Physics is boring.

ALL TOGETHER: Promise Sir.

SIDDHARTH: Thank you very much, I take that promise as my reward.

CHRIS: (Standing up) Give a big hand to Siddharth.

All the students stand up and clap and Siddharth acknowledges with a smile.

Based on some thoughts as to how Physics, or for that matter, other Science subjects should be approached; this stageplay is dedicated to all my SACAR friends.